Los Alamos National Laboratory

11th Annual Student Symposium

August 9th & 10th 2011

"Championing Scientific Careers"
Highlighting Student Research

LA-UR 11-04575

Symposium 2011
"Championing Scientific Careers"
August 9 and 10, 2011
University of New Mexico-Los Alamos

Tuesday, August 9

10:00 – 12 Noon	Registration and Poster Setup
12:00 – 1:00	Lunch (on your own)
1:00 – 4:00	Poster Judging Open to judges and presenters only

Wednesday, August 10

8:00 – 12:00	Poster Viewing Session – open to the public Students must be present at their posters from 8:00 to 12 noon
8:00 – 4:00	Technical Talk Registration--dependent on student's scheduled talk time (1 – 4 pm)
12:00 Noon	Poster take down--display boards to be broken down at 12:15 pm
12:15 – 12:45	Poster display board break down Remaining posters will be destroyed
1:00 – 5:00	Technical Talk Presentations

Awards Ceremony

5:00	Introductions	Dave Foster, Education and Postdoc Office, Program Mngr
5:15	Welcome & Congratulations	Terry Wallace, Principal Associate Director for Science, Technology, and Engineering
5:30	Student and Mentor Distinguished Performance Award Presentations	James Colgan, Student Programs Advisory Committee Chair
6:00	Introduction of Speakers	Scott Robbins, Education and Postdoc Office Team Leader
6:05	Distinguished Student Speaker	Dominique Price, Lindau Scholar and Ph.D. student, C-PCS
6:25	Keynote Speaker	Katherine Prestridge, Mentor and Deputy Group Leader, P-23
6:50	Symposium Awards Presentation	Terry Wallace and Kathy Prestridge
7:25	Closing Remarks	Scott Robbins

2011 Student Symposium

Table of Contents

Posters

Student Last Name	First Name	Presentation Title	Category	Page#
Boncella	Amy	Identification of Host Factors Involved in Yersinia Pestis Infection	Biosciences	1
Langan	Patricia	Evolution of Thermo-Stable Fluorescent Proteins	Biosciences	2
Patel	Namrata	Parallel Epidemic Processes in a Human Population May Display Different Evolutionary Rates	Biosciences	3
Pino	Fatima	Defining Parameters for High-Resolution AFM Imaging of Photosynthetic Assemblies	Biosciences	4
Poehler	Allison	Technical Challenges in Lipid Extraction for Algal Biofuel Production	Biosciences	5
Simmons	Karen	Characterization of Microbial Diversity in Clayey Halite	Biosciences	6
Snook	Jeremy	Using Gel Microdrop Technology to Sequence Environmental Community Genomes	Biosciences	7
Tiee	Nicholas	The Use of Multimeric Domains to Increase the Sensitivity of Affinity Reagents	Biosciences	8
Castro Finney Hundley	Lauren Krystal Frances	Detection of Citrus Pathogens using a Ligation-Based Molecular Assay	Biosciences	9
Gupta Schoonover Tumas	Neel Will Keyla	Ultrasonic Fields for Harvesting and Extracting Lipids and Proteins from Algae	Biosciences	10
Archuleta	Felicia	Glutamic Acid-based Trifunctional Linkers: Versatile Species for Bio-detection	Chemistry	11
Bene	Balazs	Separation of Neighboring Lanthanides for Ho-163 Production	Chemistry	12
Bowen	James	Nanomanipulation – A Tool for Analysis of Trace Nuclear Forensic Evidence	Chemistry	13
Davis	Lauren	Applications of Ionic Liquids	Chemistry	14
Graham	Aubrey	Novel Ligands for Exploring Charge Effects in Nanocrystal QD-Bio Interactions	Chemistry	15

Hejde	Christopher	Observations from Background Spectra Acquired by a Germanium Gamma-ray Detector	Chemistry	16
Holmes	Aatirah	Capillary Based Biosensors	Chemistry	17
Longhair	April	Validation of the Fluorescence Method for Beryllium Analysis	Chemistry	18
Lou	Alexander	Dye Extraction using Ionic Liquids for Forensic Purposes	Chemistry	19
Mares	Isaac	High Nitrogen Energetic Salts	Chemistry	20
Montoya	Victoria	Sustainability of Diverting Cooling Tower Drainage to the SWWS Facility	Chemistry	21
Rim	Jung	Preparation and Characterization of Cerium Dioxide Particles	Chemistry	22
Roman	Audrey	Characterization of Actinide Chromatographic Resins to Improved Separations for Microcalorimetry	Chemistry	23
Roybal	Daniel	Maximum Contaminant Removal from Sewage Waste Waters Using Crude Glycerin	Chemistry	24
Schulze	Maxwell	Energetic Material N-Nitrodifurazanopyrrole (NDFP)	Chemistry	25
Timmers	Kristjana	C-NR Autoradiography	Chemistry	26
Castaneda	Gerald	PCoIP	Computing	27
Chertkov	Eli	Flow Algorithms for Applications of National Interest in Supply Chain Modeling	Computing	28
Chrien	Natalie	Filling in the Gaps: Gap and Overlap Utilities for Osoloco	Computing	29
D'Amore	Rico	IOFSL (Input Output Forwarding Software Layer)	Computing	30
Halverson	Scot	Accelerating Particle Simulations with GPGPU Computations	Computing	31
Paiton	Dylan	Scaling of Object Detection Algorithms with Training Set Size	Computing	32
Rivera	Richard	Moving Towards a Dynamic VoIP Architecture	Computing	33
Robinson	Aaron	Application Server Engineering for RADIUS Software	Computing	34
Romero	Marisol	Documentum Statistical Information Web Application	Computing	35
Trujillo	April	Routing and Extension Solutions	Computing	36
Valdez	Roxane	Windows Server 2008 for Air Quality Monitoring	Computing	37
Van Heule	Graham	Configuration Management in HPC	Computing	38
Webster	Meredith	Improving Tutorials and Documentation of Geometric Setup Code	Computing	39
Davis Nicholaeff Trujillo	Neal David Dennis	Cell-based AMR on the GPU with Applications to Exascale Supercomputing	Computing	40

Antos Gale	Scott Bruce	High Performance Computing: Event Analysis and Trending	Computing	41
Burns Gaines	Ian Lucinda	V&V Framework for Geospatial Image Analysis Algorithms	Computing	42
Dong Ravishankar Sathre Taitano	Han Mahesh Paul William	Quasi-Diffusion-Accelerated Monte Carlo on Heterogeneous Architectures	Computing	43
Birdsell	Daniel	Predicting Engineered Natural Systems (CO_2-PENS) System-Level Model Verification	Earth and Space Science	44
Casper	William	EnKF Data Assimilation in the POP Global Ocean Model	Earth and Space Science	45
Cleveland	Kenneth	3D Structure of Iran and Surrounding Areas From The Simultaneous Inversion of Complementary Geophysical Observations	Earth and Space Science	46
Gorkowski	Kyle	Aerosol Optical Properties of Smoke from the Las Conchas Wildfire	Earth and Space Science	47
Klein	Benjamin	Discriminating Multiple Trace Gas Sources in Cool, CA and Farmington, NM	Earth and Space Science	48
Lerner	Allan	Determination of Calcite-Fluid Interfaces at high P/T via Neutron Reflectometry	Earth and Space Science	49
Vander Wiel	Jonathan	Soil Layer Visualization Under CMRR	Earth and Space Science	50
McNamara Quinn	Harold Sean	Investigating the Origin of Meteoroids Using High-Power-Large-Aperture Radar	Earth and Space Science	51
Armstrong	Hirotatsu	Addition of a Cosmic Ray Source to MCNP6	Engineering	52
Barton	Brenton	Gathering Evidence for Validation of Large Scale Monte Carlo Code	Engineering	53
Cassidy	Daniel	Design of a Crane Based Sensor Transportation System	Engineering	54
Castano	Nicolas	Adhesive Transfer Tape Options for Microfluidic Enzymatic Reactions	Engineering	55
Driscoll	John	Statistical Analysis of Low Flow Filter Efficiency Testing Results	Engineering	56
Haines	Timothy	The Physics Behind the Magic Fountain	Engineering	57
Hammond	Kyle	Modeling a Loss of Coolant Accident at South Texas Project Nuclear Power Plant	Engineering	58

Hashem	Joseph	Evaluation and Implementation of Glovebox Automation for Plutonium Slump Casting	Engineering	59
Hill	Brett	Determining Thermal Conductivity of PuO_2 Powders	Engineering	60
Jacquez	Joshua	Prior to Move MAR Treanding	Engineering	61
Jimenez	Stephen	The Effects of Dry Machining on the Metallurgical Properties of HP Copper	Engineering	62
Kruszelnicki	Juliusz	Velocity Fragment Analysis via Examination of Spectral X-Ray Images	Engineering	63
Lopez III	Armando	Muon to Electron Conversion Tensioning Device	Engineering	64
Manning	Kaity	EBID Micro-Hydro Turbine Analysis	Engineering	65
Montoya-Wiuff	Alynna	Monitoring and Improving Data Center Efficiencies at the Los Alamos Strategic Computing Complex	Engineering	66
Moro	Erik	Performance Optimization of Fiber Optic Displacement Sensors	Engineering	67
Olson	Mitchell	Triaxial Residual Stress in a Dissimilar Metal Weld from a Nuclear Reactor	Engineering	68
Parkinson	David	Drop Weight Impact Sensitivity Testing at LANL	Engineering	69
Rivas	Jessica	Foundry Upgrades	Engineering	70
Rodriguez	Kevin	Controllers for Accurate Spatial Positioning of Diagnostic Equipment	Engineering	71
Saeger	Veronica	The Plate Dent Simulation	Engineering	72
Schumaker	Merit	Safety, Security, and Environmental Stewardship	Engineering	73
Steuben	John	Improvements to the ARIES NDA Robotic System	Engineering	74
Streusand	David	Design of Robotic Gripper for RIPS	Engineering	75
Taylor	Stuart	Embedded Sensor Node for Structural Health Monitoring and Predictive Modeling	Engineering	76
Wermer	Lydia	Thermal Storage System Modeling	Engineering	77
Williams	Edwin	Design of Mechanical Cooling Loads for Increases in High Performance Computing	Engineering	78
Winter	Jacob	Analysis of the SAVY-4000 Nuclear Material Storage Container for Transportation	Engineering	79
Zheng	Lin	Limited Volume Chilled Water System Design	Engineering	80
Zimmerman	Caitlin	Plate Installation Simulation and Evaluation in Delmia	Engineering	81
Aragon Trujillo	Daniel Miquela	Blast Mat Structure Load Test Analysis	Engineering	82

Brooks Vigil	Robbie Francisco	DARHT Cell-Magnet Flow Meter Upgrade	Engineering	83
Graves Shirey	Benjamin Jeremy	Modeling for Ergonomic and Radiation Analysis	Engineering	84
Brophy Ortiz Armstrong	Jakob Gabriel Christopher	Accuracy of a Measurement-User Performed Calibration	Engineering	85
Schnakenberg Young	Jeffrey Justin	Trak Lathe	Engineering	86
Baydar Hebert	Ezgihan Jason	Modeling Turbulent Reactive Flow in Internal Combustion Engines	Engineering	87
Castelo	Daniel	LANL Hazmat Challenge and its Contribution to Public Health and Safety	Health & Safety	88
Idler	Alissa	Office Ergonomics at Los Alamos National Laboratory	Health & Safety	89
Keller	Brad	Cost Benefit of Implementation of Visual Survey Data System at LANL	Health & Safety	90
Lucero	Alyssa	A Comparison of Dose Calculation Software Used in Radiation Therapy	Health & Safety	91
Andrews	Scott	Solid State Drive (SSD) Security and Forensics	Information Technology	92
Miller	Laniece	Digital Asset Management – Why LANL Should Care	Information Technology	93
Webber	Michael	The "Power" of Windows PowerShell"In a System Administrators Environment"	Information Technology	94
Gasca Martinez Armijo	Jose Jacob Erica	Development of 802.11 Indoor/Outdoor Wireless Network at TA-54	Information Technology	95
Generous McClure	Eric Erin	Laboratory Information Management Systems (LIMS) for the Use of Data Management	Information Technology	96
Alson	Seth	Knowledge Capture Tool Kit for Forensic Signatures Using Nuclear Material Images	Materials Science	97
Breiner	Megan	Two Time-Based Analysis Tools	Materials Science	98
Brener	Yaniv	Characterization of Amphiphilic Block Copolymers	Materials Science	99
Dimas	Miguel	Effects of Surfactant Composition on Colloidal Single-Wall Carbon Nanotube Photoluminescence	Materials Science	100
Emigh	Megan	Fabrication of Controlled Porosity in CeO2 Pellets: A Nuclear Fuel Surrogate	Materials Science	101
Forrest	Eric	Surface Science and Bond Strength Measurements Supporting U10Mo Fuel Fabrication	Materials Science	102

Gustafson	Nathaniel	Purification of Dielectric Fluids for Pyroelectric Heat Engines	Materials Science	103
Haglund	Amanda	In-Situ XRD Deformation Testing of HT-9 Steel Cladding	Materials Science	104
Hernandez	Sarah	Experimental and Theoretical Studies on the Electronic and Magnetic Structure of Plutonium	Materials Science	105
Kilburn	Aaron	High Purity Germanium Detector Annealing	Materials Science	106
Koby	Joseph	Examining Dynamic Strain Behavior of PBXN-9 via the Taylor Anvil Test	Materials Science	107
Martinez-Palmer	Meaghan	Characterization of Plutonium Buttons Produced at Savannah River Site	Materials Science	108
Mercer-Smith	Alison	Characterization of a Dielectric Fluid for a Heat Switch	Materials Science	109
Montoya	Robin	Sylgard 184 Thin Section Cure Study	Materials Science	110
Mukhopadhyay	Saikat	Understanding the Electronic Conduction in PPV-oligomer With and Without Defects	Materials Science	111
Stan	Tiberiu	Light Ion Irradiation Effects on the Crystal Structure of Mg_2TiO_4	Materials Science	112
Telila	Helen	Charge-Fluctuating Atomistic Models of Metals	Materials Science	113
Torres	Joseph	Thermal Stability of Precursors for Potentially Energetic Materials	Materials Science	114
Weichman	Kathleen	Development of a Low-Dose Irradiation Campaign for Thoria-Based Ceramic Fuels	Materials Science	115
Lee Need	Weston Ryan	Nanostructuring of Coin Silver by Equal Channel Angular Extrusion	Materials Science	116
Mutnick Tudela	David Adriana	Mechanical and Electrical Properties of Glidcop Processed by ECAE	Materials Science	117
Longo	Claire	Applications of Wavelet Analysis to Solution Monitoring for Nuclear Safeguards	Mathematics	118
Oestreicher	Samantha	Studying Fast/Slow Dynamics of Shallow-Water Equations and its use for Heterogeneous Computing	Mathematics	119
Whitton	Christin	Fair Assignment of Posters to Judges	Mathematics	120
Langteau	Jason	Wildlife Management at LANL	Non-Technical	121
Martinez	Zachary	Nuclear Material Container Knowledge Database	Non-Technical	122
Sandoval	Leslie	The Environmental Data Management (EDM) Cloud	Non-Technical	123
Whitton	John	The Psychology of a Terrorist: Case Studies in the Ideology of Radicalization	Non-Technical	124

Breiner Helland Parker	Emily Loren Jamie	Operations in Water Quality Monitoring and Environmental Stewardship	Non-Technical	125
Achiam	Joshua	Ray Splitting Model of O-X Mode Conversion	Physics	126
Baglee	Claire	Shielding Factor of a Shielded Room	Physics	127
Edelmann	Erik	Investigating 1D Radiation Hydrodynamics Simulations of ICF Experiments	Physics	128
Francis	Michael	The Phenomenology of Hydrogen Vacancy Interactions, A Discussion	Physics	129
Kafle	Rudra	Berry-Gauge Tuned Bose-Einstein Condensate Gyroscope	Physics	130
Martin	Zoe	Using RAGE for ICF Simulations	Physics	131
McKinney	Alex	Non-Destructive Assay with Delayed Neutrons	Physics	132
Schulze	Peter	Accurate Sample Manufacturing for Distance Raman and Explosive Detection	Physics	133
Vidisheva	Aleksandra	Using PDV to Measure Velocity	Physics	134
Wigger	James	Behavior of a Linear Superluminal Accelerator	Physics	135
Zerkle	Sandra	Electroencephalography Study of Visual Object Recognition	Physics	136

Technical Talks

Student Last Name	First Name	Presentation Title	Category	Page#
Banisadr	Afsheen	Discovering Molecular Determinants of Transcription Factors	Biosciences	137
Do	Truc	Characterizing the Influenza B Genome by Sanger & Illumina Sequencing Processes	Biosciences	138
Romero	Raymond	Breaking Down Plant Cell-Walls for Biofuels	Biosciences	139
Shiffler	Stacy	AFM Investigation of C. Tepidum Photosynthetic Antenna Complexes	Biosciences	140
Auxier II	John	Development of a New Method for Determination of Pu and Am-241in Aqueous Samples	Chemistry	141
Thomas	Kyle	Local Structure Determination of Perovskites Using the Pair Distribution Function	Chemistry	142
Jacobi	Michael	Applied Parallel Metadata Indexing	Computing	143
Mendon	Ashwin	High Bandwidth Disk Access using FPGA-based Custom Cores	Computing	144
Relson	Eric	Development and Automation of Criticality Benchmarks for Cross Section Data Test using MCNP6 and Partisn	Computing	145
Samanas	Evan	Automating MPI Task Placement for Torus Interconnects	Computing	146
Kendrick	Alexander	Los Alamos Sferic Array Observations of Lightning during the Joplin EF-5 Tornado	Earth and Space Science	147
Brennan	Nicholas	Analyzing the Performance of a 3 Megawatt VHF Amplifier	Engineering	148
Brown	Matthew	Advanced Control System for Remote Handling Equipment	Engineering	149

de la Torre	Luis	Capacitated Vehicle Routing with Pickups, Deliveries, and Service Choice	Engineering	150
Dominguez	Samantha	Optimizing Systems Engineering (SE) for Research and Development (R&D)	Engineering	151
Griego	Marisa	Design Engineering Concepts	Engineering	152
Kinyua	Alexander	Process and Automation Domain System Analysis: The True Cost of Comfort Control	Engineering	153
Lamb	Christopher	Modeling Long Rod Penetration with Oblique and Yaw Angles	Engineering	154
Mancini	Peter	Modeling Tungsten Long Rod Penetration of Semi-Infinite Steel Target	Engineering	155
Markham	Dylan	Ingenuity of Design	Engineering	156
Nunez	Marcel	The Rheology of Molten Composition B	Engineering	157
Quintana	Hope	Completely FAB	Engineering	158
Rimkus	Nathan	Slump Casting Furnace Design	Engineering	159
Roybal	Joshua	Shear Induced Particle Migration Shown From MD Calculations	Engineering	160
Savage	Danielle	How to Create a Slurry Injector	Engineering	161
Schmalzer	Andrew	A Novel Method for Modeling Wear of a Soft Material on a Hard Substrate	Engineering	162
Seegmiller	Daniel	Hydrodynamic Investigation of Detonation Transfer in Onion Skin Experiments	Engineering	163
Solntsev	Stefan	Electric Vehicle Charging Stations: When and Where?	Engineering	164
Xu	Yunjian	Plug-in Electric Vehicles (PHEVs) Scheduling	Engineering	165
Chavez	Christella	Mathematical Modeling of Telecommunications Disaster Recovery	Information Technology	166

Bloomer	Breaunnah	Determining the Role of Calcium in Geopolymerization Synthesis: PDF Analysis	Materials Science	167
Conradson	Dylan	Hydrogen Storage Properties of MgNi Nanoparticles	Materials Science	168
Mosbrucker	Paula	Dislocation Density and Texture Analysis of HT9 Steel Irradiated in the FFTF	Materials Science	169
Salazar	Alicia	Thermal Property Analysis of MgO-Nd2Zr2O7 Inert Matrix Fuel	Materials Science	170
Williams	Joshua	InGaN Growth on <111> Si with an AlN Buffer Layer	Materials Science	171
Cardenas	Andres	Stability and Dynamical Properties of Compactons	Physics	172
Fisher	Kevin	Optimizing Divergence of the Simulated MaRIE XFEL	Physics	173
Meyers	Michael	Oscillation Modes of a Relativistic Drifting Cold Plasma	Physics	174
Wood	Suzannah	Mass Loss and Electron Screening to Address Solar Abundances	Physics	175

Name: Amy Boncella
Program: UGS
School: University of Colorado at Boulder
Group: B-7
Mentor: Elizabeth Hong-Geller
Category: Biosciences
Type: Individual Poster Presentation

Identification of Host Factors Involved in Yersinia Pestis Infection

Over the last several decades, microbial pathogens have become increasingly resistant to many different antimicrobial drugs. Thus, there is a great public health need for the development of new strategies and techniques to combat bacterial infection. This project focuses specifically on the bacterium Yersinia pestis, which is the causative agent of bubonic and pneumonic plague. When pathogens begin the process of infection, they need to exploit certain proteins from the host cell in order to proliferate. The objective of this project is to identify specific host proteins that facilitate pathogen infection, as potential targets for drug development. From previous high-throughput RNA interference (RNAi) functional genomics studies, we have indentified several genes as potential 'hits' that facilitate Yersinia driven downregulation of cytokine release. We are currently in the process of performing a two-hybrid screen as a means to test for protein-protein interactions between Yersinia effector proteins and the gene 'hits'. The initial host factor tested, serum and glucocorticoid-inducible kinase, SGK1, did not show interactions with the Yersinia effector proteins tested. We are continuing to assess additional host proteins from the pool of initial 'hits' using this assay. In addition to the two-hybrid screen, we are performing an enzyme-linked immunosorbent assay (ELISA) to elucidate the role of one of the additional host factors c-Kit, which is involved in cytokine release upon bacterial infection. Upon incubation of a specific kinase inhibitor of c-Kit (ISO 930) with host cells, cytokine release was restored during in response to Yersinia infection, thus validating the efficiency of the RNAi screen. Given these results, we pose that kinase inhibitors can be effective for development of novel antimicrobial therapeutics.

Name: Patricia Langan
Program: GRA
School: University of New Mexico
Group: B-9
Mentor: Geoffrey Waldo
Category: Biosciences
Type: Individual Poster Presentation

Evolution of Thermo-Stable Fluorescent Proteins

The development of Fluorescent Proteins as molecular reporters has aided the way complex biological systems can be visualized and interrogated. However, the broad application of fluorescent proteins has been limited by their thermal and pH sensitivity. We have recently evolved an extremely thermo-stable fluorescent protein from a consensus green protein using monomeric Azami Green. This protein is being used as a template to carry out site directed mutagenesis and molecular evolution to modify the emission wavelength from green to red. Amino acids that could affect the dynamics of the fluorophore were chosen for mutation. A unique aspect of this work is our use of the National Flow Cytometry Resource in order to rapidly analyze and sort color-shifted clones. The instrument used in this analysis is the FACS aria. This 3-laser cytometer allows for data collection with 8 optical filters with sharp transmissivity cutoffs, due to the angle of incidence, and allowing for bandpass filters to be designed very specifically and close together. . This ability to resolve wavelengths that are close together was exploited to capture signal from fluorescent protein libraries. The ratio of the signals differed from the wild type when the mutation in the expressing cell causes a red shift. Shifted colonies were sorted then analyzed using a Tecan 96-well-plate fluorimeter. Having the having the sorting speed and computing time of the aria, and having the capability of sorting into various mediums allowed a drastically reduced amount of time needed to analyze each library. This capability gave us the freedom to rapidly analyze any library that we could design on TGP. The results obtained using this innovative approach, and their implications for developing a robust palette of new thermo-stable fluorescent proteins were realized.

Name: Namrata Patel
Program: UGS
School: New Jersey Institute of Technology
Group: T-6
Mentor: Thomas Leitner
Category: Biosciences
Type: Individual Poster Presentation

Parallel Epidemic Processes in a Human Population May Display Different Evolutionary Rates

One of the fastest evolving organisms, human immunodeficiency virus type 1 (HIV-1) has become a leading pandemic [2]. High genetic variation leads to rapid evolution of HIV-1 making vaccines ineffective. The evolutionary rate of HIV-1 varies among human populations due to the group's genetic composition, means of transmission, and other factors. Interestingly, HIV-1 sequences among intravenous drug users (IDU) often lack genetic diversity even after many years contrary to sequences found in heterosexual spread despite that the number of incident IDU in a given time period is typically much greater [1,3]. The rapid spread of HIV-1 in an IDU epidemic means that the virus has spent a short time in a host before it is transmitted to the next host, this may be too short of a timeframe for the host's immune system to exert a selective pressure driving the evolution of the virus whereas in a heterosexual epidemic, that spreads at slower rates, immune selection has an impact [1]. Phylogenic trees from the two types of epidemic are available for a comprehensive dataset from Latvia. A method that estimates the evolutionary rate (TreeRate) was used to generate divergence plots where regression analysis suggested mixed epidemic patterns. Interestingly, one scenario of the IDU displayed an increasing trend followed by a confusing decreasing trend. It is hypothesized that part of the IDU population forms a bridge between the two populations, hence introducing two different evolutionary rates within the larger epidemic. From the current data, it is difficult to classify which phylogenetic member comprises which rate. Hence, an algorithm is being developed to exhaust all possibilities of individuals belonging to these characterizations to obtain better results needed for understanding the epidemic.

References

[1] I.M. Berry, R. Ribeiro, M. Kothari, G. Athreya, M. Daniels, H.Y. Lee, W. Bruno, and T. Leithner. 2007. Unequal Evolutionar Rates in the Human Immunodeficiency Virus Type 1 (HIV-1) Pandemic: the Evolutionary Rate of HIV-1 Slows Down When the Epidemic Rate Increases. J Virol. USA 81:10625-10635.
[2] I.M. Berry. 2008. Genetic aspects of HIV-1 evolution and transmission. PhD dissertation at Karolinska Institute.
[3] D. Boulos, P. Yan, D. Schanzer, R.S. Remis, and C.P. Archibald. 2006. Estimates of HIV prevalence and incidence in Canada, 2005. CCDR. Canada 32:165-176

Name: Fatima Pino
Program: UGS
School: University Of New Mexico-Los Alamos
Group: MPA-CINT
Mentor: Gabriel Montaño
Category: Biosciences
Type: Individual Poster Presentation

Defining Parameters for High-Resolution AFM Imaging of Photosynthetic Assemblies

Performing Atomic Force Microscopy (AFM) in liquid on biological samples allows one to obtain molecular level, three-dimensional information of biological samples under controlled conditions. In the work presented, attempts were made to determine appropriate parameters for investigating biological samples under conditions that are necessary for the integrity of the samples, however not conducive for performing high-resolution AFM. The complexes being investigated are light-harvesting complexes from photosynthetic bacteria. Isolated membrane fragments from the bacteria with LH complexes adhered were put in several types of buffer solution and were imaged. Conditions were adjusted accordingly to help induce membrane adherence to the mica substrates as well as minimize noise due to other forces in solution such as electrostatics. Examples of images under various conditions will be shown as well as an interpretation of solution and instrument conditions that effect image rendering.

Name: Allison Poehler
Program: UGS
School: McKendree University
Group: T-6
Mentor: Gnana Gnanakaran
Category: Biosciences
Type: Individual Poster Presentation

Technical Challenges in Lipid Extraction for Algal Biofuel Production

In recent years, the rising cost and environmental impacts of conventional fuel sources have created a need for new sources of energy that are cleaner and lessen the dependence on foreign oil. Currently, biofuels produced from terrestrial crops are mixed with conventional fuels, but there exists a need for sustainable biofuels that do not threaten food sources and are economically viable while being environmentally conscious. The use of algae as an energy source to replace fossil fuels could be possible. However, for algal biofuel production to be practical it must be economically feasible on a large scale. For this to be possible many technical challenges must be overcome. These challenges exist in the growth, production, and management of algal cells as well as the separation, extraction, and conversion of cell lipids into useful fuels. Specifically, the lipid extraction process is one of the most costly processes in algae-based biofuels. It requires disruption of the cell wall, and current mechanical (press, ultrasonic), chemical (organic solvent, supercritical fluid) and other (enzymatic, osmotic, etc) approaches are not efficient. Our project directly targets the technical challenge of lipid extraction in algae by devising an algae specific separation scheme and characterizing the structural and mechanical nature of the algal cell wall for better disruption techniques.

Name: Karen Simmons
Program: GRA
School: New Mexico Tech
Group: EES-12
Mentor: Juliet Swanson
Category: Biosciences
Type: Individual Poster Presentation

Characterization of Microbial Diversity in Clayey Halite

The Salado Formation is a halite evaporite bed located in southeastern New Mexico. It lies approximately 250-850 meters below ground and contains layers of halite interspersed with clay seams, anhydrite, gypsum, and polyhalite. This creates a heterogeneous environment containing some “clear” halite which has relatively few impurities, and some clayey halite which contains significant impurities. In previous work with the clear halite, DNA was amplified from both direct halite extracts and high ionic strength enrichment cultures. The goal of this study was to characterize the microbial diversity in a sample of clayey Salado halite and compare the results to those obtained from clear halite. The composition of the clayey halite was determined analytically, and the levels of sulfate, boron, magnesium, and bromide were found to be higher in the clayey halite than in the clear halite. DNA was extracted from a dissolved clayey halite sample, and a clone library was constructed from amplified bacterial 16S rRNA-encoding genes. Two groups were found in this library: Limnobacter thiooxidans and a Pelomonas species. Clayey halite samples were also inoculated into enrichment media containing varying concentrations of NaCl. Growth was observed in one culture after eight weeks. DNA was extracted from the culture, and an archaeal clone library was constructed. Only one group, a Halorubrum-like archaeon, was found. The communities from the clayey halite samples were far less diverse than the communities from the clear halite. These results show that variation within halite samples can result in distinct microbial communities arising.

