1995: A Good Year for Science and Technology at Los Alamos National Laboratory

Sig Hecker
Director

March 7, 1996

LA-UR-96-855

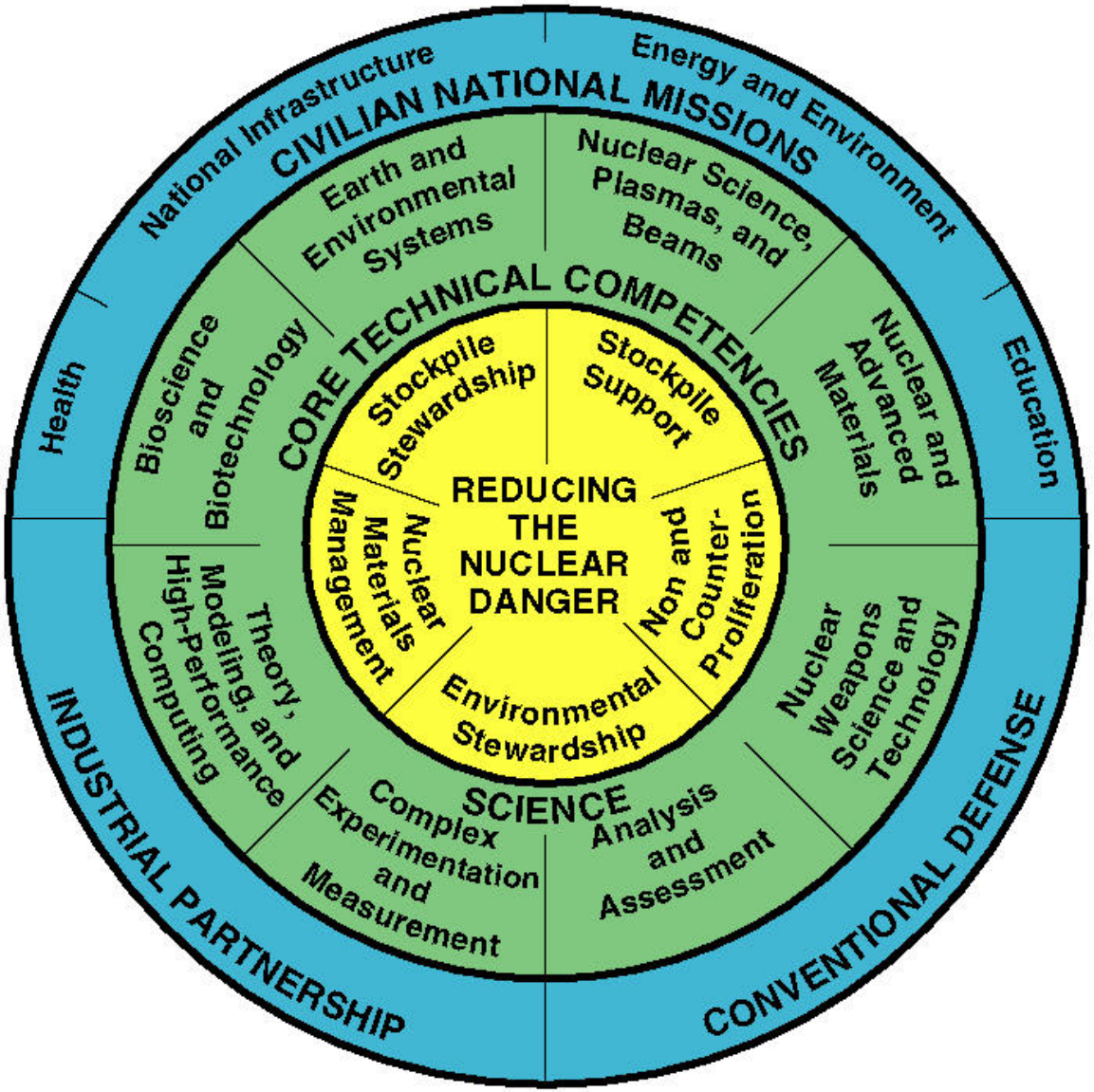
SAFETY FIRST

Science Serving Society

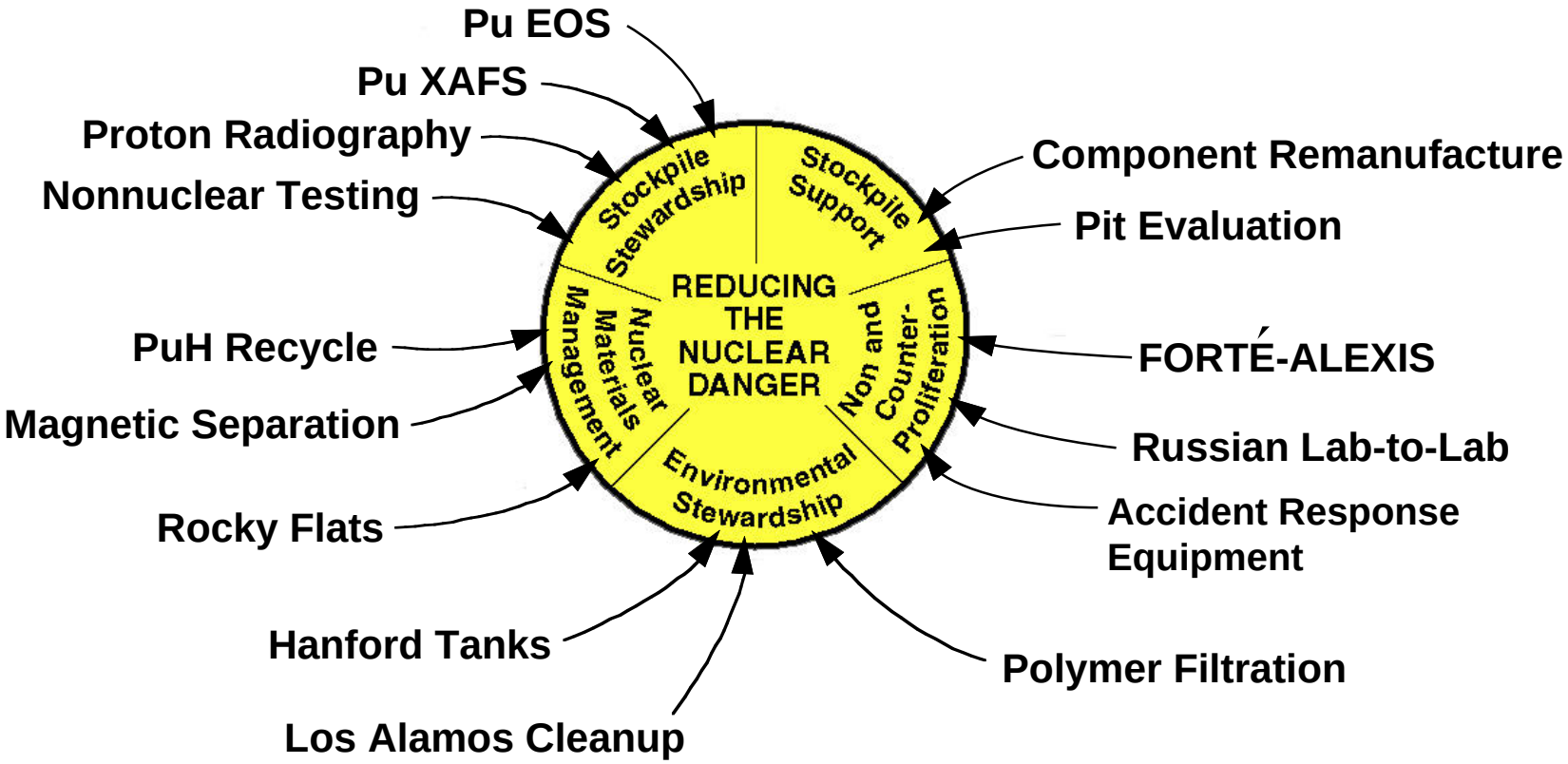
"...you saved civilization"

Richard Rhodes: June 7, 1993, *A Different Country*

Lab Mission


CIVILIAN NATIONAL MISSIONS
National Infrastructure
Energy and Environment
Health
Education
INDUSTRIAL PARTNERSHIP
CONVENTIONAL DEFENSE
CORE TECHNICAL COMPETENCIES
Earth and Environmental Systems
Nuclear Science, Plasmas, and Beams
Bioscience and Biotechnology
Nuclear and Advanced Materials
Theory, Modeling, and High-Performance Computing
Nuclear Weapons Science and Technology
SCIENCE
Complex Experimentation and Measurement
Analysis and Assessment
Stockpile Stewardship
Stockpile Support
Nuclear Materials Management
Non and Counter-Proliferation
Environmental Stewardship
REDUCING THE NUCLEAR DANGER

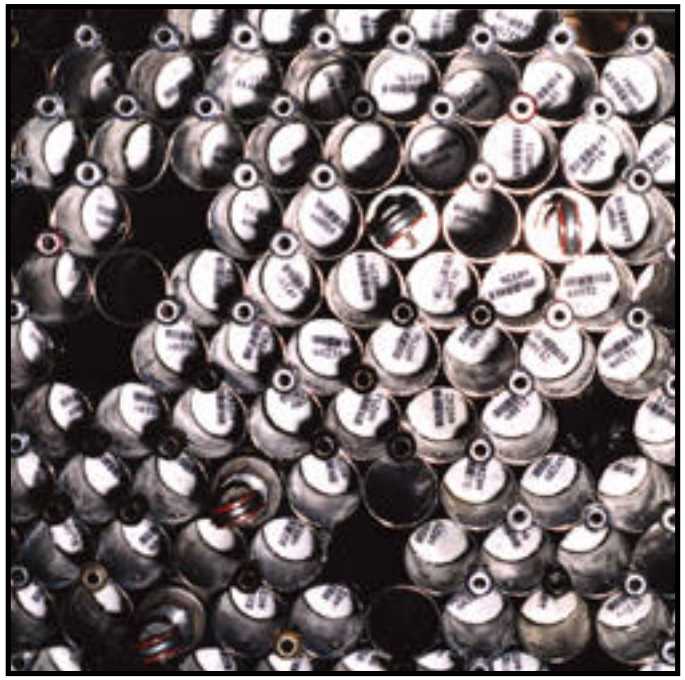
Core Mission Accomplishments



Lab-to-Lab Agreements in Russia

Lab-to-Lab Agreement in Russia

Obninsk Institute of Physics and Power Engineering



Bar-coded seals on tubes in reactor

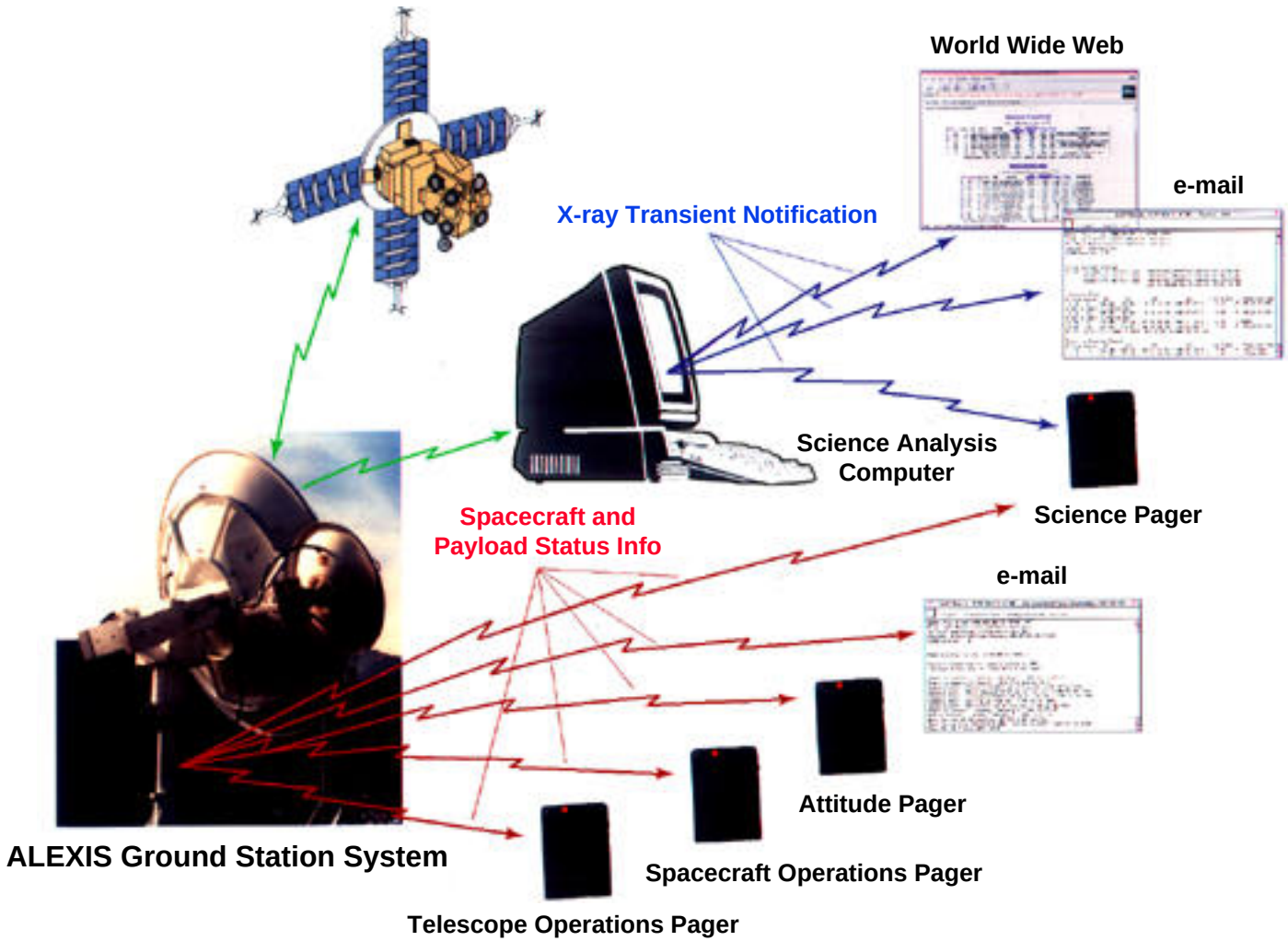
Vehicle monitor

Accident Response Equipment

Los Alamos Mobile Radiography System Loaded on Aeroflot, April 1, 1995

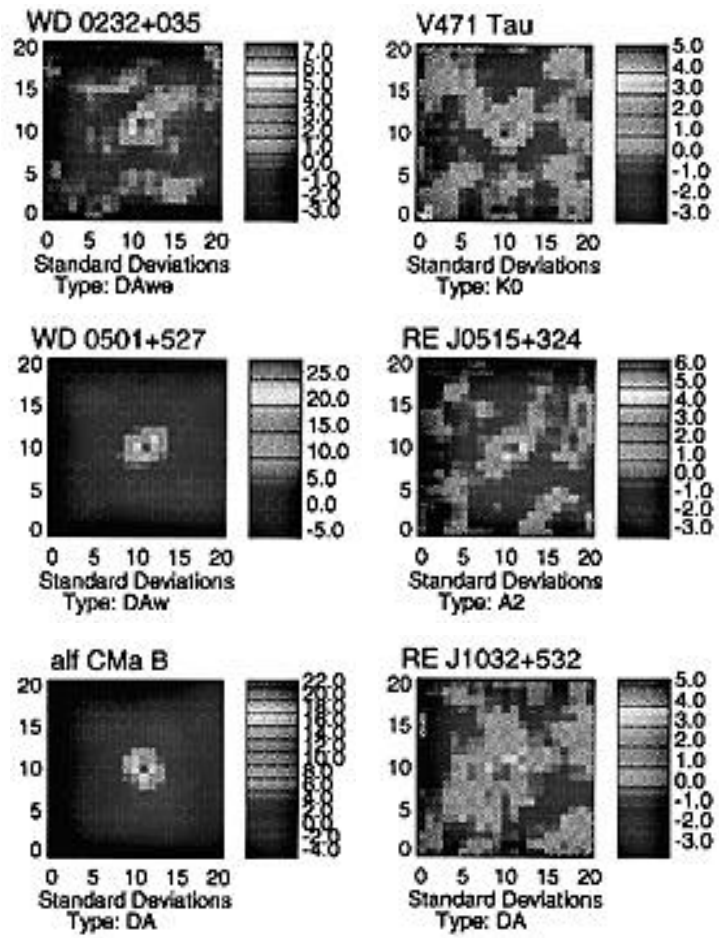
Array of Low-Energy X-ray Imaging Sensors (ALEXIS)

Automated Operations and Science Analysis at Los Alamos Ground Station



Array of Low-Energy X-ray Imaging Sensors (ALEXIS)

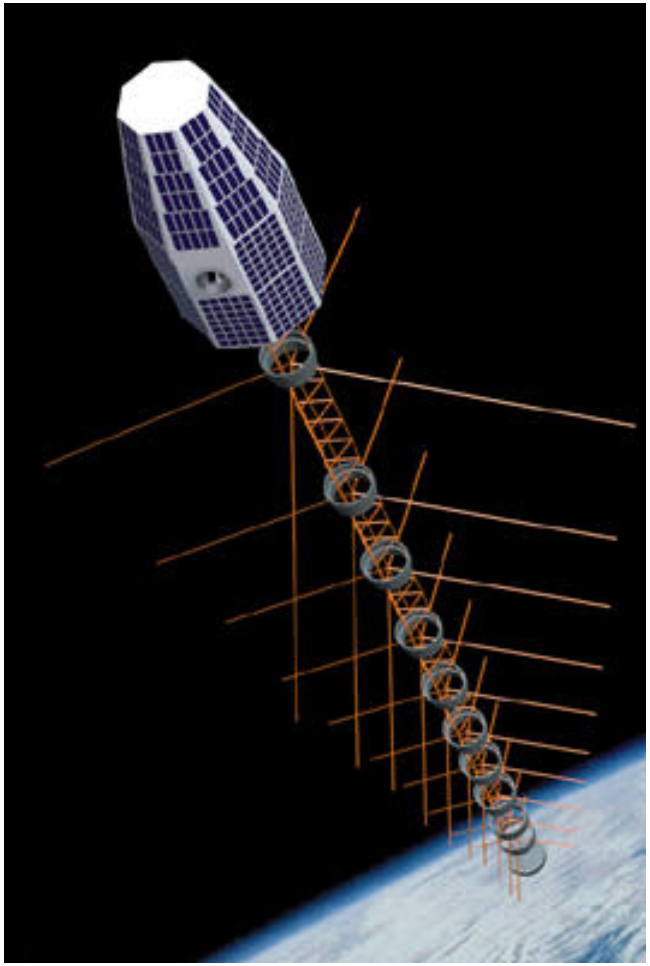
- **Los Alamos-built satellite containing X-ray telescope and BLACKBEARD rf instrument**
- **Deployment damage compensated through Los Alamos ingenuity**
- **Telescopes see one-half of sky each satellite rotation**
- **Collaboration with UC-Berkeley Space Sciences Lab**
- **Expected lifetime: 4/93 launch + 1 year —still operating with no detectable degradation**
- **See ALEXIS Web page**
  http://nis-www.lanl.gov/nis-projects/alexis/



Celestial X-ray sources detected by ALEXIS

Fast On-Orbit Recording of Transient Events (FORTÉ)

- BLACKBEARD successor—
  VHF transient recorder
  plus optical sensor
- Dual benefit: national security, atmospheric physics
- Los Alamos leads Sandia, Air Force, NASA team
- Launch expected Fall 1996
- See FORTÉ Web page
  http://sst.lanl.gov/nis-projects/forte/



Ultrasonic Pit Inspection

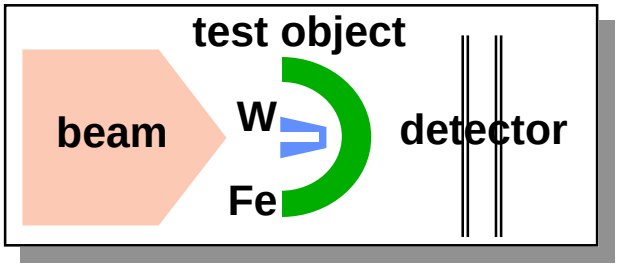
Lab's ultrasonic Integrated Inspection Station sees through Kopek. The system is now inspecting pits and other components.