Name: Jeremy Snook
Program: UGS
School: Arizona State University
Group: B-6
Mentor: Shunsheng Han
Category: Biosciences
Type: Individual Poster Presentation

Using Gel Microdrop Technology to Sequence Environmental Community Genomes

Acquiring genomic information on individual members of complex microbial communities is exceedingly difficult. These communities contain many different species of bacteria, when these communities are sequenced as a whole the information produced can only be applied to single species in a limited manner because of bias and dominant inhabitants. Single cell genomics has made strides in isolating and sequencing individual species within a community but there is still a need for improvement. Gel Microdops (GMDs) allow for the sequestering of a single bacterial cell that can be grown in a contained space. The reduction to a single parent cell allows for a more consistent genomic makeup of the enclosed community. A known strain of Escherichia coli within an artificial community was encapsulated, subjected to a growth period and sorted via Flow Cytometry. The target GMDs were subjected to whole genome amplification (WGA) and sequenced (Illumina HiSeq). This process was repeated for unencapsulated single cells. In this study, we compared GMDs and single cell results with respect to genome coverage and contamination. The presence of more cells in a single GMD allow for more template to be amplified thus resulting in a higher quality genomic sequence output than a single cell subjected to the same procedure. GMD technology is useful when applying it to a complex community in which separation of single species of bacteria is desired for individual analysis. It also has the direct ability to assist in analyzing human microbiome samples in a more in depth manner than previously available.

Name: Nicholas Tiee
Program: UGS
School: Rice University
Group: B-9
Mentor: Devin Close
Category: Biosciences
Type: Individual Poster Presentation

The Use of Multimeric Domains to Increase the Sensitivity of Affinity Reagents

The ability to detect specific molecules (antigens) is a fundamental aspect in nearly all fields of molecular research. The use of highly specific binders enables the detection of extremely low levels of an antigen. The antibody is the most well-known affinity reagent and is used naturally to detect bacteria, viruses and other harmful substances in our bodies. In our lab we use two antibody-like affinity reagents, the scFv (single chain variable fragment) that constitutes the variable region of an antibody, and fluorobodies, which are fluorescent proteins that contain antibody-like elements that can bind antigens. Although affinity reagents can be highly sensitive, it is advantageous to increase their sensitivity even further since many molecules that are harmful to human health are at levels lower than can currently be detected. One method of increasing the sensitivity is to generate affinity reagents that can multimerize. Multimerization results in an increase in avidity since each individual protein has an increased amount of binding sites and interactions. We have developed a system for multimerizing affinity reagents and have generated multimerized scFv's and fluorobodies. We have shown using purified protein ELISAs that by increasing the avidity using multimerization of these binding modules, we can achieve synergistic increases in detection of specific antigens.

Name: Lauren Castro
Program: UGS
School: Princeton University

Name: Krystal Finney
Program: UGS
School: Eastern New Mexico University

Name: Frances Hundley
Program: UGS
School: Pomona College

Group(s): B-7, D-3
Mentors: Alina Deshpande, Scott White
Category: Biosciences
Type: Group Poster Presentation

Detection of Citrus Pathogens using a Ligation-Based Molecular Assay

The citrus pathogens *Xylella fastidiosa*, *Xanthomonas* species, *Citrus tristeza virus* (CTV), and "*Candidatus* Liberibacter" species are detrimental to citrus orchards in the southeastern United States and across the globe. Currently, the citrus industry is limited to using prohibitively slow detection assays to screen citrus propagative material to prevent the spread of disease. We aim to simultaneously screen plant extracts for the four citrus pathogens utilizing multiplex oligonucleotide ligation-polymerase chain reaction (MOL-PCR), a fast and efficient assay previously developed at Los Alamos National Laboratory. MOL-PCR employs ligatable probes (MOLigos) capable of single nucleotide polymorphism discrimination to detect the presence of several subtypes of the four pathogens. MOLigo pairs bound to target DNA are PCR amplified using fluorescently labeled universal primers. The amplicons are then hybridized to microspheres and detected with a flow cytometer. In the current phase of this project, we are optimizing assay conditions to improve sensitivity, specificity, and efficiency by varying reaction conditions. Our findings suggest further improvements may be made through increased MOLigo concentrations, lowering the PCR annealing temperature, and increasing the ligation annealing hold time. After optimization and validation, these assays will be deployed to California Citrus Research Board and the United States Department of Agriculture.

Name: Neel Gupta
Program: UGS
School: University of Minnesota

Name: Will Schoonover
Program: UGS
School: University of Arkansas

Name: Keyla Tumas
Program: UGS
School: Ithaca College

Group(s): B-9, C-CDE
Mentor: Taraka Dale, Babetta Marrone, Jim Coons
Category: Biosciences
Type: Group Poster Presentation

Ultrasonic Fields for Harvesting and Extracting Lipids and Proteins from Algae

As fossil fuel prices increase and petroleum supplies decrease, alternative sources of energy are becoming of great interest to our Nation. Here at Los Alamos National Laboratory, a small team of researchers and students are developing a simple yet remarkably innovative technology, ultrasonic acoustic fields, aimed to transform the biofuels industry by cutting the costs required to isolate lipids and co-products from algal cultures. We are using this method to create an energy and cost efficient process for (1) concentrating the algae, (2) extracting the lipids from the algae, and (3) separating the lipids, co-products, and algal biomass from the remaining water, all critical steps prior to refining lipids into biofuels. A major step in making our process industrially viable is scale-up. To this end, we are evaluating the effectiveness of different transducers for the harvesting vessel. Also, in order to assess and validate each step in the process, we need to track and characterize the integrity of the lipids, as well as other cellular components, such as proteins and DNA. Therefore, we are developing electrophoretic and microplate assays for tracking these components. With the challenges of separating and harvesting undertaken, we are transgressing towards our economically sound industrial-scale goal.

Name: Felicia Archuleta
Program: UGS
School: University of New Mexico
Group: C-PCS
Mentor: Aaron Anderson
Category: Chemistry
Type: Individual Poster Presentation

Glutamic Acid-based Trifunctional Linkers: Versatile Species for Bio-detection

Rapid, specific and sensitive detection of proteins plays an important role in disease diagnostics, drug discovery and other biomedical studies. Although antibodies are a popular choice for analyte detection, they have certain limitations. Antibody production and identification must be performed in vivo and is often laborious and expensive. Also, antibodies are very sensitive to temperature, have a limited shelf life and performance may vary from batch to batch. The recent developments of aptamers—a new class of DNA and RNA molecules—have shown many potential uses in analyte detection. Aptamers offer several advantages over antibodies in that they can be identified in vitro and accurately reproduced by chemical synthesis. They are also stable to long-term storage. In this study, we sought to develop a tri-functional linker molecule containing a dye, lipid tail, and oligoethylene glycol attached to a DNA for small molecule detection in a fluorescence resonance energy transfer (FRET) assay. The tri-functional linker is based on glutamic acid, a naturally occurring amino acid that is commercially available with protecting groups that ease the synthesis. Through a series of chemical manipulations we produced flexible, modular molecules that could incorporate dyes and other receptors in the same species. The DNA aptamers were attached using alkyne-azide "click" chemistry. Future studies include FRET assays using these modified aptamers, changing the length of the PEG spacer, varying the number and length of lipid tails, and incorporating other oligonucleotides for the detection of other targets.

Name: Balazs Bene
Program: GRA
School: University of Nevada, Las Vegas
Group: C-IIAC
Mentor: Eva Birnbaum
Category: Chemistry
Type: Individual Poster Presentation

Separation of Neighboring Lanthanides for Ho-163 Production

Production of holmium-163 through (p, 2n) reaction at the LANL Isotope Production Facility using a stable dysprosium target would mitigate a need in the field of nuclear physics. Recently it was proposed that holmium-163 due to its extremely low electron capture Q value may allow direct measurement of the mass of neutrinos by cryogenic micro-calorimeter detectors with sub-eV sensitivity.

After irradiation, the holmium product needs to be separated from the dysprosium target material. The separation chemistry of the lanthanide elements is quite challenging due to relatively small gradual changes in their properties across the group as a result of the lanthanide contraction. On account of their chemical similarity, the investigation of methods for recovering and separating the lanthanides has been an important field of research since their discovery. The introduction of chromatographic methods, in particular ion exchange chromatography, has revolutionized the field of lanthanide separations, but ion exchange approaches have a very limited mass capacity for lanthanides. Consequently, the scope of this project, recovery of micro/nanogram quantities of holmium from tens of grams of irradiated dysprosium target material represents a significant challenge.

In this study the separation of a model solution containing holmium, dysprosium, terbium and gadolinium using a preparative scale high performance liquid chromatography system (HPLC) will be optimized by varying parameters such as cation exchange resin, column packing, flow rate, α- hydroxyisobutyric acid concentration and pH. The purity of fractions will be assessed using inductively coupled plasma optical emission spectrometer (ICP-OES).

Name: James Bowen
Program: GRA
School: University of Cincinnati
Group: C-NR
Mentor: William Kinman
Category: Chemistry
Type: Individual Poster Presentation

Nanomanipulation – A Tool for Analysis of Trace Nuclear Forensic Evidence

Trace evidence can provide tremendous insight into people, places, materials, and criminal intentions associated with illegal activities involving nuclear materials. Clear separation of a trace forensic signature from background signals is necessary but is seldom simple. Environmental background such as actinide-rich global fallout or naturally occurring uranium in a matrix such as soil may mask important characteristics of a material related to a nuclear incident. Isolation of an actinide-rich material from a bulk soil sample can make a wide range of destructive and non-destructive analysis more achievable. Our goal in this study has been to develop a technique to physically isolate actinide-rich soil constituents from background soil material to make the material available for more in-depth and essentially background-free analyses.

To develop a technique, we used soil samples from the 1960 BOMARC nuclear weapons incident, in which nuclear material was introduced to the surrounding soil following the destruction of nuclear warhead in an accidental fire. Soil collected following large-scale soil remediation efforts were affixed to electrically conductive carbon tape and evaluated with the intent to isolate actinide-rich constituents for isotopic analysis by thermal ionization mass spectrometry (TIMS). The locations of actinide-rich materials of interest were identified using backscatter electron imaging (BSE) and X-ray microanalysis. A DCG Systems S200 nanomanipulator interfaced with an FEI Quanta 200F field emission scanning electron microscope (FE-SEM) was used to maneuver the target constituents. A target particle, roughly 80 microns in diameter, was moved largely intact approximately 3.5 mm to a soil free landing area. The etched portion of the carbon tape was removed and placed in a vial to dissolve the material of interest for isotopic analysis by TIMS.

Name: Lauren Davis
Program: UGS
School: University of New Mexico
Group: MPA-MC
Mentor: Rico Del Sesto
Category: Chemistry
Type: Individual Poster Presentation

Applications of Ionic Liquids

Ionic liquids (ILs) are a versatile group of compounds which have a wide variety of applications. They are composed solely of ions, which make them non-volatile due to strong ionic interactions. They also have hydrophobic hydrocarbon chains, preventing the formation of a crystalline structure and resulting in low melting points near or below room temperature. The ionic properties make ILs good solvents for charged species such as organic acid dyes, and the hydrophobic side chains also enable them to dissolve non-polar species such as isoprenoids and triacylglycerols, both of which can be processed and used as biofuels.

Ionic liquids are ideal for biofuel extraction since they are generally non-toxic and non-volatile, the latter of which allows for the distillation of high purity biofuels from the IL in a simple process without contamination from the extracting agent. We are testing the extraction and separation of biofuel-based products from microorganisms in several ILs, and testing the toxicity of these ILs on algae and cyanobacteria.

Ionic liquids can also be used to introduce agents into textiles or surfaces. This could potentially be a very useful application for dyeing textiles. Currently industrial dyeing of textiles results in waste water which is a major source of industrial pollution. Ionic liquids can be usedfor dyeing solvent-free or with ethanol, which is easier to handle at the industrial scale than water. We are testing the solubility of acid dyes in several ILs and using the ILs as a dyeing agent for textiles such as wool. We are also trying to introduce sensor and detector materials into textile fibers by the same method.

The unique properties of ILs make them ideal solvents that are easy to work with and less hazardous than many other organic solvents, with potential applications in the Energy and Global Security areas.

Name: Aubrey Graham
Program: UGS
School: Smith College
Group: MPA-CINT
Mentor: Andrew Dattlebaum
Category: Chemistry
Type: Individual Poster Presentation

Novel Ligands for Exploring Charge Effects in Nanocrystal QD-Bio Interactions

The ability to control the extent and nature of nanomaterials interactions with biological systems—from the molecular and cellular level to the level of the tissue or organism—is becoming increasingly important in the context of understanding and managing human/environmental health impacts, as well as applying this new class of materials to advanced bioimaging and biomedicine. Nano-bio interactions are strongly influenced by a nanomaterial's surface chemistry, which can be "tuned" by manipulating surface charge, adding "bio-compatible" elements, such as poly (ethylene glycol) groups, and/or including specific biomolecular coupling or targeting agents. In addition, each of these features contributes to limiting or enhancing the stability of a nanoparticle in a biologically relevant environment, e.g., nanoparticles that are exclusively electrostatically stabilized suffer from aggregation in common buffers and media. The most common approach to controlling nanomaterial surface chemistry is to bind "ligands" to the nanoparticle surface that afford the desired properties of, for example, stability, targeted interactions, limited non-specific binding, etc.

My research aimed to address these needs in the context of semiconductor nanocrystal quantum dots. I synthesized multidentate poly(ethylene glycol) ligands that were terminated on one end with two dihydrolipoic acid "anchor groups" and on the other with a methoxy group. The approach followed literature precedent (Stewart et al. J. Am. Chem. Soc., 2010, 132, 9804) and entailed Michael addition to establish a branch point at the end of a PEG chain together with carbodiimide-coupling to attach two thioctic acid groups (DHLA precursors) per PEG chain. I have further modified this initial methodology to allow for alternative terminal chemistries, i.e., amine, carboxyl, and biotin end groups. In all cases, the DHLA's bind to the quantum dot surface, affording a stable (tetradentate) interaction, while the unbound end-group provides a selection of charging conditions (neutral, positive, negative) and/or coupling options (e.g., biotin mediated).

Name: Christopher Hejde
Program: UGS
School: University of New Mexico
Group: C-AAC
Mentor: Donivan Porterfield
Category: Chemistry
Type: Individual Poster Presentation

Observations from Background Spectra Acquired by a Germanium Gamma-ray Detector

High-purity germanium (HPGe) detectors are well accepted for the measurement of gamma-ray photons given their combination of good energy resolution and good detection efficiency. Given the prevalence of naturally occurring radioactive material (NORM) the presence of background peaks in the spectrum of most any HPGe detector spectrum is expected and can be substantial. We will be examining HPGe background spectra to determine the relationship between the NORM contributors and observe detector characteristics.

Name: Aatirah Holmes
Program: UGS
School: Norfolk State University
Group: C-PCS
Mentor: Aaron Anderson
Category: Chemistry
Type: Individual Poster Presentation

Capillary Based Biosensors

The mission to create an inexpensive and portable biosensor has been ongoing and research on the subject has greatly progressed in recent years. This technology is urgently needed, and could be especially useful in disease stricken countries with low return rates of patients, as well as in remote settings. In our labs we use planar optical waveguides for signal transduction. An optical waveguide is a physical structure that guides electromagnetic waves in the optical spectrum. Our current waveguides are hampered by their expense and complexity and a simpler, less costly system is needed. Capillaries are ideal for resource-poor or remote settings because they are small, inexpensive, and disposable. The goal of this project was to develop techniques to clean and coat capillary tubes for use as a signal transduction platform. Herein, the cleaning and coating of the inner surface of capillaries, as well as the apparatus created to complete these processes, are described. Further, we discuss a simple assay using streptavidin-coated quantum dots. Future work will include coupling laser light and a spectrophotometer through the side of the capillary to allow for fluidic connections and permit multiple injections. These steps will allow the use of capillary tubes in sandwich immunoassays and will pave the way for a more cost-effective biosensor.

Name: April Longhair
Program: UGS
School: University of New Mexico
Group: C-CDE
Mentor: Peter Stark
Category: Chemistry
Type: Individual Poster Presentation

Validation of the Fluorescence Method for Beryllium Analysis

Beryllium is a metal that has many industrial and laboratory uses. Occupational exposure to beryllium can cause irreversible adverse health effects before signs and symptoms are seen or felt. Either air or surface sampling or both may be used to determine the chance for beryllium exposure in the beryllium areas. An Industrial Hygiene Laboratory (IH Lab) is accredited by the American Industrial Hygiene Association (AIHA) for analysis for air filters and swipes for beryllium. Traditional beryllium analysis, done by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), takes expensive instrumentation, is high maintenance, requires expensive consumables, takes highly trained operators, is time consuming, and not amenable to automation, miniaturization, or field work. In 2004, Los Alamos researcher, Mark McCleskey, developed a new method for beryllium analysis based on fluorescence measurement. Subsequently this method has been recognized by the National Institute for Occupational Safety and Health (NIOSH) and ASTM International as a standard method. The new method is faster, less expensive, more sensitive, and more flexible than the ICP-OES method. The IH lab is currently undergoing internal validation of this method with the ultimate goal of certification by AIHA and full implementation at LANL as a certified method. This work increases our understanding of beryllium sensitization that could lead to acute or chronic beryllium diseases.

Name: Alexander Lou
Program: UGS
School: Williams College
Group: MPA-MC
Mentor: Rico Del Sesto
Category: Chemistry
Type: Individual Poster Presentation

Dye Extraction using Ionic Liquids for Forensic Purposes

Natural and synthetic dyes in wool can offer important forensic evidence, especially in cases when extreme conditions or explosions have destroyed other organic material. Unlike many other fibers, wool can endure high temperatures and physical trauma allowing dyes embedded within it to remain unharmed. While this is helpful for preserving dyes as evidence, the disulfide crosslinking and hydrogen bonding that give wools its resilience also makes it difficult to extract dyes from within the fibers. Room temperature ionic liquids (RTILs), essentially molten organic salts, are an ideal choice for dye extraction for forensic analysis for the following reasons. First, as RTILs can be made to have specific properties, it is possible to use them to disrupt crosslinking and hydrogen bonding to release dyes embedded between peptides. Secondly, past research has shown that RTILs can also serve as a matrix for one step Matrix Assisted Laser Desorption Ionization – Time Of Flight (MALDI-TOF) analysis. Through two-phase aqueous extractions and synthesis of new ionic liquids, we aim to discover ionic liquids that will serve to efficiently extract a broad range of dyes from wool. We have tested several phosphonium and imidazolium based RTILs, some of which had high extraction efficiency in water and are therefore promising candidates for dye extraction from wool.

Name: Isaac Mares
Program: UGS
School: Colorado School of Mines
Group: WX-7
Mentor: David Chavez
Category: Chemistry
Type: Individual Poster Presentation

High Nitrogen Energetic Salts

The purpose of this project was to develop and characterize a series of energetic salts based on the tetranitrobiimidazolium anion (N4BIM). The cations incorporated are Guanidine based; Guanidinium (Gu), Monoamino Guanidinium (MAG), Diamino Guanidinium (DAG), and Triamino Guanidinium (TAG). Performance and sensitivity testing of the energetic materials/explosives were analyzed through shock, friction and impact testing methods, while characterization of the salts applied methods of NMR spectroscopy, Infrared Spectroscopy, Differential Scanning Calorimetery and Vacuum Stability. Due to the high nitrogen content of the series of salts, all can be used as nitrogen gas generators. As they burn, they release an excessive amount of nitrogen gas, making the compounds favorable as systems of inflation for air bags or life vests. Meanwhile, each salt shows different characteristic when ignited. For example, the salt MAGN4BIM burned quickly releasing most of its energy over a short period of time. While, the salt DAGN4BIM burned slowly releasing most of their stored energy over a longer period of time. These types of characteristics are favorable in stage I and stage II propellants. Stage I propellants need a fast burst of energy to propel a projectile out of the barrel and stage II propellants need a slow but constant thrust to propel the projectile over a distance. The series of salts are also favorable as gun propellants because, as they are used the nitrogen from the explosive reacts with the gun barrel, making it harder and stronger. The development of these high nitrogen energetic salts is a significant technological advancement in multi-purpose modern energetics.

Name: Victoria Montoya
Program: UGS
School: University of New Mexico
Group: C-CDE
Mentor: Edward Gonzales
Category: Chemistry
Type: Individual Poster Presentation

Sustainability of Diverting Cooling Tower Drainage to the Sanitary Waste Water System (SWWS) Facility

The Department of Energy (DOE) via Executive Order 13514 mandates a16-17% reduction in potable water consumption by 2015 relative to fiscal year 2007 baseline (Erickson, 2011). One approach to potable water consumption at Los Alamos National Laboratory (LANL) would be recycling water from cooling towers and reclaiming sanitary effluent for use in cooling towers (Wingo). Once the sanitary effluent is reclaimed, via the Sanitary Effluent Reclamation Facility (SERF), the water can be sent back to the cooling towers for reuse. In order for this process to work, water from cooling tower blow down proposed for rerouting from National Pollution Discharge Elimination System (NPDES) outfalls to the SWWS plant must pass three tests: (1) a water toxicity test,(2) total dissolved solids test (TDS), (3) and a chemical oxygen demand test (COD). Currently there are 13 Cooling Towers around LANL that are being monitored to determine the toxicity, COD, and TDS of the water. The results from these data collected will assist in determining whether blow down from these cooling towers can be discharged to the SWWS facility and subsequently reclaimed at the SERF for future reuse.

Name: Jung Rim
Program: GRA
School: Penn State University
Group: C-NR
Mentor: Donald Dry
Category: Chemistry
Type: Individual Poster Presentation

Preparation and Characterization of Cerium Dioxide Particles

A method was developed to produce cerium dioxide particles with a narrow size distribution. Cerium is a good nonradioactive surrogate material for plutonium and this procedure was developed with the intention of applying it to the production of plutonium oxide. The CeO2 particles were prepared by precipitate cerium oxalate from a solution of 0.0581M ceric ammonium nitrate by adding 200mL of 10% oxalic acid. The Ce(C2O4)2 precipitate was washed with DI water then calcined in a furnace at 600oC to convert it to CeO2. The procedure produced a narrow particle size distribution and consistent particle morphology. Scanning Electron Microscope (SEM) was used to characterize the particle size distribution and morphology. The SEM stub was prepared by pipetting CeO2 on to a carbon tape. The morphology of particles was first visually inspected for any substantial discrepancy. The roundness or shape of each particle was then calculated. The particle size distribution was also determined at the same time as particle morphology study. The particle size distribution was estimated by calculating a 2D surface area of a large number of particles. The area was calculated by adding all the pixels within the particle and converting the number of pixels into square microns.

Name: Audrey Roman
Program: GRA
School: University of Nevada, Las Vegas
Group: C-NR
Mentor: Evelyn Bond
Category: Chemistry
Type: Individual Poster Presentation

Characterization of Actinide Chromatographic Resins to Improved Separations for Microcalorimetry

For nuclear forensic purposes, samples which contain actinides and fission products require separation and purification before analysis by alpha spectrometry. Due to overlapping actinide alpha peaks, efficient separation is needed for complete sample analysis. With the recent advancement of cryogenic microcalorimeters, as written by Horansky et al., ultra-high resolution alpha spectrometry has reached a FWHM of 1.06±0.06 keV for 5.3 MeV alpha particles, which would enable alpha spectrometry to be used for analysis of mixed actinide samples. Even better resolution could be obtained with improved chemical separation and preparation techniques. These improved techniques could produce samples that are more pure, consistent, and applicable to microcalorimetry.

To improve the separation techniques of actinides, Eichrom Technologies' DGA resin is studied for metal sorption. DGA is an extraction chromatographic resin that has proven in varying acid matrixes and concentrations to have high sorption properties for actinides. Due to the possible interference and synergistic affect metals may have on actinide separation it is essential to have a full understanding of DGA's affinity for all metals which could be found in a sample. For this reason DGA has been preliminarily characterized for many metals, however, not all metals have been studied for all acids and ranges of interest. The goal of this research is to further elucidate the character of DGA towards other metals (Na, La, Ga, Sc, Mo, Yb, Rh, and Sn) under a broad range of nitric, hydrochloric, and hydrobromic acid conditions to improve the separations of samples analyzed by microcalorimetry.

Reference:
1. Horansky, R.D., Stiehl, G.M., Beall, J.A., Irwin, K.D., Plionis, A.A., Rabin, M.W., Ullom, J.N., Journal of Applied Physics 107, 044512 (2010)

Name: Daniel Roybal
Program: UGS
School: University of New Mexico
Group: C-CDE
Mentor: Robert Wingo
Category: Chemistry
Type: Individual Poster Presentation

Maximum Contaminant Removal from Sewage Waste Waters Using Crude Glycerin

The primary method for treating sanitary (sewage) influent uses biological organisms to metabolize carbon present in sewage. These organisms' Biological Oxygen Demand (BOD) can be supplemented by the addition of crude glycerin into a wastewater treatment plant. Crude glycerin, a low-cost byproduct of biodiesel, has been shown to improve biological growth and stability of a wastewater treatment plant such as Los Alamos National Laboratory's (LANL) Sanitary Waste Water facility (SWWS). An increase in crude glycerin should increase biological growth which, in turn, will improve contaminant removal. To examine this, influent and effluent samples of the SWWS were taken between July and October of 2010. During fiscal year (FY) 2011, these samples were tested for contaminants and that data interpreted with regard to the amount of crude glycerin added to the plant. The formula used in this project for determining the effectiveness of contaminant removal is defined as the concentration of a contaminant in the influent minus the concentration of the contaminant in the effluent divided by the concentration of that contaminant in the influent. Using this definition for effectiveness, SWWS effluent water quality improved following the addition of crude glycerol as a supplemental carbon source. For example, there was a correlation between the amount of arsenic, iron, and dichloro PCB homologue in the effluent and the amount of crude glycerin injected at LANL's SWWS. With the right amount of crude glycerin injected, one could easily achieve an optimal amount of BOD, promoting the growth of biological organisms to operate the plant most efficiently.

Name: Maxwell Schulze
Program: UGS
School: Colorado School of Mines
Group: WX-7
Mentor: David Chavez
Category: Chemistry
Type: Individual Poster Presentation

Energetic Material N-Nitrodifurazanopyrrole (NDFP)

Energetic materials with higher performance and lower sensitivity are constantly being sought for use in a variety of explosive applications. NDFP is as of yet an undocumented and uncharacterized material. Calculations predict a density of 1.90 g/cm3 and a heat of formation of 147.7 kcal/mol; both suggest this as a promising candidate for an energetic material.

One potential synthesis pathway for NDFP includes the precursor Diaminobifurazan (DABF), a previously documented and characterized inert compound. I established a synthesis pathway for DABF using reactions previously documented in literature. After performing the literature syntheses as published, I optimized the reaction conditions in each step to improve purity and yield by analysis of reaction results. These improvements also helped to reduce cost of starting materials, and had the added benefit of reduced environmental impact and size of waste streams. I then accumulated a large amount of DABF for use in developing a procedure for the synthesis of NDFP.

Furthermore, I applied the same synthetic methodology to the synthesis of Diaminofurazan (DAF), providing a cheaper and safer synthesis than that currently used. DAF is a precursor for many already characterized, developed, and high performing energetic compounds. The new synthetic procedure for DAF was able to increase yields from around 20% to 65% as well as eliminate the use of pressure reactors, making the large-scale production of DAF and its energetic products cheaper and safer.

Name: Gerald Castaneda
Program: UGS
School: Northern New Mexico College
Group: DCS-4
Mentor: Benny Montoya
Category: Computing
Type: Individual Poster Presentation

PCoIP

PCoIP technology allows for the compression of display for connecting desktop machines over a standard IP-based network. This technology is not limited to certain users, all users across the board can benefit from PCoIP. PCoIP centrally stores the user's information in a datacenter and the users use a zero-client at their end to remote in and transmit back to its machine the pixels only. PCoIP supports full definition and high resolution displays on large monitors. It also supports 3D display. PCoIP falls under layer 4 of the OSI model which is the transport layer. One thing about PCoIP is that it encrypts the data going across the network. This is a very secure technology. It is cost effective and very secure because the thin clients themselves do not have any memory that can be used against the corporation if compromised. PCoIP uses host rendering. Meaning that the user experience is rich because the applications will not have to render on the client side and therefore the applications will work like they should. Network bandwidth too is not affected by PCoIP sending just encrypted pixels across the network. PCoIP is multi-codec. It changes the codec to suit every object that goes through the network to help stabilize the connection and free it from latency of any kind.

Name: Eli Chertkov
Program: UGS
School: Princeton University
Group: D-4
Mentor: Russell Bent
Category: Computing
Type: Individual Poster Presentation

Flow Algorithms for Applications of National Interest in Supply Chain Modeling

Much of modern society depends on the ability to move resources and every-day commodities through supply chains, i.e., transporting resources from multiple raw suppliers to numerous levels of processing facilities and their final destinations at consumers' local stores. Clearly, the proper routing of commodities has a tremendous impact on the through put of materials and the associated cost of this through put. The ability to analyze and address the pitfalls of existing supply chains proves invaluable in utilizing resources to their fullest potential. This problem of supply chain optimization is not computationally easy to solve and requires an understanding of graph theory, linear programming (LP), and mixed integer programming (MIP). I discovered, when properly utilized, these techniques tractably solve the problem. Additionally, I generalized the problem to accommodate varying degrees of scope and complexity, allowing for additional constraints on the optimization - such as multiple commodities, cost per flow of commodity, commodity substitution, and cost of waste/underutilization - to be considered. In addition to finding optimal solutions of flow distribution in well-defined supply chains, by using these techniques, I model the most efficient operations of legal and beneficial supply chains and the most effective disruptions of illegal supply chain activities in the "Shadow Economy." More specifically, I use this model to determine the resiliency of legal supply chains and to discover the exploitable weaknesses of illegal supply chains. I show that randomly generated supply chains are quite resilient to random disruptions, but are susceptible to coordinated attack strategies.

Name: Natalie Chrien
Program: UGS
School: Pacific Lutheran University
Group: HPC-1
Mentor: Laura Lang
Category: Computing
Type: Individual Poster Presentation

Filling in the Gaps: Gap and Overlap Utilities for Osoloco

Osoloco is a powerful 3D modeling tool used to create problem setups for various scientific applications, such as radiation transport and hydrodynamics codes. It allows the user to create, edit, and view a wide variety of 3D objects; assign material information to them as needed; and output them to a number of different file formats. One of the largest problems with past versions of Osoloco was the difficulty in locating overlaps or gaps between objects (which can cause problems in client codes); in order to locate gaps and overlaps, one had to rely on visual inspection and manual calculations of the boundaries of various objects, an often impractical task. In order to eliminate this shortcoming, two new utilities have been developed. The first is an overlap finder, which locates any overlapping regions in a given project and writes them to an Oso file. This overlap program is written in Python, and makes use of Osoloco and Etch libraries. The second new tool is a gap finder, which makes use of Spica and GMV to search for areas not covered by any region. If any gaps are found, they are likewise written to a file and can be viewed using GMV. Both utilities are still in early forms, but already meet their core functionalities and have the potential to be immensely useful tools for Osoloco users.

Name: Rico D'Amore
Program: GRA
School: New Mexico Highlands University
Group: HPC-5
Mentor: John Bent
Category: Computing
Type: Individual Poster Presentation

IOFSL (Input Output Forwarding Software Layer)

Today's leadership class machines such as Jaguar at ORNL and Blue Gene/P at Argonne consist of hundreds of thousands of processing cores. Applications running on these machines can experience an I/O bottleneck because the I/O systems are not capable of handling the immense amount of I/O traffic with present day parallel file systems. IOFSL (Input Output Forwarding Software Layer) is a software layer designed to handle the I/O bottleneck. IOFSL aggregates and delegates I/O requests from client nodes. I/O nodes run a software library that intercepts I/O calls from the client nodes, before they reach the parallel file system. The result is the parallel file system thinks it is handling fewer client nodes and is perfectly capable of handling the I/O traffic, as it appears to be a more traditional I/O load.

Name: Scot Halverson
Program: GRA
School: University of Minnesota Duluth
Group: D-3
Mentor: Matthew Nelson
Category: Computing
Type: Individual Poster Presentation

Accelerating Particle Simulations with GPGPU Computations

Graphics Processing Units (GPUs) in modern computers are cheap and powerful computational devices. As a result of recent advancements in general purpose GPU computing, we are able to take advantage of these devices for computationally intensive simulations. Our initial goal was to accelerate the runtime of an existing particle simulator written in FORTRAN 95. This presented a number of challenges. Because CUDA is a subset of the C programming language, much of the existing code had to be rewritten. Even so, it was not desirable to completely rewrite the application in C/CUDA. With this in mind, we rewrote only computationally expensive sections of the FORTRAN code in C and CUDA then linked the separately compiled results together. Furthermore, the original code was designed to be computed linearly, while general purpose GPU computing is advantageous for primarily parallel computations. Thus, much of the logic of the original code had to be redesigned to operate in a parallel environment. We were successful in converting the majority of the linear computations to parallel equivalents, but a select few could not be parallelized. Even so, the conversion resulted in a significant acceleration of the simulation. In the parallelized version of the code, results are obtained several times faster than the original linear version of the code. Additionally, with a minor change in logic, the parallel version outperforms the linear version by upwards of a factor of 10. However, this results in a minor loss in accuracy in the results.

Name: Dylan Paiton
Program: GRA
School: University of New Mexico
Group: ISR-2
Mentor: Steven Brumby
Category: Computing
Type: Individual Poster Presentation

Scaling of Object Detection Algorithms with Training Set Size

Viewpoint invariant object detection in natural images has been a long-standing challenge in computer vision. To date, algorithms exist that have demonstrated 80-90% performance with single category recognition tasks and 10 to 100 training images. However, these algorithms are meant to simulate human performance by quickly recognizing tens of thousands of categories with consistently high accuracy. Li Fei-Fei's recent work from Stanford University has shown that performance of common algorithms decreases to as low as 30% with identifying 200 categories and 5% with 10,000 categories. This decrease in performance can be attributed to the limited amount of training stimulus presented to the neural networks. It is estimated that the average person receives roughly one TeraPixel/day (10^12 pixels/day) of visual information. To properly represent the human visual experience, an algorithm would have to be trained with over 2-million average-sized images per day, which is impossible given current image datasets. It is therefore interesting to predict how well today's algorithms perform as the number of training images is scaled. Here I explore the performance of a Los Alamos National Laboratory viewpoint-invariant, hierarchical model of the visual cortex using the Stanford ImageNet database, one of the most well populated image datasets available. I will compare the single-object detection results with theoretical performance estimations for increasing amounts of training data. This data could then be used to predict how well PANN will perform with many-category recognition tasks.

Name: Richard Rivera
Program: UGS
School: New Mexico Tech
Group: NIE-1
Mentor: Ian Philp
Category: Computing
Type: Individual Poster Presentation

Moving Towards a Dynamic VoIP Architecture

Voice over Internet Protocol (VoIP) is both a technology and a service that enables packet and voice transmission over a single data network. The introduction of VoIP into a local and wide-area network infrastructure requires proper design and management to obtain network quality of service (QoS). In terms of quality design and management, evaluating the impact of VoIP on the network infrastructure is essential. Common design challenges include dissimilarity when migrating from a static network to dynamic network architecture and trade-offs between delay and the efficient use of bandwidth. To achieve an efficient VoIP integration a series of network engineered policies will need to be applied including QoS, port queuing, metering, and packet differentiation. Migrating to a VoIP solution provides an abundance of features best equipped for call management, overall lower cost of communication, and a reduced infrastructure footprint.

Name: Aaron Robinson
Program: UGS
School: University of New Mexico
Group: SAE-3
Mentor: David Moir
Category: Computing
Type: Individual Poster Presentation

Application Server Engineering for RADIUS Software

Applications have become widespread in today's society and have a variety of uses. Designing an application is only the first step in the development process. The application must be then made available to a greater audience for testing and feedback purposes and an application server can aid in this process. RADIUS, or Rapid Automated Decomposition of Images for Ubiquitous Sensing, is software that aids in analyzing digital images. RADIUS allows the user to control very specific input parameters in order to achieve the desired output. In order for Radius to be deployed on an application server, a unique environment needed to be created that allowed the software to function properly and maintain performance regardless of the user. Through the use of XML, Java, and HTML the RADIUS web project was created in a manner that allows the program to be deployed on an application server and be accessed remotely regardless of the user's operating system and specifications. This project will continue to be developed in order to create the best environment possible for the software.

Name: Marisol Romero
Program: UGS
School: New Mexico State University
Group: SAE-3
Mentor: Reggie Maestas
Category: Computing
Type: Individual Poster Presentation

Documentum Statistical Information Web Application

EMC Documentum is an enterprise content management platform that allows users to create, manage, and store information needed for specified users at Los Alamos National Laboratory. Users have the ability to access this information at any given point off multiple systems and repositories. A user who has authority to the multiple systems and repositories of Documentum may find it difficult to access statistical information over all systems and repositories they have access to i.e. document sizes, user count, etc. Therefore, a web application will be developed to give users a onetime access to the statistical information needed from all or some of the systems and repositories. The web application can be easily accessed from a browser and used appropriately by authorized users. The web application will be built with a combination of JAVA, XHTML, Facelets, AJAX, etc. There will be appropriate measures taken to access the web application including proper security access through a lightweight directory access protocol (LDAP), authorization and authentication precautions, and verification of user type. Some benefits of the web application include software maintenance with no user installation as well as the ability to access it form any computer with no specified operating systems, or browser.

Name: April Trujillo
Program: UGS
School: University of New Mexico
Group: DCS-4
Mentor: Marsha Trujillo
Category: Computing
Type: Individual Poster Presentation

Routing and Extension Solutions

The Velocitykvm System 28 series offers a compelling solution for those who are in need of maximum resolution with flawless image quality and no frame dropping this technology also extends to centralizing IT support of their machines while keeping confidential data secure and easier to manage. Using multi-mode or single-mode fiber, the system allows users to locate a DVI monitor and peripherals via fiber from just a few meters up to 10 kilometers away from the controlling computer securely without the loss of resolution.

Three fibers are dedicated to the video and USB while the fourth fiber is the back channel for the USB and DDC. The DDC (Display Data Channel) or EDID (Extended Display Identification Data) information is provided to the CPU by either a generic table stored inside the transmitter, or from a display connected to the transmitters local port. Also, the added capability of active DDC allows the remote monitor to send its display capabilities to the CPU.

The use of these types of systems can be seen here at the lab. The Velocitykvm System 28 receiver may be sitting in a central location such as a server room or vault while the user and transmitter sits in another room or building. These types of system allow you to better protect a system and its data because you are controlling physical access to the system.

Name: Roxane Valdez
Program: UGS
School: Northern New Mexico College
Group: DCS-3
Mentor: Stephanie Lovato
Category: Computing
Type: Individual Poster Presentation

Windows Server 2008 for Air Quality Monitoring

Many industries such as healthcare, hospitality, airports, universities and the Los Alamos National Laboratory purchase an application developed by Alerton in order to monitor and determine the Heating Ventilation and Air Conditioning (HVAC) temperatures throughout the year within several buildings. The DCS team was appointed to build a server for the Engineering Services group and a vendor from Alerton was appointed to install and configure the HVAC monitoring software. Once the software is installed on the server, it allows you to view various temperature readings in the building from a workstation, make sure they remain consistent, and show buildings and HVAC systems that need special attention.

Name: Graham Van Heule
Program: GRA
School: Michigan Technological University
Group: HPC-3
Mentor: Quellyn Snead
Category: Computing
Type: Individual Poster Presentation

Configuration Management in HPC

In the past twenty years we have seen major advances in the world of computer technology in both administrative tools and complexity. Despite these advances, most professional systems administrators configure and maintain their systems manually on each individual system. This approach does have the advantage of simplicity and immediacy. However, it also has several major drawbacks. The main drawback is that restoring a system can be time consuming and difficult using a manual approach. Administrators that "inherit" a system will find themselves scrambling to understand how to fix or rebuild it in the event of a hard drive failure. The traditional method of restoring a failed system via full disk backup will keep a massive amount of files that the administrator has never even touched. Even a simple task such as reverting a file to a previous version can be difficult.

These issues cause plenty of trouble when administering standard desktops and servers; however, in a High Performance Computing environment of large scale clusters these problems become unmanageable through manual methods. We have solved these issues in HPC-3 by using a comprehensive configuration management solution (CM). This solution allows us to rebuild a system or restore to a previous configuration quickly, and accurately. This solution only keeps track of files that the systems administrators have modified from the default OS configuration given at build time. With such a small subset of changes, this greatly reduces the amount of time to rebuild or reversion any given system. This also gives us a comprehensive list of changes made to each file on every system; thereby allowing us to easily look up what has changed or revert to a previous configuration.

Name: Meredith Webster
Program: UGS
School: University of Minnesota-Twin Cities
Group: HPC-1
Mentor: Laura Lang
Category: Computing
Type: Individual Poster Presentation

Improving Tutorials and Documentation of Geometric Setup Code

Help documents and tutorials can help users learn and become comfortable with software. Unfortunately creating these items can be time consuming for developers but, it is important that help documents are updated with the improvement of software, as it is released or during the development stage. OsoLoco, a constructive solid geometry editor, and Etch, the multi-tabular surface editor, are two in-house extremely useful programs which can prove challenging to learn. These programs contained on-line user documentation; however, the documentation was out of date and misleading to user. As a student, I was able to learn how to use these packages, reformat the documentation, review and update the documentation, and create new user tutorials. Additionally I wrote a python script that automatically generated sections of the documentation from program files. Now these simplified user guides can be placed on-line at setup.lanl.gov and displayed from within OsoLoco and Etch. This accomplishment will aid users to effectively understand the program they are working with.

Name: Neal Davis
Program: GRA
School: University of Illinois--Urbana-Champaign

Name: David Nicholaeff
Program: GRA
School: University of California, Los Angeles

Name: Dennis Trujillo
Program: UGS
School: New Mexico State University

Group(s): XCP-4
Mentor: Robert Robey
Category: Computing
Type: Group Poster Presentation

Cell-based AMR on the GPU with Applications to Exascale Supercomputing

For the exascale computing paradigm, a hundredfold optimization of power consumption will be required. The primary power demand comes from the memory hierarchy and associated memory transfers. GPU-based computing hides compute node memory latency with increased throughput and provides one of the most promising paths to exascale computing. Currently there is a lack of numerical applications on the GPU.

We present an OpenCL implementation of a cell-based adaptive mesh refinement (AMR) scheme for the shallow water equations. The challenges associated with ensuring the locality of algorithm architecture to fully exploit the massive number of parallel threads on the GPU is discussed. This includes a proof of concept that a cell-based AMR code can be effectively implemented, even on a small scale, in the memory and threading model provided by OpenCL. Additionally, the program requires dynamic memory in order to properly implement the mesh; as this is not supported in the OpenCL 1.1 standard, a combination of CPU memory management and GPU computation effectively implements a dynamic memory allocation scheme. Load balancing is achieved through a new stencil-based implementation of a space-filling curve, eliminating the need for a complete recalculation of the indexing on the mesh. A cartesian grid hash table scheme to allow fast parallel neighbor accesses is also discussed. Finally, the relative speedup of the GPU-enabled AMR code is compared to the original serial version. We conclude that parallelization using the GPU provides significant speedup for typical numerical applications and is feasible for scientific applications in the next generation of supercomputing.

Name: Scott Antos
Program: UGS
School: New Mexico State University

Name: Bruce Gale
Program: GRA
School: Colorado Technical University

Group(s): HPC-3
Mentor: Terri Morris, Kyle Lamb
Category: Computing
Type: Group Poster Presentation

High Performance Computing: Event Analysis and Trending

Within the realm of High Performance Computing (HPC) event tracking is a crucial aspect of maintaining system performance, stability, and reliability. With this is mind, there is always a need to monitor and track the ebb and flow of that data and the systems that are being employed. As such, event tracking serves as an intricate tool for ensuring system performance and reliability, system error analysis and diagnostics.

In this project, the authors focus on the files system and network infrastructures contained within a HPC environment. Within HPC reside a vast number of components that transmit event data. This data is then compiled into system logs. The purpose of these system logs is to compile any and all events that occur. This data is then analyzed to determine any potentially detrimental events prior to failure.

This however can be a monumental task as there can be hundreds of thousands of events transmitting across the system at any one moment. To combat this problem there have been several advances in monitoring software to track this data and render the statistics of its passing in a useful way. Within this project, the authors employ the systems Zenoss and Splunk>.

The proposed outcome is to utilize scripts to load daily log data into Splunk>. Once the data has been aggregated within Splunk> it will be indexed, filtered, and finally passed to Zenoss. Once received by Zenoss the events will be used for monitoring and trending of availability, performance, and events.

Name: Ian Burns
Program: UGS
School: New Mexico Tech

Name: Lucinda Gaines
Program: UGS
School: University of Colorado at Denver

Group(s): ISR-2
Mentor: Paul Pope
Category: Computing
Type: Group Poster Presentation

V&V Framework for Geospatial Image Analysis Algorithms

The focus of our research was to develop a framework for the Verification and Validation (V&V) of geospatial imagery algorithms. Currently, there is no V&V methodology that exists in this field. Geospatial imagery analysis algorithms are an active area of research and have applications in detecting nuclear proliferation activities. These algorithms are designed to aid Geospatial Imagery Analysts with image annotation and identification of the salient parts of the facilities. This allows the categorization of the type of industry present, but it is a tedious, labor intensive task plagued by human inconsistency and error.

Our framework centered around two tools: Words to Image (W2I), and Image to Words (I2W). The W2I tool generates synthetic geospatial imagery using natural language descriptions. The I2W tool performs simple image analysis and reciprocates the descriptive natural language that the W2I tool produced. The “closed loop” system permitted the examination of the entire V&V methodology and helped the refinement of both the tools and our V&V methodology. We examined our framework through the “closed loop” evaluation of two and three dimensional benchmark imagery.

Our framework based on benchmark imagery from W2I remains a work in progress. However, our V&V framework is already accomplishing its goal of refining geospatial imagery algorithms, while simultaneously refining a benchmark suite of synthetic imagery. Our V&V framework has already shown itself to be a valuable tool in geospatial imagery analysis algorithm development, and as it matures looks to provide similar valuable additions to other projects.

Name: Han Dong
Program: GRA
School: State University of New York at Buffalo

Name: Paul Sathre
Program: GRA
School: Virginia Tech

Name: Mahesh Ravishankar
Program: GRA
School: Ohio State University

Name: William Taitano
Program: GRA
School: University of New Mexico

Group(s): T-1, T-3, CCS-7
Mentor: D. Knoll, T. Germann, P. McCormick, B. Lally
Category: Computing
Type: Group Poster Presentation

Quasi-Diffusion-Accelerated Monte Carlo on Heterogeneous Architectures

Classic Monte-Carlo approach to the Boltzmann transport equation is expensive. To accelerate convergence of the stochastic solution, a hybrid approach is taken where the lower-order-moments solution to the original Boltzmann transport equation provides the scattering source to the higher-order Monte-Carlo system using the Eddington tensor information from the higher-order solution. This hybrid-algorithm was tested on a GPU-CPU hybrid architecture to investigate a proof of concept of mapping the GPU to solve particle (higher-order Monte-Carlo) system and CPU to solve the lower-order partial differential equation (PDE) system (moments system).

Name: Daniel Birdsell
Program: UGS
School: University of New Mexico
Group: EES-16
Mentor: Hari Viswanathan
Category: Earth and Space Science
Type: Individual Poster Presentation

Predicting Engineered Natural Systems (CO_2-PENS) System-Level Model Verification

Predicting Engineered Natural Systems (CO_2-PENS) is a system-level model that assesses the risk, cost, and feasibility of geologic carbon sequestration. In this model, CO_2 is injected into a geologic reservoir, and CO_2 and brine can leak from the reservoir into the three overlying aquifers via poorly cemented wells. Process-level models to simulate leakage are time consuming because they involve the multiphase flow of CO_2 and water and uncertain parameters such as wellbore permeability. They are therefore not amenable for use in a system-level model. We instead develop a computationally efficient decision tree that mimics the behavior of the process-level model. To develop confidence in the model, leakage as a function of pressure in the reservoir, CO_2 saturation in the reservoir, and wellbore permeability is investigated. The results show expected trends in leakage. Higher reservoir pressure and higher permeability wellbore cement lead to increased leakage for both brine and CO_2, and higher CO_2 saturation increases CO_2 leakage and decreases brine leakage. Additionally only one to three leakage rates per simulation is observed. There are both negative and positive conclusions for the predictive ability of CO_2-PENS. On the negative side, the decision tree is very coarse as evidenced by the small number of leakage rate changes. On the positive side, the coarseness of the decision tree does not give the user overconfidence in the significance and accuracy of CO_2-PENS predictions, and all of the expected leakage trends are captured.

Name: William Casper
Program: GRA
School: University of Washington, Seattle
Group: CCS-2
Mentor: Balu Nadiga
Category: Earth and Space Science
Type: Individual Poster Presentation

EnKF Data Assimilation in the POP Global Ocean Model

We present results from our initial attempts at ensemble-based data assimilation in a global ocean general circulation model (POP, Parallel Ocean Program) at one degree resolution. We hypothesize that model error (due to unresolved scales) is responsible for the insufficient ensemble diversity and spread witnessed in initial tests. To correct this, we implement a spread restoration algorithm which restores estimates of the background error covariance toward a fixed error covariance estimate taken from a control run. Initial tests show significant improvement in the assimilation system over both uncorrected runs and runs using adaptive inflation schemes.

Name: Kenneth Cleveland
Program: GRA
School: Pennsylvania State University
Group: EES-17
Mentor: Monica Maceira
Category: Earth and Space Science
Type: Individual Poster Presentation

3D Structure of Iran and Surrounding Areas from The Simultaneous Inversion of Complementary Geophysical Observations

We present a three-dimensional seismic-structure model of the Arabian-Eurasian collision zone obtained via simultaneous, joint inversion of surface-wave dispersion measurements, teleseismic P-wave receiver functions, and gravity observations. We use a simple, approximate relationship between density and seismic velocities so that the three data sets may be combined in a single inversion. The sensitivity of the different data sets are well known: surface waves provide information on the smooth variations in elastic properties, receiver functions provide information on abrupt velocity contrasts, and gravity measurements provide information on broad-wavenumber shallow density variations and long-wavenumber components of deeper density structures. The combination of the data provides improved resolution of shallow-structure variations, helping produce the smooth features at depth with less contamination from the strong heterogeneity often observed in the upper crust. We also explore geologically based smoothness constraints to help resolve sharp features in the underlying shallow 3D structure. We focus on the region surrounding Iran from east Turkey and Iraq in the west, to Pakistan and Afghanistan in the east. We use Bouguer gravity anomalies derived from the global gravity model extracted from the GRACE satellite mission. Surface-wave dispersion velocities in the period range between 7 and 150 s are taken from previously published tomographic maps for the region. Final results of the simultaneous inversion will help to better understand one of the most prominent examples of continental collision. Such models also provide an important starting model for time-consuming and fully 3D inversions.

Name: Kyle Gorkowski
Program: UGS
School: Michigan Technological University
Group: EES-14
Mentor: Manvendra Dubey
Category: Earth and Space Science
Type: Individual Poster Presentation

Aerosol Optical Properties of Smoke from the Las Conchas Wildfire

The Las Conchas wildfire was started on June, 26 2011 from a tree falling down and arcing across two power lines. Due to the close proximity to the fire the Los Alamos National Laboratory (LANL), Earth and Environmental Sciences Division (EES-14) attained unique measurements of the smoke by the Physics Building, after the LANL was restarted. Ambient measurements of Total Particulate Matter (PM2.5 and PM10) were collected continuously at the LANL air monitoring stations. Three Integrated Photoacoustic/Nephelometer Spectrometers were setup to measure aerosol light absorption and scattering coefficients. The aerosol's optical properties where measured before and after denuding the sample, at 405nm (blue), 532nm (green), 781nm (red) and 375nm (ultraviolet non-denuded only). The size distributions were also measured with a laser based sizer. The smoke is composed of organic and black carbon (soot) that are formed during wood combustion and pyrolysis. The optical properties of the smoke are complex and are the largest source of uncertainty in assessing global warming (soot absorbs sunlight, while CO2 absorbs thermal radiation emitted by earth). The Las Conchas fire provided us a high smoke regime that we exploited to investigate its optical properties. By heating the smoke to temperatures ranging from 75 to 200C we removed the volatile organics and measured the optical properties. This thermal denuding of the aerosols removes the outer organic coatings leaving behind the inner core of black carbon (soot). By simultaneously measuring the optical properties of the whole aerosol (non-denuded) and the core aerosol (denuded), we revealed how the coatings affect the optical properties. The absorption coefficient measurements show that coatings can cause an increase or decrease absorption, depending on their thickness. Our results provide the first analysis of the dependence of organic aerosol optical properties as a function of coating thickness in the field.

Name: Benjamin Klein
Program: UGS
School: Amherst College
Group: EES-14
Mentor: Manvendra Dubey
Category: Earth and Space Science
Type: Individual Poster Presentation

Discriminating Multiple Trace Gas Sources in Cool, CA and Farmington, NM

The atmospheric trace gases CO_2, CH_4 and CO were measured during field campaigns in Cool, California during June 2010 and in Farmington, New Mexico from January to July, 2011. These gases are of interest because they either directly (CO_2, CH_4) or indirectly (CO) contribute to the atmospheric greenhouse effect, but also because when considered relative to each other, they provide valuable information about their sources. Different sources produce these gases in distinctive proportions, allowing for their discrimination using trace gas ratios.

The trace gas compositions at the two studied locations are markedly different. Cool is a rural forested community near the foothills of the Sierra Nevada Mountains approximately 40 miles NE of Sacramento and 100 miles NE of the San Francisco Bay area. Trace gas levels in Cool are dominated by local biogenic sources and transport episodes where plumes of anthropogenic pollution are transported from San Francisco or Sacramento to Cool. Farmington is a city of approximately 45,000 located in the high desert of Northwestern New Mexico. Trace gas signals in Farmington are dominated by the nearby San Juan and Four Corners coal-burning power plants and other anthropogenic sources. Additional trace gas sources in Farmington include the smoke plume from the Wallow fire in eastern Arizona and possibly methane seeping from local coal-beds. Using a combination of trace gas measurements and their ratios, basic meteorological data and back-trajectory models, the various trace gas sources and events at the two field sites have been delineated and characterized.

Name: Allan Lerner
Program: UGS
School: Amherst College
Group: EES-14
Mentor: Donald Hickmott
Category: Earth and Space Science
Type: Individual Poster Presentation

Determination of Calcite-Fluid Interfaces at high P/T via Neutron Reflectometry

Calcite (CaCO3) is one of the most abundant crustal minerals and is a crucial phase in a wide-range of energy and environmental applications. Calcite interacts with H2O-CO2 fluids at subsurface nuclear waste sites, during the extraction of hydrocarbons, during the production of geothermal energy, and in geological CO2 sequestration. Unfortunately the details of these phenomena are poorly understood because calcite surface properties have primarily been studied at ambient conditions, which are not directly applicable to the geological conditions at which these processes occur. A joint EES/LANSCE project aims to fill this void by studying calcite-fluid interactions in geological conditions in-situ using neutron reflectometry. Neutron reflectometry is an ideal technique for investigating such processes because neutrons are strongly penetrating and able to pass through robust, high P/T aluminum cells with minimal attenuation. Additionally, neutrons are highly sensitive to deuterium due to its large neutron scattering cross section, allowing heavy water (and correspondingly normal water) to be detected. Hereby, neutron scattering provides great advantages over x-ray imaging techniques, which can neither detect water nor penetrate high P/T cells. A new LANL-unique neutron cell allows neutron reflectometry studies in conditions up to 200°C and 200MPa (corresponding to a crustal depth of 6 km) in fluid environments varying in pH and mineral and CO2 saturations. These studies will elucidate the atomic scale interactions occurring at calcite-fluid interfaces, including fluid structuring and precipitation and dissolution processes. Chemical vapor deposition (CVD) is being pursued as a promising mechanism for solving the challenge of producing calcite surfaces of the requisite angstrom-level smoothness for neutron reflectometry.

Name: Jonathan Vander Wiel
Program: UGS
School: LeTourneau University
Group: D-5
Mentor: Mike Salmon
Category: Earth and Space Science
Type: Individual Poster Presentation

Soil Layer Visualization under CMRR

When a seismic event occurs, massive structures will shake with enough force that they will feedback into the overall seismic profile. As preparations are made for the construction of Chemical and Metallurgy Research Replacement (CMRR), the building's feedback in the event of a seismic event must be analyzed and understood. An important piece of the research is an understanding of the soil profiles under the building in question. Over the past forty years multiple companies have been contracted by the laboratory to do studies regarding the engineering and geologic features of the planned construction site. From these studies data from the boring hole logs has been extracted and then synthesized into a comprehensive three dimensional model. The model is centered around DSC-1b, a bore hole drilled and analyzed by Klienfelder, and extends far enough to include SHB-1, a hole drilled by Woodward-Clyde Federal Services. This model has then been compared to the current accepted model of soil layers under CMRR. The results of the model show that the layers are very nearly planar, as expected, and no significant difference is found between it and the SSI profiles.

Name: Harold McNamara
Program: UGS
School: Yale University

Name: Sean Quinn
Program: UGS
School: Rochester Institute of Technology

Group(s): ISR-2
Mentor: Rohan Loveland
Category: Earth and Space Science
Type: Group Poster Presentation

Investigating the Origin of Meteoroids Using High-Power-Large-Aperture Radar

We present meteor flux maps and a general characterization of meteors observed using data sets from the ALTAIR radar facility (9.40° N, 167.48° E). This campaign has provided us with 8031 observations taken over 30 days. Following a transformation to standard coordinates we obtained radiant distributions for each of the detected meteor heads. We find that these distributions are consistent with six well documented sources: north and south apex, helion and anti-helion, and finally north and south toroidal; however, evidence for toroidal sources is weaker. Roughly 4.7% of observed meteors are extra solar--these meteors do not exhibit clustering and appear to be randomly distributed. We have identified the requirement for instrumental and atmospheric debiasing, and are currently developing a time integrated sensitivity function to improve the accuracy of our results. This function will allow us to compare our results to similar studies in the literature.

This project was supported by the LANL LDRD office and the DOE Office of Science.

Name: Hirotatsu Armstrong
Program: GRA
School: University of Texas
Group: D-5
Mentor: Russell Johns
Category: Engineering
Type: Individual Poster Presentation

Addition of a Cosmic Ray Source to MCNP6

Modeling cosmic radiation is needed to characterize background radiation used in many simulation applications. Cosmic rays are particles composed primarily of high energy protons and alpha particles. As they enter the atmosphere, they interact with earth's magnetic field. Particles with an energy/unit charge below a "cutoff" are deflected back into space while higher energy particles make it through. The cutoff values are given in terms of the rigidity (GV) which is independent of particle type. Rigidity values depend on the location on the earth as well as the direction of the incoming particle. As the particles travel through the atmosphere, they interact with molecules in the air and create particle showers. These showers generate many secondary particles that are not present in the primary cosmic ray spectrum. These particles eventually make it to ground level and contribute to background radiation. I am adapting a program developed at the University of Delaware into a module which samples a particle type, energy, and incident direction based on specified latitude and longitude coordinates. With this, I generate energy distributions for each particle type entering the top of the earth's atmosphere and compare these distributions with published data. The ultimate goal of the project is to pass the particle information to MCNP6 so that one can correctly model the cosmic ray contribution to background for various locations on the earth.

Name: Brenton Barton
Program: UGS
School: University of New Mexico
Group: XCP-8
Mentor: James Langenbrunner
Category: Engineering
Type: Individual Poster Presentation

Gathering Evidence for Validation of Large Scale Monte Carlo Code

Validation of computer codes and models is a key to predictive modeling and stockpile stewardship. An objective of our work is to design and model historical nuclear experiments and an atomic-physics physics diagnostic as part of an effort to collect evidence of validation for the large-scale computer code MCNP (trademark). This is a challenge that is becoming more frequent for engineering applications. For example, Divider (09/23/1992) was the last U.S. full-scale weapon related test. An example of validation with full-scale testing for young university engineers is provided by the Society of Automotive Engineers, which hosts an annual competition to design, manufacture, and race formula racecars. The paradigm of stockpile stewardship is computer design, manufacture/life-extension, but without full-scale nuclear testing. The stockpile must be able to perform flawlessly if ever called to duty, without full-scale nuclear testing. We exercised 3D computer design, and validation by comparing computer simulations to nuclear- and atomic- physics for three applications: a laboratory experiment of 12C(n,n'γ); a diagnostic design of a beryllium γ-to-e- converter; and a Gas Cherenkov detector precursor signal. We will discuss evidence of validation using these examples.