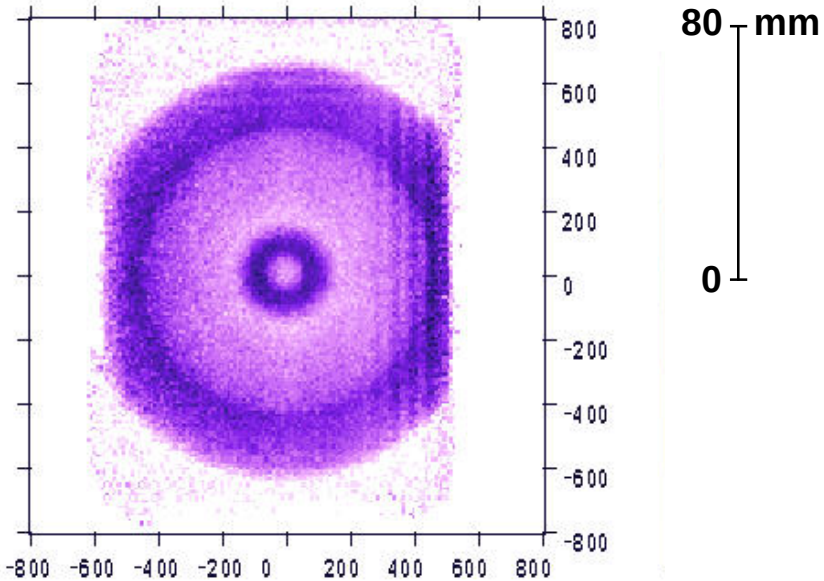
Proton and Neutron Radiography for SBSS

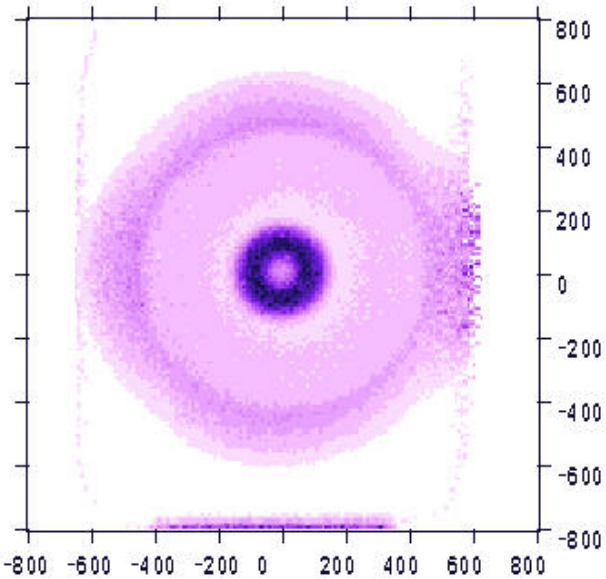
Probe	Protons	Neutrons
Application	Static–stockpile surveillance Dynamic–hydrotests	Static–stockpile surveillance Dynamic–materials studies
Interaction	Coulomb & nuclear scattering	Nuclear absorption
Advantage	Range ~ energy High intensity Z-dependence Easily detected, imaged High resolution possible	Penetrating Isotopic selectivity
Status	Proof-of-Principle ‘95 JASON review 1/96	Developed ‘94–‘95 ‘95: Pu experiments
1996	Imaging system development Demo dynamic measurement AGS 10 GeV experiment	Extensive LANSCE program Thermal $\rightarrow$ 800 MeV

Proton Radiography

Object structure and material differentiation—
1995 proof-of-principle at LANSCE
using 188-MeV protons in P^3 channel





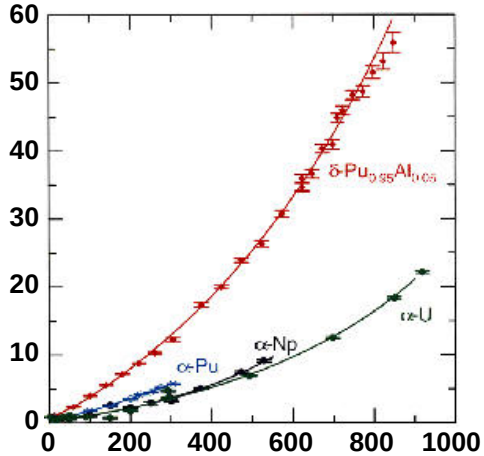


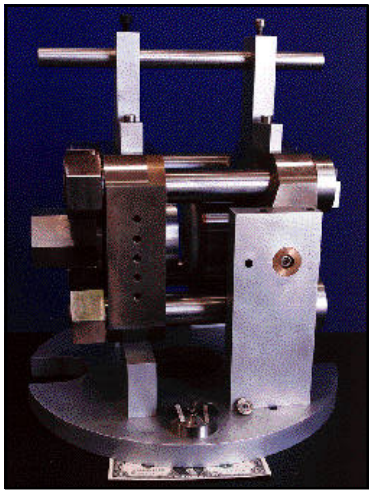
Radiograph with large-angle (nuclear) scatters sensitive to $\mathbf{A^{2/3}}$

Radiograph with small-angle (Coulomb) scatters sensitive to $\mathbf{Z^2}$

Plutonium Equation-of-State from Neutron Scattering

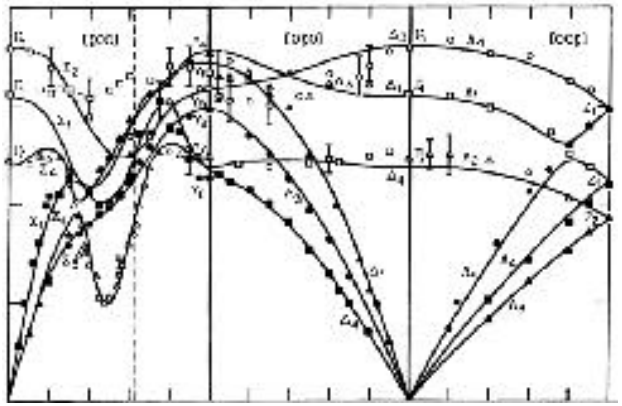
- **Debye-Waller factors for Pu alloys**
  - **Extend to high pressures, temperatures**





Pressure Cell

- **Pu phonon spectra for basic EOS modeling through inference of interatomic potentials**

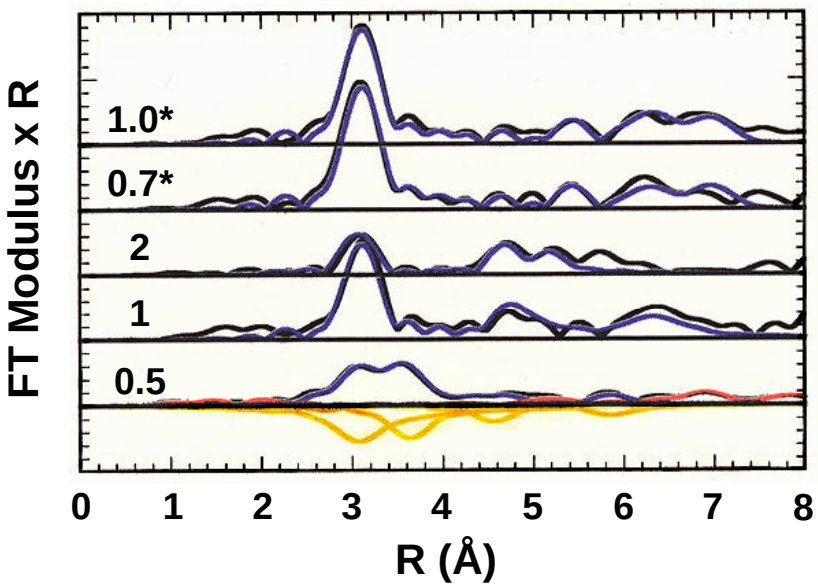


Phonon Dispersion Curve for X-Uranium

PHAROS Spectrometer

Pu XAFS

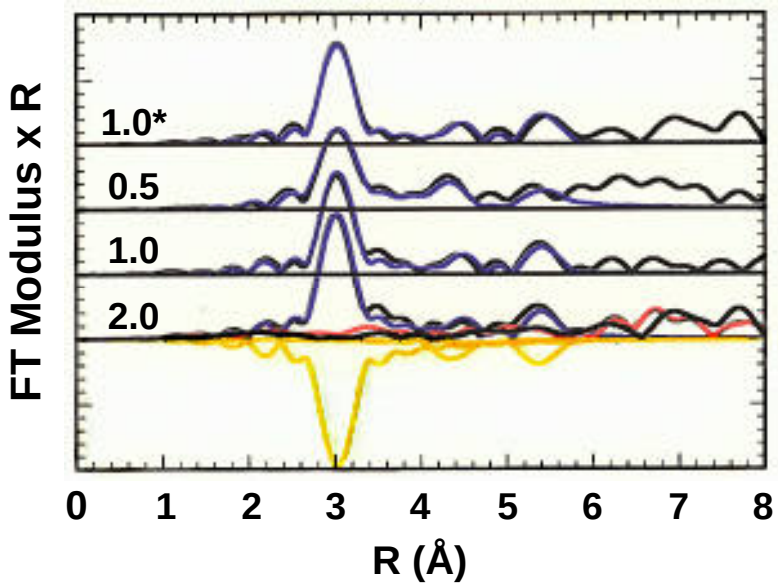
PuGa 0.5, 1, 2, 0.7,* 1.0,* wt% alloy



Average local structure around Pu atoms by % wt of Ga

***Not freshly-prepared sample**

PuGa 2.0, 1.0, 0.5, 1.0,* wt% alloy

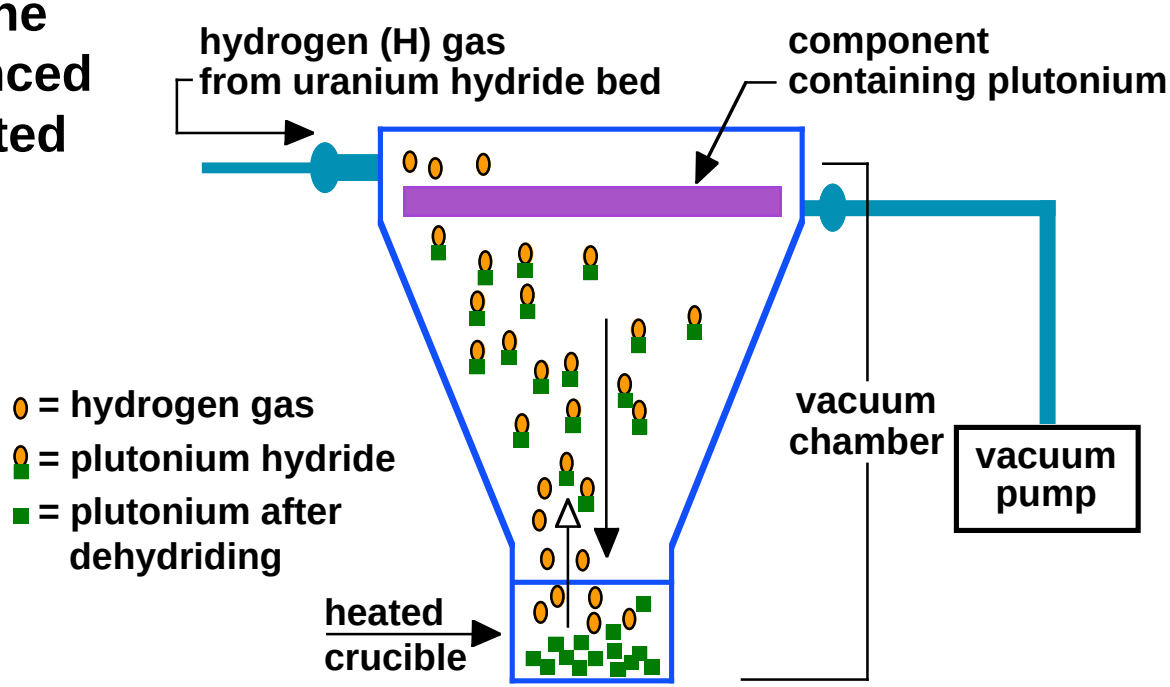


Average local structure around Ga atoms by % wt of Ga

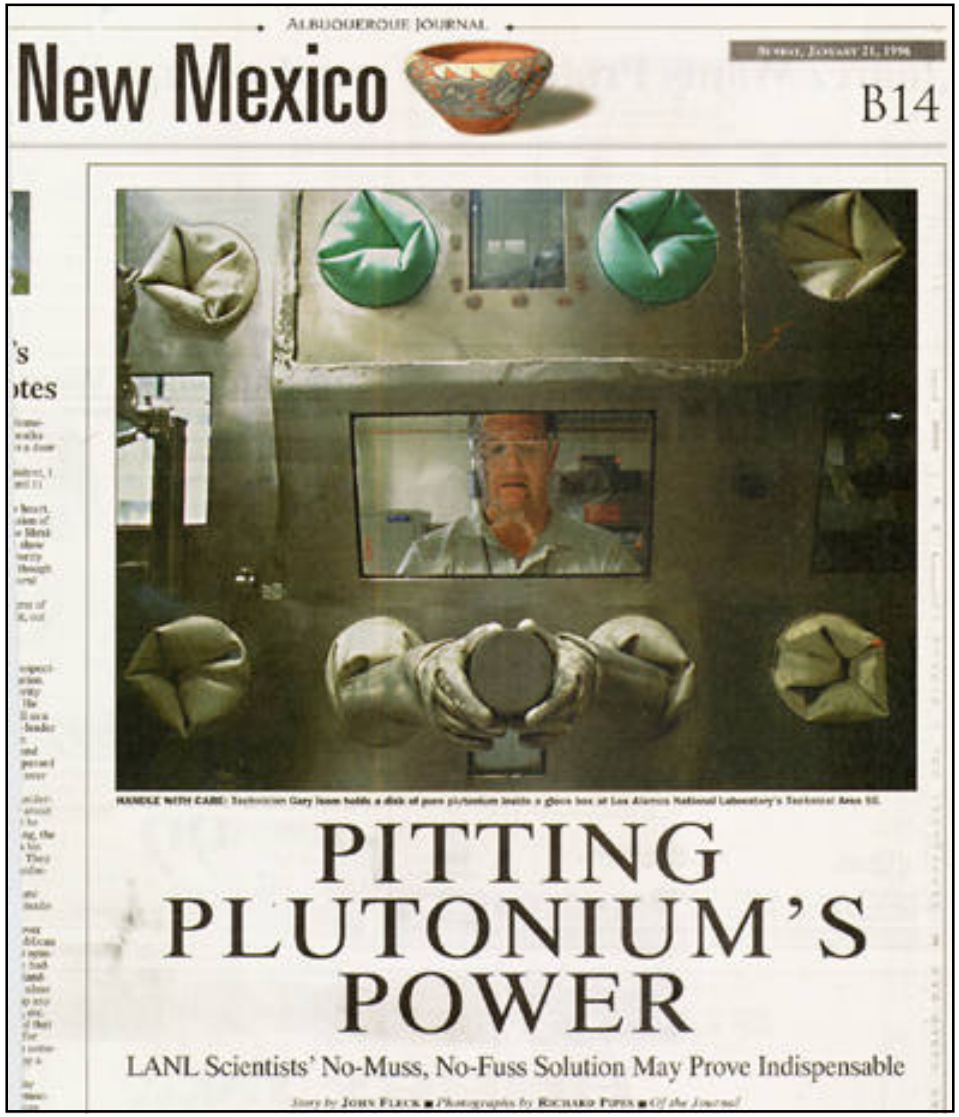
- **XAFS + XRD indicate local, aperiodic distortions in otherwise fcc lattice**
- **Structure has many characteristic scales**
- **Issue for SBSS**
- **Related to HTSC and other binary materials**

Plutonium Recycle—Hydride/Dehydride Process

- 99.9% of the Pu is recovered
- Results in unclassified storable ingot with low waste
- Core technology for the ARIES system (Advanced Recovery and Integrated Extraction System)



Plutonium Gets Rave Reviews



ALBUQUERQUE JOURNAL

New Mexico

B14

HANDLE WITH CARE: Technician Gary Isom holds a disk of pure plutonium inside a glove box at Los Alamos National Laboratory's Technical Area 55.

PITTING PLUTONIUM'S POWER

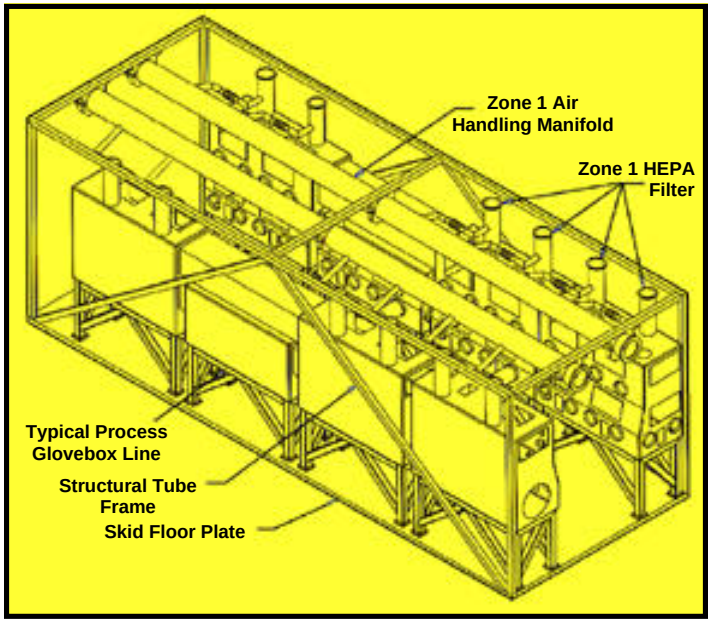
LANL Scientists' No-Muss, No-Fuss Solution May Prove Indispensable

Story by JOHN FLECK ■ Photographs by RICHARD PIPES ■ Of the Journal

Modular Concepts for Pu Operations—Rocky Flats

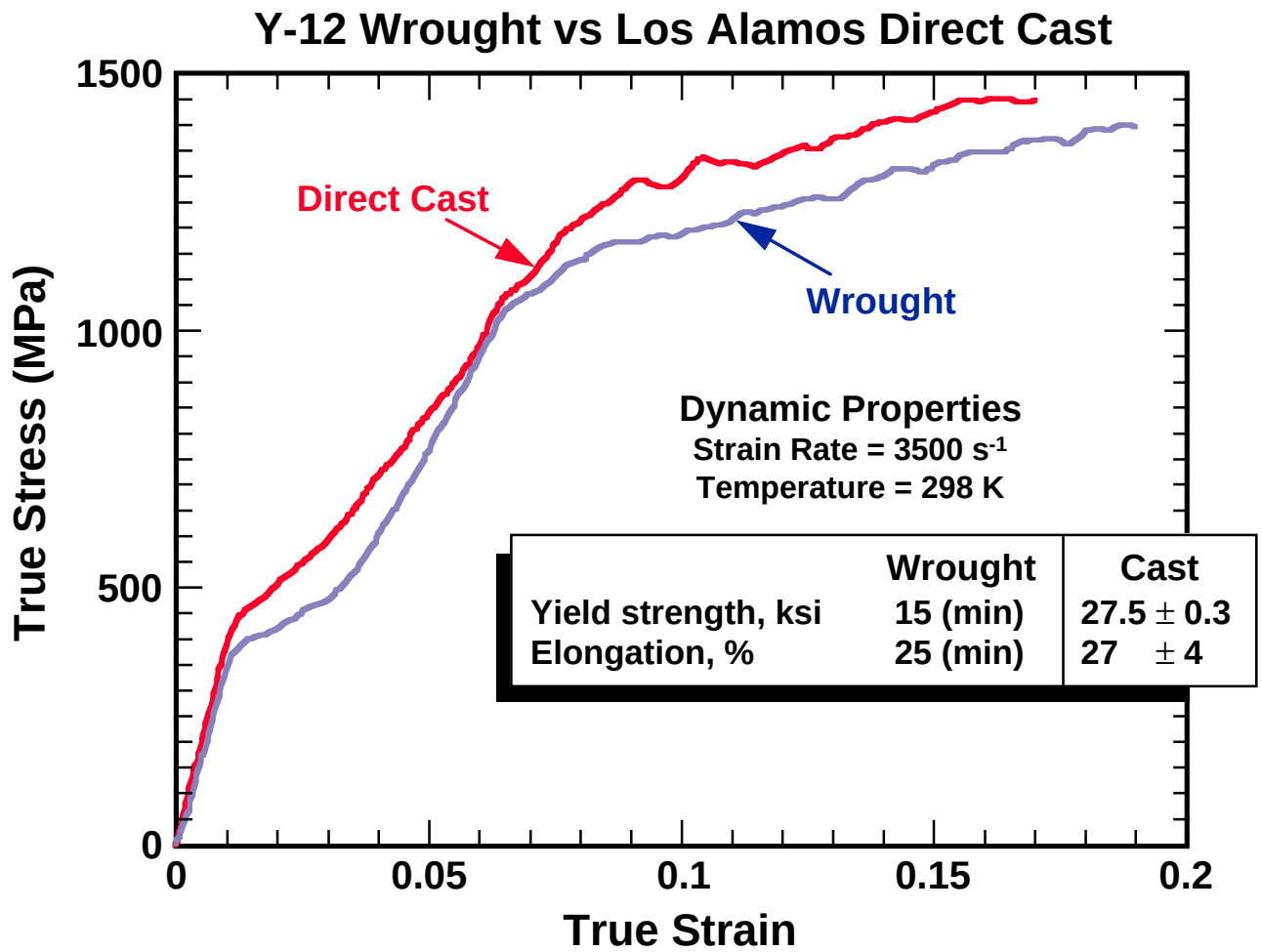
FY95 Feasibility Study

- Team: Los Alamos, Rocky Flats, Savannah River
- Extended Los Alamos modular waste treatment methods to Category 1 Pu operations
- Avoid full restart of major facilities
- Potential Applications
  - Potential NDA, stabilization, repackaging
  - Conversion of excess pits to unclassified form
  - Rapid reconstitution
- Beginning implementation of residue treatment at RFETS