Name: Daniel Cassidy
Program: UGS
School: Bradley University
Group: ISR-6
Mentor: Bruce Carlsten
Category: Engineering
Type: Individual Poster Presentation

Design of a Crane Based Sensor Transportation System

Today, professionals doing non-proliferation work do not have an accurate way of measuring how much Pu-239 (spent fuel) remains in a fuel assembly of a nuclear power plant. The most common instrument used today is a FORK detector that obtains the total amount of neutron and gamma levels in the fuel. This method does not measure the plutonium levels directly but rather measures the Curium. This results in a high uncertainty that makes detection of the theft of plutonium very difficult.

Currently LANL is developing promising new sensors to make base line measurements of Pu-239. These sensors can take direct measurements of plutonium and they have greater accuracy than existing FORK detectors. However, they are still in the prototype phase. One problem with the new sensors is that they have no consistent and reliable mechanical system/structure to mobilize them from a crane to the fuel rod assemblies.

The objective is to design a crane-based system that will transport either of two LANL sensors to the midpoint of a fuel assembly during fuel transportation between the reactor to the spent fuel pool. LANL has set the following requirements:

• No part of the system damages the fuel assembly.
• The system operates within 5 minutes.
• The system can transport either PNAR or SINRD sensors to their specified locations.

Name: Nicolas Castano
Program: HS COOP
School: Los Alamos High School
Group: P-21
Mentor: Pulak Nath
Category: Engineering
Type: Individual Poster Presentation

Adhesive Transfer Tape Options for Microfluidic Enzymatic Reactions

Microfluidics deals with the functions and precise manipulations of liquids confined in small, sub millimeter scaled flow channels. We pattern adhesive transfer tapes using a CO2 laser cutter for inexpensive and quick fabrication of microfluidic platforms. This method can be compared to the soft-lithography and photo-lithography techniques for microfluidic production, but with the advantages of rapid, low cost prototyping. Most microfluidic developments are geared towards biological applications. The objective of this work is to study the biocompatibility of our platforms for biochemical applications. Two types of microfluidic platforms were designed for different types of enzymatic reactions. The fabrication methods of the platforms were optimized for their functions and biocompatibility. The first platform was designed to perform microfluidic Polymerase Chain Reactions (PCR) and the second platform was designed to perform air-liquid cavity acoustic mixing for rapid protein digestion. We will present the fabrication and biocompatibility aspects of our platform by demonstrating successful PCR and protein digestion on our microfluidic platforms.

Name: John Driscoll
Program: UGS
School: New Mexico State University
Group: NPI-1
Mentor: Paul Smith
Category: Engineering
Type: Individual Poster Presentation

Statistical Analysis of Low Flow Filter Efficiency Testing Results

Air filters designed to contain plutonium particulates while allowing hydrogen gas to escape are used in a variety of low flow rate applications in the nuclear industry. Examples include nuclear material storage containers, glove box bag-out bags and waste drums. Filter efficiency testing is essential to ensure filter performance, and yet the low testing flow rates present some challenges because the testing flow rates can be 5 to 6 orders of magnitude lower than those used to test large HEPA filter systems used in facility ventilation systems. Statistical analysis of low flow filter efficiency test results on nuclear material storage container filters has proven to be essential to ensure that the testing processes, test equipment, and filters meet the design requirements. This poster will describe the testing apparatus used to test nuclear material storage container filters and the use of statistical methods to analyze low flow filter efficiency test results.

Name: Timothy Haines
Program: GRA
School: University of Washington
Group: P-23
Mentor: Katherine Prestridge
Category: Engineering
Type: Individual Poster Presentation

The Physics Behind the Magic Fountain

Under a grant from the American Physics Society, we are developing demonstration fluid dynamics experiments for a prototype kit that will be used for high school outreach by APS volunteers. We describe an experiment that illustrates properties of pressure and density, and that can be easily and inexpensively constructed for use in outreach activities. The experiment is called Heron's fountain, and it is named after the Greek mathematician Heron of Alexandria, who created many different inventions based on fluid dynamics principles from 10 to 70 A.D. Heron's fountain is often referred to as the magic fountain. Upon first glance, it appears that Heron's fountain has achieved perpetual motion because it causes water to flow up hill. However, an in-depth analysis reveals that the bulk of the water is actually flowing down hill. By applying Bernoulli's equation at four different positions in the fountain, the velocity of the fluid leaving the nozzle of the fountain can be calculated. Through the use of differential equations and properties of incompressible fluid streams, a formula for the amount of time that the fountain will flow can be derived. Students in a class can measure five different critical dimensions of the fountain and predict how long the fountain will flow. They can then compare their results with their own experimental observations.

Name: Kyle Hammond
Program: UGS
School: New Mexico State University
Group: D-5
Mentor: Bruce Letellier
Category: Engineering
Type: Individual Poster Presentation

Modeling a Loss of Coolant Accident at South Texas Project Nuclear Power Plant

The South Texas Project (STP) nuclear power plant, just outside of Houston, has recently begun an investigation into the transport of debris generated from a loss of coolant accident (LOCA). It is proposed that debris may induce blockage at the water recirculation sump screens and reduce or eliminate the ability to utilize recirculated water for cooling purposes. This calculation is being performed in order to establish the thermodynamic conditions of the containment pool after a LOCA has occurred. STP specific geometry and operating conditions were modeled using the MELCOR (Severe Accident Modeling Code) and executed to generate pressure and temperature histories of the pool and containment building for various lengths of time. The data generated are being integrated into an examination of the pressure loss that occurs when potential debris beds form at the recirculation sump screen. Containment accident calculations will eventually be performed for a variety of prototypical pipe break sizes that represent a range of possible accident severity.

Name: Joseph Hashem
Program: GRA
School: The University of Texas at Austin
Group: MET-2
Mentor: Stephen Stout
Category: Engineering
Type: Individual Poster Presentation

Evaluation and Implementation of Glovebox Automation for Plutonium Slump Casting

When a process or task requires workers to function in a radioactive environment, additional constraints and requirements increase the complexity of the design problem. Finding a solution that optimizes radiation protection As Low As Reasonably Achievable (ALARA) goals and also allows for successful task completion in the hazardous domain can be difficult. In order to meet ALARA goals, large dose reductions are possible through process optimization, utilization of nuclear design principles, and removing the worker from the environment when possible using automation and/or robotics. At MET-2, one induction heating furnace, located in a glovebox, is used to melt and slump cast Plutonium-239 metal. The purpose of this work is to evaluate the current casting furnace design and develop a remote handling system that limits dose and ergonomic injuries when handling Pu metal. The most significant amount of radiation in this glovebox project comes from alpha-emitting Americium-241, which is a beta-decay product of Pu-241. The measured dose rate for the Pu metal used in this project is 1 rem/hour at contact, due to the age of the metal and accumulated decay (daughter) products. Furthermore, ergonomic injuries to glovebox operators occur because of the limited dexterity and reach. Task analysis of glovebox processing was performed in order to determine which automated design alternatives, including the use of fixed automation, flexible automation, and/or teleoperation, achieve the greatest radiation dose reduction as well as to reduce ergonomic injuries. These remote handling techniques were also evaluated for their capability to execute certain tasks in the process.

Name: Brett Hill
Program: UGS
School: Colorado State University
Group: MET-1
Mentor: Kirk Veirs
Category: Engineering
Type: Individual Poster Presentation

Determining Thermal Conductivity of PuO2 Powders

The effective thermal conductivity of plutonium oxide powder is an essential piece of information when determining possible safety hazards of the 3013 container used for long term plutonium storage. The average gas temperature, which affects container pressure through the ideal gas law, and thermal gradients, which affect water distribution and corrosion, are impacted by the effective thermal conductivity. The effective thermal conductivity of material in a container can be calculated using standard equations for heat transfer in an infinite cylinder with internal heat generation, k_eff=(q*r_o^2)/4ΔT [1-(r/r_0)^2]

We have access to temperature measurements of real plutonium-containing material loaded into 3013 containers taken during destructive examination for surveillance purposes. We investigate the effect of limited time to reach thermal equilibrium and the advantages/disadvantages of fitting temperature data to a decay function. The specific heat is determined from the total power and material volume measured by radiography. We find that the thermal gradient measured at six hours yields equivalent results as twelve hours allowing reduction of temperature data collection times to less than one working shift. Theoretical models of effective thermal conductivity of powder materials have the void fraction as an important parameter. Our measurements of plutonium oxide materials with similar void fractions result in widely varying effective thermal conductivities suggesting that we need to take into account additional material properties.

Name: Joshua Jacquez
Program: HS COOP
School: Espanola Valley High School
Group: ES-55
Mentor: Ron Aguilar
Category: Engineering
Type: Individual Poster Presentation

Prior to Move MAR Treanding

The material control and the accountability program is a programmatic control that reduces risk by maintaining a system for monitoring the amount of material in the PF-4 inventory. This program supports the tracking and the control of the inventory of the MAR (Material a Risk) to be within specified limits for the applicable location. MAR is defined as the amount of hazardous material available to be acted on by a given physical stress. Trending uses engineering and technical resources to review manufactures repair history and vendor information to determine preventive maintenance schedules throughout TA-55. The 2008 DSA specifies a MAR inventory, prior to adding new material to a specified location to insure the MAR limits are not exceeded. For some locations that are subject to a large number of transactions and may substantially reduce productivity throughout the Facility and could possibly effect agreed upon milestone. As MAR surveillance is a new requirement, we are studying if a "prior to move" requirement is justified by trending MAR data for high material transaction areas.

Name: Stephen Jimenez
Program: UGS
School: New Mexico Tech
Group: MET-2
Mentor: Matt Martinez
Category: Engineering
Type: Individual Poster Presentation

The Effects of Dry Machining on the Metallurgical Properties of HP Copper

Dry machining offers manufacturers a 7 to 17 percent savings in machining cost due to the absence of cutting fluid and provides a more eco-friendly workplace that is safe for personnel and the environment [1]. As dry machining becomes more advanced, the need for optimizing these processes becomes paramount. Optimization of these processes will result in higher quality products, an increase in production, and decrease overall cost. Today, dry machining processes operate efficiently for harder materials such as steel alloys. Near-dry machining techniques have been developed that are effectively used to machine ductile or softer materials such as aluminum. Currently, there are numerous studies on dry machining aluminum but very few studies done on pure copper. As a result, there is a need to study the surface of dry-machined, high purity copper and to characterize its metallographic properties. These metallographic characteristics will be used to develop ranges for feed rates and speeds for lathe operations that will produce the best surface finish on high purity copper rods. It has been determined after speaking with a Kennametal Engineer that the use of a KD1400 insert is best suited for this experiment. Maximum and minimum cutting speeds (900 – 3200 sfm) were determined via Kennametal's website [2]. A constant cutting depth will be chosen between the depths of 0.002in - 0.005in, or a depth that is feasible for turning copper rods to produce a finished surface. For each experiment, the cutting speed (V), feed rate (v) and the spindle speed (N) will vary while the depth of cut and the feed (f) will be held constant.

[1]
http://www.todaysmachiningworld.com/how-it-works-%E2%80%93-dry-and-near-%E2%80%93dry-machining/
[2]
http://www.kennametal.com/images/repositories/PDFs/A-08-01324_Advanced_Materials_portfolio_sec.pdf

Name: Juliusz Kruszelnicki
Program: UGS
School: University of Florida
Group: D-5
Mentor: Bruce Letellier
Category: Engineering
Type: Individual Poster Presentation

Velocity Fragment Analysis via Examination of Spectral X-Ray Images

In high-energy explosions, it is often shrapnel, as opposed to heat or air compression, that causes gravest harm. For the purpose of predicting the possible damage resulting from explosively driven debris, a high-explosive assembly was detonated, and images of the resulting projectiles were recorded using commercial-grade, PulseRad X-Ray tubes of varying energies. These tubes were placed at alternate view angles and downrange distances from the blast. Of the 9 screens deployed to capture images, only 4 survived. Scanning equipment was employed to record and digitize the results for kinetic analysis. To calculate the energies of distinct debris items, it is necessary to know their individual masses and velocities. A MatLab-based code was written that adjusts image qualities, maps the distinct objects, and provides crucial information regarding projected sizes and pixel intensities. The results also supply information about the velocities of the projectiles; however, the mass component of the kinetic energy remains unknown because the particular objects' material composition has to be identified. To assist with material identification, a method was developed for calculating the energy spectra of each of the X-Ray tubes that, in turn, enable for a future capacity for generating synthetic radiographs of idealized fragments with known thicknesses and material types. Comparisons of synthetic and experimental results can, potentially, assist in identification of the material composition of each projected fragment that appears in the radiographs.

Name: Armando Lopez III
Program: UGS
School: New Mexico State University
Group: P-25
Mentor: Dale Tupa
Category: Engineering
Type: Individual Poster Presentation

Muon to Electron Conversion Tensioning Device

The Mu2e experiment is designed to search for the coherent, neutrino-less conversion of a muon to an electron (Mu2e), in the Coulomb field of a nucleus. A tensioning device is developed to support these disks in a coaxial sequential manner. The purpose of each tensioning device is to suspend each disk with a half millimeter precision in two directions. The volume of this apparatus is minimized, yet it still can tension loads in excess of four pounds and maintain fine tuning ability. An array of thirty-three disks will be tensioned requiring three tensioners per disk. A safety factor of five was included in the design stages to ensure the integrity of the wire tensioning throughout the life of the experiment. In addition, the design requires several other challenges including mass reduction and vacuum rated parts.

Name: Kaity Manning
Program: GRA
School: Colorado School of Mines
Group: D-4
Mentor: Loren Toole
Category: Engineering
Type: Individual Poster Presentation

EBID Micro-Hydro Turbine Analysis

Elephant Butte Irrigation District (EBID) in southern New Mexico has asked LANL's assistance in helping to install micro-hydro systems in order to generate electricity that will either benefit the farmers in the area directly, or else be part of a buyback plan with El Paso Electric. This low-head, high-flow hydro will consist of a reaction propeller turbine. The EBID wants to be able to make the propellers in-house to save on cost, thus it needs to have a simple design. Their current design is only yielding 25-30% efficiency, which is low compared to other propeller turbine efficiencies which are in the 55-70% range. Our goal is thus to improve upon EBID's design to improve efficiency, while still keeping it simplistic and cheap.

Name: Alynna Montoya-Wiuff
Program: UGS
School: New Mexico State University
Group: HPC-2
Mentor: Richard Rivera
Category: Engineering
Type: Individual Poster Presentation

Monitoring and Improving Data Center Efficiencies at the Los Alamos Strategic Computing Complex

Los Alamos National Laboratory is home to several supercomputers that are on the frontier of technology innovation and high performance computing. These machines and their supporting facility equipment consume a significant amount of power and require 24/7 observation and administration support. In order to gain a comprehensive understanding of a data center's energy consumption, you must have access to current power and environmental data.

You can't control or manage what you don't measure; therefore in order to determine the Strategic Computing Complex's (SCC's) energy efficiency position and compare it to the rest of the data center industry, a monitoring system called Environet was implemented during the summer of 2010. Power and environmental monitoring are essential pieces of improving and keeping a data center running efficiently. Environet allows facility personnel to generate benchmarks and starting points to track, report, and continually refine data center operations in search of best practice methods.

The historical and live data available from the Environet system has helped the HPC-2 group plan for infrastructure upgrades and new computer installation. High-density and exascale computing are in the near future, and current projects are underway to prepare the SCC for the next generation of computing by bringing in more power and installing additional cooling. The data retrieved has served as a tool in bringing the SCC's power usage effectiveness (PUE) down from a 1.65 to a 1.34 daily average. The PUE is a ratio of total facility power to IT equipment power, and the Uptime Institute published an industry average PUE of 1.8 in May 2011. Saving energy and maximizing efficiencies is a priority goal for DOE's data centers, and Environet has helped HPC-2 take the necessary steps towards improving efficiencies.

Name: Erik Moro
Program: GRA
School: University of California San Diego
Group: INST-OFF
Mentor: Anthony Puckett
Category: Engineering
Type: Individual Poster Presentation

Performance Optimization of Fiber Optic Displacement Sensors

Optical fiber sensors offer potential advantages over traditional electro-mechanical sensors, such as being small, lightweight, and minimally invasive, being immune to electromagnetic interference, and not generating sparks. Further, some optical fiber sensor architectures offer substantial performance increases over their electro-mechanical counterparts, making them ideal for use in certain sensing applications. A variety of intensity-modulated optical displacement sensor architectures have been proposed for use in non-contacting sensing applications, with one of the most widely implemented being the bundled displacement sensor. The performance of any such bundled optical displacement sensor is governed by the quantity and the relative positioning of transmitting and receiving optical fibers within the bundled sensor probe. In other words, the radial offsets between transmitting and receiving fibers in the probe dictate the relationship between axial displacement and sensor output. In this work, an optical transmission model is validated and used for accurately characterizing displacement sensor performance a priori; thereby guiding the arrangement of fibers within the bundle to meet application-specific performance needs. A genetic algorithm is then implemented for efficiently exploring the design space of the proposed bundle sensor architecture in search of optimal bundle configurations that offer high-sensitivity, with an allowable degree of nonlinearity, over a prescribed axial displacement range. It is shown that the output of the genetic algorithm is sensitive to the structure and properties of the cost function employed. It is also shown that this approach may be generalized for developing application-specific optical displacement sensors, which offer high-sensitivity over a variety of axial displacement ranges and with a variety of acceptable error levels.

Name: Mitchell Olson
Program: GRA
School: University of California, Davis
Group: W-13
Mentor: Michael Prime
Category: Engineering
Type: Individual Poster Presentation

Triaxial Residual Stress in a Dissimilar Metal Weld from a Nuclear Reactor

Residual stresses are stresses that remain after all external loads and temperature gradients have been removed from a structure. Residual stresses are important because they can positively or negatively affect material behavior, simply because they are added to the applied stresses. Particularly, they can have strong effects on fatigue, fracture, and stress corrosion cracking. Over the course of this summer I am investigating the residual stress distribution in a dissimilar metal weld, where the primary failure mode is stress corrosion cracking. The sample that this research revolves around is a pressurizer and relief nozzle from a decommissioned nuclear power plant. It is common for stress corrosion cracks to occur in this type of nozzle. The repair is costly, consisting of shutting the reactor down and making a thick weld overlay around the crack. Because this specimen cannot be adequately measured with existing technology, this research will use a new measurement technique called the surface superposition contour method.

The surface superposition contour method consists of combining the hoop residual stress measured from the contour method with post-sectioning, in-plane residual stresses using an alternative method. In this case, neutron diffraction was employed to measure in-plane residual stresses after the contour method cut. Prior to the cut, the part was too thick for adequate penetration with neutrons. Hole drilling was also used in the surface contour superposition method and compared against the surface superposition contour method using neutron diffraction results. When the results of the two methods are superposed, a triaxial residual stress map is found on a given plane, which is a significant improvement over the contour method or hole drilling alone. In the future, this work will help enable the extension of the contour superposition method to measure triaxial residual stresses in large components.

Name: David Parkinson
Program: UGS
School: Brigham Young University
Group: WX-7
Mentor: Daniel Preston
Category: Engineering
Type: Individual Poster Presentation

Drop Weight Impact Sensitivity Testing at LANL

All new explosives at LANL undergo sensitivity testing for safety. Drop Weight Impact testing determines the relative sensitivity of an explosive to different levels of impact. In this poster presentation I introduce the Drop Weight Impact test that workers perform at LANL including an upgrade to new microphones and sound level meters. I also provide a sensitivity rank ordering of explosives based on Drop Weight Impact results gathered from 2010 through this summer. Workers perform the Drop Weight Impact tests using a LANL Type 12 apparatus and the Neyer D-optimal method to collect and evaluate results. To start the process of upgrading the microphones and sound level meters, I collected data for various explosives using the old microphones and sound level meters and compared it to data collected using the new microphones and sound level meters. The results show that data collected with the old and new meters compares favorably. Minimal additional testing is needed to verify this result.

Name: Jessica Rivas
Program: UGS
School: New Mexico State University
Group: MET-2
Mentor: James Jurney
Category: Engineering
Type: Individual Poster Presentation

Foundry Upgrades

The foundry, located at TA-55, is based upon a 1950s design; therefore, we need to improve the reliability, availability, maintainability and inspectability of the system. A major component of the upgrade is the control system. I have begun training as well as hands-on work with Allen-Bradley Programmable Logic Controllers (PLC) in order to start familiarizing myself with the design, fabrication and installation of a functioning control system. A control system is a device or set of devices used to direct, manage, command or regulate the behavior of other devices or systems. It focuses on the modeling of a diverse range of dynamic systems and the design of controllers that will cause these systems to behave in a specific manner. A system can be mechanical, electrical, fluid, chemical, financial and even biological. Examples of apparatuses that ran from control systems are automobiles, washing machines, thermostats and computers, just to name a few; almost every machine uses a control system. Even though we will not starting installation of the foundry upgrades project until later this year, I anticipate more in-depth training for the fundamentals and troubleshooting of the controller equipment. With training, I will be able to provide the necessary data collection, safety interlocks and remote control through the PLCs. Upgrading is essential when a system meets the end of its life cycle. Control systems help save time, energy, money, reduce the risk of operator error, and make it easier to maintain the process.

Name: Kevin Rodriguez
Program: UGS
School: Turabo University
Group: P-23
Mentor: Katherine Prestridge
Category: Engineering
Type: Individual Poster Presentation

Controllers for Accurate Spatial Positioning of Diagnostic Equipment

The Extreme Fluids Team in P-23 specializes in high spatial- and temporal-resolution experimental diagnostics. These diagnostics use lasers to illuminate the flow, and digital cameras to record the signal. Very high precision is required in the positioning of the lasers and cameras, and knowledge of the absolute and relative position of the stages is important. Lasers and cameras are mounted on optical breadboards or plates, and these plates are then mounted to positioning stages surrounding the experimental facility. We describe a new positioning system being developed for the new Vertical Shock Tube (VST) experiment. The positioning stages are moved using mechanical actuators, and the actuators are best controlled via a computer interface. The challenges faced in this project were to convert the step-wise movements of the mechanical actuator into a smooth positioning in real space, as specified by the operator. LabVIEW, a programming interface between the computer and the hardware, was used to control the actuators. The graphical interface of LabVIEW has been programmed so that a user can input the desired position of the stage, read out the current position, and record the position information during the experiment.

Name: Veronica Saeger
Program: UGS
School: New Mexico Tech
Group: XTD-1
Mentor: Renida Carter
Category: Engineering
Type: Individual Poster Presentation

The Plate Dent Simulation

This project was based on the paper "On Brisance, and a Plate-Denting Test for the Estimation of a Detonation Pressure", Louis C. Smith, 1967. The paper provides results for an experiment which consisted of a cylinder of HE being detonated over a stack of steel plates. The dent made in the plates was then measured. Several high explosives where evaluated. In this project the Pagosa code was used to explore the same experimental set up with a group of similar high explosives. Results obtained using Pagosa will be presented and compared to those given in the paper.

Name: Merit Schumaker
Program: UGS
School: Marquette University
Group: OS-PT
Mentor: Jose Abeyta
Category: Engineering
Type: Individual Poster Presentation

Safety, Security, and Environmental Stewardship

Operations Support of Packaging and Transportation (OS-PT) provides operational oversight of all P & T activities at Los Alamos National Laboratories (LANL), including activities at the LANL Gas Facility. OS-PT also ensures safe, secure and environmentally conscience activities which involve the understanding of Hazardous Material Transportation regulations, available Packaging Engineering support, and delivery around the Lab of safe reliable compressed gases. During the past couple of months, I personally have gotten an opportunity to help OS-PT provide solutions to various safety concerns. Some safety improvements that I participated in included tracking all Laboratory compressed gas cylinders and dewars with the Acutrax software, ensuring Integrated Work Documents (IWD's) and procedures were up to date, and checking that the new tanks and pumps (e.g. the new liquid nitrogen (LN2) tank at the gas facility) were mechanically sound and up to LANL and ASME pressure safety requirements. With the Acutrax software and the Radio Frequency Identification Devices (RFIDS) placed on the cylinders, real time inventory and tracking of the cylinders will help to notify employees of any hazards or confusion. By ensuring that documents were up to date, specifically the argon and nitrogen filling operations procedures at the gas facility, employers and customers of the gas facility could adhere to a safe procedure. The improvement of the gas facility operations with the installation of the new LN-2 tank, allowed me to observe correct engineering techniques and the attainment of proper approvals. Thanks to LANL and my mentor Joe Abeyta, I want other students to see what I have observed firsthand in dealing with the importance of safety, security and the environmental stewardship at OS-PT and overall, at LANL.

Name: John Steuben
Program: GRA
School: Colorado School of Mines
Group: MET-1
Mentor: Scott Breashears
Category: Engineering
Type: Individual Poster Presentation

Improvements to the ARIES NDA Robotic System

The Automated Recovery and Integrated Extraction System (ARIES) is an automated glovebox line for the recovery, packaging, and assay of special nuclear materials. The final step of the ARIES process is the non-destructive assay (NDA) of the packaged nuclear material. The automated system developed for this task is relatively mature and reliable, and consists of a gantry robot, several instruments and instrument computers, and a master host computer system. The robotic subsystem still exhibits occasional failures when handling packages of nuclear material, which is highly undesirable. The most prominent of these failures is occasional jamming when inserting materials into the NDA instruments. This poster details work performed this summer in order to understand and prevent these failures, and to increase the reliability of the NDA system in general.

A review of the gripper, or end-of-arm tool, used by the robot was conducted to understand potential failure mechanisms. Additionally, documented handling failures were examined and the root cause of the gripping failures was identified: sub-optimal gripper geometry and actuation result in unreliable gripping. Based on this investigation, viable alternatives for upgrading the problematic gripper were developed. These included minor modifications to the original design, and several more comprehensive re-designs.

Additional steps towards improving the reliability of the NDA system were initiated as well. The development of a maintenance plan and the procurement of replacement robot components accounted for a great deal of this effort. Issues with manufacturers discontinuing a critical force-control sensor board led to the investigation of alternative force sensing hardware. A reliable 3rd party supplier for this critical component was identified. An interactive simulation of the NDA robot was constructed; it may be useful for training or logistic purposes.

Name: David Streusand
Program: GRA
School: Colorado School of Mines
Group: MET-1
Mentor: Scott Breshears
Category: Engineering
Type: Individual Poster Presentation

Design of Robotic Gripper for RIPS

Robotic grippers are essential for automated systems as they perform actions that mimic the human hand in situations too hazardous for human interaction. This is especially true in LANL's Robotic Integrated Packaging System (RIPS), an automated system used to contain nuclear materials for later disposal and monitoring. Currently, RIPS has been having some problems with its robotic gripper experiencing degradation of performance when grasping objects. Objects being grasped include cylinders of nuclear material and the declining performance of the gripper has led to the need for a new gripper to be developed.

The gripper was developed by using a classical design methodology. This methodology defines the needs of the system, develops a functional analysis, and develops design concepts into a working solution. This methodology is a robust technique for developing design solutions since it evolves form-independent analysis tools into a variety of design concepts that can become a final design solution. The final solution for this project was development of a double actuated band gripper. This new gripper uses two pneumatic pistons to create a larger clearance and a simpler v-block for maintaining grasp stability. The final design has been prototyped, tested, and improved. The tests show improved performance over the currently used design. Work this summer has been toward manufacturing and integrating the design into RIPS.

Name: Stuart Taylor
Program: GRA
School: University of California, San Diego
Group: INST-OFF
Mentor: Gyuhae Park
Category: Engineering
Type: Individual Poster Presentation

Embedded Sensor Node for Structural Health Monitoring and Predictive Modeling

A prototype embedded sensor node has been designed, assembled, and deployed for structural health monitoring (SHM) on two structural systems. The first system is the 9-meter CX-100 wind turbine blade, which is undergoing fatigue loading as part of a full-scale fatigue test of the blade for the Intelligent Wind Turbine (IWT) LDRD at LANL. The test is being conducted at the National Renewable Energy Laboratory (NREL) National Wind Technology Center (NWTC). The sensor node actively monitors critical sections of the wind turbine blade for signs of fatigue cracking throughout the course of the test. The second system is a robotic astronomical observatory that makes up part of the RAPid Telescopes for Optical Response (RAPTOR) observatory network at LANL. The drive systems of these telescopes are maintained in an ad hoc manner, in which certain components are permitted to run to failure. The sensor node passively monitors vibration characteristics indicative of imminent failure of these components to reduce unnecessary system down time.

The sensor node, dubbed the WASP, can serve as a wired or Wireless Active Sensing Platform. In active sensing mode, the WASP provides a voltage signal to excite a piezoelectric patch connected to any of its six channels. Operating on the piezoelectric effect, the patch converts the electrical energy to strain energy and vice versa. The response of the structure to that excitation is measured using similar piezoelectric patches connected to the WASP's other five channels. In passive sensing mode, the WASP records data from voltage-output sensors, such as accelerometers, strain gauges, or piezoelectric patches. In either mode, changes in the measured response over time can be attributed to damage in the structure. Algorithms developed to detect such changes can be executed by the WASP, which enables the WASP to act as a standalone active structural health monitoring system.

Name: Lydia Wermer
Program: UGS
School: New Mexico Tech
Group: AET-1
Mentor: Todd Jankowski
Category: Engineering
Type: Individual Poster Presentation

Thermal Storage System Modeling

Two thermal storage systems were modeled in Engineering Equation Solver (EES), and then compared to a conventional air-conditioner used in homes today. One system uses a phase-change material as the refrigerant. The phase-change material undergoes a reversible phase transformation from liquid to liquid/solid slurry. The "frozen" material resembles water-ice slurry. The phase transition temperature for this phase-change material can be tuned over a wide range (0-60°C). At night, when the air temperature is colder, the phase-change material is cooled and stored, and then used to cool a building during the day. Since the material's phase transition temperature can be adjusted, there is no need for a mechanical refrigeration system to cool the material; ambient air at night can be used. Without the need for mechanical refrigeration, using this phase-change material would make for a more energy efficient thermal storage system.