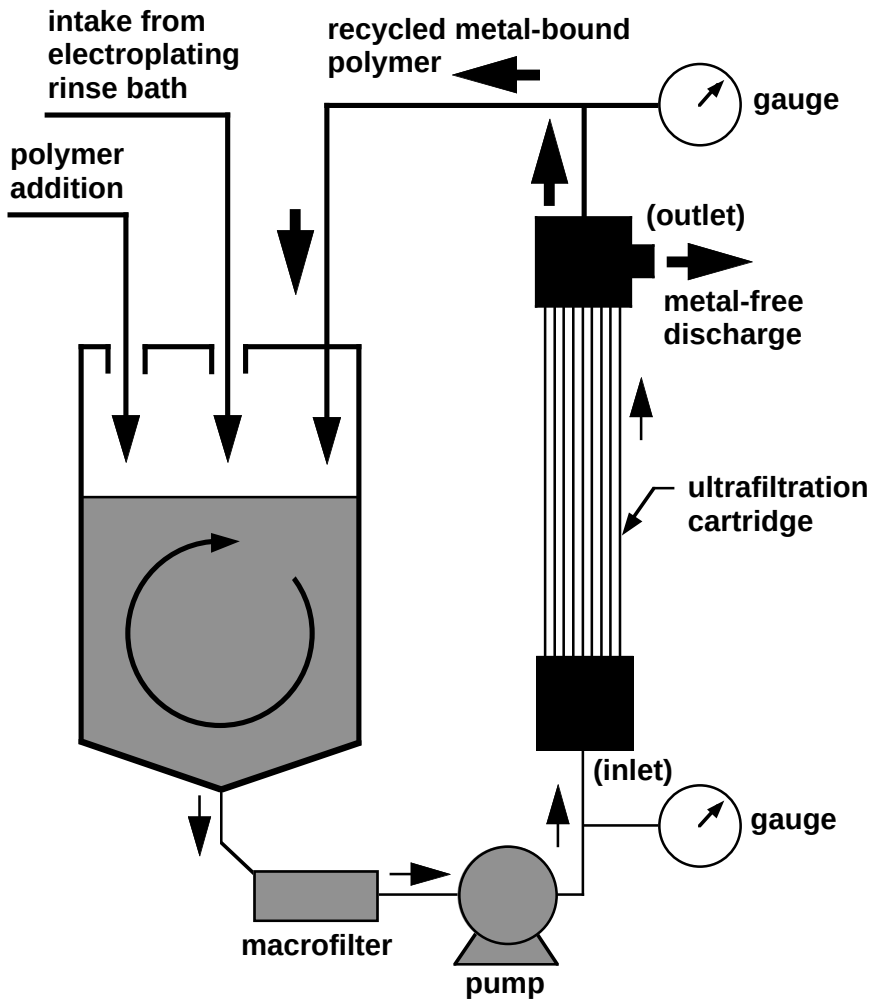
Component Remanufacturing

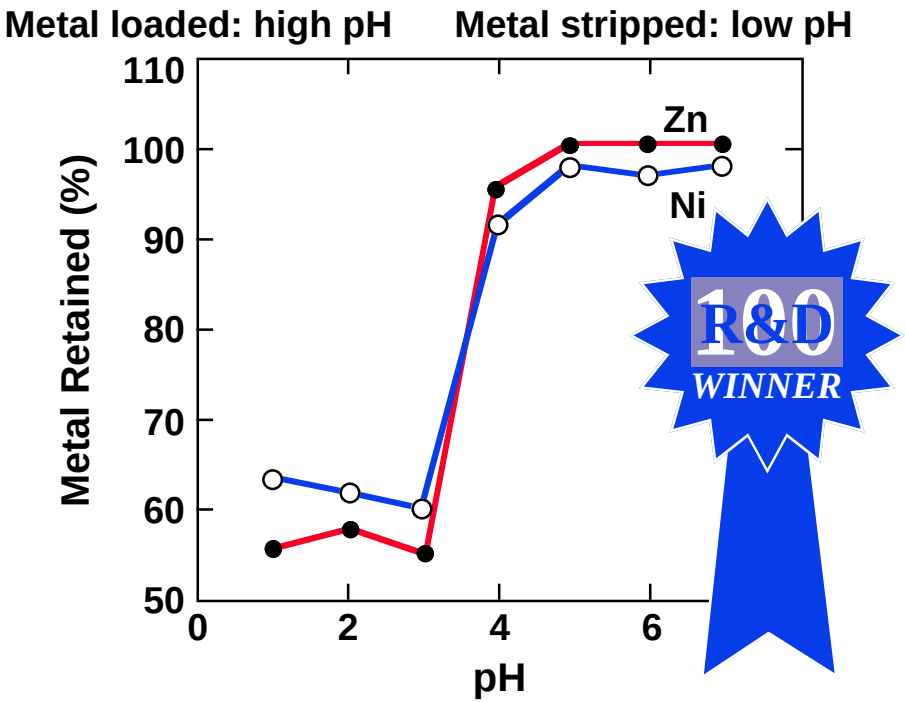
U-6Nb Radiation Case



	Wrought	Cast
Yield strength, ksi	15 (min)	27.5 ± 0.3
Elongation, %	25 (min)	27 ± 4

Polymer Filtration



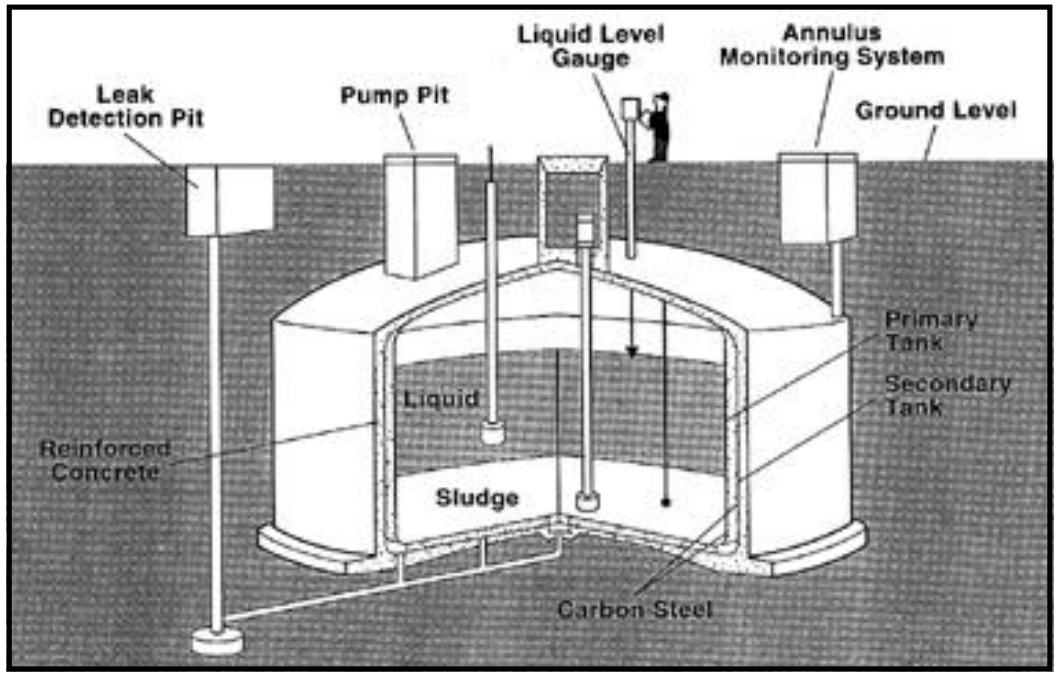


- Example of new environmental technology
- 500 gallons treated in 2-3 hours
- Metal ions concentrated to ~1 gallon
- Industrial partner agreement signed

Hanford Tanks

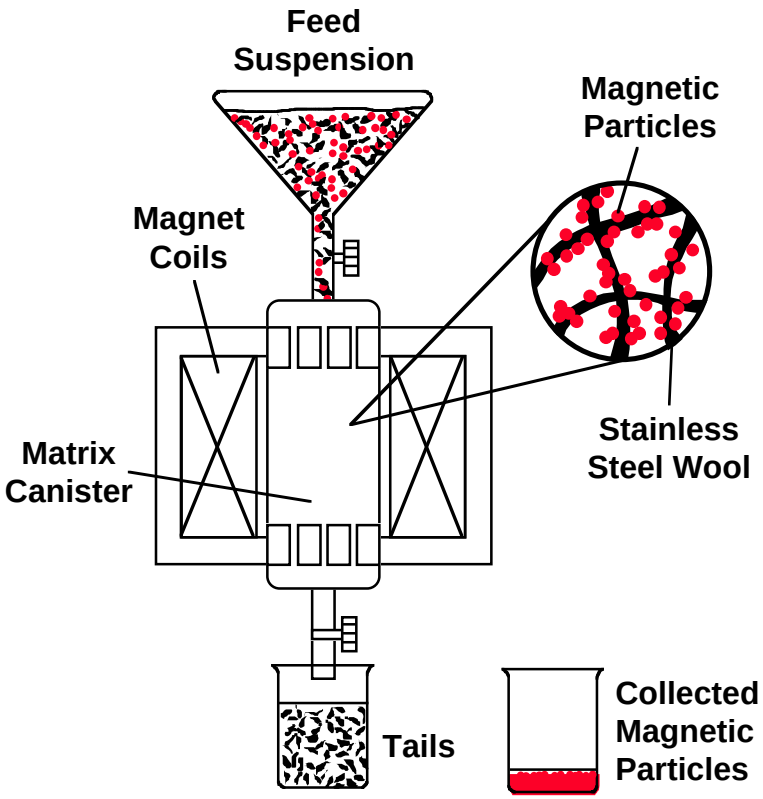
- Los Alamos delivered first-ever comprehensive estimate of chemical contents of high-level waste (HLW) tanks
- Performed thousands of tests on experimental absorbers to remove HLW constituents
- Conducted small-scale studies of actual sludge samples
- Performed new safety assessments to allow characterization and retrieval of tank wastes

177 Hanford Liquid Waste Tanks



High-Gradient Magnetic Separation (HGMS)

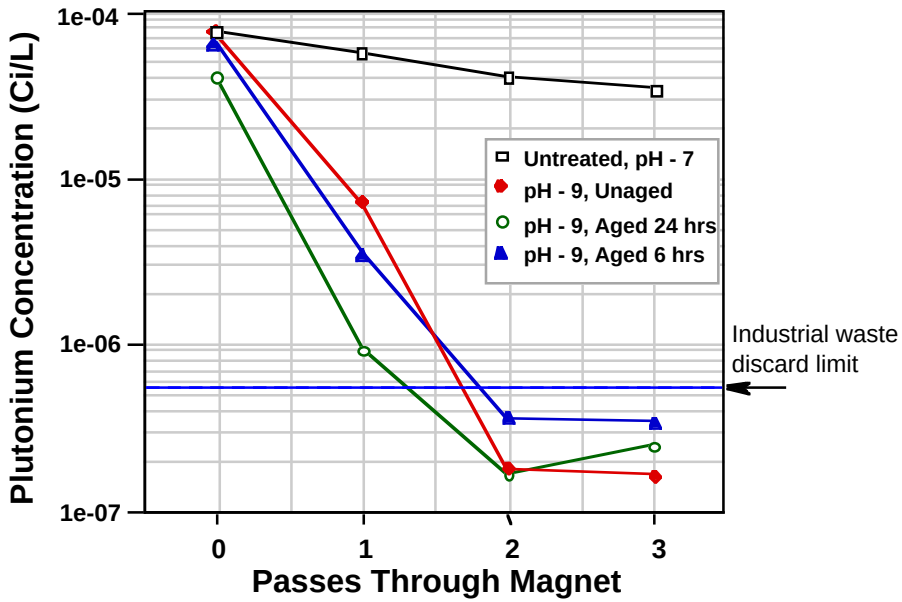
Simplified HGMS Diagram



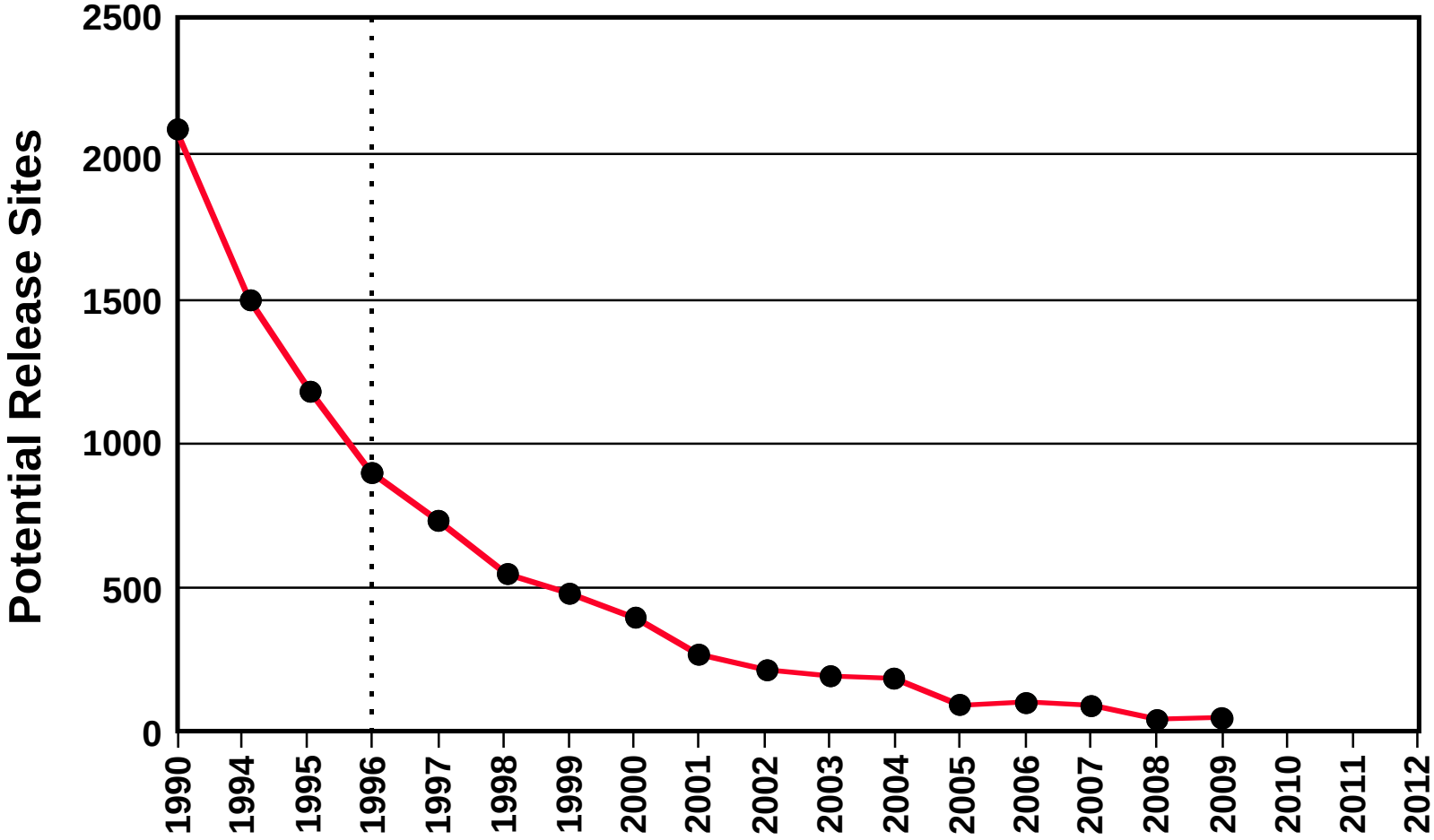
- **Successful demonstration on radioactive waste streams in 1995**

- **Projected Use:**
  Radioactive waste water treatment
  Soil cleanup (RFETS, Fernald, ...)
  Actinide recovery from residues

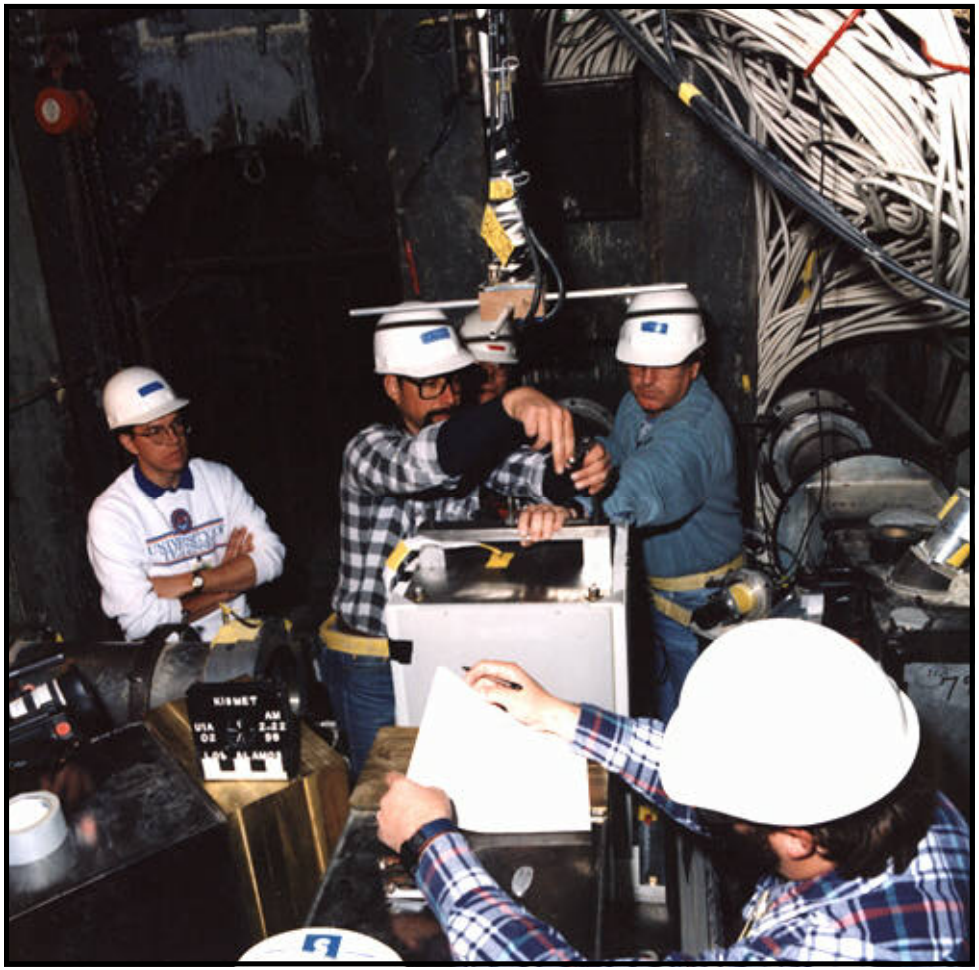
HGMS of TA-55 Waste Effluent



Schedule for Los Alamos Site Cleanup



NTS Exercise



RN95-001-71

March 1995

Underground HE test for Stockpile Stewardship and ASCI modeling

"Our problem isn't new weapons. Our problem is keeping the ones that you have out there workin

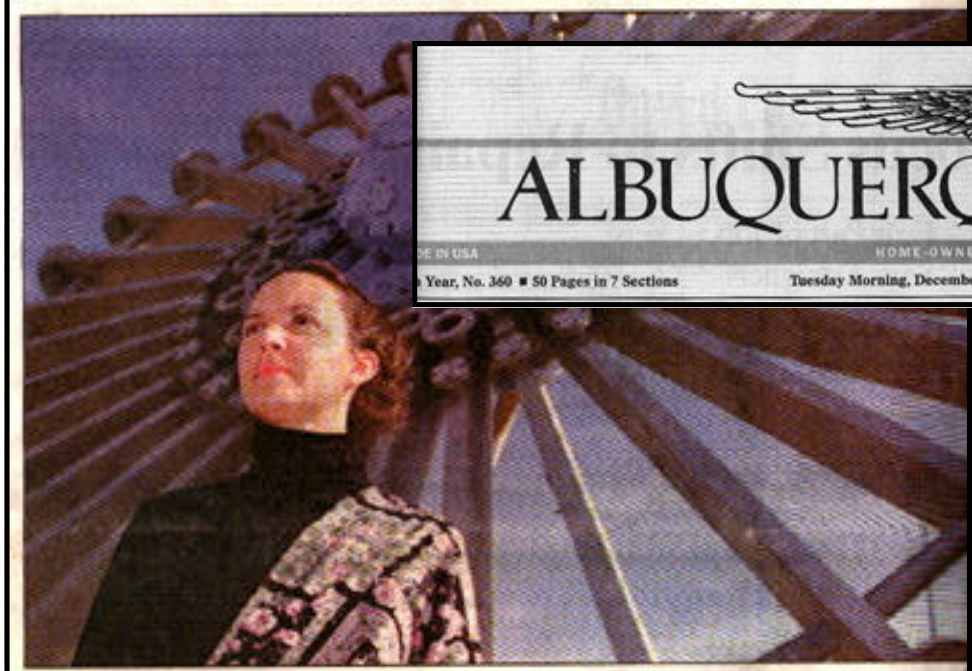
JAS. MARCUS SMITH, FORMER WEAPONS DESI

NEW MEXICO'S LEADING NEWSPAPER

ALBUQUERQUE JOURNAL

HOME-OWNED AND HOME-OPERATED

Year, No. 360 ■ 50 Pages in 7 Sections Tuesday Morning, December 26, 1995 ■ Copyright© 1995, Journal Publishing Co. NOR



WORKLOAD INTACT: Los Alamos National Laboratory scientist Merri Wood says there is still much work to do for the nation's nuclear Wood is shown in front of a nuclear weapon simulator at Sandia National Laboratories, where she recently worked on a series of tests.

DR. STRANGELOVE TO MR. GOODWRENCH

■ *Nuclear weapon designers turn attention to keeping arsenal in working order*

Story by JOHN FLECK
Photograph by GREG SORBER
Of the Journal

used.

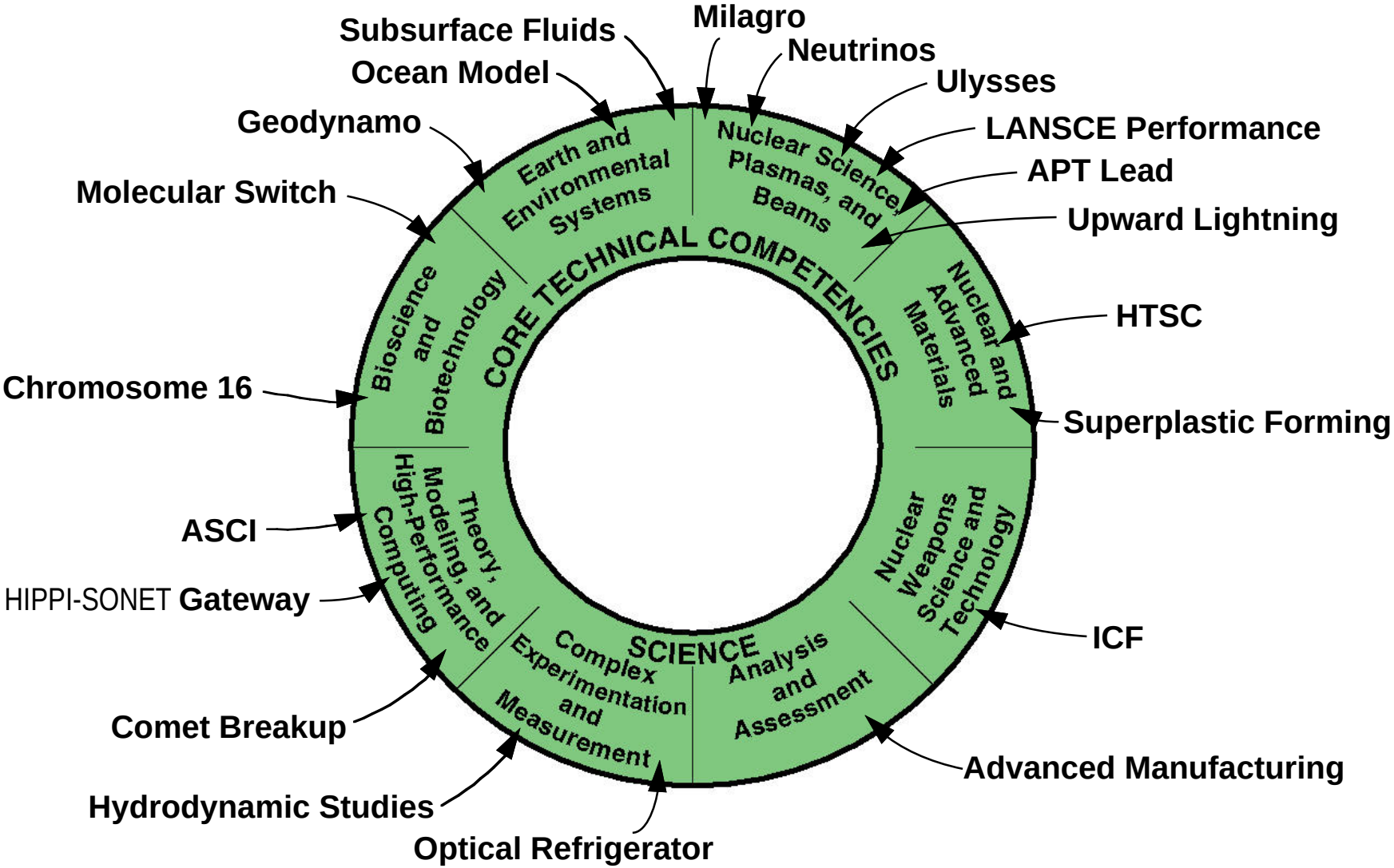
But that doesn't mean Wood and her colleagues face unemployment.

manage Los Alamos' nuclear weapons program.

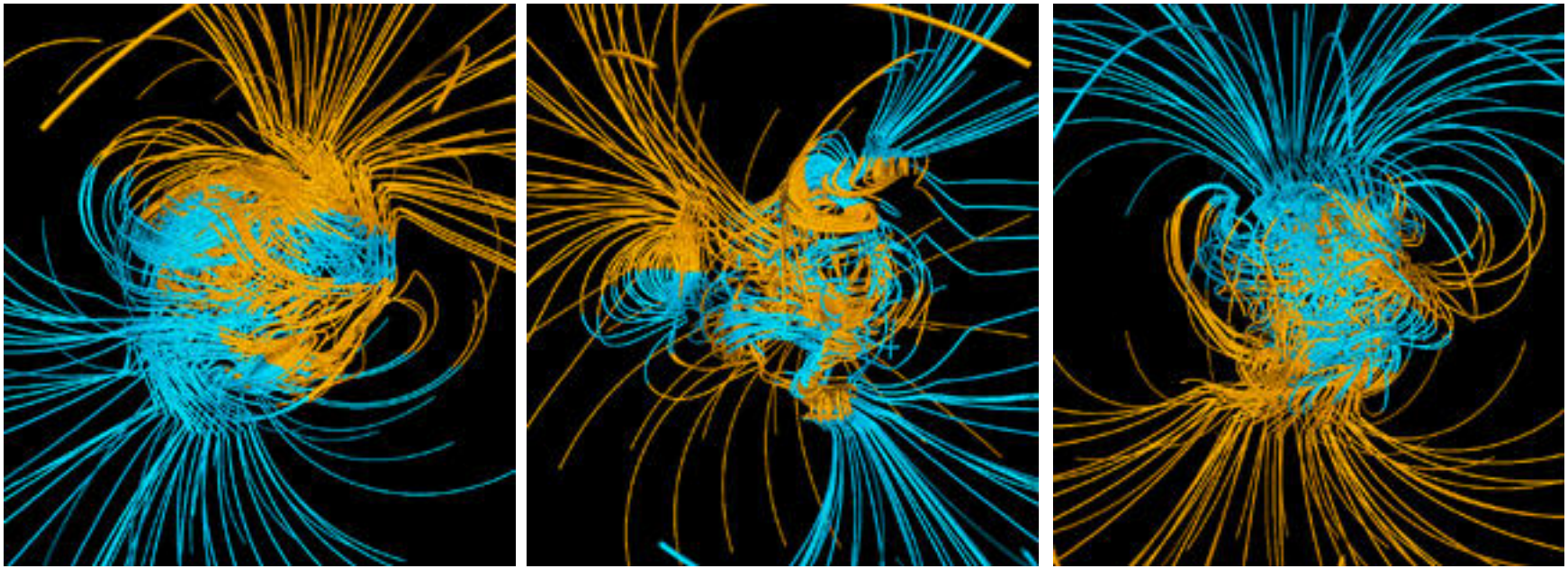
That is why the milestone, the completion of their last design project, was barely noticed.

"Yes, it is a milestone," Wood said, sitting in her cramped office on the second floor of Los Alamos' administration building,

Core S&T Competencies: 1995 Accomplishments



Geodynamo



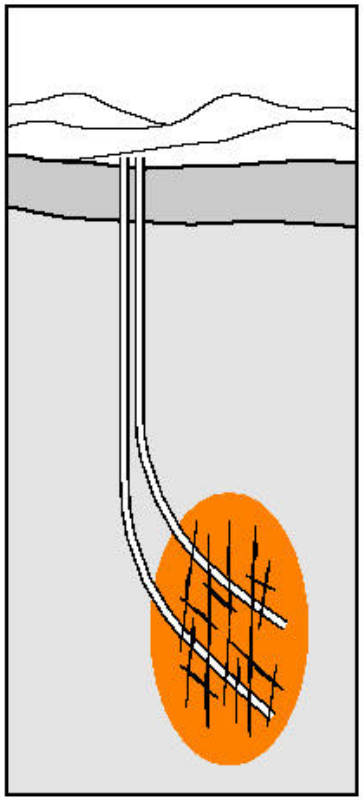
5,000 years before reversal | Middle of reversal | 4,000 years after reversal

- Simulation spans 80,000 years; took >4,000 cpu hours (Cray)
- Field reversal at 40,000 years into simulation
- Gold (blue) = outward (inward) directed magnetic field, plotted to two Earth radii

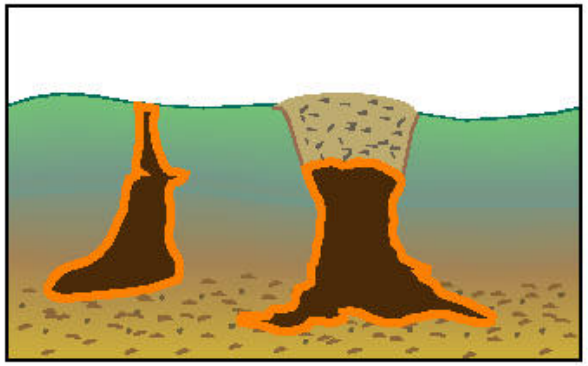
Subsurface Fluid Processes

Understanding of Underground Reservoirs and the Rock-Fluid System:

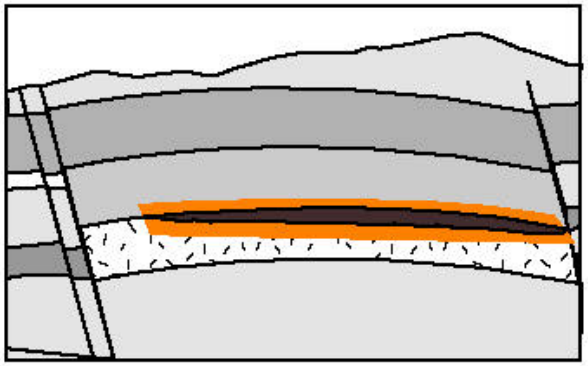
- **Transport of Mass and Energy**
- **Characteristics of Rock Mass, Fluids, and Flow Paths**



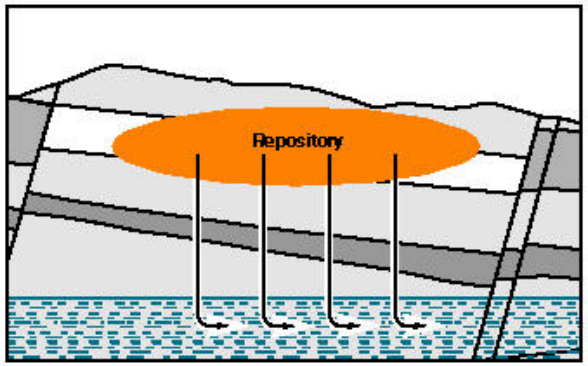
Hot Dry Rock Geothermal Reservoir



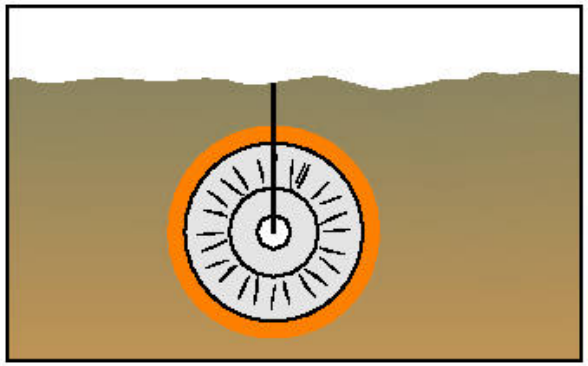
Contaminated Zone Reservoir



Petroleum Reservoir



High-Level Nuclear Waste Repository Reservoir



Underground Nuclear Weapons Test Reservoir

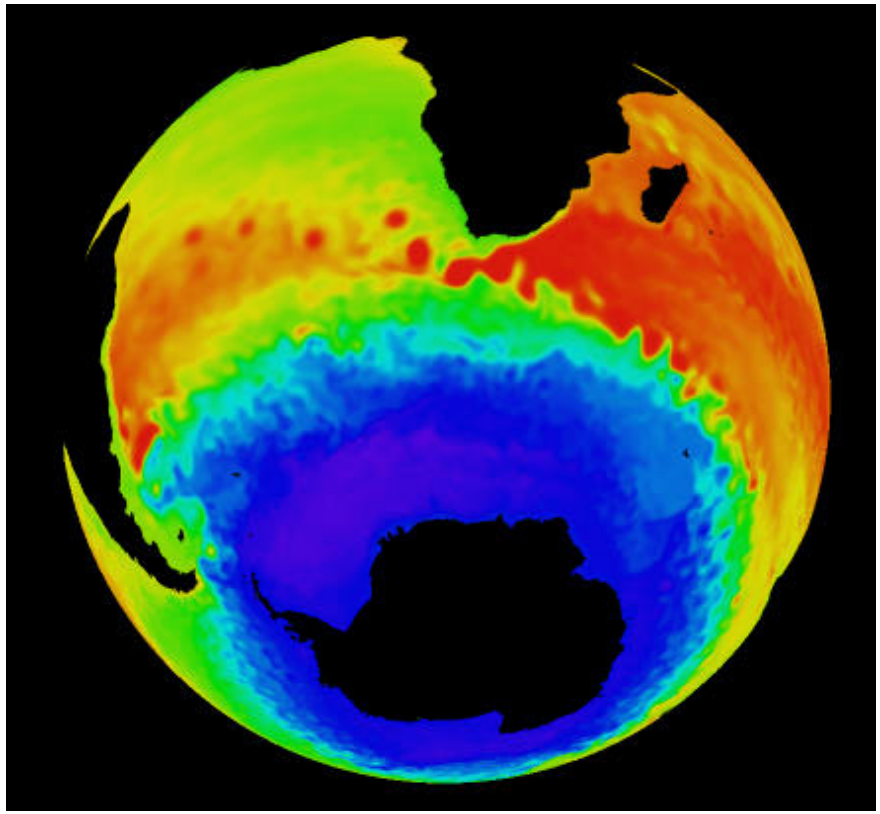
"... imaging the "sub-salt" beds is totally dependent upon supercomputing capability now reaching the research stage in centers such as Los Alamos.... The potential exists for several billion barrels of oil (or its gas equivalent) to exist in targets which could be recognized by the successful application of the technologies...."

H. Leighton Steward
Chairman, CEO, and President
LL&E Company

Global Ocean Modeling

OGCM: Ocean General Circulation Model

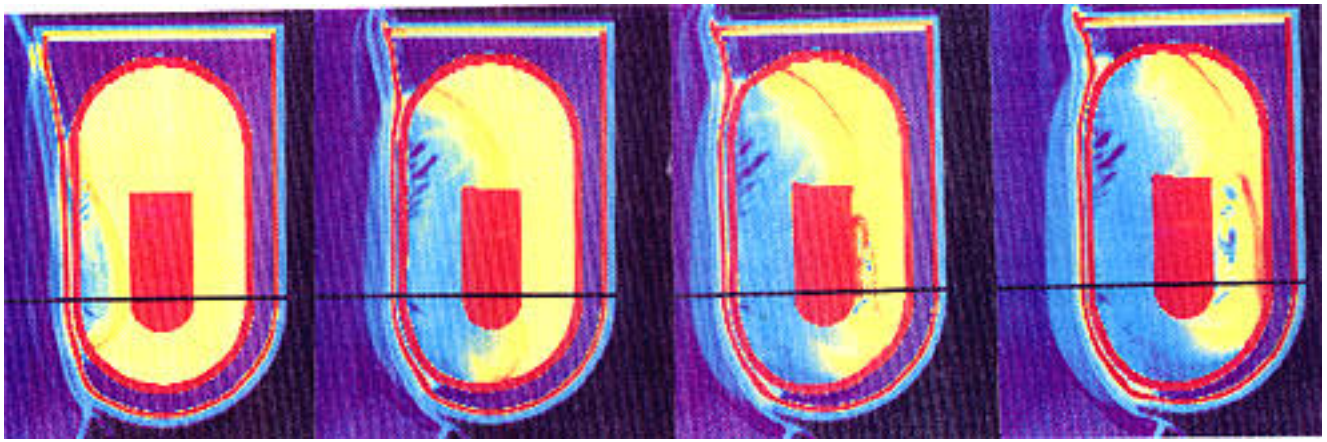
- **Los Alamos *Parallel Ocean Program (POP)*—Efficient modeling on massively parallel computers**
- **Highest resolution global simulations to date (horizontal cell size ~20 km)**
- **Agreement between model and satellite observations for sea surface height variability**
- **Ocean and atmospheric models to be coupled for climate study (DOE CHAMMP program)**



Accelerated Strategic Computing Initiative (ASCI)

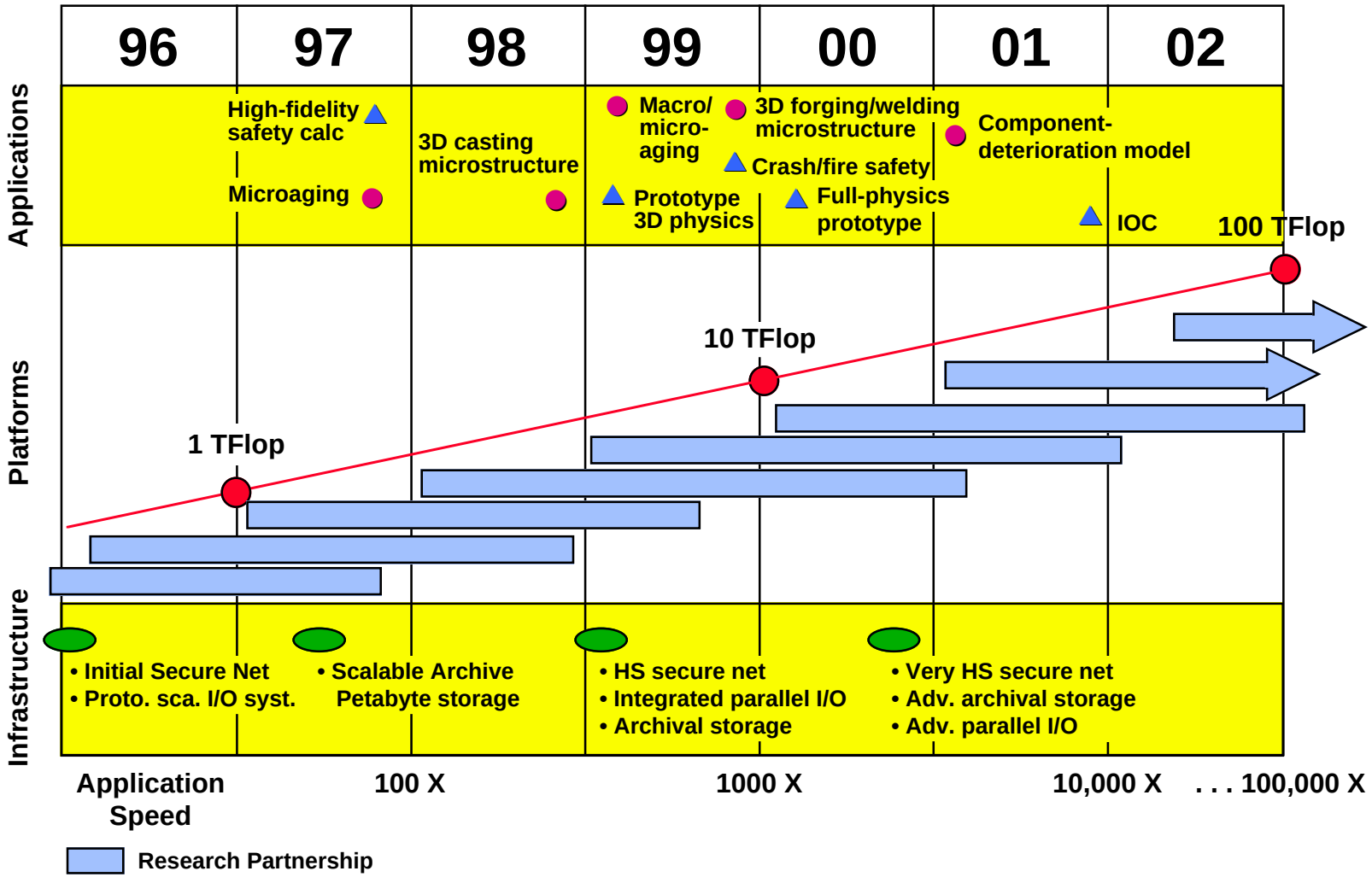
- **Leading-edge computational modeling and simulation capabilities**
- **Applied to stockpile safety and reliability issues**
- **ASCI Blue: 1995 Los Alamos/Livermore innovative approach to cost-effective multiteraflop computing**