For the first system modeled in EES the phase-change material is used as the refrigerant. Given that the phase-change material is a slurry, it takes more work to pump it through the system. Thus another system was developed.

The second heat transfer system keeps the phase-change material in a tank and uses water as the refrigerant. The water would accept heat from the material in the tank, cooling the phase-change material

Through the thermal models in EES, it was found that the second system was much more efficient. While the first system had a coefficient of performance (COP) of 12, the second system had a COP of 35. Therefore, the second system would be the more energy efficient choice.

Name: Edwin Williams
Program: GRA
School: Arizona State University
Group: HPC-2
Mentor: Richard Rivera
Category: Engineering
Type: Individual Poster Presentation

Design of Mechanical Cooling Loads for Increases in High Performance Computing

At the beginning of September 2011 a new High Performance Computer called Mustang will be installed in the LDCC Room 341. This new computer adds another 750 kilowatts of IT load. The current design of the mechanical cooling has 5.3 megawatts of cooling available for rooms 341, 205, 105, offices, the CCF, and other remote buildings. Room 341 currently has a maximum load of 800 kilowatts. With the addition of Mustang there will be a total of 1550 kilowatts or 1.55 megawatts of IT load. The available cooling in kilowatts for room 341 is 1.4 megawatts. The additional IT load will require mechanical/electrical design, computational fluid dynamic (CFD) modeling, and thermal air flow management. Also, upgrades to previous equipment and installation of new equipment will be required to meet the specifications.

Name: Jacob Winter
Program: UGS
School: New Mexico State University
Group: NPI-1
Mentor: Paul Smith
Category: Engineering
Type: Individual Poster Presentation

Analysis of the SAVY-4000 Nuclear Material Storage Container for Transportation

The SAVY-4000 nuclear material storage container developed by Los Alamos National Laboratory and Nuclear Filter Technology, Inc. was designed for worker protection during handling and storage. However, the design lends itself to potential uses in transportation environments. For example, some potential customers have inquired about DOT Type A certification for use in transporting uranium within the LANL site. Other customers have stated a need to use the SAVY-4000 design as an internal container for the 9975 or 9977 Type B shipping containers. The idea is that material could be loaded into the SAVY-4000-like internal container at the shipping site, placed into the shipping container, shipped, and it would be ready for M441 compliant storage at the receiving site without subsequent repackaging or over-packing. This poster will analyze the requirements for Type A certification of the SAVY-4000 container and provide a proposed design for a SAVY-4000-like internal container for potential use in Type B shipping containers.

Name: Lin Zheng
Program: UGS
School: University of New Mexico
Group: AET-5
Mentor: Troy Harden
Category: Engineering
Type: Individual Poster Presentation

Limited Volume Chilled Water System Design

LANL Currently has a limited volume chilled water system for use in a glove box, but the system needs to be updated. A limited volume chilled water system utilizes basic fundamentals of heat transfer between fluids to dissipate a heat load in a given system, but has a restriction placed on the amount of working fluid that can be present in the system at one time. The primary components necessary for a chilled water system to work are a pump and motor to drive it, a heat exchanger for the heat transfer between two fluids, a supply of chilled water, and the necessary piping network for the system. The pump is the driving force behind fluid flow within the system and must be able to provide sufficient fluid flow for the system to meet operating requirements. A heat exchanger is a device that permits the transfer of heat energy between two fluids with different temperatures. Within the heat exchanger convection is the primary heat transfer mechanism between the two fluids. The heat exchanger is divided into two separate areas of flow, one for the chilled fluid and the other for the hot fluid. The amount of surface area the fluid can come into contact with inside the heat exchanger, coupled with the mass flow rate of the fluids through the system, determines the total amount of heat flow that can be exchanged through the working fluids.

Name: Caitlin Zimmerman
Program: UGS
School: University of New Mexico
Group: AET-2
Mentor: Starr Johnson
Category: Engineering
Type: Individual Poster Presentation

Plate Installation Simulation and Evaluation in Delmia

This project consists of simulating the installation process of a plate in Delmia. The plate holds an actuator in place in the roof of a glovebox. The actuator is needed to lift a 100-pound cover up from the glovebox floor. Three workers are needed to install the plate in the roof. The RULA results from these workers are individually analyzed and evaluated to determine if this approach of lifting the cover is feasible or not. A video of the simulation was compiled and delivered to LANL. The results of the simulation determined that this installation process is not a good method from an ergonomic standpoint or from a safety standpoint.

Name: Daniel Aragon
Program: GRA
School: New Mexico State University

Name: Miquela Trujillo
Program: UGS
School: New Mexico Tech

Group(s): WX-2, WX-3
Mentor: Michael Archuleta, Theresa Montoya
Category: Engineering
Type: Group Poster Presentation

Blast Mat Structure Load Test Analysis

A Blast Mat Structure, also known as the "Taco Stand," was designed and constructed for Eenie Site (TA-36-8), an open-air firing facility. The Taco Stand, which is designed for fragment mitigation, will prevent hot fragments from starting nearby vegetation on fire. To verify that the Blast Mat Structure is capable of supporting the necessary load, calculations were done using RISA, a structural engineering software. Several load tests were also performed to support the calculations. During the tests, the Blast Mat Structure was tested with loads which exceeded the recommended 120% of the required weight that the structure needed to withstand during static loading of the blast mat. As a result, the deflection in the horizontal I-Beams of the structure is minimal, illustrating that the structure is capable of withstanding the necessary load. The structural analysis supports the results of the load tests and validates the safety of the structure under blast conditions.

Name: Robbie Brooks
Program: UGS
School: New Mexico State University

Name: Francisco Vigil
Program: UGS
School: New Mexico Tech

Group(s): WX-1
Mentor: Edward Jacquez
Category: Engineering
Type: Group Poster Presentation

DARHT Cell-Magnet Flow Meter Upgrade

DARHT's axis two has a series of flow meters which are necessary for it to remain operational. A brass piston within the flow meter tends to corrode quickly due to a reaction with the water that flows through it. When these flow meters are removed for maintenance, axis two must be temporarily taken offline. Between axis two being taken offline and the personnel required to clean the flow meters the laboratory is spending unnecessary money.

Our plan is to fabricate multiple pistons made from different composites to replace the brass piston that is currently being used. Our goal is to reduce maintenance costs and to elongate the lifespan of the flow meters. We will test the reliability of the new composite pistons by analyzing the material properties of the chosen composites as well as by analyzing the chemical makeup of the water used in the cooling system so that we can find the cause of the corrosion. In addition to the analysis of this data we will construct a test stand that contains a flow meter with the brass piston and flow meters with the composite pistons. After a period of time we will disassemble our test stand and inspect the pistons. We will compare the results from the two pistons and make recommendations as to whether or not a composite piston will increase the operational lifespan of the flow meters.

Name: Benjamin Graves
Program: UGS
School: University of New Mexico

Name: Jeremy Shirey
Program: UGS
School: University of New Mexico

Group(s): AET-5
Mentor: William Santistevan
Category: Engineering
Type: Group Poster Presentation

Modeling for Ergonomic and Radiation Analysis

Equipment in use by laboratory employees, specifically glove boxes and related tools, are becoming either outdated or can cause repetitive injuries during operation. These injuries can include rotator cuff, wrist and back injuries. Our objective has been to model existing and prototype glove boxes to be used in radiation exposure and ergonomic analysis. The programs that utilize our models are Attila and Delmia which runs radiation and ergonomic analysis respectively. In conjunction with the glove boxes are ergonomic tool design improvements, which not only can help to prevent repetitive motion injuries, but provide the worker with a more efficient work environment. Our modeling and design of glove boxes and their respective tools will benefit not only workers, but the entire lab community itself. The data obtained from the analysis of the models will help to reduce strenuous activities, improve efficiency, prevent injuries, and help identify weaknesses in the equipment being used daily by laboratory employees.

Name: Christopher Armstrong
Program: UGS
School: University of New Mexico

Name: Jakob Brophy
Program: GRA
School: University of New Mexico

Name: Gabriel Ortiz
Program: UGS
School: New Mexico State University

Group(s): QA-DI
Mentor: Karen Mehlin, Brian Medina
Category: Engineering
Type: Group Poster Presentation

Accuracy of a Measurement-User Performed Calibration

Los Alamos National Labs is well known for having one of the highest standards for accuracy in the world. With a variety of instruments to measure parts, calibration is the largest issue QA-DI faces. Any type of improvements in the calibration process can potentially be of major improvement to assisting the work done in QADI. A user preformed calibration is when a more accurate measuring device is used to calibrate a less accurate device. Our summer research project, we are tasked with determining the accuracy of two measurement tools, the Mahr Linear 100 and the Starrett Bench Micrometer. From this accuracy, can these two instruments, be used for measuring gage pins, If the data is accurate enough, it not only makes these micrometers eligible for different measurements but it also makes them suitable for a user preformed calibration as well.

There were many variables involved in this testing; pressure, temperature and linearity just to name a few. Without access to a temperature controlled environment, correction calculations to the data are used to represent the actual values of a controlled environment. Also taken in to account is that a pressure study was conducted on the Mahr Linear 100, to document what pressure gave the best accuracy to the data. This data will be presented for verifications. Based off of the results and analysis, the bench micrometer is not accurate enough to measure gage pins, therefore cannot be utilized for further testing. The Mahr Linear 100, however, did meet requirements, so can further be utilized for user performed calibration

Name: Jeffrey Schnakenberg
Program: UGS
School: Central New Mexico Community College

Name: Justin Young
Program: UGS
School: Pueblo Community College

Group(s): NCO-1
Mentor: George Neal
Category: Engineering
Type: Group Poster Presentation

Trak Lathe

Justin Young and Jeff Schnakenberg will be presenting a poster on the CNC Trak Lathe. This presentation will show how effective the Trak Lathe works, cuts down time, increases production, and limits the dose for the worker.

Name: Ezgihan Baydar
Program: UGS
School: University of Texas at Arlington

Name: Jason Hebert
Program: GRA
School: New Mexico Tech

Group(s): T-3
Mentor: David Carrington
Category: Engineering
Type: Group Poster Presentation

Modeling Turbulent Reactive Flow in Internal Combustion Engines

Modeling combustion in an internal combustion engine requires a computational fluid dynamics (CFD) solver capable of simulating multi-species turbulent reactive flow in all flow regimes - low-speed incompressible to supersonic compressible flow. In addition, chemical reactions, injection spray processes and moving parts, such as pistons and valves, are modeled. Critical to good simulations is the development of the grids representing the engine domain. Using a complicated CFD solver, the parallel version of KIVA-4, on complex geometries, requires understanding of the physics and how various phenomena are represented numerically. We began our investigations by developing grids simple engine geometries and determining what might be sufficient for modeling needs using Sandia National Laboratory's Cubit grid generator. Producing well functioning grids using Cubit requires an understanding of the moving parts system in KIVA-4 and specific geometry dissection. With proper geometry dissection, control of Cubit's grid generation creates grids that are compatible with the moving parts representations. We also began investigating one aspect of the physics within the engine, evaluating the behavior of turbulence at the cylinder wall and over valves. We compare solutions generated by KIVA to a few well understood benchmark problems. In the process of understanding fundamental needs for CFD modeling, we developed a web-based user manual for KIVA-4 that discusses all the input parameters and models.

Name: Daniel Castelo
Program: UGS
School: New Mexico Tech
Group: EO-ER
Mentor: Christian Rittner
Category: Health & Safety
Type: Individual Poster Presentation

LANL Hazmat Challenge And Its Contribution to Public Health and Safety

The annual Hazmat Challenge, hosted by LANL Emergency Operations- Emergency Response Group, is a training event/competition which allows regional Hazardous Materials Response Teams to train to real world events in a safe, controlled environment. Teams are required to address hazardous materials incidents ranging from transportation accidents, clandestine labs, industrial releases, radioactive materials incidents and confined space scenarios. The scenarios allow teams to exercise existing skills and learn new ones to better protect themselves and overall public health.

The student's role this summer is to devise and/or assist in setting up the training scenarios. There is much research that goes into creating a scenario; modeling after similar incidents and researching the materials are just the first steps to creating a scenario. After the scenario is assembled the best way to DECON must be determined, the DECON must also be feasible to perform in full PPE. This gives the student an insight of the full process of a HAZMAT response from beginning to end.

Name: Alissa Idler
Program: UGS
School: New Mexico State University
Group: IHS-CS
Mentor: Cindy Lawton
Category: Health & Safety
Type: Individual Poster Presentation

Office Ergonomics at Los Alamos National Laboratory

Los Alamos National Laboratory has been tracking lab wide use of the Ergonomics Team through the Footprints system for approximately four years. Safety history records give us partial understanding of the effect poor ergonomics has on laboratory employees. This presentation will discuss: office ergonomics at Los Alamos National Laboratory, the impact direct funding makes on office ergonomics, and the benefits versus the disadvantages of hiring an ergonomic office evaluator.

Name: Brad Keller
Program: UGS
School: Brigham Young University - Idaho
Group: RP-3
Mentor: John Garcia
Category: Health & Safety
Type: Individual Poster Presentation

Cost Benefit of Implementation of Visual Survey Data System at LANL

The Visual Survey Data System or VSDS is a computer program that is currently being implemented at LANL. This program allows radiological surveys to be digitized and transferred and stored without paper. The developer, S&W Technologies, makes certain claims about the program, related to increased efficiency and reduced costs. This research tests these claims. To do this, two methods are implemented. One is analyzing data from other users of VSDS in a survey that was sent out. The second is to time our own RCTs doing their work using VSDS against the current method. From the user surveys and timing runs, it is concluded that some of S&W Technologies' claims are exaggerated and do not relate to LANL. Others, like data retrieval time, are relevant and do increase efficiency and reduce costs. The most significant feature of VSDS that benefits LANL is the trending function which helps detect increasing radiation levels and comply with CFR 835.401. Using VSDS, time is cut from 6 months to near instant to trend survey data. This data and other reasons prove that the transition is worthwhile and that VSDS will help reduce costs and increase efficiency.

Name: Alyssa Lucero
Program: UGS
School: New Mexico Tech
Group: RP-3
Mentor: Virginia Rey
Category: Health & Safety
Type: Individual Poster Presentation

A Comparison of Dose Calculation Software Used in Radiation Therapy

The goal of radiation therapy is to treat tumors, either with curative or palliative intent, while trying to expose surrounding healthy tissue to as little radiation as possible. However, in trying to achieve this goal, contributing factors such as dose calculation software accuracy and body movement from breathing and organ movement which can change tumor location in between treatment may result in healthy tissue being exposed to excessive radiation or the affected area(tumor) being treated insufficiently. Overexposure can result in complications and even death, whereas underexposure may lead to cancer recurrence. In an attempt to prevent such occurrences, scientist and researchers have developed various dose calculation software programs to be used in treatment planning which are generally quite accurate and fast.

Name: Scott Andrews
Program: GRA
School: University of New Mexico
Group: NIE-2
Mentor: Kersti Rock
Category: Information Technology
Type: Individual Poster Presentation

Solid State Drive (SSD) Security and Forensics

Solid state drives (SSDs) have seen an upswing in popularity and they are poised to hold considerable hard drive (HD) market share in the future. This development has tremendous implications for system security and digital forensics. Because of this, it is important to understand how SSDs operate and how they differ from standard hard drives. An analysis of current SSD security measures will be discussed, highlighting current encryption technology. The forensic implications of adopting SSD technology will be examined next. To do this, a breakdown of current forensic practices on SSDs, along with the differences between SSD and traditional HD forensics will be discussed.

Name: Laniece Miller
Program: GRA
School: Florida State University
Group: STBPO-RL
Mentor: Miriam Blake
Category: Information Technology
Type: Individual Poster Presentation

Digital Asset Management – Why LANL Should Care

Scientific and technical information (STI) can be found in any medium including images, video, and data sets. Managing and preserving digital STI can be challenging due to a lack of proven management techniques and awareness among employees at LANL, especially researchers, about methods and benefits of preserving their data. Ideally, all STI will be searchable to promote review of scientific ideas and reuse of data, beyond just the databases of today, many of which lack preservation characteristics. The Department of Energy's (DOE) Office of Science and Technology Information (OSTI) has recently mandated that the DOE sites submit all STI regardless of format, not just published documents. Proper digital STI management includes a storage system which allows easy searching and retrieval, attaching appropriate metadata to objects, and required preservation policies. Various toolkits exist to aid staff in assessing digital asset management, including DRAMBORA, TRAC, and the Assessing Institutional Digital Assets (AIDA) Toolkit which the Research Library and an OSTI working group has reworked to better fit the DOE facilities. With the reworked AIDA toolkit, conversations are underway to determine the current status of scientific digital asset management at LANL. Some efforts in electronic records management and enterprise IT systems touch on STI, and some scattered activities are already underway by researchers themselves, including deposition into discipline specific repositories. We hope our work will aid in assessing the readiness of LANL to participate as a "trustworthy" partner in managing the STI rapidly being produced.

Name: Michael Webber
Program: GRA
School: North Carolina A&T State University
Group: DCS-3
Mentor: Alexandra Sherwood
Category: Information Technology
Type: Individual Poster Presentation

The "Power" of Windows PowerShell "In a System Administrator's Environment"

Windows Powershell is a command-line shell that provides Component Object Model and Windows Management Instrumentation that allows System Administrators to perform on both local and networked Window Systems. Windows Powershell is used for many functions such as, creating scripts, executing programs, commands, and functions. My experience with Powershell is that I designed and executed a series of command line instructions and also created a script using Microsoft.NET properties. In order to do such functions, you can either create them in the command prompt or in a Integrated Development Environment (IDE) found on the web. Also, Windows Powershell can be hosted inside other applications such as a Graphical User Interface (GUI). The GUI can leverage Windows PowerShell functionality to implement certain operations, for example Microsoft Exchange and Active Directory. Windows Powershell is a great tool that all System Administrators should use. It enables the admin to automate tasks and increase productivity.

Name: Erica Armijo
Program: GRA
School: University of Phoenix

Name: Jose Gasca
Program: UGS
School: University of New Mexico-Los Alamos

Name: Jacob Martinez
Program: UGS
School: Northern New Mexico College

Group(s): NIE-1
Mentor: Erik Anderson
Category: Information Technology
Type: Group Poster Presentation

Development of 802.11 Indoor/Outdoor Wireless Network at TA-54

TA-54 is currently a nuclear facility with thousands of waste containers that are constantly being relocated. The containers are tracked and monitored with the use of handheld scanners. These scanners record current location, receiving location, and approve MAR (Material at Risk) levels. Current operating procedure requires one team member to travel to a central location to sync information into the database. With TA-54 being a 100 acre site with over 20 storage areas, having to scan and sync every container relocation causes lengthy downtime for crew members and is an overall operational inefficiency. Implementing an 802.11 wireless network would improve productivity since information checks and balances would be performed in real time across a wireless medium. Designing an 802.11 wireless network requires vigorous evaluation and site surveying of current infrastructure in order to meet a customer's needs and requirements. Using predictive wireless survey software and site visits as a design approach, we hope to meet our goal of implementing a wireless solution for TA-54 that greatly improves workplace efficiency.

Name: Eric Generous
Program: GRA
School: Johns Hopkins University

Name: Erin McClure
Program: UGS
School: New Mexico State University

Group(s): B-7, D-3
Mentor: Momchilo Vuyisich, Alina Deshpande
Category: Information Technology
Type: Group Poster Presentation

Laboratory Information Management Systems (LIMS) for the Use of Data Management

Life sciences research has experienced the proliferation of vast amounts of data in the past few decades. This unprecedented scale of data generation has exacerbated the need for better methods of data management. Laboratory Information Management Systems (LIMS) provides laboratories with a highly customizable and flexible system to automate portions of their data generation and management process. Since it is the intention of laboratories to generate meaningful and substantiated data, LIMS fosters efficiency through the integration of laboratory workflow. The main advantages of LIMS include: the automation of data entry, the storage and organization of large amounts of data, the automation of quality control (QC), the lifecycle tracking of samples and increased data accessibility. LIMS is capable of accelerated data entry through the networking of instruments that capture and process multiple data streams. It then funnels the data into a relational database management system. This integration allows for easy manipulation of data presentation. In addition, this cross-linking of data facilitates quality control by tracking individual samples and providing instantaneous feedback on experimental results, thus aiding adherence to regulatory guidelines. Furthermore, LIMS fosters daily lab productivity via timely report generation and easy accessibility. The advantage of a LIMS system is best illustrated through routine implementation in molecular analyses, a prime example being swipe analyses. Ultimately, these benefits provide laboratories with the necessary information needed to make data driven decisions, resulting in a more efficient work environment.

Name: Seth Alson
Program: UGS
School: University of California, Santa Barbara
Group: N-4
Mentor: Christy Ruggiero
Category: Materials Science
Type: Individual Poster Presentation

Knowledge Capture Tool Kit for Forensic Signatures Using Nuclear Material Images

Evaluating technical nuclear forensic (TNF) data, including the chemical, physical, and radiological characteristics of nuclear materials is difficult. The number of subject matter experts with these skills is small and declining. As a result the DHS's Domestic Nuclear Detection Office (DNDO) is developing tools and methods to effectively capture, organize and access forensic knowledge and expertise. The goal is the rapid and effective interpretation of TNF data, including the identification and comparison of known sample signatures, and the discovery and validation of new signatures.

DNDO has sponsored a three year project at LANL titled "Knowledge Capture Tool Kit for Forensic Signatures Using Nuclear Material Images." This software and database project will create the capability to automatically identify and capture relevant nuclear material characterization and production process data in a computational framework. The project focuses on both the software tools that capture Subject Matter Expert (SME) knowledge while reducing analysis workload, as well as creating a database of well characterized nuclear materials with known processing histories.

Although the software utilizes all analytical data, it focuses on under-utilized nuclear material microscopy (SEM, Optical) images. One key challenge of this approach is creating consistency in image analysis. Currently, SMEs use a variety of terms to describe an image. By creating a standard glossary of terms used to describe microscopy images, we not only create greater consistency in analysis, but also have a much more usable and searchable image database. We have also standardized calculations for particle shape within the software. Additionally, we have been using machine learning tools to provide 'expert' guidance on interpreting features in these images, similar to knowledge capture systems in medical microscopy images.

Name: Megan Breiner
Program: UGS
School: New Mexico Tech
Group: WX-7
Mentor: Elizabeth Francois
Category: Materials Science
Type: Individual Poster Presentation

Two Time-Based Analysis Tools

Acetaminophen (Tylenol) is a useful inert crystalline material that can be studied as a surrogate for high explosives. It consists of para-acetylaminophenol (PHA or acetaminophen) and a synthetic impurity, para-acetoxyacetanilide (PAA). The distribution and location of PAA can dramatically effect properties like growth and dissolution rate. It is important to develop a method to investigate the ratio of PHA to PAA and distribution uniformity. Using liquid chromatography mass spectrometry (LCMS) and ultraviolet visible spectrometry (UV-Vis), the measured ratio of PHA to PAA was 93:1 consistently. Studying inert crystals is a safe and helpful method for gaining an understanding of some properties of high explosives.

The data from dynamic experiments involving explosives is sometimes esoteric and difficult to visualize. A method is needed to take numerical data and translate it into a meaningful three-dimensional representation of the event. Programs such as Mathematica are helpful tools for visualizing the explosion in a “hairball” experiment where the progress of the detonation is measured over time. A “hairball” experiment consists of a high explosive placed in the center of a plastic hemisphere housing probes at a given radius. These probes measure the arrival time of detonation for a given location on the hemisphere. Using Mathematica, development of a program to map the surface of a detonation over a period of nanoseconds shows where the explosion originally breaks out and how it proceeds over the hemispherical surface. Visual aids such as those developed in Mathematica lead to further understanding of the detonation and its propagation.

Name: Yaniv Brener
Program: UGS
School: The University of Texas at Austin
Group: MPA-CINT
Mentor: Gabriel Montano
Category: Materials Science
Type: Individual Poster Presentation

Characterization of Amphiphilic Block Copolymers

Block copolymers are versatile materials applicable to a multitude of fields including materials manufacturing, medical applications, and biological research. Recently, we discovered that deposition of micelle-forming PEO-b-PBD polymers can be used to create supported artificial biomembranes through Langmuir-Blodgett trough deposition. In this work, we investigated the mechanics of L-B monolayer films monitoring phase behavior and quality of the films both at the air/water interface and the solid/air interface. To do so, we used a number of techniques to characterize the films – specifically, L-B isotherms, fluorescence microscopy, and atomic force microscopy. Monitoring surface pressure while varying L-B trough area and taking real-time fluorescence images of the air/water interface allowed us to study the polymer's phase behavior, calculate compressibility moduli, and view aggregation at the different stages of compression. When performing multiple compression/expansion cycles we observed hysteresis of the PEO-PBD polymer, which we found was directly correlated to the frequency of aggregation domains forming at the air/water interface. The results allow us to better understand the properties of micelle-forming polymers; specifically, their structures at different packing densities. Further, the results lay the building blocks for future investigations; possible subjects of interest include monitoring speed of diffusion through stacked PEO-PBD films at different phases, repeating these experiments with varied molecular weight PEO-PBD or similar polymers, and creating composite films of multiple polymers.

Name: Miguel Dimas
Program: UGS
School: University of California Santa Cruz
Group: C-PCS
Mentor: Juan Duque
Category: Materials Science
Type: Individual Poster Presentation

Effects of Surfactant Composition on Colloidal Single-Wall Carbon Nanotube Photoluminescence

Single-wall carbon nanotubes (SWNTs) are of great interest because of their outstanding electrical and optical properties. SWNTs can be thought of as circumferentially quantized graphene tubules whose electronic properties depend strongly on geometry. The honeycomb structure where the graphene is rolled from, or roll-up vector, determines the chiral angle, diameter, and therefore the semi-conducting or metallic properties of the SWNTs. Their unique conductivity make them ideal for applications as transistors, diodes, photovoltaics, and quantum communication.

The widespread use of SWNTs is limited by their strong van der Waals attraction that aggregates them into bundles with a wide distribution of diameters and conductivities. Colloidal techniques adapted from bio-chemistry have been used to overcome aggregation by physisorption of aqueous surfactants to the SWNT surface. However the role that surfactants have on the optical properties, specifically exciton decay dynamics, of SWNTs is still unclear.

Here, we show how various surfactants change the optical properties of bulk and individual SWNTs. This is accomplished by changing surfactant composition in situ while monitoring their optical properties. Similarly, by adding donor/acceptor molecules to suspensions of SWNTs, such as organic molecules and transition metal salts, we want to understand how extrinsic factors such as local charging affect colloidal SWNT photoluminescence. Moreover, we are developing models that will help us tune optical properties for specific applications relying on correlations from the individual and bulk level of SWNTs.

Name: Megan Emigh
Program: UGS
School: New Mexico Tech
Group: MST-6
Mentor: Erik Luther
Category: Materials Science
Type: Individual Poster Presentation

Fabrication of Controlled Porosity in CeO2 Pellets: A Nuclear Fuel Surrogate

Recent events in Japan at the Fukushima-Daiichi reactors have highlighted the need for increased stability in nuclear fuel. Although fuel rod reliability has advanced over the years, there is a need to continually improve the stability of this reactor component to promote overall safety. While in-pile, gaseous fission products can build up within a fuel pellet, causing fuel swelling. As swollen pellets fill the gas gap within fuel rods, local hot spots arise which may lead to mechanical pellet-cladding interactions, causing failure. In order to address this concern, fuel pellets with interconnected porosity have been considered as a method of allowing release of fission gas. The purpose of this project is to demonstrate techniques of producing interconnected porosity in ceria pellets. Ceria was chosen as a surrogate for urania because both oxides crystallize in the fluorite structure, cations in the quadrivalent state have similar ionic radii, and hazards of working with radioactive material were avoided.

To control porosity, various starches were used as pore-formers during fabrication of ceria pellets. Starches were chosen over other material candidates because they burn out cleanly. Four types of starches were selected: rice, tapioca, wheat, and flour. The average diameters of each starch are 4.8, 12.2, 20.7, and 48.3 microns, respectively [1, 2]. Porosity of 14% was sought and the pores were visually analyzed using SEM. To continue this research, the microstructure of the pellets will be examined using x-ray computed tomography. Additionally, the burn-out properties of the starches will be analyzed using TGA.

Name: Eric Forrest
Program: GRA
School: Massachusetts Institute of Technology
Group: MST-6
Mentor: Roland Schulze
Category: Materials Science
Type: Individual Poster Presentation

Surface Science and Bond Strength Measurements Supporting U10Mo Fuel Fabrication

A primary component of the NNSA Global Threat Reduction Initiative (GTRI) involves conversion and removal of high enriched uranium (HEU) fuel from research reactors worldwide. By removing weapons-usable HEU from these civilian facilities, the threat of proliferation is permanently reduced. Despite the continued success of the Reduced Enrichment for Research and Test Reactors (RERTR) program, six high performance research reactors in the U.S. still rely on the use of HEU fuel for continued operation. The NNSA Convert program is currently developing an advanced low enriched uranium-molybdenum monolithic fuel as an HEU fuel replacement. MST-6 of Los Alamos National Laboratory is leading the Fuel Fabrication Capability (FFC) for the Convert program.

As the newly developed fuel will be exposed to irradiation, temperature gradients, and other adverse conditions, assurance of fuel performance and quality is of the utmost concern. In particular, surface cleanliness affects bond strength between fuel components. Using X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES), oxidation and contamination on fuel surfaces are determined quantitatively. Surfaces of interest include zirconium, 6061 aluminum, and Zr-clad U-10Mo foil. Bonding between foils is achieved using a hot isostatic press (HIP). Bond strength is measured using a bulge testing apparatus that has been assembled and validated in-house. Bond strength is then correlated to the varying degrees of surface contamination and oxidation. Surface cleanliness of the cladding surface may also have a significant effect on heat transfer characteristics of the fuel. Therefore, surface wettability, which is tied to heat transfer, is thoroughly studied for varying levels of clad contamination.