24.5 μs **29.0 μs** **30.5 μs** **32.0 μs**



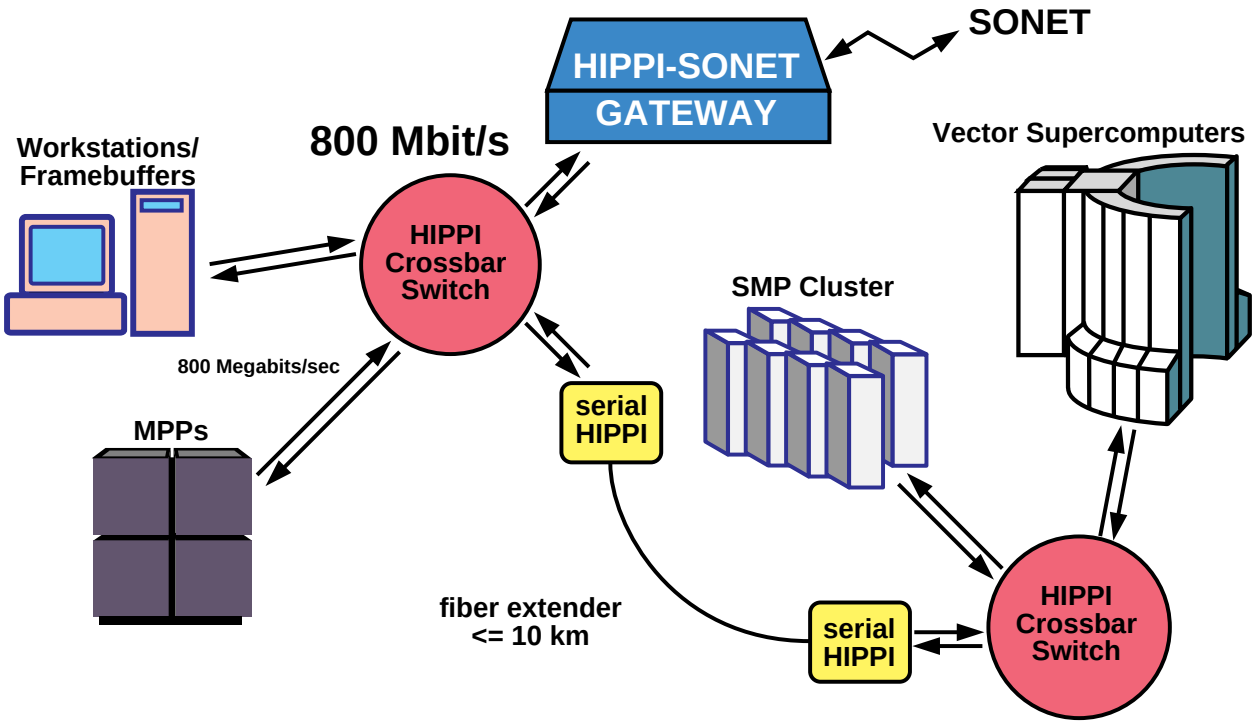
Parallel Computer Simulation of Weapon Safety

ASCI Roadmap



HIPPI-SONET Gateway

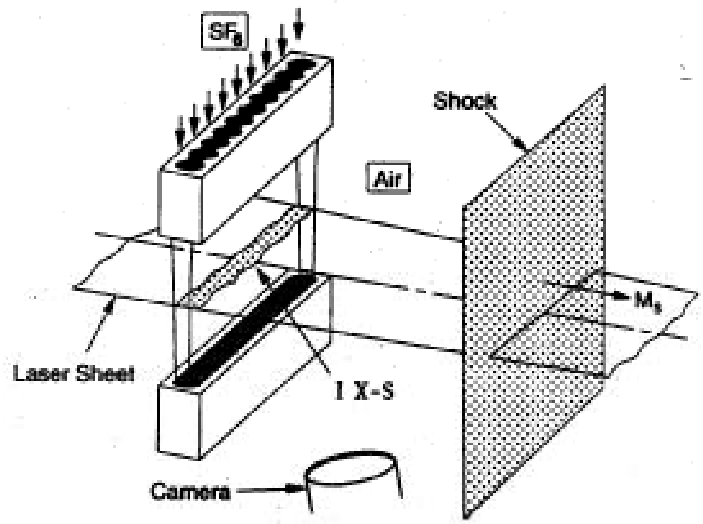
- Nation's widest and fastest networking to date—800 Mbit/s
- Distributed supercomputing to address complex problems
- Collaboration with Cal Tech, JPL, San Diego Supercomputer Center
- HIPPI speeds through satellites possible



Validation of Hydrodynamic Models

- **Objective: develop and validate realistic model**
  - **Extreme range of conditions**
  - **Show development of instabilities**
  - **2D and 3D; couple with ASCI**
- **Approach**
  - **Advanced code development**
    - **Eulerian 2D and 3D hydrocode**
    - **Adaptive mesh refinement (AMR); multicomponent EOS; 2T radiation diffusion**
  - **Special experimental techniques**
    - **Shock tube laminar flow expt (next slide)**
    - **NOVA laser**
    - **Russian collaboration (S. Zaytsev w/contract)**
- **Results**
  - **Excellent agreement between 2D theory and 2D experiment**
  - **Extension to 3D models will require ASCI resources**

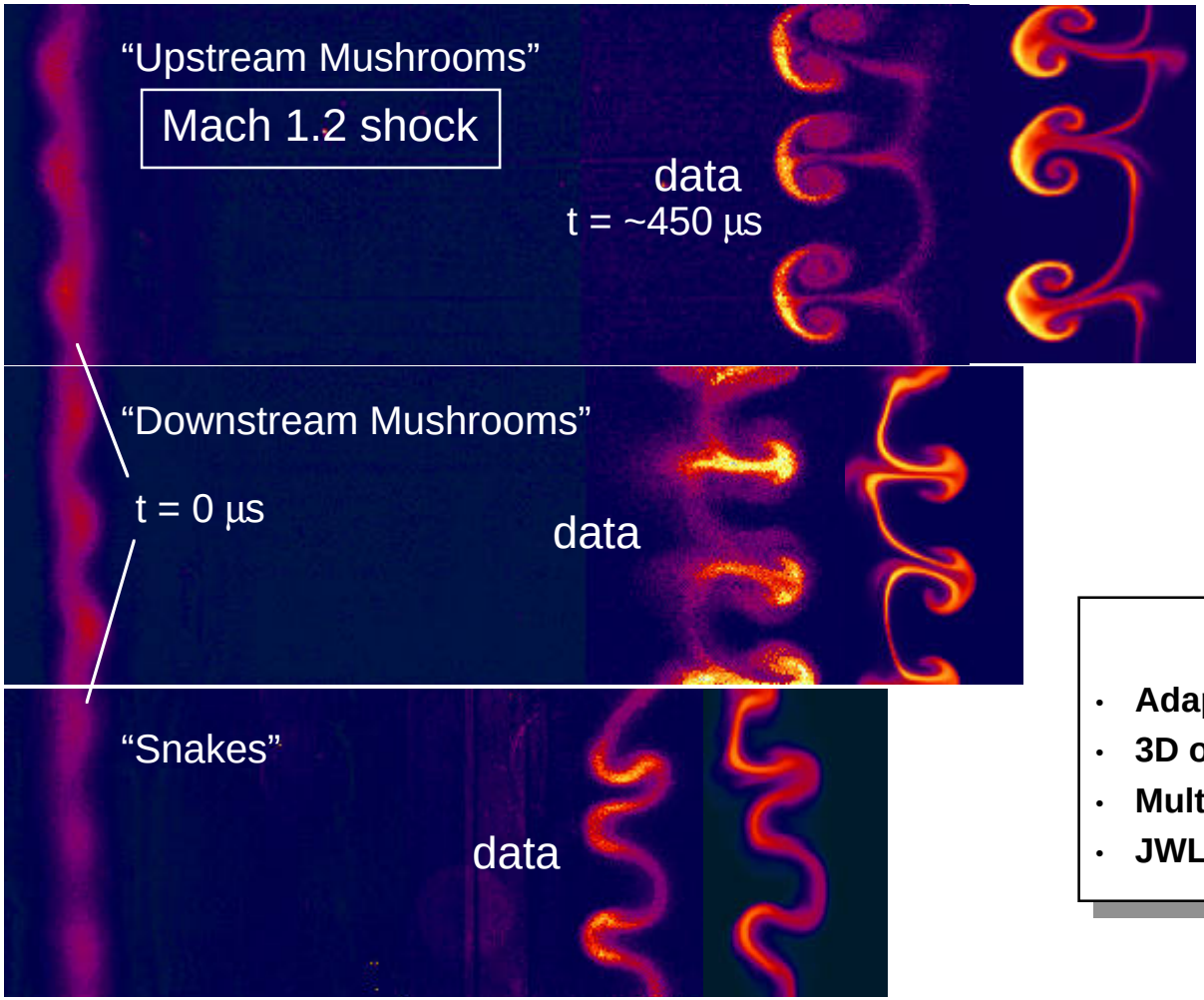
Experiment



Simulation of data provides confidence in hydrodynamics of codes
"Necessary but not sufficient"

Hydrodynamic Simulation and Validation

RAGE Simulation of DX-13 Shock Experiments



RAGE Simulation

RAGE Code

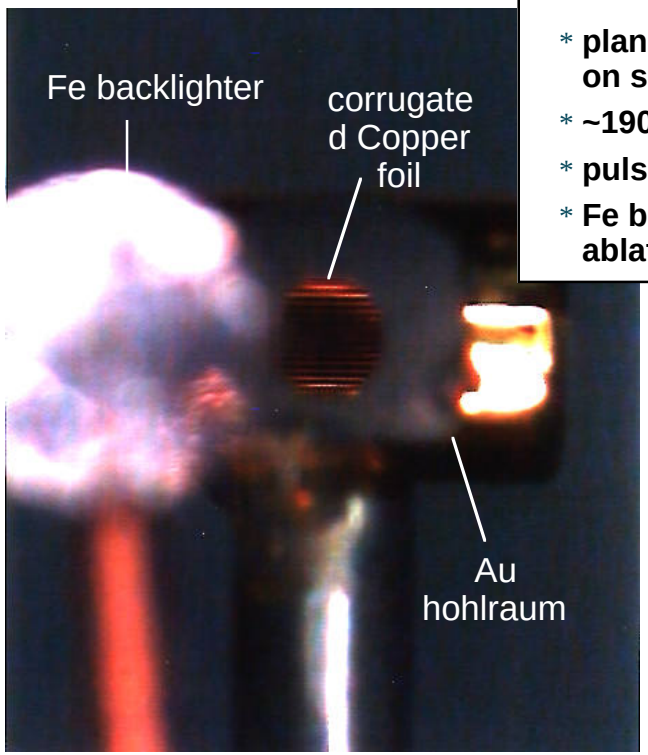
- **Adaptive mesh refinement (AMR)**
- **3D option with radiation available**
- **Multimaterial EOS with strength**
- **JWL explosive EOS**

RAGE Simulation of Ablation Instability

NOVA Experiments

NOVA Experiment

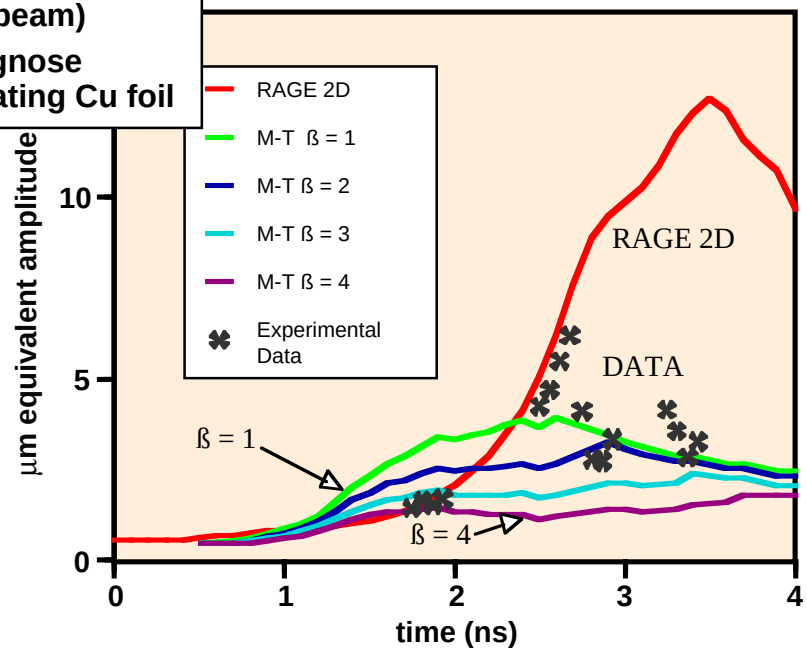
Simulations



NOVA Hohlraum

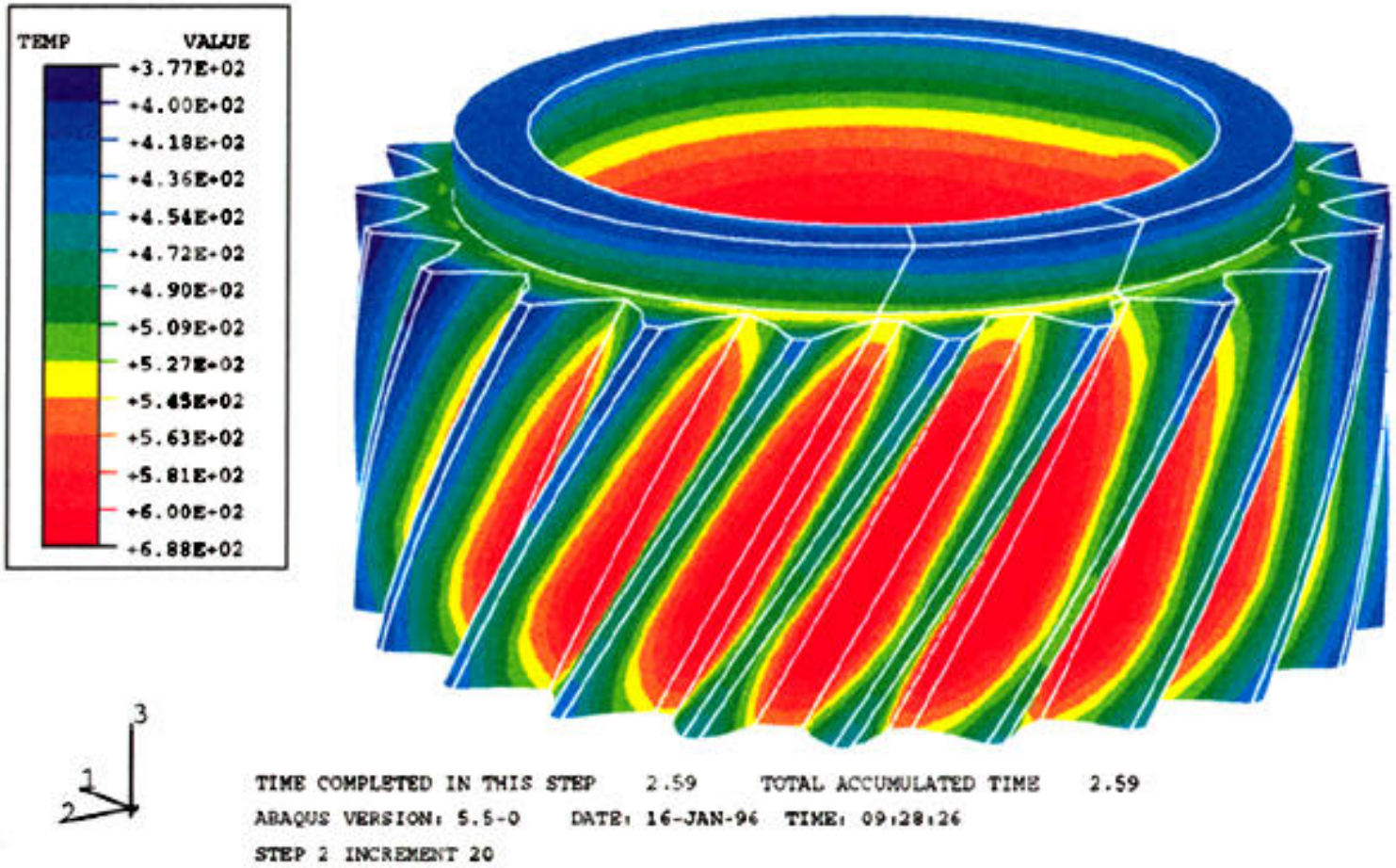
- planar corrugated Copper foil on side
- ~190 eV peak temperature
- pulse shape 26 (8 beam)
- Fe backlighter diagnose ablating & accelerating Cu foil

Comparison of ID & 2D models to data



Process Modeling and Advanced Manufacturing

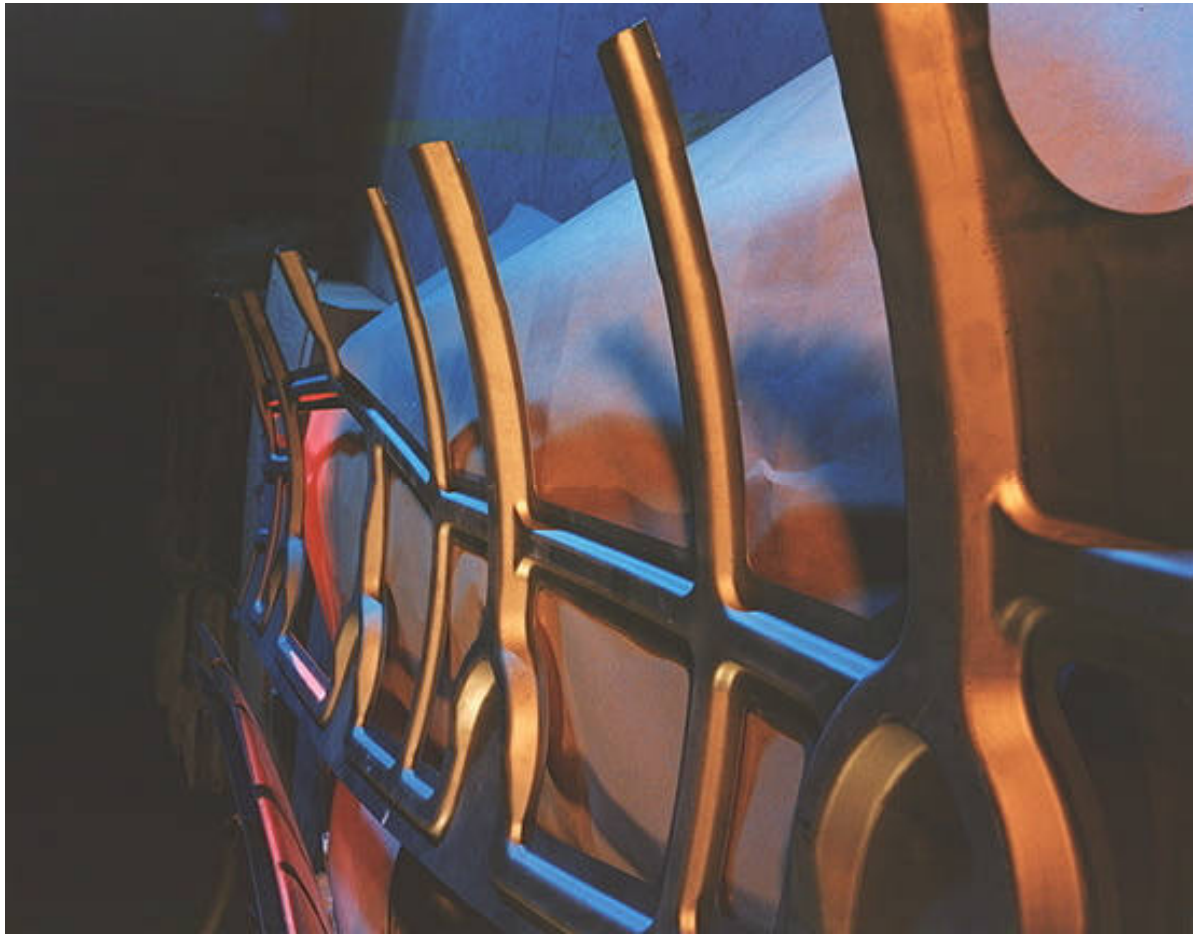
- **Industrial - Defense Synergy**



Model of gear: distortion predicted from quenching

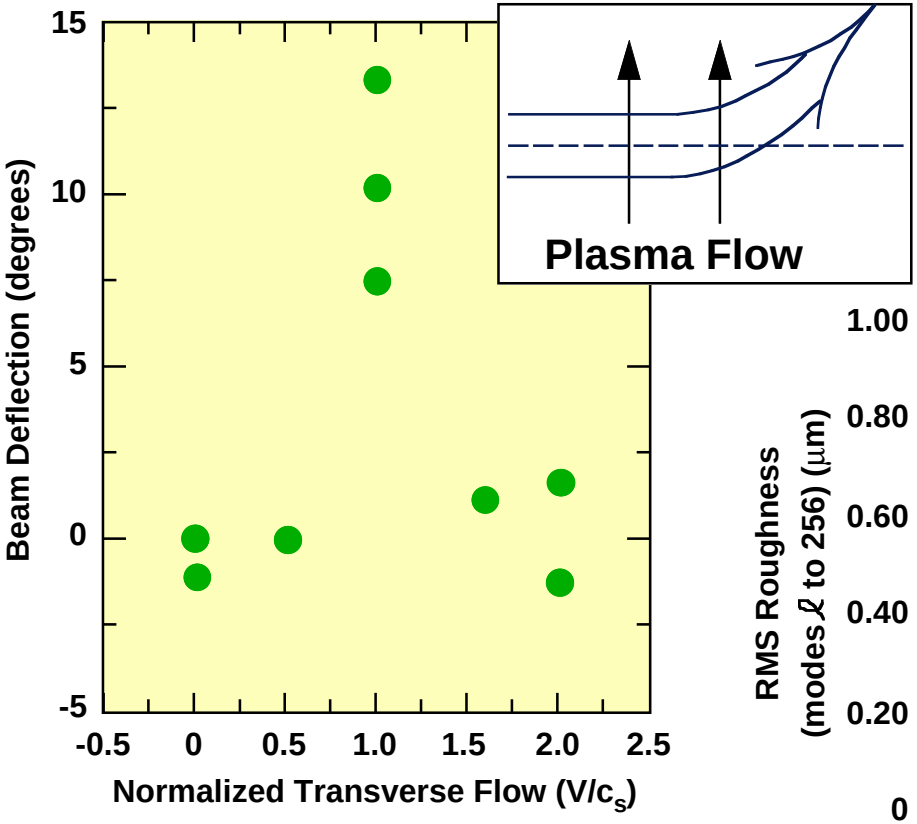
Superplastic Forming

3rd year CRADA
Flameco (Utah)