Name: Nathaniel Gustafson
Program: UGS
School: University of California, Davis
Group: MST-7
Mentor: Markus Hehlen
Category: Materials Science
Type: Individual Poster Presentation

Purification of Dielectric Fluids for Pyroelectric Heat Engines

The traditional thermal cooling systems used for everything ranging from residential air conditioning to CPU heat management are outdated, inefficient systems that are inadequate for today's needs. The development of thin-film pyroelectric heat engines (PHE) could lead to novel, environmentally friendly thermal-management applications that are much more efficient than the usual vapor-compression devices. Thin-film heat engines are composed of two heat switches with an electro-caloric material between them. The heat switches consist of a dielectric fluid between two closely spaced electrodes with sharp discharge spikes. Dielectric fluids are electrically insulating, but electrohydrodynamic flow can be induced by charge injection for sufficiently high electric fields. By injecting an electrical current into the dielectric fluid, the electrohydrodynamic convection currents that are created can be used to change the thermal conductivity of the heat switch.

Recent experiments suggest that the dielectric fluids contain unknown impurities that interfere with EHD flow by conducting electricity at low voltages (ohmic conduction). The total effect of the impurities on the dielectric fluids is not completely understood, but efficient EHD flow is critical for the heat engines to be effective. The goal of this project is to identify and quantify impurities in the dielectric fluid by using ICP-MS and FTIR spectroscopy. This information will be helpful in proposing possible purification methods.

Name: Amanda Haglund
Program: UGS
School: University of Alabama at Birmingham
Group: MST-8
Mentor: Donald Brown
Category: Materials Science
Type: Individual Poster Presentation

In-Situ XRD Deformation Testing of HT-9 Steel Cladding

HT-9 steel is considered a candidate material to be used as a fuel cladding in high-burnup, high-temperature nuclear reactors. From a materials science standpoint, the steel is a composite of a ferritic matrix with fcc carbides. An HT-9 duct (coined the "ACO-3 duct) was irradiated for 6 years as part of an experiment in the Fast Flux Test Reactor Facility (FFTF). Six samples, each experiencing different temperature and dose conditions and a control sample were removed from the duct for this study. In-situ synchrotron x-ray diffraction (XRD) measurements were carried out during tensile deformation at beamline 1-ID at the Advanced Photon Source. The diffraction data collected during deformation were analyzed to determine the difference in the microstructure due to the differing irradiation conditions as well as to monitor the response of each microstructure to the deformation. Diffraction easily distinguishes between the response of the ferritic matrix and that of the particulate carbide, and is used to observe load shedding from the matrix to the particulate.

Name: Sarah Hernandez
Program: GRA
School: University of Texas at Arlington
Group: MST-6
Mentor: Christopher Taylor
Category: Materials Science
Type: Individual Poster Presentation

Experimental and Theoretical Studies on the Electronic and Magnetic Structure of Plutonium

For many decades now, many theoretical and experimental efforts have been devoted to studying the electronic and geometric structures of the actinides. The actinides are characterized by gradual filling of the 5f-electron shell with increasing localization of the electrons. One controversial element, plutonium, has had a great deal of divisive history and today still remains one of the most interesting and complicated elements among the actinides. Plutonium's complex nature includes six crystal phase transitions with increasing temperature, which includes the monoclinic α phase at room temperature to the simple face-centered cubic δ phase. Within these phases, we observed a boundary between the actinides, where we have itinerant electrons in the lighter actinides and localized electrons in the heavier actinides. It is this peculiarity that has given theorist and experimentalist difficulty explaining the electronic and magnetic structure of Pu. Many experimental studies, which for example include angle-resolved photoemission spectroscopy, have been performed to find the magnetic state, density of states, and thermodynamic properties of Pu; these have been followed by theoretical calculations, which invoke density functional theory in an array of different methods. Examples of theoretical methods include local density approximation, generalized gradient approximation, hybrid, or adding in the Hubbard U parameter. These two different approaches have had a handful of agreements, but additional intensive bulk and surface studies on Pu is required into understanding fundamentally what is occurring within the 5f-electron shell. In this work, we applied different DFT methods to understand the effect they have on the ground state energy, volume, magnetic state, and bulk modulus. To supplement these studies, observations of experimental characterization of the electronic states were performed.

Name: Aaron Kilburn
Program: UGS
School: New Mexico State University
Group: NPI-1
Mentor: Charles Bonner
Category: Materials Science
Type: Individual Poster Presentation

High Purity Germanium Detector Annealing

High purity germanium (HPGe) detectors are used to determine an objects output of gamma-ray radiation. This is done by counting charged particles released from the detectors inner materials when exposed to gamma-rays. As detectors age operational parameters change for the worse and detectors must be repaired. The damage that is received is due to both an accumulation of particulate matter and occasionally radiation damage (i.e. dislocation sites or trapping centers) to the germanium crystal. Liquid nitrogen operating temperatures expedites the collection of harmful particles. Crystal dislocations are created by the interaction between fast neutrons and the atoms of the crystal, these cause charge trapping, reduce amplitude of full-energy pulses and produce low-energy tails. All of which contribute to gamma-ray spectrum resolution degradation.

Under these conditions the spectrum that the instrument produces is of much lower quality resolution which may cause confusion during spectra analysis. For this project, known damaged detectors will be used to take a spectrum before undergoing the repair process, called detector annealing. After which a second spectra of the same source will be gathered in order to compare quality of resolution.

The procedure for detector annealing requires heating and a low pressure vacuum system. Application of high temperature dissociates particulate build up. The vacuum removes the particles and produces the necessary air free environment within the detector housing.

The annealing process is able to restore the detector to operate within tolerance. Results indicate that it will be beneficial to continue development and refinement of a detector repair station and procedure.

Name: Joseph Koby
Program: UGS
School: New Mexico Tech
Group: WX-7
Mentor: Geoffrey Brown
Category: Materials Science
Type: Individual Poster Presentation

Examining Dynamic Strain Behavior of PBXN-9 via the Taylor Anvil Test

The quasi-static mechanical properties of many plastic bonded explosives are well known and documented. However, there is substantially less information available concerning dynamic mechanical properties of these same materials. The deformation of PBXN-9 under rapid loading was studied in this experiment, via the Taylor method. This technique involves firing a right circular cylinder of the test material into a steel anvil, and observing the deformation of the material. Our impact tests were conducted at velocities of approximately 120, 160, and 200 m/s, using a gas gun. Sample dimensions were measured during impact through use of a high speed camera, and were used to determine strain values at regular intervals from the anvil surface. Once curve fitted, these measurements allowed distance between the anvil and any point in the sample to be described as a function of strain. This made it possible to calculate the speed of the deformation wave within the material, and ultimately determine the engineering stress-strain behavior during impact.

(Funded by Weapons Surety and Joint Munitions Programs)

Name: Meaghan Martinez-Palmer
Program: UGS
School: University of Notre Dame
Group: Seaborg
Mentor: Patrice Stevens
Category: Materials Science
Type: Individual Poster Presentation

Characterization of Plutonium Buttons Produced at Savannah River Site

Elemental impurities and plutonium isotopics for 1588 plutonium buttons produced at the Department of Energy's Savannah River Site (SRS) between 1986 and 1988 are characterized. The plutonium metal buttons were produced by irradiating uranium fuel in five reactors at SRS, separating the plutonium from the spent fuel in F-Canyon, and purifying the plutonium in the FB-Line. Variations in isotopic levels and impurity levels as a function of time are described.

Name: Alison Mercer-Smith
Program: UGS
School: Pomona College
Group: MST-7
Mentor: Markus Hehlen
Category: Materials Science
Type: Individual Poster Presentation

Characterization of a Dielectric Fluid for a Heat Switch

Pyroelectric heat engines (PHE) could be an environmentally friendly and inexpensive alternative to vapor-compressed devices for heating and cooling purposes. A PHE can change temperature by drawing in heat from the cold side of the heat engine and expelling it from the warm side. These heat engines are comprised of a pyroelectric polymer between two thin-film heat switches. A heat switch consists of a planar electrode and array of sharp spikes in a dielectric fluid. When voltage is applied, a high field is generated around the spikes, which causes charge to be injected into the fluid. This creates electrohydrodynamic flow (EHD) that can transport heat. The model used consists of only one sharp needle in dielectric fluid and a planar electrode. The goal of this project is characterization of the dielectric fluid and high field, as measured by current, by changing the voltage and the distance between the needle and the electrode.

Name: Robin Montoya
Program: UGS
School: New Mexico Tech
Group: MST-7
Mentor: Dominic Peterson
Category: Materials Science
Type: Individual Poster Presentation

Sylgard 184 Thin Section Cure Study

Sylgard 184 is a two-part liquid silicone elastomer. It is generally used as an inert potting material to occupy excess space in weapon and test assemblies. In this study, Sylgard 184 sections were observed at different thicknesses, using multiple formulations, cure temperatures, and component lot numbers to establish if curing was possible. In the application of concern, nominal thickness for thin sections is 0.008in, so it was of interest to investigate if sections could be cured +/- 0.002in of the nominal thickness. The standard Sylgard 184 formulation is composed of resin/elastomer base and curing agent. The standard formulation was modified, by adding various amounts of accelerator, to determine a range of thin section cure times that are available/needed for assemblies. The cure of thin sections was studied at two different temperatures using two different lots to verify the results. The experiments were conducted by first mixing calculated amounts of standard and modified Sylgard 184 formulations in a THINKY rotational mixer to avoid the introduction of air and minimize porosity development in the material. The Sylgard 184 thin sections were allowed to cure in specialized fixtures then removed and inspected. Viscosity profiles were also obtained to characterize the pot life of the formulations under study. The pot life was defined as the time it took for the viscosity to double from its initial viscosity. The repeated studies showed that the standard and modified formulations of Sylgard 184 cured at thicknesses 0.006in, 0.008in, and 0.010in under all conditions tested.

Name: Saikat Mukhopadhyay
Program: GRA
School: Michigan Technological University
Group: T-1
Mentor: Enrique Batista
Category: Materials Science
Type: Individual Poster Presentation

Understanding the Electronic Conduction in PPV-oligomer With and Without Defects

We investigate the electronic conduction along a single oligomer of poly-p-phenylene-vinylene (PPV) in its ground state configuration and with configurational defects in it. We introduced defects of two possible kinds, namely, rotation of its one of benzene ring-moieties and distortion in its planar geometry. The calculated results based on non-equilibrium green function theory (NEGF) in concert with the density functional theory (DFT) under the local density approximation (LDA) predict the current to rise up with the applied bias voltage in the lower bias regime (V_{ds}= |1*V*|) both for pure PPV and with defects. Interestingly, the current-voltage characteristics exhibit negative differential resistance (NDR) in the higher bias regime (V_{ds}>|1*V*|), however, with a small peak (I_p) to valley (I_v) current ratio (PVR). The origin of the NDR effect may be understood by the sudden reduction of the HOMO-LUMO gap of the molecule at 1.25V and also the change in the nature of the electronic wave function of the whole molecule under the effect of applied bias voltages. Surprisingly, we found a similar NDR effect in the higher regime of the bias voltage when we introduced the defects in the PPV-molecule. The total current was found to be almost similar when we introduced small distortion (15º) in the planar geometry of the molecule. On the other hand, a significant reduction [I_{pure} / I_{30^o} ~ 2 @V_{ds}=2*V*] in the conductivity was observed when one of the benzene rings was rotated by 30º. The presence of torsional defects hinders the conductance as one would expect due to the disruption in the conjugation. The insight from this study is expected to be helpful in designing the PPV-based electronic devices.

Name: Tiberiu Stan
Program: GRA
School: University of California, Santa Barbara
Group: MST-8
Mentor: James Valdez
Category: Materials Science
Type: Individual Poster Presentation

Light Ion Irradiation Effects on the Crystal Structure of Mg_2TiO_4

Materials used in high radiation environments can fail for reasons such as amorphization, swelling, point defect hardening, and embrittlement. Some materials with the spinel crystal structure have been found to have good radiation damage resistance properties, mainly resistance to swelling and resistance to amorphization up to 25 displacements per atom (dpa) at cryogenic temperature (77 K) using 200keV Ne^+ ions. To further investigate and understand the radiation tolerance of spinels, we chose to study the inverse spinel compound Mg_2TiO_4. Mg_2TiO_4 crystallizes in a cubic system, with a $[Mg(MgTi)O_4]$ inverse spinel structure, in which Magnesium (Mg) occupies both tetrahedral and octahedral sites but Titanium (Ti) occupies only octahedral sites. We synthesized Mg_2TiO_4 pellets using conventional solid-state synthesis techniques and obtained a phase pure high quality sample (95% of theoretical density). To test the radiation damage stability of Mg_2TiO_4, we performed irradiations using 400 keV Ne^{2+} ions at cryogenic temperature over a fluence range of 5×10^{14} Ne/cm^2 to 1×10^{16} Ne/cm^2. We chose irradiate with Ne^{2+} because it produces dilute cascades (similar to neutrons), allowing us to study the radiation damage evolution in the material. Ion irradiation-induced structural changes were post-characterized using Grazing Incidence X-Ray Diffraction (GIXRD) and Electron Backscatter Diffraction (EBSD). GIXRD results showed: a) evidence for crystal-to-crystal structure changes (Fd3m spinel to Fm3m rocksalt); b) changes in texturing; and c) grain growth with increasing ion fluence. Ongoing EBSD measurements seem to agree with the GIXRD results. We believe that the radiation damage stability in Mg_2TiO_4 occurs by randomization of the Mg and Ti cations into octahedral sites. Mg and Ti have similar Shannon ionic radii (0.57 Å and 0.61 Å respectively) which allow for low transformation energies thus suppressing amorphization of the material.

Name: Helen Telila
Program: GRA
School: University of New Mexico
Group: MST-8
Mentor: Steve Valone
Category: Materials Science
Type: Individual Poster Presentation

Charge-Fluctuating Atomistic Models of Metals

Charge-dependent Potential Energy Surfaces (PESs) are important in systems where there is a large variation of charge such as at metal-metal oxide interfaces. One of the best methods currently used to treat systems with large charge fluctuations is the empirical valence bond (EVB) approach. However, PESs from the EVB approach lack many desirable features such as correct dissociation limits and explicit charge dependence. Simple, charge-dependent pair potentials are typically used to model ceramic materials such as metal oxides. Presently, there are no atomistic models that deal adequately with material interfaces where charge transfer occurs. Here we describe a new set of atomistic models that can unite models for metals based on the Modified Embedded Atom Method (MEAM) with models for metal oxides that incorporate explicit charges. We present our formulation of a charge fluctuating model of metals and illustrate how that compares to MEAM.

Name: Joseph Torres
Program: UGS
School: New Mexico Highlands University
Group: MST-7
Mentor: Michael Blair
Category: Materials Science
Type: Individual Poster Presentation

Thermal Stability of Precursors for Potentially Energetic Materials

Homemade Explosives (HME) have been of increasing interest due to the increased activity of terrorists. Properties such as thermal stability, aging, chemical and physical all affect the characteristics of HMEs. Understanding these properties of the precursors (i.e., constituents) is essential in order to handle HMEs safely. This poster presents an in depth review of current literature through the NEXESS reports as well as a general internet search. The project will focus on presenting data on the precursors.

Investigation of precursors such as sugar, pepper, and Chapatti flour will focus on Differential Scanning Calorimetry, FT-IR, and NMR spectroscopy. The data is collected at various temperatures, 40°C, 50°C, and 70°C, to determine if any reactions or phase changes take place occur due to thermal energy. The data will provide information on the thermal stability of the precursors. The thermal stability of the precursors will improve the safe handling and general knowledge of HMEs.

Name: Kathleen Weichman
Program: UGS
School: University of Illinois
Group: MST-7
Mentor: Andrew Nelson
Category: Materials Science
Type: Individual Poster Presentation

Development of a Low-Dose Irradiation Campaign for Thoria-Based Ceramic Fuels

Thoria-based ceramic fuels are an attractive alternative to traditional urania-based fuels, offering desirable fuel characteristics and increased proliferation resistance. Basic knowledge of properties such as the thermal conductivity is required to model the performance of thoria-based fuel cycles. The thermal conductivity of ceramic fuels can be affected by factors such as composition, stoichiometry, microstructure, and the presence of defects. The effects of microstructure changes on the thermal conductivity of thoria-based ceramics under irradiation will be studied using the High-Flux Isotope Reactor (HFIR) located at Oak Ridge National Laboratory.

Samples of (Th,U)O2 with 5-30 mol% urania, (Th,Ce)O2 with 1-10 mol% ceria, and pure ThO2, UO2, and CeO2 have been selected for study as being relevant to the future implementation of thoria-based fuels. To avoid handling and other issues, cerium will be used as a surrogate material for plutonium. Unirradiated samples will be analyzed by x-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and laser flash analysis (LFA) to determine the typical fuel characteristics prior to irradiation. Using HFIR, samples will then be irradiated for 5 to 500 hours at fixed temperatures ranging from 400 to1000K. Irradiated samples will be examined by SEM, TEM, and LFA to assess the extent of damage and the decrease in thermal conductivity. Comparison of the properties of unirradiated and irradiated samples will be made to better understand the effects of microstructure changes on the thermal conductivity of thoria-based ceramic fuels under irradiation.

Name: Weston Lee
Program: UGS
School: New Mexico Tech

Name: Ryan Need
Program: UGS
School: Clemson University

Group(s): MPA-CMMS
Mentor: Chuck Mielke
Category: Materials Science
Type: Group Poster Presentation

Nanostructuring of Coin Silver by Equal Channel Angular Extrusion

Non-destructive, high-field pulsed magnets are capable of producing fields of up to 90T. Such high fields are fundamental for advancing research in condensed matter physics and material science; however, these fields create large mechanical and thermal stresses (near 1.3 GPa) within the conducting wires. To accommodate these extreme physical conditions, conductors of superior strength and conductivity to those existing today are required. Therefore, a series of experiments were arranged to evaluate the properties of ultra-fine grained coin silver as a potential novel conducting material. Ultra-fine grained coin silver samples were fabricated by multi-pass Equal Channel Angular Extrusion (ECAE) with a die angle of 120°. Two ECAE routes, Bc and C, were employed. Microstructure of the deformed samples was investigated using standard metallographic techniques. Physical and fatigue properties were measured via quasi-static, uniaxial tensile testing and tensile-tensile fatigue testing, respectively. Electrical conductivity was quantified by the four point probe method.

Name: David Mutnick
Program: UGS
School: Colorado School of Mines

Name: Adriana Tudela
Program: UGS
School: Illinois Institute of Technology

Group(s): MPA-CMMS
Mentor: Chuck Mielke
Category: Materials Science
Type: Group Poster Presentation

Mechanical and Electrical Properties of Glidcop Processed by ECAE

The development of high strength, high conductivity materials capable of withstanding the high stresses and currents associated with non-destructive pulsed magnets poses a significant challenge to the scientific community. Severe plastic deformation techniques have been used previously to produce ultra-fine grained (UFG) and nanostructured materials in attempts to optimize the mechanical and electrical properties of these conductors. This investigation chose to focus on Equal Channel Angular Extrusion (ECAE) because it has the advantage of maintaining the specimen's dimensions through multiple passes. This allows for the formation of large wires with high strain that are necessary for pulsed magnet applications. Glidcop AL-25 and AL-60 samples were subjected to multiple ECAE passes at a die angle of 120° using routes BC and C. The extent of grain refinement was determined using typical metallographic techniques. Quasi-static, uniaxial tensile testing and tensile-tensile fatigue testing were performed to study the mechanical properties of the material. Electrical conductivity was analyzed by the four point probe method.

Name: Claire Longo
Program: GRA
School: University of New Mexico
Group: CCS-6
Mentor: Tom Burr
Category: Mathematics
Type: Individual Poster Presentation

Applications of Wavelet Analysis to Solution Monitoring for Nuclear Safeguards

This research explores applications of wavelet analysis to solution monitoring(SM) for nuclear safeguards. SM data is a time series record of levels and volumes from tanks at a nuclear plant. Large changes in these measurements are assumed to be shipment or receipt events. The identification and estimation of these events are used to recognize diversion of nuclear material. Three goals included in SM are to smooth the errors from the data, detect the change points that indicate events, and estimate the change in quantity during events.

Wavelets can be used to estimate a function by expanding it into a wavelet series. These wavelet transformations retain significant features of the function because wavelets are localized in frequency and time. Wavelet change detection uses wavelet coefficients to identify time and quantity of an event. Gibbs phenomenon, the tendency of a reconstructed function to overshoot or undershoot the real value, appears in wavelet analysis. This affects both smoothing and change detection as it can obstruct change points (change detection application), and add to an overall poor fit to the data (smoothing application). A mathematical approach is used to determine a wavelet that reduces Gibbs effect. In this research, an effective wavelet thresholding method for smoothing the SM data is determined based on a statistical study. Wavelet smoothing is compared to smoothing methods previously used on SM data. Wavelet change detection and estimation are presented and examples with simulated and real data are provided.

Name: Samantha Oestreicher
Program: GRA
School: University of Minnesota, Twin Cities
Group: T-CNLS
Mentor: Beth Wingate
Category: Mathematics
Type: Individual Poster Presentation

Studying Fast/Slow Dynamics of Shallow-Water Equations and its use for Heterogeneous Computing

Earth's oceans are full of simultaneously interacting fast and slow dynamics, or waves. Because the 3D slow dynamics can be split from the 2D fast, Global Climate Models (GCMs) can improve integration times. This requires scientists to separate fast/slow waves when possible. New mathematical theory sheds light on a broadly applicable solution to this task.

The new theory uses a projection operator which projects the state space onto the null space of the fast dynamics- leaving only the slow. This theory has been rigorously developed by not yet used to this extent in numerical GCMs. We complete the theory by applying it to the remaining limit on one of the simplest models which displays fast/slow ocean dynamics: the rotating shallow-water equations. In completing this work we will discover previously unknown dynamics to the equations.

If implemented, this theory will allow next generation GCMS to more broadly split the fast/slow dynamics. Then the fast dynamics will be sent to a separate processor, the graphics processing unit, to execute many iterations for each of the slow dynamic time steps, thus improving integration times further. As GCMs achieve higher resolution, computer architectures must be used more effectively and this theory will be a valuable tool for splitting fast/slow dynamics to take advantage of multiple processors.

Name: Christin Whitton
Program: GRA
School: Brigham Young University
Group: CCS-6
Mentor: Leslie Moore
Category: Mathematics
Type: Individual Poster Presentation

Fair Assignment of Posters to Judges

The Annual Los Alamos Postdoc Research Day took place on June 16, 2011. We were asked to help with a small task: produce a randomized matrix to assign available judges to posters. Initially, 26 or 28 judges (j) were expected for 90 posters (p), and each judge was to judge 15 posters (k). Two requirements were considered: 1) each judge would be assigned 15 unique posters, and 2) each poster would be judged by as many judges as possible. The calculation (j*k)/p gives the average number of judgings per poster. For 26 judges this number is 4.333, indicating that each poster would be judged 4 or 5 times.

We tried two initial approaches to assignment of posters to judges and proposed a criterion: posters should be competed against as many other posters as possible. Our strategy also had to flexibly adjust for a fluctuating numbers of posters and judges. We developed an algorithm for our strategy and a metric to quantify "goodness" of an assignment of posters based on proportion of unique posters out of total possible posters one poster is judged against. Cycling thru random assignments and applying our metric, we chose one with the best value of the metric. Though our solution may not be universally optimal, our assignment resulted in each poster being judged against a minimum of 64% of the number of posters it could have been judged against. This effort motivated research this summer in combinatorial mathematics, statistical experimental design, statistical sampling, and optimization.

Name: Jason Langteau
Program: UGS
School: Radford University
Group: ENV-ES
Mentor: Jennifer Nisengard
Category: Non-Technical
Type: Individual Poster Presentation

Wildlife Management at LANL

In 1969, the US government passed the first National Environmental Policy Act (NEPA) requiring federal agencies to incorporate environmental planning into the decision making process for future projects. Environmental impact analyses include Environmental Impact Statements (EIS) and Environmental Assessments (EAs); both include sections related to biological resources. As part of NEPA implementation and to comply with relevant Federal and State laws, LANL biologists evaluate the potential impacts to wildlife and habitats from proposed projects and construction activities at the Laboratory. LANL also implements a Biological Resources Management Plan, approved by the US Fish and Wildlife Service to comply with applicable laws and to preserve and protect biological resources and to support the LANL mission. All new and modified projects at LANL are subject to environmental reviews and biologists work with project managers to ensure that mitigation actions, associated with EISs, EAs, and reviews, (e.g., wildlife monitoring and reporting) are completed. This study reflects the environmental laws applicable to LANL and the ways in which LANL conducts its environmental compliance requirements.

Name: Zachary Martinez
Program: UGS
School: New Mexico Tech
Group: NPI-1
Mentor: Paul Smith
Category: Non-Technical
Type: Individual Poster Presentation

Nuclear Material Container Knowledge Database

Los Alamos National Laboratory utilizes a wide variety of containers to store and transport nuclear material both within and external to the laboratory. The variety of containers stems from a correspondingly wide variety of needs and requirements that are constantly updated with new information. The requirements are generally driven by the need to protect workers and the public during normal usage (i.e., storage, handling, transport,) and in the event of particular accident scenarios. Furthermore, containers designed for shipping are sometimes used for storage purposes, and vice versa. A database of relevant information concerning different containers was developed to enhance employee productivity. This poster will describe a nuclear material container knowledge database developed at Los Alamos to collect requirements, specifications, drawings, and photographs related to nuclear material containers into a searchable system that can be readily navigated.

Name: Leslie Sandoval
Program: UGS
School: New Mexico State University
Group: WES-DO
Mentor: Andrew Ashbaugh
Category: Non-Technical
Type: Individual Poster Presentation

The Environmental Data Management (EDM) Cloud

WES Division operates the environmental data management systems for Los Alamos National Laboratory environmental surveillance and environmental compliance measurements. The current data management system is comprised of WES Division operated servers, WES Division subcontractor developed database software, and subcontractor developed software applications. The ECM- Cloud replaces the current WES Division environmental database management systems with an environmental data management system in the form of software -as- a service (SaaS), cloud based platform for this SaaS, and a publicly available web portal for this SaaS.

Name: John Whitton
Program: UGS
School: Brigham Young University
Group: D-6
Mentor: George Tompkins
Category: Non-Technical
Type: Individual Poster Presentation

The Psychology of a Terrorist: Case Studies in the Ideology of Radicalization

Radicalization is the process of adopting an extremist belief system, including the willingness to use, support, or facilitate violence as a method to effect societal change. This study focused on understanding the elements, foundations, and catalysts of an individual or group evolving from peaceful protest to the use of violence and/or murder for personal or group means and purposes. Using social anthropological and psychological theory and both current and historic case studies depicting the development of the radicalization and fanaticism process, an applied Bayesian net statistical model was developed. This probabilistic model attempts to quantify the collected set of qualitative data. The model explores factors in the radicalization process, the logic of political murder and genocide, and the ideological ethics of religious demonic violence. It will be added to existing models which are currently used to predict human movement in physical and human terrain scenarios.

Name: Emily Breiner
Program: UGS
School: Mesa State College

Name: Loren Helland
Program: GRA
School: University of Phoenix

Name: Jamie Parker
Program: GRA
School: Willamette University

Group(s): CAP-FS
Mentor: Mike Alexander, Ryan Romero, Steve Maze
Category: Non-Technical
Type: Group Poster Presentation

Operations in Water Quality Monitoring and Environmental Stewardship

Environmental stewardship practices were not implemented at the Los Alamos National Laboratory until the 1970s. Before this time, the environmental effects of laboratory operations were not a priority due to the political climate and the LANL mission during World War II and the advent of the Cold War.

Today, federal and state regulations require LANL to monitor legacy waste and environmental impacts, including water quality. Specifically, the Corrective Actions Program investigates and monitors groundwater, storm water and erosion control in order to attain compliance with NMED and EPA standards. Corrective Actions Field Services and Operations facilitate the water monitoring process, including drilling, sampling, water levels, storm water gauging, Best Management Practices, flood mitigation, and fire recovery. Through these monitoring systems, LANL has accumulated quantitative data supporting the achievement of the lab's environmental stewardship mission. "We assure all stakeholders that the Laboratory is a good environmental steward by cleaning up contaminated sites in compliance with the New Mexico Environment Department (NMED) Consent Order, performing beyond regulatory expectations, and minimizing impacts on natural resources." Conducting these tasks allows LANL's Corrective Action Program to monitor, compile, and report the necessary results to all stakeholders.

Name: Joshua Achiam
Program: UGS
School: University of Florida
Group: T-5
Mentor: Andrew Richardson
Category: Physics
Type: Individual Poster Presentation

Ray Splitting Model of O-X Mode Conversion

Mode conversions (MCs) allow waves to be transmitted through evanescent layers and power to be deposited in (and diagnostic information to be extracted from) otherwise inaccessible regions in magnetized fusion plasmas. MCs can only be modeled by conventional ray tracing techniques if the incident ray is fully converted into an outgoing, transmitted ray and if the WKB approximation is fulfilled everywhere. However, in most experiments the conversion is partial; only some of the incident power is mode-converted. The WKB approximation also fails in the cases of resonances and cutoffs. An algorithm was recently developed which models the MC as the splitting of a single ray into a transmitted and reflected part. Continued testing of this algorithm was carried out by developing a module for the ART ray tracing code and modeling the O-X mode conversion, where an incoming ordinary mode ray splits into a reflected ordinary mode ray and a transmitted extraordinary mode ray. Computed conversion efficiencies were compared with analytical predictions as functions of the view angles.

Name: Claire Baglee
Program: UGS
School: Tulane University
Group: P-21
Mentor: Michelle Espy
Category: Physics
Type: Individual Poster Presentation

Shielding Factor of a Shielded Room

Shielded rooms are used to house equipment, such as Ultra Low Field Magnetic Resonance Imaging, that relies on the measurement of very small or very sensitive signals. The ideal shielded room has no magnetic field inside its bounds, but most are imperfect. Where the shielded room is not 100% free of a magnetic field, a high shielding factor is the most desirable for optimal equipment performance. I will be using a magnetometer to measure the magnetic field inside a shielded room before the Mu-Metal is applied, and comparing it to the magnetic field inside a completed shielded room to calculate an approximate shielding factor.