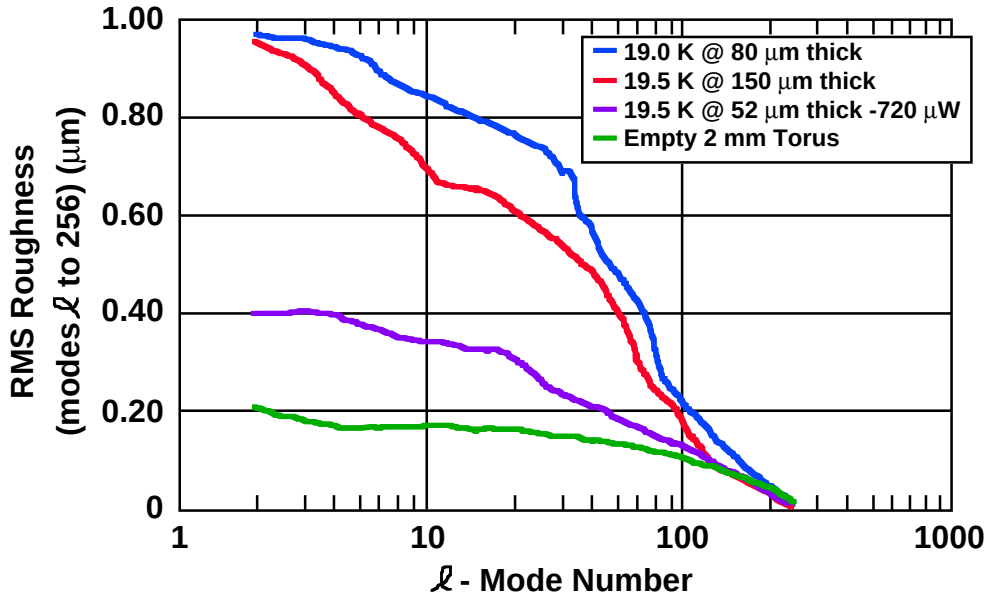


Ti reinforcing rib for engine cowling, 7’ long

ICF Plasma ⇨ Laser Interaction; Target Capsules



Laser-beam deflection by plasma flow, measured at Trident facility

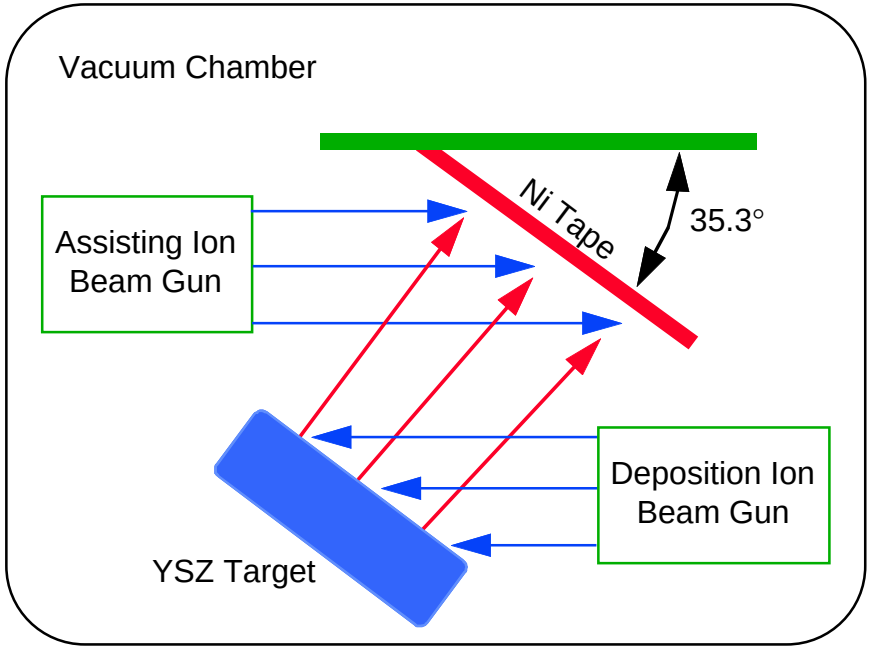


Achieved 0.5 μm RMS surface finish on curved D-T ice surface (sufficient for ignition capsules)

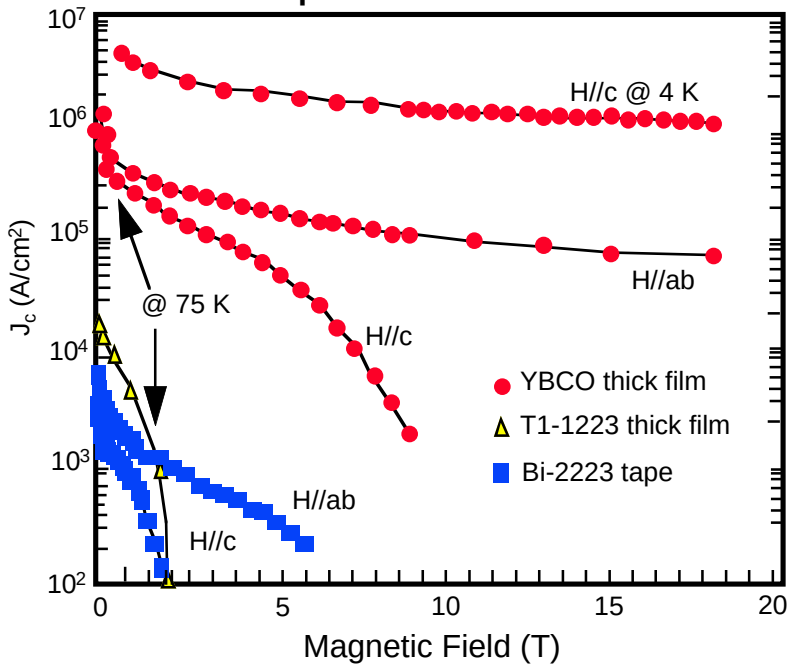
High-Temperature Superconducting Tape

Achieved through interdisciplinary skills and facilities

Deposition Process



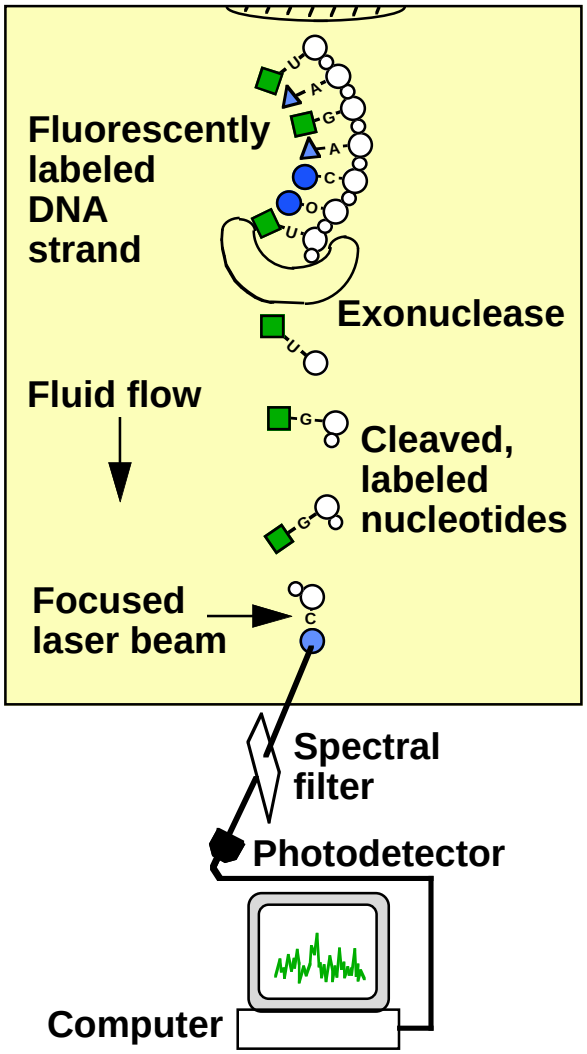
Comparion of HTSC Materials



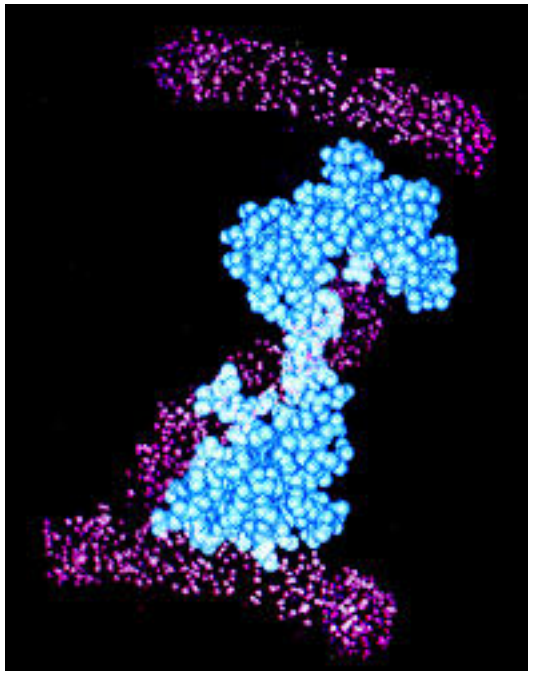
- **Amperage doubled this year to 200 A on 1-cm-wide tape 1 micron thick**
- **Discussions with potential industrial partners**

Chromosome 16

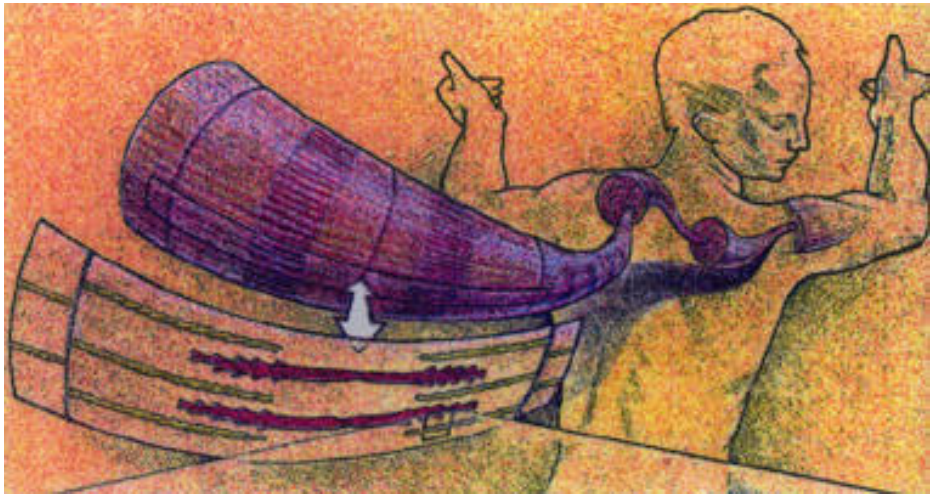
- Completed low-resolution map with a high level of coverage being high-resolution
- Higher resolution than any other completed map
- Resulted from improved mapping processes developed by Human Genome Project team
- High-resolution mapping nearing completion; large-scale sequencing begun
- One million base pairs of sequence (1% of chromosome) is nearing completion



Neutron Scattering and Isotope Labeling Reveal Structure of a Molecular Switch



- This switch, made of two intertwined protein molecules, controls interactions between sliding filaments in muscle cells by binding and releasing Ca^{2+}.



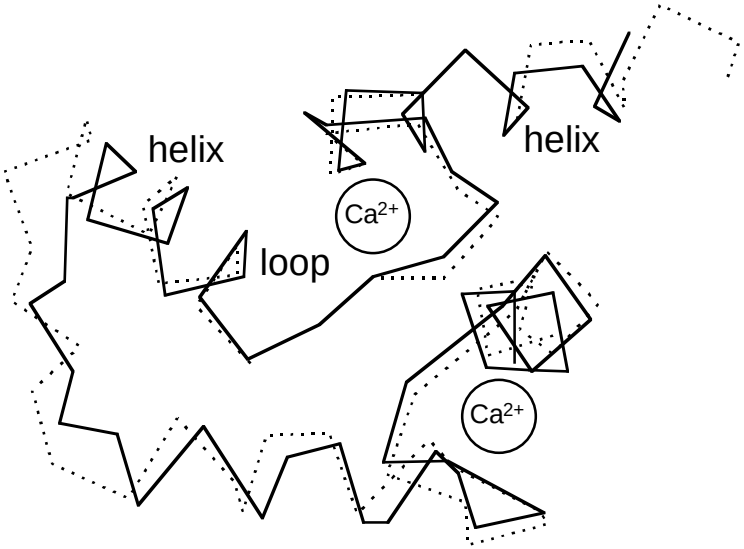
- Muscles contract and relax when filaments made up of proteins slide past each other.

Neutron Resonance Scattering from ^{240}Pu-Labeled Protein

- **Calmodulin regulates by reversibly binding Ca^{2+}**

- **1995 LANSCE Experiment:**
  - **substitute Ca^{2+} with $^{240}Pu^{3+}$**
  - **employ neutron resonance scattering to measure molecular structure**

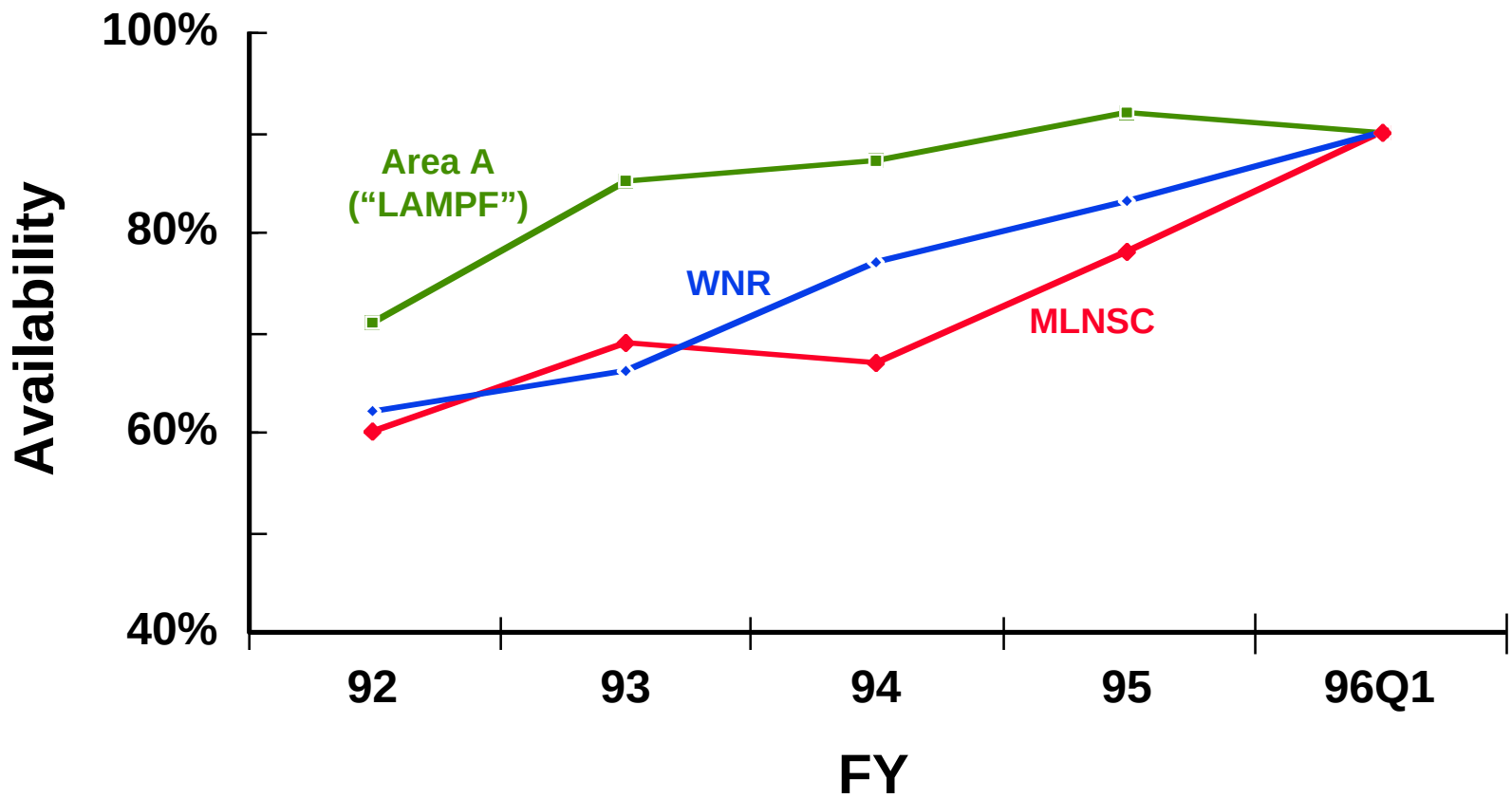
- **Features of Experiments**
  - **showed specific binding of Pu to protein**
  - **first use of ^{240}Pu resonance scattering**
  - **first use of neutron resonance scattering as structural probe in protein**
  - **interdisciplinary combination of unique Los Alamos capabilities**



Superimposed backbone structures of two globular domains of calmodulin showing Ca/Pu-binding sites.

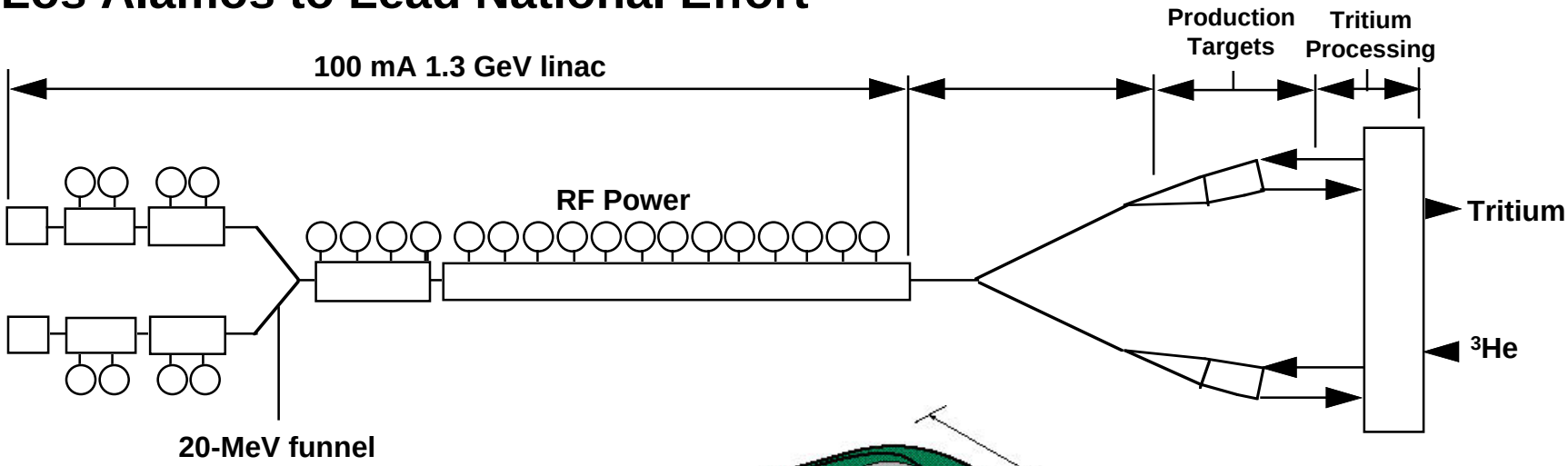
LANSCE Performance

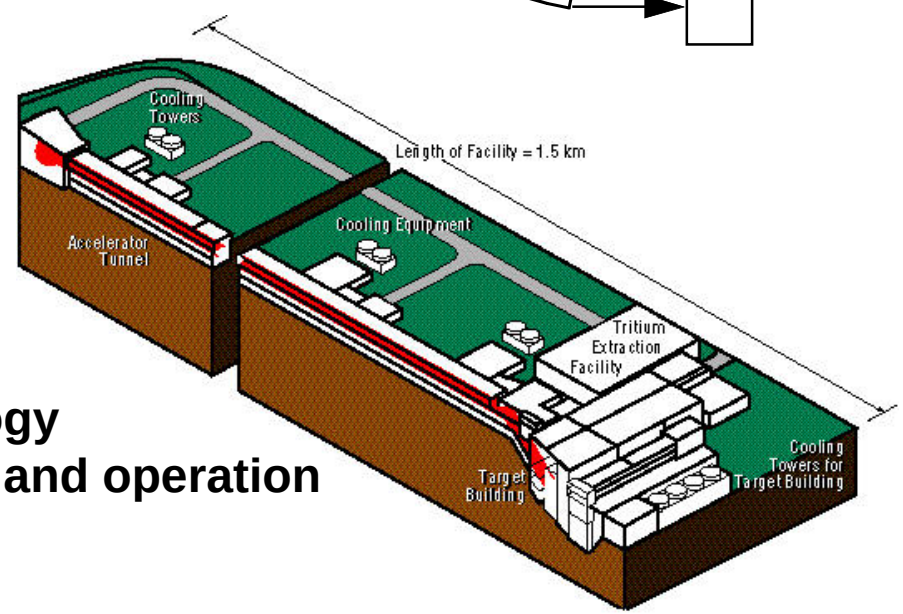
- Beam *reliability increased* in time of declining budget
- Focus on future customer's requirements rather than program variety



Accelerator Production of Tritium

Los Alamos to Lead National Effort

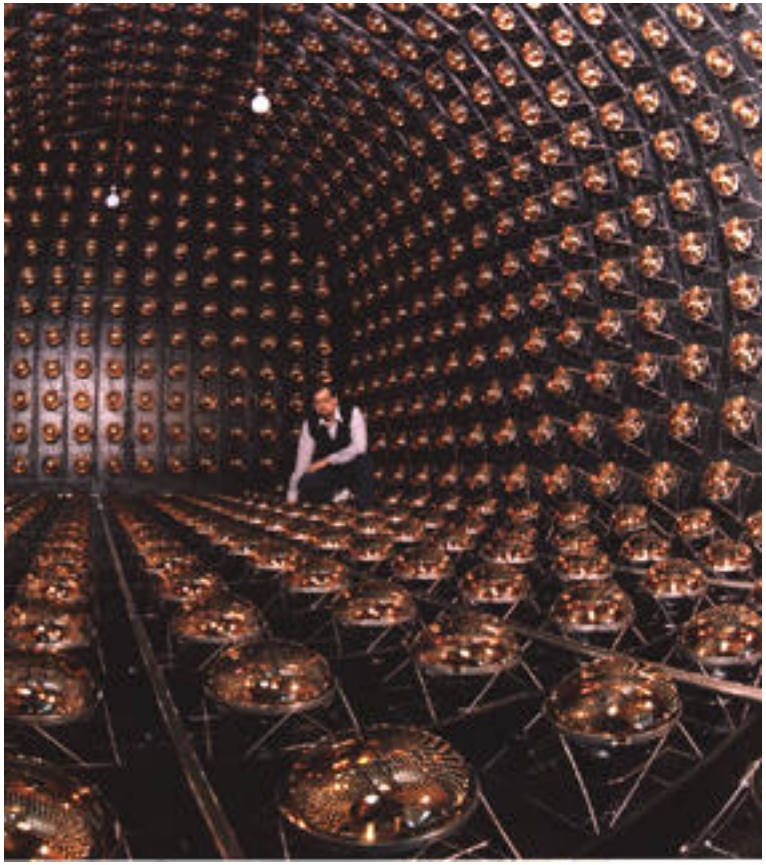




- **Achievement result of Los Alamos accelerator technology**
  - **High-power accelerator design and operation**
  - **High-power target systems**

Neutrinos

- **LSND (Large Scintillator Neutrino Detector) at LAMPF-LANSCE A6 beamstop**
- **1200-phototube tank filled in Aug 1993 with dilute scintillator solution**



Reaction	Events/mA-month
υ_2 C $\rightarrow$ e^- x	100
υ_2 C $\rightarrow$ e^- ^{12}N(g.s.)	60
υ e $\rightarrow$ υ e	~12
υ_μ C $\rightarrow$ μ^- x	200
υ_μ C $\rightarrow$ μ^- ^{12}N(g.s.)	~7
$\bar{\upsilon}_e$ p $\rightarrow$ e^+ n	*several*

$\bar{\upsilon}_e$ are not made in the beamstop - appearance may indicate $\bar{\upsilon}_\mu \rightarrow \bar{\upsilon}_e$ oscillation

Neutrinos: A Nobel Story at Los Alamos

NEWSPAPER / JOURNAL
THE NEW MEXICAN

DATE:
Thursday, October 12, 1995

Page 1 Of 1

Ex-LANL Physicist Shares Nobel Prize

New Mexic

PALO ALT
Perl, a physic
one of the el
of matter at h
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Using an a
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NEWSPAPER / JOURNAL
ALBUQUERQUE JOURNAL

DATE:
Thursday, October 12, 1995

Page 1 Of 1

Physicist Wins For Los Alamos Work

By John Fleck
Journal Staff Writer

The 1950s experiments that won then-Los Alamos scientist Frederick Reines the Nobel Prize in physics Wednesday were, in a way, no big surprise at the time.

But that did not make them any less spectacular.

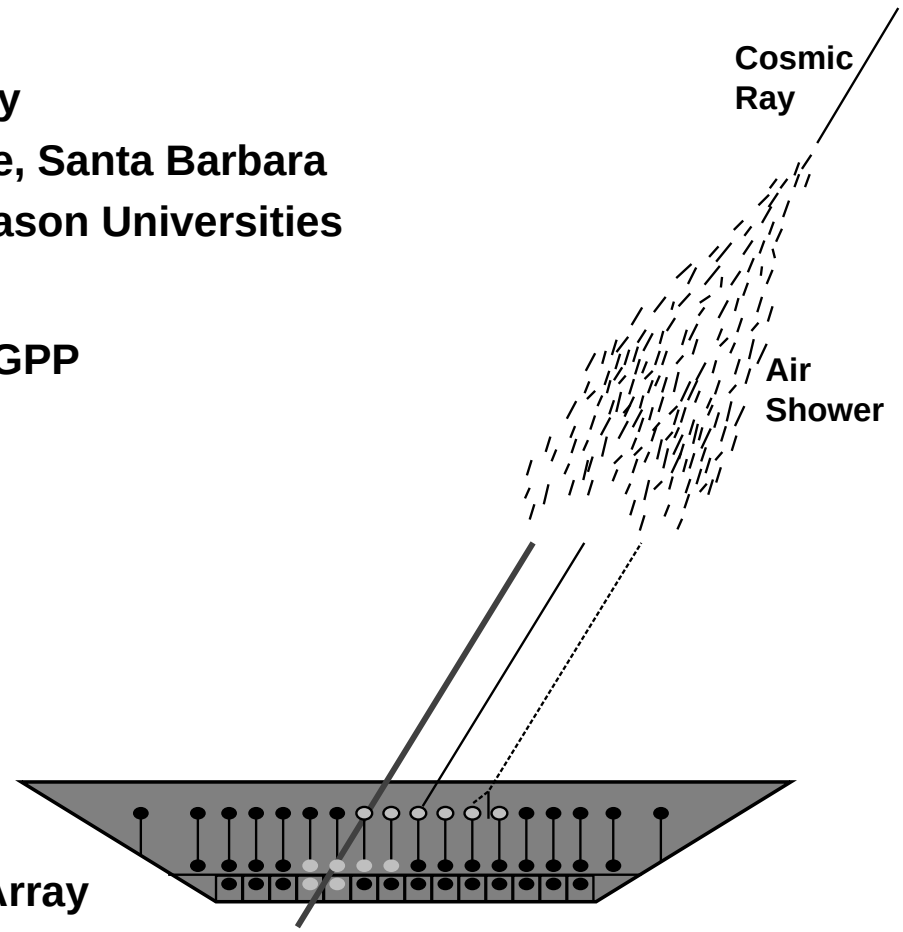
The team's work "opened the doors to the region of 'impossible' neutrino experiments," the Nobel committee said. Because they usually slip effortlessly through solid matter, neutrinos are notoriously difficult to capture.

No physicist seriously doubted that neutrinos existed, said Murray

The Milagro γ-Ray Observatory

Unique TeV γ-ray all-sky monitor—"Black Hole Telescope"

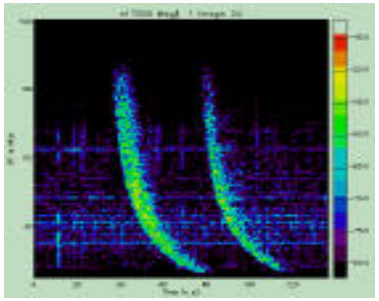
- **Collaboration**
  - Los Alamos National Laboratory
  - UC Irvine, Santa Cruz, Riverside, Santa Barbara
  - Maryland, New York, George Mason Universities
- **Funded by**
  - DOE (HEP, NP), NSF, UCDRD, IGPP
- **Construction began 1995**
- **First light 1996**
- **Full operation 1997–1998**



Milagro at Fenton Hill
Water Cerenkov Light Phototube Array

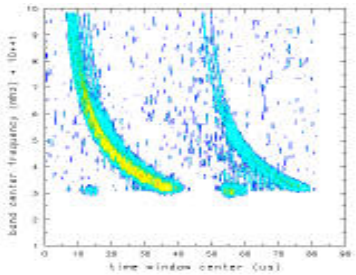
Upward Lightning

Goal: Identify nuclear explosion EMP in electromagnetic background dominated by lightning phenomena



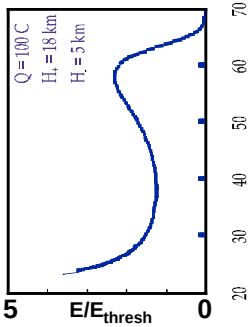
Blackbeard Measurement

RF power spectrum chirp pairs



Theoretical Calculation

Ionosphere

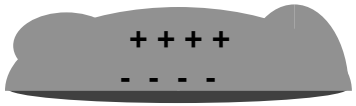


70 km

UPWARD-PROPAGATING ELECTRON BEAM

25 km

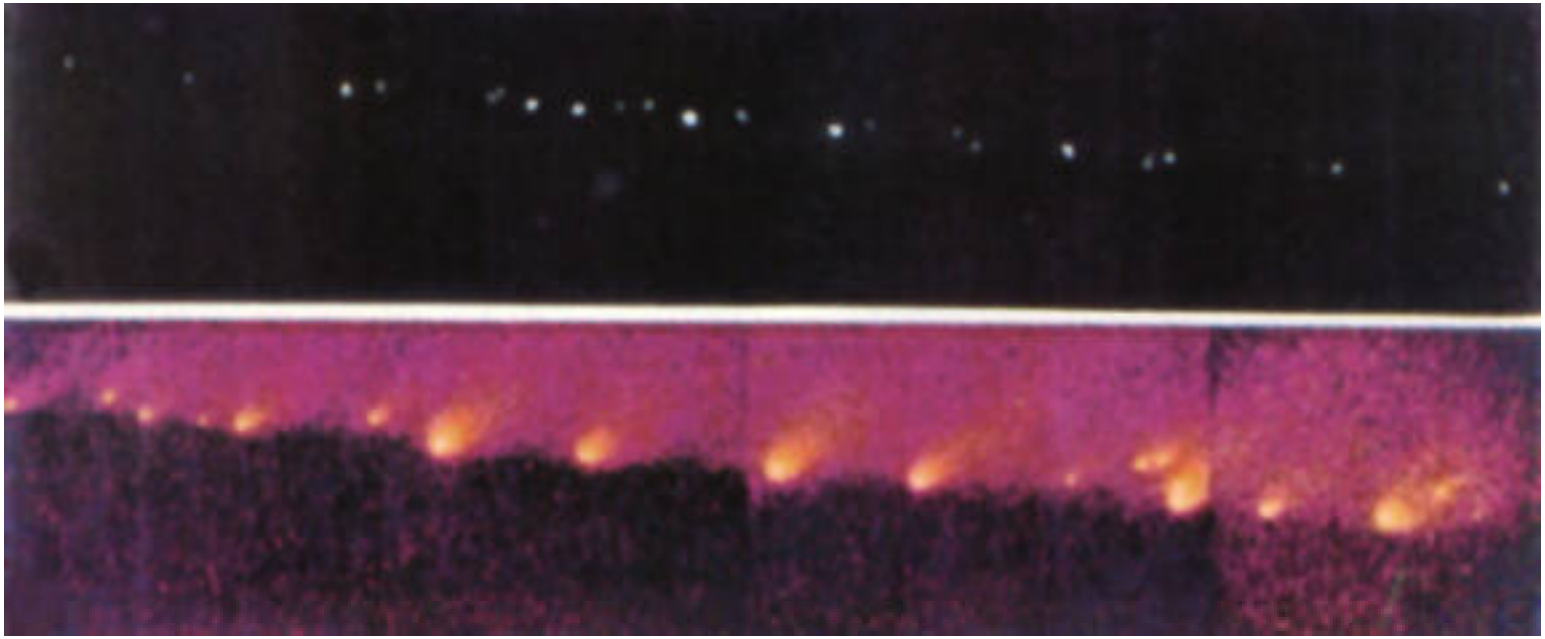
15 km



1995 Achievement: Theory of 'sprites'—upward propagating, relativistic, air breakdown; fits rf chirp pairs, optical, and gamma ray pulses

Comet Properties from Analysis of Breakup

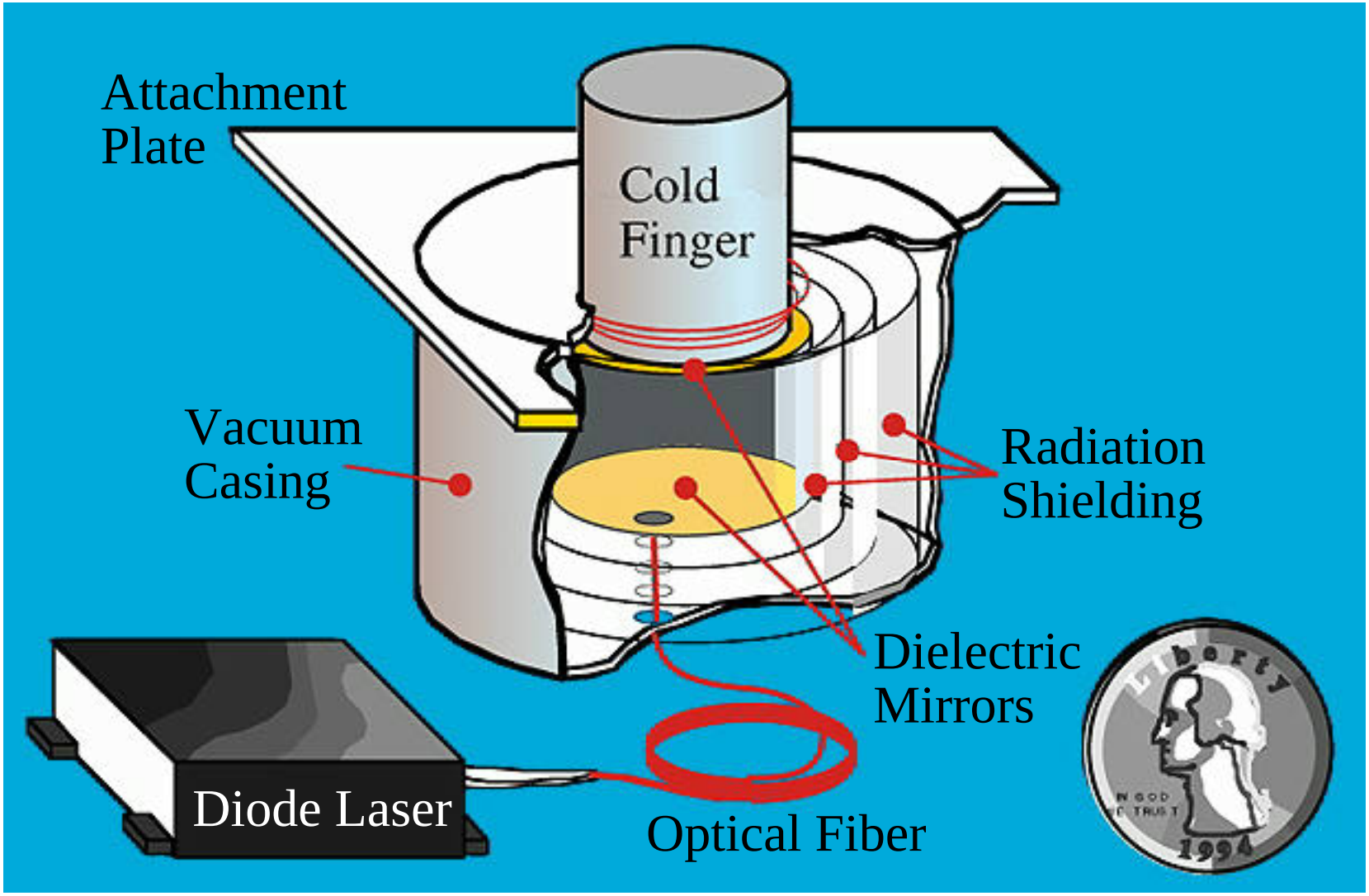
Simulated observation from model



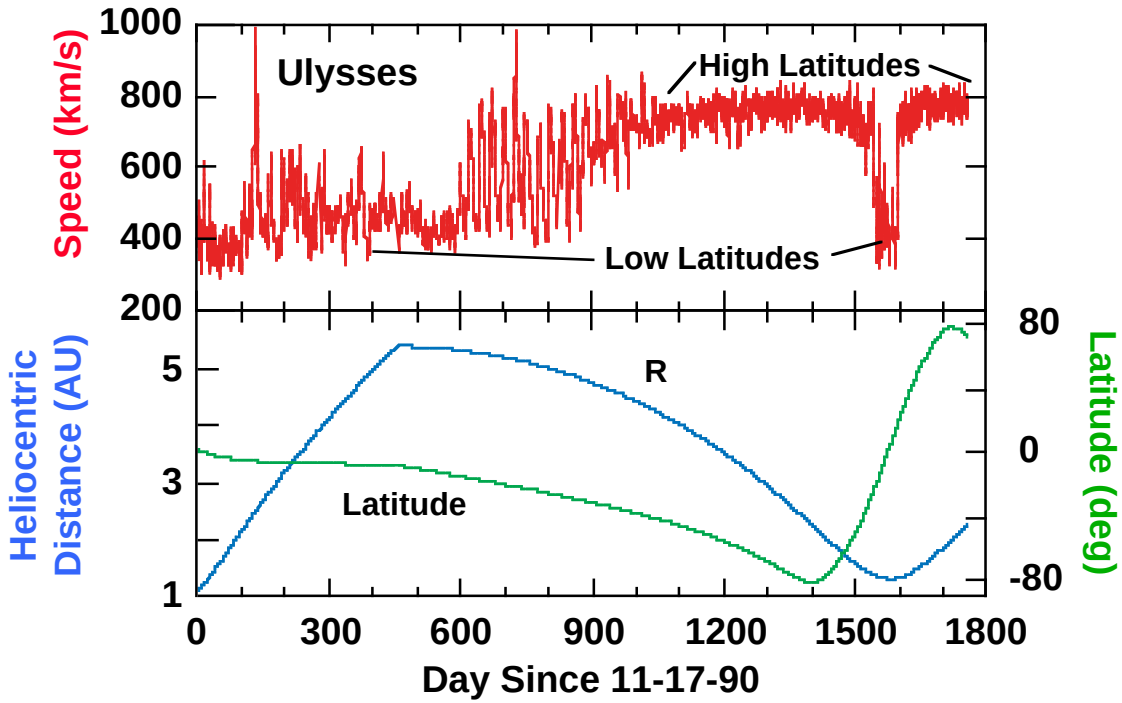
Hubble telescope observation

Density and size of Shoemaker-Levy 9 deduced from tidal breakup model from fragmentation data as comet passed near Jupiter

Optical Refrigerator



Ulysses Solar Wind Data



Measured solar wind correlated with sensor latitude

- **Solar wind depends on latitude through solar magnetic field**
- **Most of heliosphere is filled with fast solar wind that originates from only 13% of solar atmosphere near the poles**

Space Plasma Physics

JOURNAL NORTH PUBLIC WORKPLACE MONDAY, JANUARY 1, 1996 5

RANK AND FILE

Scientist Finds Place in Sun

Ulysses Returns Solar-Wind Data To Lab Specialist

BY PETER EICHSTAEDT
Journal Staff Writer

No matter the weather, the forecast is always the same for Los Alamos National Laboratory scientist John Phillips: sunny and windy.