Name: Erik Edelmann
Program: UGS
School: Cornell University
Group: XTD-2
Mentor: Leslie Sherrill
Category: Physics
Type: Individual Poster Presentation

Investigating 1D Radiation Hydrodynamics Simulations of ICF Experiments

Inertial Confinement Fusion (ICF) is a potential energy source that is being studied at various laser laboratories such as the Laboratory for Laser Energetics (LLE) at the University of Rochester. The LLE is one of the nation's premier sites for the study of ICF and is home to the OMEGA laser system. The 60-beam OMEGA laser system has amassed thousands of shots worth of data since 1995 and has provided these data to laboratories such as LANL since 1996.

HELIOS is a 1D Lagrangian radiation hydrodynamics code that can be used to simulate many ICF experiments such as those performed at the OMEGA laser. Here, the effects on the clean yield when adjusting various initial physical parameters have been investigated. The initial parameters in these simulations range from the beam-averaged laser pulse power spectrum as a function of time to the materials which comprise each zone of the laser target. After these parameters have been adjusted by the user, the simulation can be run and the code can output various quantities like integrated neutron yield rates and regional electron temperatures as a function of target radius. I started by undertaking a holistic examination of how HELIOS and its theoretical fusion models respond to particular parameter adjustments, and since have found some particular cases that have merited further study. In particular, the simulated radial position of the lasers' focus on the target, and the displacement of the initial core-shell interface position have been taken into consideration. The yield in both cases was optimized while the limiting outputs such as electron temperatures and mass densities were scrutinized to ensure consistency with physical experimental observations. These considerations can be used to in theory improve the design of future ICF experiments.

Name: Michael Francis
Program: GRA
School: University of Virginia
Group: MST-6
Mentor: Christopher Taylor
Category: Physics
Type: Individual Poster Presentation

The Phenomenology of Hydrogen Vacancy Interactions, A Discussion

In 1994 Fukai discovered that when palladium was exposed to high chemical potential hydrogen a novel super-abundant vacancy (SAV) phase formed (Fukai PRL 1994). The palladium and hydrogen formed a Cu3Au type structure with a vacancy concentration one in four, Pd3VacH4. The discovery sparked a great deal of investigation which demonstrated that SAV phases could be formed in Ni, Cu, and other fcc materials (Fukai J Alloys Compd 2003) and that an increased hydrogen and vacancy content could be triggered by a wide range of chemical potential shifting factors not limited to pressure-temperature, pH-V, and mechanical torsion. Increased hydrogen-vacancy abundance and SAV formation may have important consequences and applications for energy storage, corrosion, and nuclear materials reliability. The focus of my work here at LANL is two-fold:

(1) To use experimental as well as theoretical thermodynamic data combined with a statistical mechanical model to determine the universality of hydrogen induced vacancy abundance. Does the presence of hydrogen increase vacancy concentration in all metals?

(2) To examine hydrogen-vacancy complexes in sample actinide materials. Does hydrogen increase vacancy density and reduce metals density in f-metals? What is the hydrogen concentration for a given chemical potential? What is the metal density?

This work seeks to establish the generality of increased vacancy concentration as induced by hydrogen in metals and seeks to understand its importance in the specific case of actinides.

Name: Rudra Kafle
Program: GRA
School: Worcester Polytechnic Institute
Group: T-4/CNLS
Mentor: Eddy Timmermans
Category: Physics
Type: Individual Poster Presentation

Berry-Gauge Tuned Bose-Einstein Condensate Gyroscope

If stable, the many-body ground state of a dilute gas of ultra-cold, bosonic atoms occupying a superposition of two internal (hyperfine) states is a Bose-Einstein condensate (BEC) of effective spin 1/2 bosons. The superfluid BEC dynamics admits long-lived quantized vortex states in which the complex phase of the superfluid order parameter, which we call the charge phase, undergoes an integer number of 2\pi windings along a multiply connected path - a closed trajectory that encloses a region in which the superfluid density vanishes. In response to an overall rotation of the ring, the BEC charge phase can suddenly switch winding number. This process, called a quantization event, can be used to sense rotation, as the winding number can be determined in a time of flight measurement. Unfortunately, the sensitivity of the ring BEC gyroscope would be limited as the quantization event sets in at a rotation frequency that is not as low as the frequencies measured by other devices such as ring laser gyroscopes. We show that the recently realized synthetic magnetic fields, in which the controlled position dependence of the spin results in an effective gauge field, can tune the BEC ring gyroscope to trigger a quantization event at much smaller rotation frequency. In addition, the effective gauge field can undergo its own quantization events in which the spin vector undergoes an integer number of 2\pi or 4\pi windings.

Name: Zoe Martin
Program: UGS
School: University of New Mexico
Group: XTD-2
Mentor: Leslie Sherrill
Category: Physics
Type: Individual Poster Presentation

Using RAGE for ICF Simulations

Because RAGE is not generally used for inertial confinement fusion simulations, the goal of this work was to compare different RAGE runs modeling ICF experiments to the results of simulations done using other ICF modeling codes. These simulations were run using a standard spherical plastic shell filled with deuterium gas. We looked at a number of parameters for each simulation including R-T plots, plastic and gas concentrations, pressure, density, temperature, stagnation time, and core size at the time of peak compression. We used both direct and indirect drive energy sources. We chose to compare RAGE to HELIOS, a 1d hydrodynamic code that has been compared to experimental results in the past and is regarded as a good tool for ICF modeling. Although HELIOS is a Lagrangian code while RAGE is Eulerian, care was taken to ensure that the simulations were comparable.

Name: Alex McKinney
Program: GRA
School: Baylor
Group: D-5
Mentor: Holly Trellue
Category: Physics
Type: Individual Poster Presentation

Non-Destructive Assay with Delayed Neutrons

The Next Generation Safeguards Initiative (NGSI) of the U.S. Department of Energy (DOE) has funded a multilaboratory/university collaboration to quantify the plutonium (Pu) mass in, and to detect the diversion of pins from, spent nuclear fuel assemblies. 1,2 This approach seeks to scan radioactive materials/equipment without having to affect them.

One of the methods currently being pursued for achieving this is called Delayed Neutron Assay. The technique is based on identifying fissile material levels based on how many delayed neutrons are emitted. A delayed neutron is the term for a neutron that is often emitted as an unstable isotope decays. The measured rates that this happens at will be different depending on the materials being examined. As 238U is transmuted into 239Pu as a function of irradiation, the delayed neutron count rate will actually get lower because the concentration of 235U, which has the highest delayed neutron fraction, decreases while 239Pu increases. For the scanning, after measuring the natural emission, neutrons are fired at the materials to cause fissions and produce more delayed neutrons for better sampling. The number of delayed neutrons detected is then examined compared to the amount of radioactive material to provide an estimate of how much plutonium is present.

In this study, the scenarios being examined are centered on detecting the removal of fuel rods from a Pressurized Water Reactor (PWR). The delayed neutron cases are modeled using MCNPX (Monte Carlo N-Particle eXtended); burnup results obtained previously using Monteburns/CINDER90 capabilities. The different scenarios vary in fuel enrichment, material cool-down time and reactor power output. Comparisons were also made between MCNPX libraries #1 and #2, where the first assumed the environment is fully symmetric, and the second was more detailed in shape.

Name: Peter Schulze
Program: UGS
School: Mesa State College
Group: WX-9
Mentor: David Moore
Category: Physics
Type: Individual Poster Presentation

Accurate Sample Manufacturing for Distance Raman and Explosive Detection

Instrumentation is developed to manufacture samples with highly accurate known areal concentrations of precursors and high explosives. Explosives or precursors are dissolved in an ethanol solution and deposited in a square array onto various different materials. Using a micro dropper capable of producing pL-scale drops, an xy scale moves the substrate while the drops are produced and cameras to monitor the drop production. The entire apparatus is controlled using LabVIEW virtual instruments. After drops are deposited on the substrate, the ethanol quickly evaporates and leaves a very consistent known areal concentration (10-100 ng/cm^2) of the sample material. The samples are then used to test the long distance capability of explosive detection using Raman spectroscopy.

Name: Kristjana Timmers
Program: UGS
School: Fort Lewis College
Group: C-NR
Mentor: Mark Smith
Category: Physics
Type: Individual Poster Presentation

C-NR Autoradiography

C-NR has been using autoradiography as a diagnostics tool for fusion research. Through the New Mexico Small Business Assistance Program, C-NR has been working with Energy Matter Conversion Corporation (EMCC) to use autoradiography imaging to aid in diagnosing the performance of fusion reactors. This summer I have been using autoradiography to image the fusion reaction. We successfully imaged X-rays from over 10 different test shots of the EMCC fusion device. We demonstrated that the image plate technique provides adequate sensitivity as well as excellent spatial resolution. The collected information has provided EMCC valuable data to understand the performance of the next generation reactor. Another goal of this collaboration was to see if we could quantify the intensities of the x-rays the reactor produces. This goal was met by varying the reactor power and showing that we could quantify the x-ray intensities with the proprietary software in use at C-NR.

Name: Aleksandra Vidisheva
Program: UGS
School: University of Southern California
Group: P-25
Mentor: Dale Tupa
Category: Physics
Type: Individual Poster Presentation

Using PDV to Measure Velocity

As part of the Velocimetry team at Proton Radiography, we perform experiments and calculations to illustrate how PDV (Photon Dopler Velocimetry) works. PDV is a diagnostic to measure the velocity of a moving surface. A laser illuminates the object and we gather light reflected off of the surface of that object. The reflected light has a different frequency than the impinging light because of the Doppler shift caused by the moving surface. We gather the shifted and the un-shifted light to determine the beat frequency and use it to measure the velocity of the surface.

Name: James Wigger
Program: UGS
School: University of New Mexico
Group: AET-2
Mentor: John Singleton
Category: Physics
Type: Individual Poster Presentation

Behavior of a Linear Superluminal Accelerator

Maxwell's generalization of Ampere's Law establishes that electromagnetic radiation can be generated by an accelerated electric-polarization current, as well as, more conventionally, by an accelerated or oscillating current of free charges. Because a current of electric polarization is created by the displacement of oppositely charged particles and is therefore immaterial, it can be made to move faster than the speed of light. Practical superluminal antennae have been built in the laboratory by different groups and have been shown to produce polarization currents that move as fast as eight times the speed of light. Here we study an electrostatic method for making a superluminal polarization current and find that the emitted radiation has a number of surprising qualities: i) If the polarization current moves at a constant speed we observe Cerenkov radiation, conical beams whose opening angle depends on the velocity of the source alone. ii) If the current, however, does not only move faster than light but is also subject to linear acceleration, we experience temporal focusing-focusing in the time domain, an electromagnetic analog to the sonic boom in acoustics. Both of these effects have been measured using range tests. Hence, superluminal radiation does not decay according to the inverse square law (1/distance^2) but rather as 1/distance, which suggests that this device has potential applications in laser technology, communications, and remote sensing.

Name: Sandra Zerkle
Program: UGS
School: University of California, San Diego
Group: P-21
Mentor: Amy Guthormsen
Category: Physics
Type: Individual Poster Presentation

Electroencephalography Study of Visual Object Recognition

How long does it take the human visual system to process complex natural images, such as cats and dogs? Measuring this time experimentally can be difficult, because reaction times include not only visual processing but also the time required for motor response. However, scalp-recorded brain activity (electroencephalography or EEG) can show signs of neural processing well before the motor output. We average EEG signals recorded during multiple trials to produce event-related potentials (ERPs). Signal averaging removes intertrial variability and allows patterns common across many trials to emerge. We are using a cat/dog/no animal task in which participants have to decide whether a previously unseen photograph, flashed on a computer screen for just 40 ms, contains the target, either a cat or a dog. The images contain either a cat, a dog, or no animal at all. This task is not challenging for subjects, and high accuracy is observed. We test on volunteer LANL employees, and place a net of 256 sponge-tipped electrodes on their heads to measure their neural activity during the 600 trials per task. Previous research has indicated that target discrimination (between animal and no animal) can occur in 150 ms, which would negate the possibility of cortical visual areas utilizing feedback. However, the data we observe suggests that although such broad discriminations (animal/no animal) may occur early, discriminating a target from a highly similar distracter (cat/dog) may take longer (over 400 ms).

Name: Afsheen Banisadr
Program: UGS
School: University of Utah
Group: B-7
Mentor: Elizabeth Hong-Geller
Category: Biosciences
Type: Technical Talk

Discovering Molecular Determinants of Transcription Factors

Transcription factors (TF) play a vital role in the expression of genetic information in a variety of organisms ranging from bacteria to humans. TFs are proteins that bind to specific sites on DNA upstream of genes they regulate. The binding of TFs to target DNA is dependent on many variables, including 1) the specific nucleic acid sequence at the TF binding site, and 2) the tertiary structure of DNA at the TF binding site (DNA breathing dynamics). To determine the importance of each of these variables in the formation of a nucleotide-protein complex, we have used the TF Fis from E. coli as a model system. Fis has been demonstrated experimentally to have specific contact points on the predicted nucleotide binding sequence at nucleotide position ±7 (X). The importance of the ±7 nucleotide positions is demonstrated by a 40-fold decrease in binding affinity when a single nucleotide mutation to change either position from a pyrimidine to a purine. In addition to dependency on the nucleotide sequence, we demonstrate that the tertiary structure of the DNA binding sequence, which regulates the breathing dynamics of the DNA, is an important variable in Fis binding to the DNA sequence. We use simulation predictions and experiment validation to show the effects of nucleotide-protein complex formation dependence on tertiary DNA structure. Our results show that introduction of nucleotide mutations of the DNA sequence at flanking regions outside the specified contact points causes a decrease in binding affinity. The nucleotide mutations eliminate the predicted bubble structure within the DNA binding site. We also demonstrate the ability to alter the structure of DNA from a stiff formation to one containing a soft bubble opening, by methylation of guanine residues. These results provide insights into the molecular determinants of TF-DNA interactions in the control of gene expression.

Name: Truc Do
Program: UGS
School: The University of Texas, Dallas
Group: B-6
Mentor: Lance Green
Category: Biosciences
Type: Technical Talk

Characterizing the Influenza B Genome by Sanger & Illumina Sequencing Processes

According to the Centers for Disease Control and Prevention (CDC), up to 49,000 people have died of flu-related causes between 1976 and 2006. Each year, billions of dollars are spent on influenza research and vaccine development. Seasonal flu vaccines include two influenza A viral subtypes and one influenza B viral strain. This study examines the complete genome of several influenza B viruses, known for its virulence by antigenic drift. We aimed to sequence the strains using Sanger and Illumina platforms.

The traditional Sanger method comprises five main steps: (1) reverse-transcriptase polymerase chain reaction (RT-PCR) to make cDNA from RNA, followed by amplification (2) AMPure magnetic bead clean-up of RT-PCR reaction (3) sequencing reaction using a universal forward and reverse primer set and Big Dye Terminator (4) CleanSEQ magnetic bead process to clean sequencing reaction, and (5) fluorescence detection on the Applied Biosystems 3730 xl robot.
The next-generation Illumina method isolates viral DNA using steps 1-2 of Sanger, but deviates in the downstream process: (3) in vitro shearing and adaptor ligation of double-stranded genomic DNA for library preparation (4) amplification of template library by bridge (cluster) PCR on the surface of a solid flow-cell substrate to give spatially distinct clonal clusters, and (5) single-base cyclic array sequencing using 'reversible terminators' with chemically cleavable fluorescent labels.

Influenza sequences generated will be used to optimize Sanger and Illumina processes for high-throughput sequencing and to determine if next-generation platforms can provide faster and more accurate data, especially for surveying and responding to global pandemics like flu outbreaks.

Name: Raymond Romero
Program: UGS
School: New Mexico State University
Group: T-6
Mentor: S. Gnanakaran
Category: Biosciences
Type: Technical Talk

Breaking Down Plant Cell-Walls for Biofuels

Biomass is becoming a very important factor in today's production of fuels, chemicals, and energy. Biomass is a renewable energy source derived from plants and woods. The plant cell wall consists of structural polysaccharides such as cellulose, hemi-cellulose, and lignin which are providing shape, elasticity, or rigidity to plants as well as protection. In order to convert biomass from the plant sources, different approaches are used to extract cellulose and to break lignin. Lignin consists of various aryl ethers, irregularly connected by a variety of linkages creating a complex structural network; hence, it is very difficult to identify selective bond breaking events. In this study, we predict dissociation tendencies of diverse set of lignin linkages encompassing 65 lignin model compounds using density functional theoretical (DFT) approach. Now for the first time we are investigating the chemical reactivity aspect of basic units of plant cell wall components. We studied the specific reactivity of lignin, xylose, arabinose, and cellulose using the Fukui Functions (FF) which is defined from the foundation of DFT. Comparisons of their nucleophilic, electrophilic and free radical properties obtained from FFs show their most probably sites for reactivity for chemical catalysts. Furthermore, these quantities are being computed in both gas and solvent media. This investigation will impact the field of biofuel research since they might provide insight into the selection and genetic design of plants that have the types of lignin structures that lead to efficient biofuel production.

Name: Stacy Shiffler
Program: GRA
School: University of Arizona
Group: MPA-CINT
Mentor: Gabriel Montano
Category: Biosciences
Type: Technical Talk

AFM Investigation of C. tepidum Photosynthetic Antenna Complexes

Nearly all life relies either directly or indirectly upon photosynthesis. The initial step in photosynthesis is photonic light-harvesting and energy transfer. Most bacterial light-harvesting complexes (LHCs) rely on intricate protein arrangement of chromophores, but several bacteria, including Chlorobium tepidum, have developed large antenna complexes called chlorosomes that self-assemble chromophores without significant protein coordination. This self-assembly results in architecturally less complex yet more robust LHCs, with thousands of chromophores inside relatively small volumes. C. tepidum bacteria also repair LHCs and adapt to environmental pressures. These attributes allow C. tepidum to thrive in extremely low light environments. Despite the wealth of information available on C. tepidum, significant questions remain about structural organization and biogenesis of its LHC. We used atomic force microscopy (AFM) to probe the supra-molecular structure of C. tepidum LHCs in isolated membrane fragments. Fragments were deposited onto mica surfaces and imaged with tapping mode AFM to reduce deformation of biological structures. Work was performed to optimize high-resolution imaging conditions. AFM results provided statistical information about both chlorosomal heterogeneity and supra-molecular photosystem organization. We explored nanomanipulation of chlorosomes to further determine interactions with underlying membrane-associated light-harvesting and reaction center complexes. We are currently growing C. tepidum under different light conditions to determine how chlorosomes are formed and how these bacteria adapt their LHCs to different light conditions.

Name: John Auxier II
Program: GRA
School: University of Tennessee - Knoxville
Group: C-AAC
Mentor: Donivan Porterfield
Category: Chemistry
Type: Technical Talk

Development of a New Method for Determination of Pu and Am-241in Aqueous Samples

We are currently pursuing the development of a new method for the determination of plutonium and americium-241 at elevated levels in process aqueous samples. The main objective of this new method is to reduce the usage of hazardous chemicals. At the same time we also wish to at least maintain comparable accuracy and precision characteristics with any new method. As well sample turn-around is an important consideration. The new method being pursued would utilize gas proportional counting for total alpha activity and alpha spectrometry for the relative amounts of plutonium and americium-241 in a diluted sample aliquot. We anticipate also utilizing typical plutonium isotopic abundance information to correct for the contribution of plutonium-238 to the americium-241 alpha spectrometry region-of-interest. While there is good separation between the major plutonium alpha emissions and that of americium-241 and plutonium-238 some correction for alpha spectrometry peak tailing is expected to be necessary.

Name: Kyle Thomas
Program: UGS
School: Texas Southern University
Group: LANSCE-LC
Mentor: Anna Llobet
Category: Chemistry
Type: Technical Talk

Local Structure Determination of Oxygen Deficient Perovskites Using the Pair Distribution Function

Anion deficient perovskites show promise for application as anode materials in solid oxide fuel cells. The oxygen deficient perovskites Sr3SbO5.5, Sr2CaSbO5.5, Sr2BaSbO5.5, Sr3NbO5.5, and Sr3TaO5.5 all have the ideal cubic double perovskite crystal structure. However, these compounds also have tolerance factors that are too small for octahedral tilting not to be present, as well as a large amount of diffuse scattering in their neutron powder diffraction patterns, both of which suggest a large amount of local disorder must be present. The goal of this research is to determine how the local structures of these compounds differ from their long range average structures. We are particularly concerned with understanding any short range ordering of oxygen vacancies that occurs, as this would directly affect their ionic conductivities. We performed neutron total scattering experiments on each sample and used this data to obtain the pair distribution function (PDF) of each compound. The PDF gives the distribution of inter-atomic distances in the material and allows us to determine the short and medium range order within the sample.

Name: Michael Jacobi
Program: GRA
School: University of New Mexico
Group: HPC-3
Mentor: Cody Scott
Category: Computing
Type: Technical Talk

Applied Parallel Metadata Indexing

The General Parallel File System (GPFS) Archive is a parallel archive used by hundreds of users in the Turquoise collaboration network. It houses 2+ petabytes of data in more than 100 million files. Currently, users must navigate the file system to retrieve their data, requiring them to remember file paths and names. A better solution should let users tag data with meaningful labels and search the archive using standard and user-defined metadata like file name, creation date, user created labels, etc. Technologies like file system extended attributes, GPFS 3.4's ability to quickly extract all metadata from the file system, and MongoDB's schema-less design and horizontal scaling enable the production of arbitrarily large, unstructured datasets with relatively fast insert and query speed. In other words, these technologies can be used as the basis for a fast, parallel metadata indexing and search system for a supercomputer archive. My research this summer involved writing a tool to let users tag their data with arbitrary labels using file system extended attributes; writing and running GPFS metadata scan queries; comparing relational databases like MySQL to newer NoSQL databases like MongoDB using insertion rate, index creation time, query response time, and row scalability as criteria; and understanding how the security implications of a full metadata index of a multi-user archive affects the system's design.

Name: Ashwin Mendon
Program: GRA
School: University of North Carolina Charlotte
Group: CCS-7
Mentor: Zachary Baker
Category: Computing
Type: Technical Talk

High Bandwidth Disk Access using FPGA-based Custom Cores

Modern High-End Computing systems frequently include FPGAs as compute accelerators. I/O intensive applications running on these systems have go through the sequential operating system stack using processor cores clocked at relative slow frequencies in order to access disks. Also, as secondary storage devices get faster with flash based SSDs and emerging technologies like phase change memories (PCM), overheads in system software like operating system and filesytem may limit the potential performance improvements. Migrating the filesystem into FPGA hardware, has the potential of improving the performance of data-intensive applications by connecting secondary storage directly to FPGA compute accelerators while bypassing the OS stack. To test the feasibility of this idea, a Hardware Filesystem (HWFS) was designed with four basic operations (open, read, write, and delete). Furthermore, multi-disk and RAID-0 (striping) support has been implemented as an option in the filesystem. Many FPGA devices today, provide high-speed serial transceivers for interfacing to SATA disks. However, to reduce design complexity and facilitate easier testing of the HWFS, a RAM disk was used initially. The filesystem core has been integrated and tested with a hardware application core (BLAST) as well as a multi-node FPGA network to provide remote-disk access. Finally, a Serial ATA host controller IP core has been developed and interfaced with HWFS to access actual disk drives. Results show that the hardware filesystem provides efficient run-time performance and consumes reasonable amount of FPGA resources.

Name: Eric Relson
Program: GRA
School: University of Wisconsin-Madison / University of Michigan
Group: XCP-5
Mentor: Jeremy Conlin
Category: Computing
Type: Technical Talk

Development and Automation of Criticality Benchmarks for Cross Section Data Testing using MCNP6 and Partisn

One of the tasks of the XCP division at LANL is to provide cross section data to the code teams. Cross section data give the probabilities of nuclear reactions for various particles and energies. The data are periodically updated as new information becomes available. Both improvement and automation of the testing of these data was desired. By comparing experimental data to the results of radiation transport code calculations for various sets of cross section data, problems in the cross section data can be identified. Two LANL-developed codes of interest, the MCNP6 Monte Carlo code and the deterministic code, Partisn were employed for this task. Both of these codes have been thoroughly benchmarked and are generally considered to be proven codes. These codes are thus an excellent tool for testing cross section data. Initially, a set of 660 criticality benchmark cases already existed for MCNP6. By carefully studying the inputs for both codes, a direct conversion from the MCNP6 inputs to Partisn input files was achieved for 440 of the MCNP6 benchmarks. Python scripts were written to automate this conversion, as well as to run the Partisn cases, and compare the results from both codes. This suite of Python scripts will allow for quick evaluation of future changes to cross section data. The comparisons focused on matching discrepancies in criticality (k-effective) between MCNP6 and Partisn to known caveats in cross section data and energy group structure for certain combinations of material, as well as verifying proper conversion to Partisn.

Name: Evan Samanas
Program: GRA
School: University of Wisconsin-Madison
Group: HPC-3
Mentor: Samuel Gutierrez
Category: Computing
Type: Technical Talk

Automating MPI Task Placement for Torus Interconnects

Massively parallel applications commonly leverage an implementation of the Message-Passing Interface (MPI) to solve computing problems in a parallel manner. MPI designates a single task, or "rank", as a representation of a single thread of execution and provides an interface for these ranks to send messages to one another. In most parallel computing environments, the manner in which MPI ranks of a given application are mapped to the machine's underlying topology of processors is not considered. A popular technique for MPI application developers to speed up their codes is to manually provide a mapping for a specific system. A framework was developed to make this an automated process that is not application-specific or machine-specific. Presented are heuristics previously developed to efficiently map MPI ranks to machines with processors organized as a 3D grid or torus. These techniques were tested on LANL's newest supercomputer, the Cray XE6, with benchmarks and widely used scientific applications emphasizing non-contiguous allocations of nodes.

Name: Alexander Kendrick
Program: UGS
School: Harvey Mudd College
Group: ISR-2
Mentor: Tim Hamlin
Category: Earth and Space Science
Type: Technical Talk

Los Alamos Sferic Array Observations of Lightning during the Joplin EF-5 Tornado

(U) On May 22nd 2011 an extremely powerful EF-5 tornado tragically impacted Joplin, Missouri. With winds above 225 mph (362 km/h), the tornado was part of a massive storm cell that moved through southwestern Missouri and led to major losses including human lives. Much of the lightning generated during the storm was detected by the Los Alamos Sferic Array (LASA, http://www.lasa.lanl.gov/). LASA is a ground-based network used to detect, locate, and characterize atmospheric radio frequency transients, mostly as a result of lightning. LASA was developed over the past 15 years as an array of distributed low-frequency sensors to provide ground-truth for the Lab's satellite missions. Operating as an array, LASA can map storm systems throughout much of the continental United States. Our goal for this study was to exploit LASA data during the 2011 Joplin storm and seek insights into the role lightning plays as an indicator of storm intensification and severity. Standard automated LASA data processing uses an algorithm-based program to geolocate individual events detected by multiple sensors. Part of this study applies a manual, expert-guided, computer-assisted method to independently geolocate the lightning sources. Cross comparison between the results from these two methods quantifies the accuracy of the automated location solutions. Building on the geolocation error estimates, we track the evolution of lightning over time and space. These are then compared to other storm activity indicators derived from satellite imagery and ground-based Doppler radar. This study allows us to explore how the remote sensing of lightning could potentially aid in the monitoring and severity projections of storm activity.

Name: Nicholas Brennan
Program: UGS
School: Texas A&M University
Group: AOT-RFE
Mentor: John Lyles
Category: Engineering
Type: Technical Talk

Analyzing the Performance of a 3 Megawatt VHF Amplifier

One of the key components of the LANSCE Risk Mitigation project, which will restore the accelerator's operation back to historic performance levels, is the development of a replacement 201 MHz amplifier system for the drift tube linac. A prototype 3 megawatt Diacrode amplifier system is currently undergoing testing at LANSCE. Although 2D electromagnetic simulations of the amplifier cavity design were carried out before fabrication, the primary approach to analyzing the performance of the design thus far has been empirical observation of the operating behavior of the prototype. In order to better inform further design modifications for the production amplifier design, the entire cavity was modeled using the 3D electromagnetic simulation software CST Microwave Studio (MWS). By visualizing and analyzing the field structure in the cavity in 3D, insight was gained into the performance of various design features and the effect of specific design modifications. By comparing the simulated behavior of the amplifier to the prototype's behavior, the production design can be finalized with much greater confidence in the future performance of the amplifier.

Name: Matthew Brown
Program: GRA
School: New Mexico Tech
Group: AOT-IC
Mentor: Peter Olivas
Category: Engineering
Type: Technical Talk

Advanced Control System for Remote Handling Equipment

The Los Alamos Neutron Science Center (LANSCE) handles irradiated material with remote handling equipment (RHE). The RHE is composed of two slave arms which handle the material, and two master arms which an operator uses to remotely control the slave arms. A new control system has been designed to replace the master arms through the use of a Novint Falcon, a haptic (sense of touch) Controller and National Instrument's CompactRIO Real-Time (cRIO) Controller. The Denavit-Hartenberg Parameters were used to mathematically describe the arms and Inverse Velocity Kinematics were implemented to create an intuitive control scheme via 3D movement of the Novint Falcon. The results of the kinematics algorithm have been visualized with a 3D model created in SolidWorks. Furthermore, the control scheme implements force feedback, allowing the user to 'feel' objects in the workspace and also alert the user to the boundaries of the workspace. All of the programming is done in National Instruments Graphical Programming Suite; LabVIEW. The project offers a unique challenge for the cRIO controller, namely that no person has before tried to integrate a USB controller with the cRIO using LabVIEW, making this project a first of its kind. It is expected that the new scheme will be installed and tested on the RHE sometime in mid-August.

Name: Luis de la Torre
Program: GRA
School: Northwestern University
Group: D-4
Mentor: Russell Bent
Category: Engineering
Type: Technical Talk

Capacitated Vehicle Routing with Pickups, Deliveries, and Service Choice

We present modeling formulations and solution heuristics for the Capacitated Vehicle Routing Problem with Pickups, Deliveries, and Service Choice (CVRPPD-SD), a new variant of the vehicle routing problem. In this problem, a fleet of vehicles must deliver homogeneous goods from pickup to delivery locations. Unlike the standard pickup and delivery problem, pickup and delivery locations are not paired a priori. Delivery locations are chosen from a candidate pool with a fairness objective, and routing minimizes the latest time of delivery. The problem is motivated by the operations of relief organizations after a disaster who provide local transportation of supplies to beneficiaries, where limited capacity prevents serving all beneficiaries and distributing equitably is important. In addition to disaster relief, the problem has applications in food rescue programs, where food is distributed from donors to food pantries. CVRPPD has seen limited work in the vehicle routing literature, and the fairness objectives and service choice have not been studied in this problem. Without these two variants, recent applications of CVRPPD to food rescue has shown mixed integer programming and constraint programming approaches fail to solve instances with as few as 30 locations and two vehicles, necessitating heuristics.

Name: Samantha Dominguez
Program: GRA
School: University at Texas at El Paso
Group: ADE
Mentor: Heidi Hahn
Category: Engineering
Type: Technical Talk

Optimizing Systems Engineering (SE) for Research and Development (R&D)

Los Alamos National Laboratory's Engineering Directorate recently developed and provisionally issued a systems engineering methodology (SEM), which is to be applied as the institutional Conduct of the Engineering (COE) program. The SEM must be adapted to both large and small projects, as well as to projects that range from technology development in support of basic research to full-scale system deployment. The goal of the project is for R&D groups to understand SEM and to relate and use it in their field. My objective will be to provide an overview of the engineering process steps contained in the SEM, describe how there was an engagement of line managers, staff and other employees in R&D during the development process, and discuss some of the challenges we experienced in gaining acceptance for this methodology. My aim is to optimize SE for R&D by developing implementation guides for process steps as well as communicating the benefits of SE. The benefits include adequate consistent documentation, increased peer review that adds credibility to the products produced, mitigated project risks related to stakeholder management, and reduced cost/schedule overruns.

Name: Marisa Griego
Program: HS COOP
School: McCurdy High School
Group: MET-2
Mentor: Deborah Lucero
Category: Engineering
Type: Technical Talk

Design Engineering Concepts

At Los Alamos National Laboratory (LANL), MET-2 (Manufacturing and Engineering Technology, Group 2) is a group that supports weapons manufacturing missions by tooling and design engineering. MET-2 provides support through science and technology to solve mission requirements. The main objective during my summer was to learn how to read and make a blueprint drawing. The CAD design program Pro-Engineer was used to make these drawings from a 3D model. Under design engineering, there are many processes and procedures. In these procedures there are certain steps of documentation need to make sure all requirements are met. Each customer has specific technical requirements. All technical aspects of a drawing must meet both customer needs and Department of Energy specifications and standards. Throughout the summer that I have spent here at LANL, I have acquired hands on experience that will assist me during my first year of college.

Name: Alexander Kinyua
Program: UGS
School: Morgan State University
Group: ES-DE
Mentor: Shirley Holaday
Category: Engineering
Type: Technical Talk

Process and Automation Domain System Analysis: The True Cost of Comfort Control

Comfort control problems in offices and buildings can lead to lower productivity and higher maintenance costs. Establishing base line controls in combination with automated systems such as Automated Logic's WebCTRL® and ALERTON®, and systems that offer an intuitive user interface can extends building life cycles to at least 50 years. This study shows that pre-configured and custom reports on energy usage allow us to adjust heating, ventilation, and air conditioning (HVAC) and other allocated equipment to alleviate comfort control challenges and opportunities. A highly leveraged situation, comfort control, can be manipulated to improve initial, operation and management (O&M), and personnel costs. For a 30-year period, initial building costs are about 2%, O&M costs are about 6%, and personnel costs are 92% of the total lifetime cost.

I worked with pre-configured Los Alamos National Laboratory (LANL) servers with conceptual techniques such as brainstorming and synectics, to enhance methods of Axiomatic Design (AD) and Trans-disciplinary System Development Life-cycle (TSDL) models, to establish my results, which, so far, indicate a correlation between comfort control and system efficiency. Laboratory workers spend nearly eight or more hours per day in their environment, many adjusting the temperature to a comfortable level. Keeping offices at a comfortable temperature is essential to creating an environment that encourages efficiency.

Name: Christopher Lamb
Program: UGS
School: Virginia Tech
Group: XTD-1
Mentor: Mark Carrara
Category: Engineering
Type: Technical Talk

Modeling Long Rod Penetration with Oblique and Yaw Angles

In this study, the Los Alamos National Laboratory (LANL) hydrocode PAGOSA was used to simulate the interaction of a depleted uranium long rod penetrator with velocity varying between 1.2 and 1.6 km/s with rolled homogeneous armor (RHA) plates at a 60-degree oblique angle and horizontal yaw ranging from -12 to 12 degrees. Simulations were conducted in a parameter study sense wherein penetrator and target strength models and equations of state (EOS) were varied. A mesh resolution study was also conducted to ensure that simulated results were grid independent. Results of simulations were compared to experimental data from Fugelso and Taylor (1978) for the same problem. It was found that the Johnson-Cook strength model and Mie-Gruneisen equation of state produced the best results. However, it was also found that regardless of the strength model/EOS combination, when simulations were conducted with sufficiently fine mesh resolution, the variation in simulated results fell within the error from the experimental result from Fugelso and Taylor.

Name: Peter Mancini
Program: UGS
School: University of Florida
Group: XTD-1
Mentor: Mark Carrara
Category: Engineering
Type: Technical Talk

Modeling Tungsten Long Rod Penetration of Semi-Infinite Steel Target

In this work, the Los Alamos National Laboratory (LANL) hydrocode PAGOSA was used for an armor/anti-armor study. A series of simulations were conducted for the configuration of a Tungsten long rod penetrator impacting a rolled homogeneous armor (RHA) target. Simulated results were compared to the experiments of Silsby (1984). Several strength models and equations of state (EOS) for both the penetrator and target were considered in a parameter study. It was found that the combination of a Mie-Gruneisen and polynomial EOS along with modified Steinberg-Guinan (SG) and elastic-plastic flow stress models produced the best results as compared to experiment. It was also found that for lower velocities, results were far more dependent on strength model than on EOS; however, the effect saturates as penetrator velocity increases. In the limit of high velocity impact, the results for SG, Johnson-Cook, and elastic-plastic strengths converged to the experimental result.

Name: Dylan Markham
Program: UGS
School: Santa Fe Community College
Group: MET-2
Mentor: Deborah Lucero
Category: Engineering
Type: Technical Talk

Ingenuity of Design

As a student working for MET-2 (Manufacturing Engineering and Technology, Group 2) here at Los Alamos National Laboratory (LANL) I have had the opportunity to obtain knowledge in the field of tooling and design engineering. This group supports all weapons manufacturing missions by producing products that use sound engineering practices and that meet the customer's quality and technical requirements. MET-2 designs the desired tooling, fixture or gage based on the quality standards by the Department of Energy. MET-2 members use a CAD/CAM program tool called Pro-Engineer to create designs for use in production and manufacturing. Over the summer I gained valuable knowledge of how to interpret technical drawings which is necessary to create them. I also learned the processes and procedures used to create and release drawings intended for items to be fabricated. In the short time that I have spent here at LANL I have acquired priceless knowledge of concepts through hands-on learning that could not be learned in a classroom.

Name: Marcel Nunez
Program: UGS
School: Massachusetts Institute of Technology
Group: D-6
Mentor: David Zerkle
Category: Engineering
Type: Technical Talk

The Rheology of Molten Composition B

Composition B is a widely used high explosive consisting of TNT densely packed with RDX crystals (63% mass loading). Although the detonation of composition B has been widely studied, its transport behavior under thermal insult is not well characterized. Discrepancies between simulations and experiments involving composition B under thermal insult have suggested that composition B in the molten state cannot be adequately described by the conventional Newtonian fluid model. The high loading of RDX crystals, which remain solid after TNT has melted at 80ºC, supports the hypothesis of non-newtonian behavior. Other complications to consider are the settling and dissolution of RDX particles over time. This project characterizes molten composition B as a non-newtonian fluid to determine which model best describes the shear rate dependent viscosity of composition B. To determine a model, data was obtained in a falling ball viscometer designed and built for this work. Balls of various densities were dropped through a graduated syringe filled with molten composition B. The experiment was repeated at various temperatures. The terminal velocities of the balls in the fluid were determined through analysis of high-speed video recordings. The experimental terminal velocities were used to fit a viscosity model for Composition B by simulating the experiment using Comsol Multiphysics.

Name: Hope Quintana
Program: UGS
School: New Mexico State University
Group: MET-2
Mentor: Deborah Lucero
Category: Engineering
Type: Technical Talk

Completely FAB

At Los Alamos National Laboratory (LANL) all weapons manufacturing missions are supported by Manufacturing Engineering and Technology, Group 2 (MET-2). The goal of MET-2 is to develop and provide process science and technology solutions to support mission requirements. MET-2 is one of the prime engineering groups that provide design, process and tooling engineering. Through the efforts of MET-2, the weapons manufacturing processes are ensured to yield products that meet all customer quality requirements. Using sound engineering practices and technical analysis of design definition, the products are made to specifications and standards defined by the Department of Energy and LANL. This summer I served as a Student Manufacturing Engineer, where I gained knowledge in the manufacturing and tooling arena. My activities focused on Fabrication Coordination to support MET-2's engineering and to meet FY11 tooling deliverables. Those activities included coordinating tooling fabrication efforts, verifying technical data and information as well as meeting with engineers to obtain technical requirements, schedules and status on tooling items during in-work processing. To succeed in these activities I needed to be proficient with computer programs, CAD (Pro-Engineer) for designs and Microsoft Project to schedule, manage and track deadlines. Mechanical drawing interpretations and geometric dimensioning and toleranceing concepts were critical in performing certain tasks. I also became familiar with the Corrective Action Management System (CAMS) and the Engineering Authorization System (EAS) allowing me to make technical decisions and dispositions in support of tooling activities. This summer's activities allowed me to apply my previous experiences as well as exercise my technical thinking.

Name: Nathan Rimkus
Program: GRA
School: The University of Alabama
Group: MET-2
Mentor: Stephen Stout
Category: Engineering
Type: Technical Talk

Slump Casting Furnace Design

The goal of the Foundry Upgrades Project is to not only correct problems known to exist in the current casting furnace designs but to implement new designs that will advance the scientific understanding and manufacturing capabilities of the foundry. Nuclear material reclamation and recycle from failed Pu castings is an important aspect of Pu production, and will be the focus of this talk. One major issue with the current method of melting and re-casting of Pu, is the long cooling time in the system leading to inefficient production and long down times in the facility. The furnace system used for these castings was not designed for this type of melting and casting. Issues with cooling of the chamber, coil design, cooling of the mold, thermocouple hookups, ergonomic problems in a glove box, and potential increased radiation exposure to workers are design considerations that must be addressed. The goal of this project is to upgrade the current casting system in such a way that eliminates or minimizes these processing difficulties. This design includes seven system components that work together for a fully functional production system; Ergonomics, Lid Design, Chamber Design, Coil Protection / Performance, Chill Plate, Mold Assembly, and Radiation Exposure. Each of these design parameters will be presented with an emphasis on production capabilities as well as cost and time efficiency.

Name: Joshua Roybal
Program: UGS
School: New Mexico State University
Group: IAT-2
Mentor: Alan Graham
Category: Engineering
Type: Technical Talk

Shear Induced Particle Migration Shown From MD Calculations

We report the results of non-equilibrium molecular dynamics simulations of pressure-driven flows of liquid argon in planar conduits. In the simulations, the conduits were ~60 atomic diameters across with ~25,000 atoms. Pressure driven flows were generated by applying a body force to each of the atoms ranging from 0.01 to 0.1 pN. When the flow rates are small, the liquid is on average incompressible and a parabolic velocity profile as predicted by incompressible creeping flow equations is observed. However, as the flow rates increase in isothermal pressure-driven flows, the molecules migrate to the low-shear-rate region in the center, and establish large density gradients across the channel under conditions that were assumed to be incompressible. The magnitude of the density gradients in the inhomogeneous shear flows increase monotonically with flow rate under conditions such that there is no significant slip at the walls. The migration of atoms to the channel center results in a higher viscosity in that region, and a blunted velocity profile that deviates from the solutions to the compressible Navier-Stokes equations that predict a parabolic velocity profile and a density that is only a function of the axial position. These isothermal flow results are distinctly different than simulations in which the walls were isothermal and viscous heating competes with the molecular migration. First, the two mechanisms balance each other and the density is constant across the channel width despite the higher temperature in that region. As the shear rate increases, the increasing temperature in the center of the channel eventually results in a density decrease in the center of the channel. We do not see these effects in cimple shear calculations where there the gradient of the shear rate is 0. Hence this phenomenon is associated with the nonlinear shear in the pressure driven flows and not the magnitude of the shear rate.

Name: Danielle Savage
Program: GRA
School: University of New Mexico
Group: W-11
Mentor: Brian Olsen
Category: Engineering
Type: Technical Talk

How to Create a Slurry Injector

This paper discusses a mechanical design process for a chemical injector (slurry injector). This injector combines a monomer and a catalyst, which are then delivered to a container in a prescribed time frame. The requirements for the injector are that it is compact, safe, adaptable to changes in chemistry, cost effective, and easy to operate. An optimal design was achieved by using mathematical models and physical prototypes. The current product is a result of the requirements and the aforementioned process.

Name: Andrew Schmalzer
Program: GRA
School: University of Wisconsin - Madison
Group: IAT-2
Mentor: Alan Graham
Category: Engineering
Type: Technical Talk

A Novel Method for Modeling Wear of a Soft Material on a Hard Substrate

We present a novel method for predicting the 2-D wear profile of a soft linearly elastic material sliding on a significantly harder linearly elastic substrate. This simulation was completed using the Matlab with COMSOL interface, which to our best knowledge has yet to be used in any previous publication. Our simulation consists of the following steps: Initial geometry creation, stress calculation, wear calculation, and lastly a calculation that applies the wear calculation to build the new geometry for the subsequent steps. The physics behind our system consists of a prescribed displacement, a boundary load, contact mechanics with friction and the appropriate elastic material models. To calculate the wear, we use the Archard-Holm wear model that calculates the volume of material worn based on its hardness, sliding distance, normal force, and a non-dimensional wear coefficient. The normal force varies with position across the contact and is a data set that can be called from COMSOL. Previous experimental results provide us with a non-dimensional wear coefficient that we can benchmark our results against. Our simulation accurately describes the amount of material lost in a timely and efficient manner.

Name: Daniel Seegmiller
Program: GRA
School: Brigham Young University
Group: W-6
Mentor: Thomas Mason
Category: Engineering
Type: Technical Talk

Hydrodynamic Investigation of Detonation Transfer in Onion Skin Experiments

In order to study the transfer of detonation between detonator, booster and main charge a simplified test geometry, called an 'onion skin', has been developed. The detonator and booster are assembled together with a spherical cap of main charge explosive, giving three layers to the 'onion'. Typically, the time-resolved break-out or emergence of the detonation front from the surface of the spherical surface of the charge has been studied to reveal the performance of the assembly. Any asymmetry or other variations from ideal performance are carefully monitored. In support of the work, a model of the 'onion skin' configuration and its mounting fixture has been created in the hydrodynamic code CTH. Simulations have been run to model both the shock wave propagation and extent of reaction during the development of the detonation in both 2D and 3D. Further simulations have been conducted to analyze the effect of misalignment of the detonator and booster on assembly performance. This will help ascertain to what degree discrepancies in the experimental results are due to misalignment of the 'onion skin' or are simply peculiar to the high explosive combination used in the experiment.

Name: Stefan Solntsev
Program: GRA
School: Northwestern University
Group: D-4
Mentor: Russell Bent
Category: Engineering
Type: Technical Talk

Electric Vehicle Charging Stations: When and Where?

Renewable energy sources and plug-In hybrid electric vehicles (PHEVs) are environmentally friendly technologies that are currently being advocated for the nation's power grid. It has been shown that some of the roadblocks for adoption of these technologies can be overcome by providing control and interaction to renewables and PHEVs. A comprehensive model for optimally locating PHEV battery exchange stations has been proposed in recent research, but some critical research questions still remain open. This research focuses on modeling and solving a multi-stage planning problem for locating the charging stations and deciding when to open them. Indeed, the number of exchange stations needs to grow over time to accommodate the growing demand. In addition, new exchange stations are viewed as further encouragement for driving a PHEV, thus driving the demand even higher. Two different modeling approaches for this multi-stage problem are presented, and computational comparison results are given.

Name: Yunjian Xu
Program: GRA
School: MIT
Group: D-6
Mentor: Feng Pan
Category: Engineering
Type: Technical Talk

Plug-in Electric Vehicles (PHEVs) Scheduling

In the future, large penetration of PHEVs will put considerable additional loads onto existing power grids. We study the scheduling problem for PHEVs to maximize social welfare. If the decision is made by a centralized operator, the centralized PHEV scheduling problem can be formulated as a dynamic programming problem. The difficulty of solving the formulated dynamic programming problem is that the state space grows exponentially with the number of vehicles. The issue on computation complexity can be addressed through an approximate dynamic programming approach. We use limited look ahead policies where the heuristics can be obtained through greedy algorithms, or by solving a simplified dynamic programming problem with an aggregated state space. For the case where each vehicle makes its decision to maximize its own benefit, we construct a dynamic game theoretical model to study the decentralized PHEV scheduling problem.

Name: Christella Chavez
Program: GRA
School: University of Oklahoma
Group: D-4
Mentor: Sara Del Valle
Category: Information Technology
Type: Technical Talk

Mathematical Modeling of Telecommunications Disaster Recovery

The nation's communications networks are an integral component of American businesses and our personal lives. The federal government considers the nation's telecommunications and information sector a critical infrastructure because of its impact on all aspects of our lives, including national defense, banking, emergency services, and energy. Therefore, understanding telecommunications dynamics and optimizing recovery activities is critical for minimizing the potential economic and population impacts of disruptions.

In this work, we formulate and analyze a mathematical and computational model of the telecommunications sector. The model incorporates the network topology and traffic of traditional wireline, wireless, and Voice Over Internet Protocol (VoIP) through the data network. We use computer simulations to analyze the effects of recovery operations on restoration times when one or more of these networks is damaged or congested due to a disaster such as hurricanes, terrorist activities, or tornadoes. We demonstrate optimal recovery activities to minimize economic and population disruptions. The results show that we can use a high-level model to simulate and predict the recovery of telecommunications infrastructure and to assess the telecommunications restoration and recovery time after a disaster.

Name: Breaunnah Bloomer
Program: UGS
School: Howard University
Group: LANSCE-LC
Mentor: Claire White
Category: Materials Science
Type: Technical Talk

Determining the Role of Calcium in Geopolymerization Synthesis: PDF Analysis

In this time of heightened environmental consciousness, there is increasing need for innovative technology based on green chemistry. Ordinary Portland cement (OPC) is responsible for approximately 5-8% of all manmade CO_2 emissions worldwide. An eco-friendly substitute, geopolymer cement, has been developed over recent decades that produces and produces 80-90% less CO_2 per ton of cement. Geopolymers are amorphous aluminosilicate materials that are synthesized by reaction of alkaline solutions with metakaolin (calcined kaolinite) or other aluminosilicate-based materials (slag/fly ash). Techniques that have been used to investigate the nanostructural characteristics of this important alternative cement include vibratrional spectroscopy, neutron and X-ray total scattering, and advanced atomistic simulations. Here the role of calcium in the geopolymerization reaction is elucidated using X-ray pair distribution function analysis (on beamline 11-ID-B at the Advance Photon Source, Argonne National Laboratory). In order to study the effect of calcium on the geopolymerization reaction, the amount of metakaolin (aluminosilicate) and slag (calcium/magnesium aluminosilicate) has been varied and the local structural characteristics have been measured. To determine certain changes in the local structure of the samples, particular bonding environments the different compositions have been followed throughout the initial 12 hours of reaction. Analysis of data has given insight into the structure of these amorphous geopolymer gels and calcium contributes to the nanostructural characteristics of this important class of alternative cement.

Name: Dylan Conradson
Program: UGS
School: University of New Mexico
Group: MPA-CINT
Mentor: Andrew Shreve
Category: Materials Science
Type: Technical Talk

Hydrogen Storage Properties of MgNi Nanoparticles

The hydrogen storage potential of Mg has long been of interest to researchers and attempts have been made to further increase the storage potential both by decreasing the particle size, and by doping with catalysts like Ni and Fe. Samples of Mg doped with 5% by wt. Ni were prepared by Colorado State University, using solution preparation the grain size was reduced to between 20 and 50 nm. These samples were loaded with D2; one set was loaded once during sample preparation, while the other set was then cycled through multiple hydrogenation/ dehydrogenation cycles. Neutron scattering data was taken at the NPDF diffractometer at Lujan Neutron Scattering Center. Complimentary XAFS data was taken to provide additional information on the local structure in addition to the average structure data gathered at LANSCE. Analysis of neutron data revealed the primary phase of the deuterated Mg samples to be MgD2. The observed data showed a shortened bond length for the Mg-D bonds, which was not observed in the fit and is thought to indicate disorder among the D atoms in the lattice. The cycled Mg samples were fit with a single phase of hexagonal Mg metal. The fit was reasonable but additional peaks that rose to the level of Bragg diffraction peaks were observed. No phase of Mg2Ni or Ni that satisfactorily fit these peaks was found. XAFS scattering showed significant disorder surrounding the Ni sites supporting the interpretation that if a second phase is present in the material it is highly disordered. Attempts to use particle size in the fitting did not produce an improvement in the general least squares analysis used and attempts to refine the particle size also had no effect, although the particle size might have an influence on the low intensity structures appearing in the baseline.

Name: Paula Mosbrucker
Program: GRA
School: Queen's University
Group: MST-8
Mentor: Donald Brown
Category: Materials Science
Type: Technical Talk

Dislocation Density and Texture Analysis of HT9 Steel Irradiated in the FFTF

HT9 steel is a ferritic/martensitic alloy being considered for use in fuel cladding in high temperature, high burnup reactors. The microstructural evolution, texture, and dislocation density of an HT9 duct were examined following the six-year irradiation of a fuel assembly in the Fast Flux Test Reactor Facility (FFTF). Samples were obtained from a variety of positions within the assembly, producing samples with a wide range of irradiation damage and irradiation temperature history. Synchrotron x-ray diffraction measurements were performed at beamline 1-ID at the Advanced Photon Source. Coupling these measurements with the Convolutional Multiple Whole Profile (CMWP) fitting technique of evaluating dislocation contribution to line broadening, we have shown that irradiation temperature, rather than dose, most significantly controls dislocation density, with higher temperatures correlating to lower dislocation densities. Further, neutron diffraction texture measurements show larger texture evolution at higher doses. The results of synchrotron XRD deformation experiments will also be presented.

Name: Alicia Salazar
Program: UGS
School: New Mexico State University
Group: MST-7
Mentor: Andrew Nelson
Category: Materials Science
Type: Technical Talk

Thermal Property Analysis of MgO-Nd2Zr2O7 Inert Matrix Fuel

The growing challenge in sustaining nuclear energy as a means of producing green energy is the storage of radiotoxic spent fuel. Spent fuel contains long-lived actinides that prevent the fuel from safely being stored without proper mitigation of hazards. One approach to safer storage is the use of inert matrix fuel forms. Inert Matrix Fuels (IMF) are important because they provide a means for consuming plutonium in nuclear reactor waste and reducing actinides present in waste fuel storage. The oxide MgO has a high thermal conductivity making it an ideal candidate for IMF. Considering the current reactor design, this property must be modified by adding the pyrochlore Nd2Zr2O7 that also benefits the crystalline structure, will tolerate radiation damage, and provide a place for rare earth and actinide lattice substitutions.

In order to calculate thermal conductivity, three material thermal properties must be known: thermal diffusivity, specific heat capacity, and density. These properties can be measured using laser flash analysis, differential scanning calorimetry, and dilatometry. Samples ranging in composition from 40-70% MgO content were produced using specimens SPEX milled with the appropriate mix of MgO and Nd2Zr2O7 powders. Thermal analysis of the samples was performed from room temperature to 1200°C. The research presented has implications in the design of IMF fuel forms and evaluation of fuel cycle options.

Name: Joshua Williams
Program: GRA
School: Arizona State University
Group: C-CDE
Mentor: Mark Hoffbauer
Category: Materials Science
Type: Technical Talk

InGaN Growth on <111> Si with an AlN Buffer Layer

Unique materials for increasing photovoltaic (PV) efficiencies are an active and crucial area in PV research. The pseudo-binary alloy of GaN and InN, InGaN, holds great promise with a theoretical efficiency of ~70% for multi-junction architectures. However, issues with thermodynamic stability at high concentrations of indium and with crystallinity due to lattice mismatch prevent the production of high-quality material.

Utilizing a LANL developed technique, known as ENABLE, we are working to solve both problems simultaneously. ENABLE is a MBE-like thin film growth technique utilizing energetic nitrogen atoms as the reactive N-source. High quality material has been grown on sapphire substrates, which provides reasonable lattice match, by us and many other researchers using both MBE and MOCVD. However, sapphire is a factor of 3-5 times more expensive than Si substrates. Through the use of an AlN buffer layer grown between <111> Si and InGaN we are working to make device-quality material grown on commercially available Si. Results of electron microscopy, RBS, photoluminescence, and electrical measurements of films grown on AlN buffered Si will be presented. Particular focus will be paid to how the crystalline quality of the AlN buffer layer affects the properties of InGaN films overgrown on it.

Name: Andres Cardenas
Program: GRA
School: New York University
Group: MST-6
Mentor: Bogdan Mihaila
Category: Physics
Type: Technical Talk

Stability and Dynamical Properties of Compactons

Compactons have the remarkable soliton property that after colliding with other compactons they reemerge with the same coherent shape. Unlike solitons which extend over the entire space, compactons represent a class of traveling-wave solutions with compact support resulting from the balance of both nonlinearity and nonlinear dispersion. We developed a Padé approximant method to study the numerical stability of single Rosenau-Hyman (RH) and Cooper-Shepard-Sodano (CSS) compactons and their pairwise interactions. The difference between RH and CSS compactons is that the CSS equation is derivable from a Lagrangian and the CSS equation exhibits the usual energy conservation law. We will show that the CSS compactons are stable, just like their RH counterparts. Similar to the collisions between RH compactons, the CSS compactons re-emerge with the same coherent shape when scattered. The collision site is marked by the creation of a compact ripple. The positive- and negative-amplitude parts of the ripple decay slowly into low-amplitude compactons and anticompactons, respectively. We also find a significant difference in the behavior of compacton-anticompacton scattering. For the CSS equation, the scattering can be interpreted as “annihilation” as the wake left behind dissolves over time. In the RH case, we have multiple shocks forming after the collision, which eventually lead to “blowup” of the resulting wave form.

Name: Kevin Fisher
Program: UGS
School: Massachusetts Institute of Technology
Group: ISR-6
Mentor: Kip Bishofberger
Category: Physics
Type: Technical Talk

Optimizing Divergence of the Simulated MaRIE XFEL

The planned Matter Radiations Interactions in Extremes (MaRIE) facility at Los Alamos National Laboratory will include an X-ray Free-Electron Laser (XFEL). This XFEL will have higher energy X-rays than any existing XFEL, and will be used to probe the bulk performance properties of materials. In a free electron laser, as electrons oscillate through the magnetic structure, or undulator, a phenomenon known as “microbunching” can occur, where electrons in the beam are bunched together and radiate coherently. A problem facing the development of MaRIE is that the X-rays generally exit the undulator with an extremely low divergence, so that they must travel hundreds of meters before interacting with the sample target. Furthermore, X-ray beam size cannot be easily controlled for a given undulator length, without needing to move the target sample. In addressing these issues, one idea is to use magnets to shape the electron bunches into “cups” to adjust the focusing of the generated beam. This is simulated using the GENESIS program to generate plots of beam behavior with different bunching factors and to compare the resulting beam properties with and without cupping. Simulation results confirm that cupping increases X-ray divergence, proving the utility of this scheme. The level of divergence, and additional effects such as total power, are studied and optimized.

Name: Michael Meyers
Program: UGS
School: Drake University
Group: XCP-6
Mentor: Chengkun Huang
Category: Physics
Type: Technical Talk

Oscillation Modes of a Relativistic Drifting Cold Plasma

Examining the behavior of a drifting plasma could shed light on proposed computational gains of boosted frame simulations [1] and allow insight to electron-ion acceleration processes associated with ultra intense short pulse lasers [2]. The cold fluid approximation is a simple way to model such a drifting plasma, assuming zero thermal distribution. Electrostatic and electromagnetic dispersion relations have been obtained for the case of cold unmagnetized plasma and are checked for agreement with particle in cell (PIC) simulations.

[1] J.-L. Vay, Physical Review Letters 98, 130405 (2007).
[2] L. Yin et al., Physics Of Plasmas 14, 056706 (2007).

Name: Suzannah Wood
Program: UGS
School: Cornell College
Group: XTD-2
Mentor: Katie Mussack
Category: Physics
Type: Technical Talk

Mass Loss and Electron Screening to Address Solar Abundances

The abundance of heavy elements in the sun and data on the acoustic pressure waves inside the sun provide insight into the otherwise non-observable structure. Prior to the publication by Asplund et al. (2005) on lower solar abundances of heavy elements, solar evolution models tended to agree well with helioseismic data. However, the results by Asplund et al. are well accepted, so a discrepancy exists between the previous models using Grevesse and Noels (1993) abundances and the same models using the Asplund et al. abundances. Therefore, an investigation of the input physics was conducted to account for these differences and restore agreement between models using the Asplund et al. abundances and helioseismic data. First, an investigation of the standard model with each set of solar abundances was conducted to understand the discrepancy between the two data sets. This investigation looks at the sound speed difference profile and the difference between calculated and observed helioseismic data. Next, a solar model incorporating mass loss via solar winds and the Asplund et al. abundances was examined. The sound speed agreement and the difference between calculated and observed helioseismic data were improved by including mass loss. Improvement was seen in all regions but the core of the sun, so dynamic electron screening was added to mass loss models to improve agreement in the core.