Phillips is the chief investigator of data being collected by the Ulysses space probe, which is measuring what is known as "solar wind."

This is not the typical wind New Mexicans experience on sunny spring days, however.

This "wind" is the solar energy and particles emitted by the sun. It has some obnoxious effects on Earth, such as knocking satellites and disrupting communications, Phillips says.

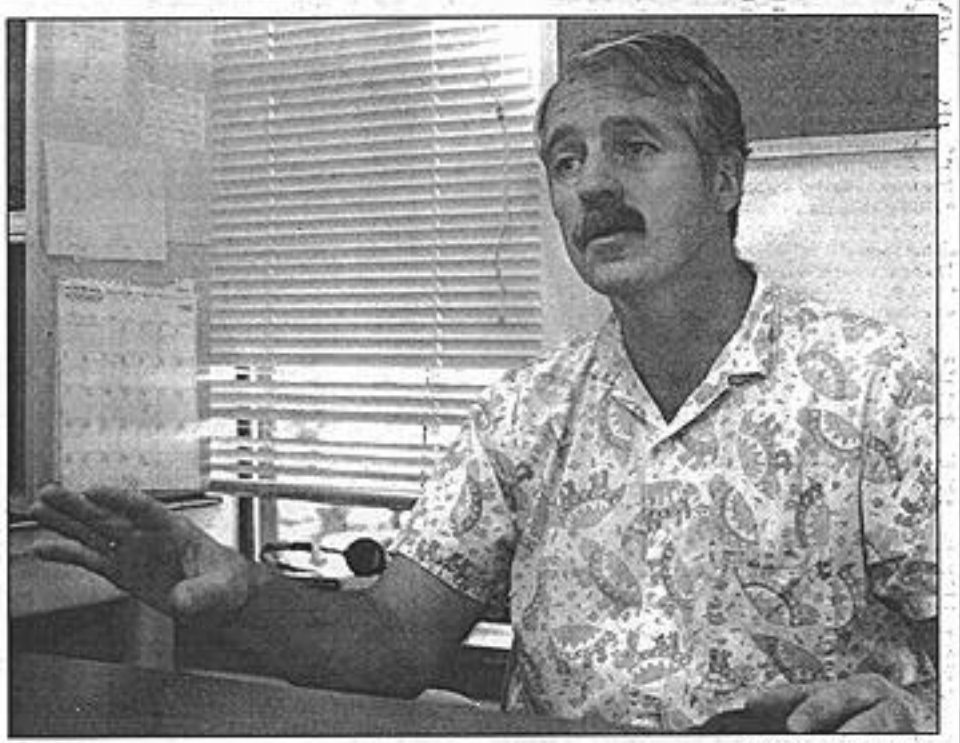
After many delays, including the blowup of the space shuttle Challenger in 1986, the Ulysses space probe was launched from the shuttle Discovery in 1990.

Until then, scientists had only been able to measure the solar wind at the sun's equator.

Ulysses was set in an orbit that would take it first under the south pole of the sun, then out and over the north pole, which will happen in five or six years.

John Phillips

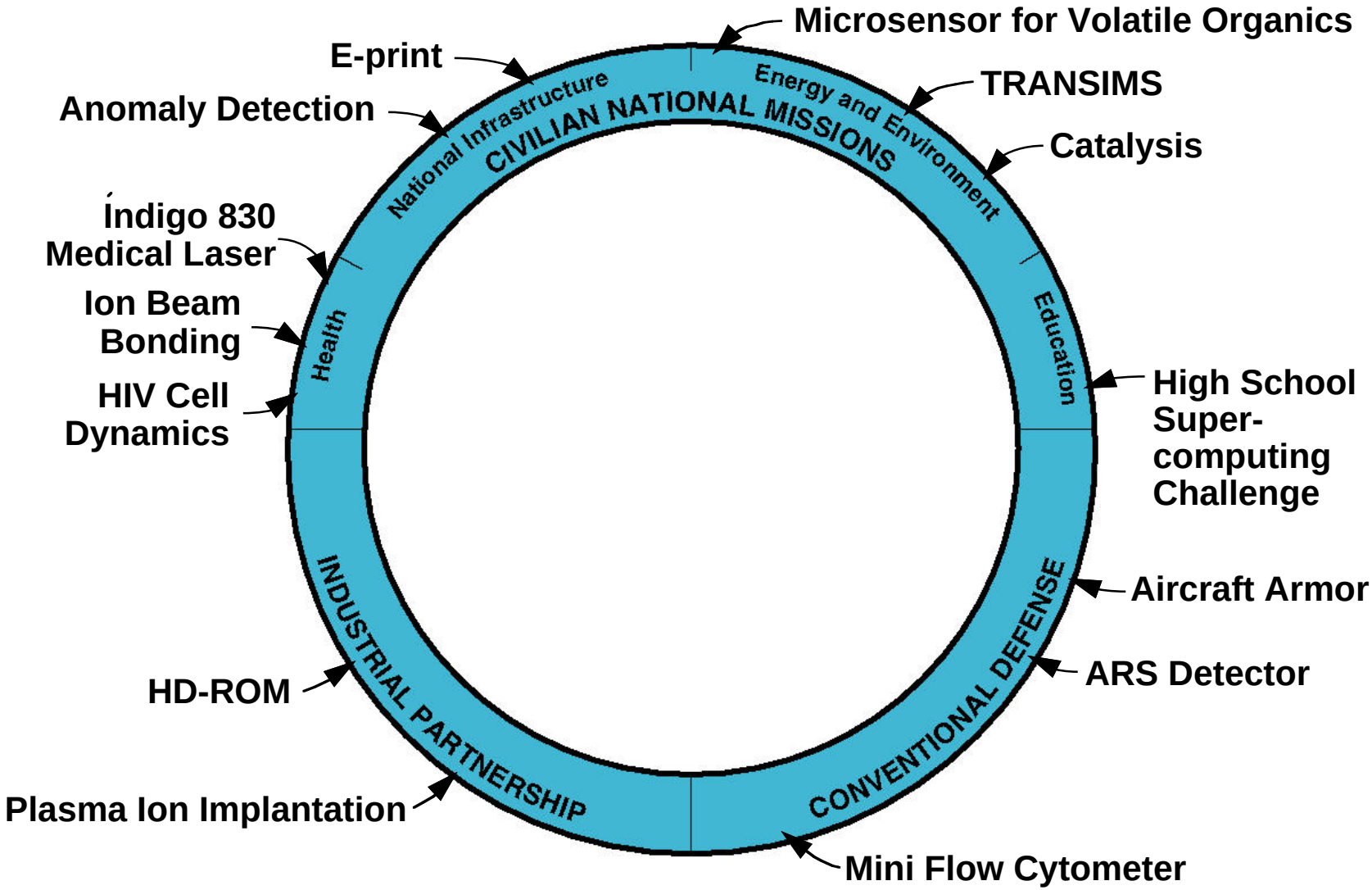
TITLE: Chief investigator, Solar Wind Plasma
RESIDENCE: Los Alamos
LONG-TERM GOAL: Become an astronaut



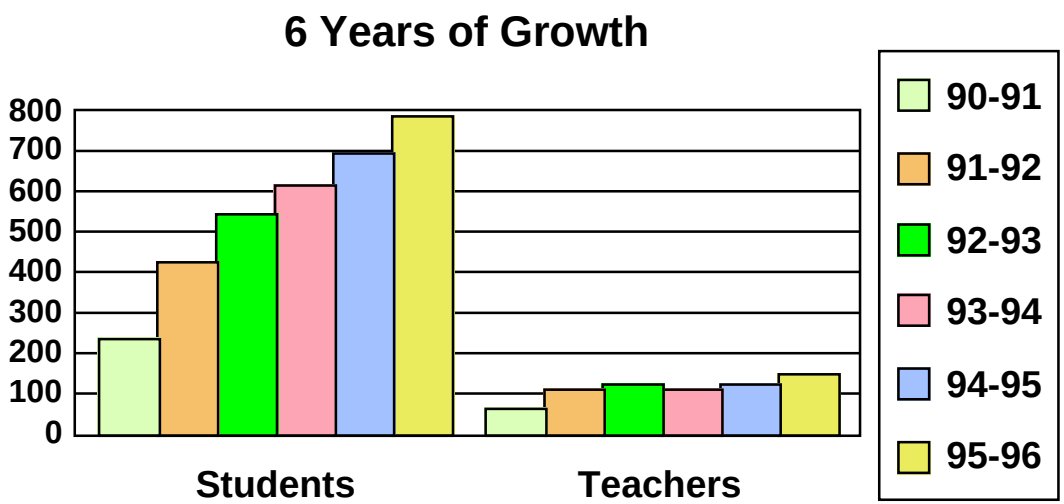
JAIME DISPENZA/JOURNAL

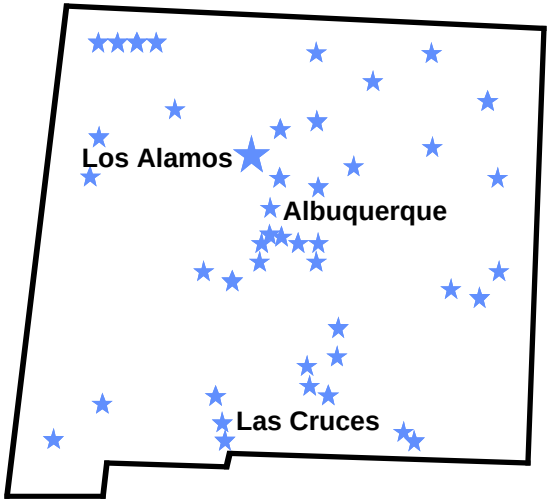
GONE WITH THE SOLAR WINDS: Los Alamos scientist John Phillips is the chief investigator of the solar-wind data being collected by the Ulysses space probe. "Eventually, we'll be a space-faring people. We need to know what's out there," he says.

Synergistic National Missions: 1995 Accomplishments



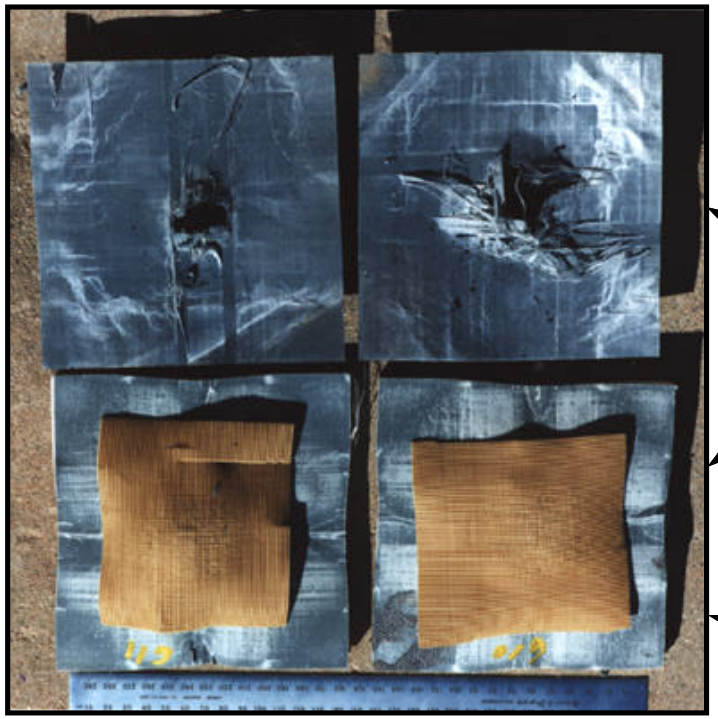
High School Supercomputing Challenge



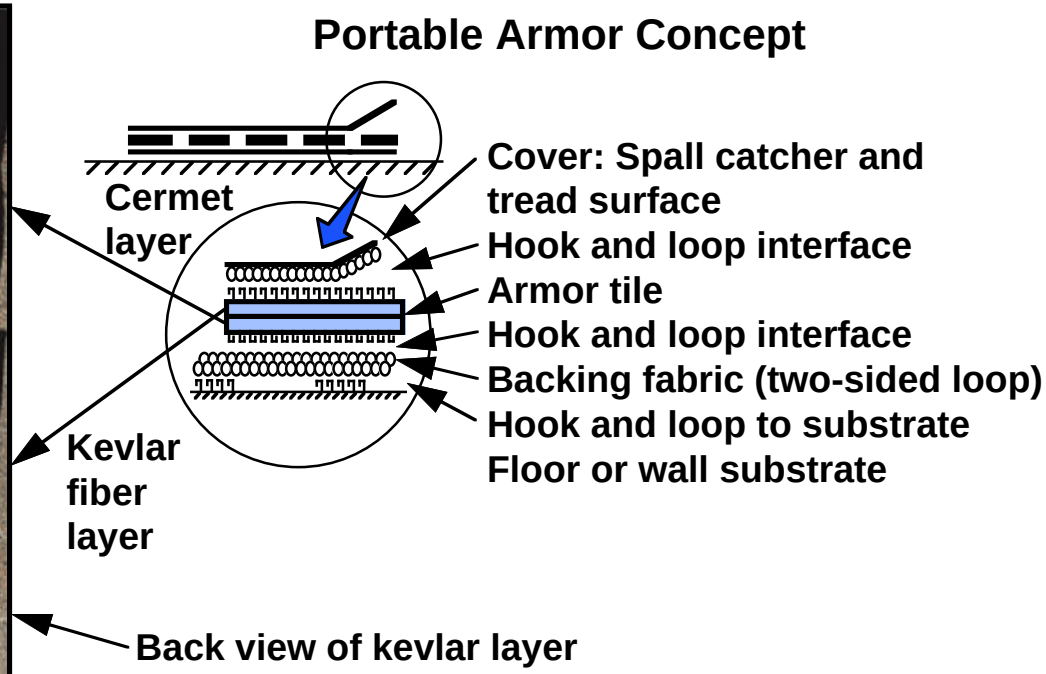


- 6th annual Challenge underway – 200 teams, over 800 students
- 30-40 project advisors from Los Alamos
- 1995 winner – Albuquerque Academy – prediction of radius necessary for an ice comet to reach Earth's surface

Aircraft Armor (C-141 and C-17 Cockpit Armor)



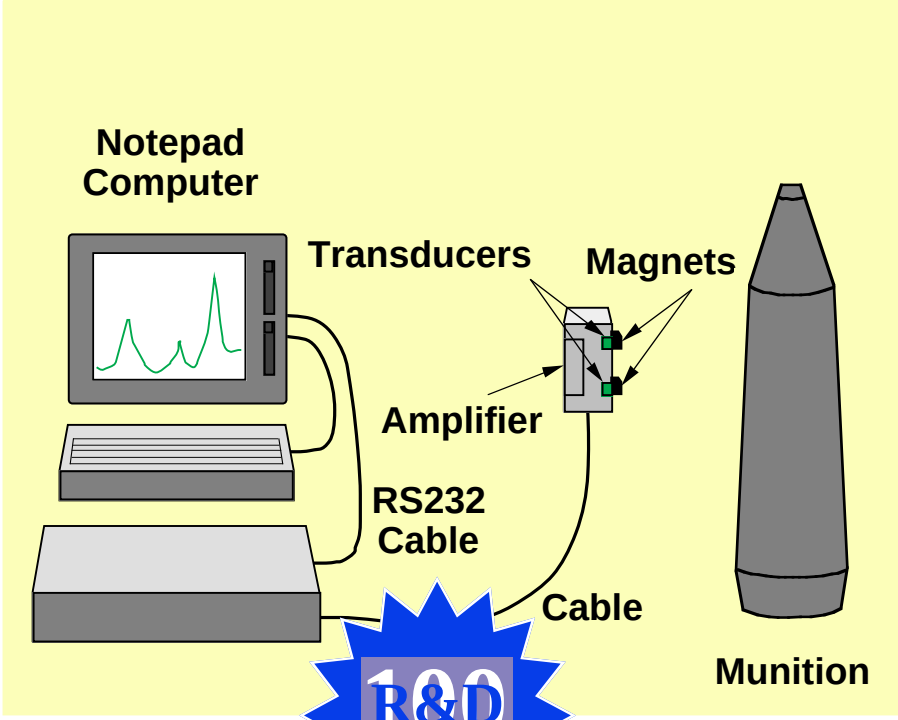
Rear of cermet layer showing penetration;
rear of fiber layer showing no penetration.



- Portable armor plates for walls and floor
- Interdisciplinary effort in materials technology
- Laboratory Distinguished Performance Award for 1995

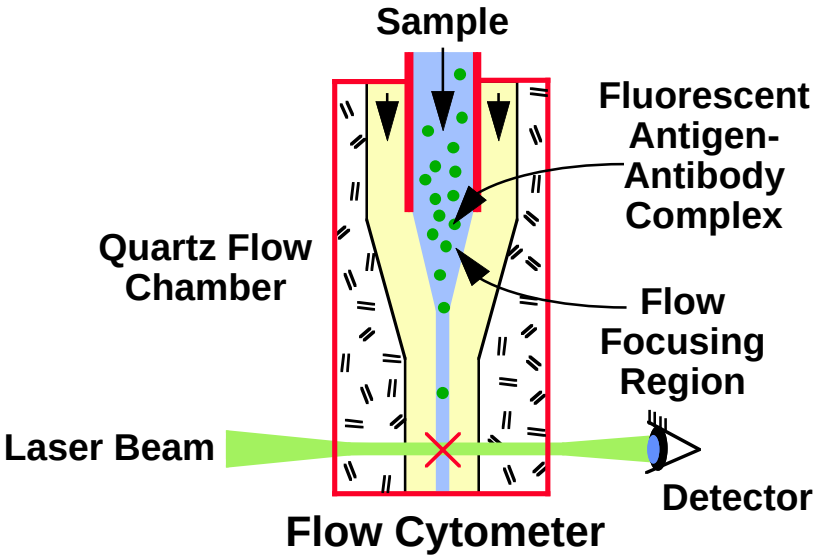
Acoustic Resonance Spectroscopy Chemical Fill Detector

- Tested 155 mm munitions containing VX, GB (sarin), and H (mustard)
- Munitions stacked on pallets in storage igloos; tested in place
- Blind test result: 90% reliability at 90% confidence
- Overall result: 96% reliability at 90% confidence

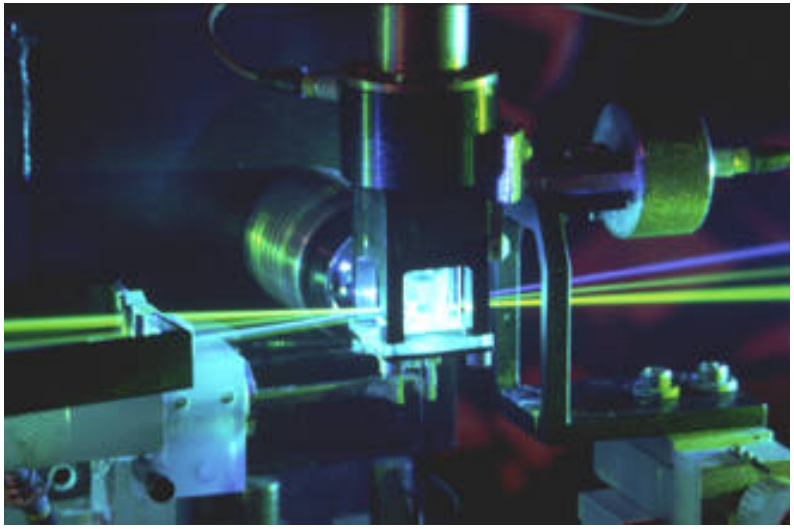


Miniature Flow Cytometer

- Developed for battlefield bioagent detection
- Rapid, specific ID; high sensitivity
- Useful for clinical microbiology, water monitoring, food production inspection
- CRADA under development



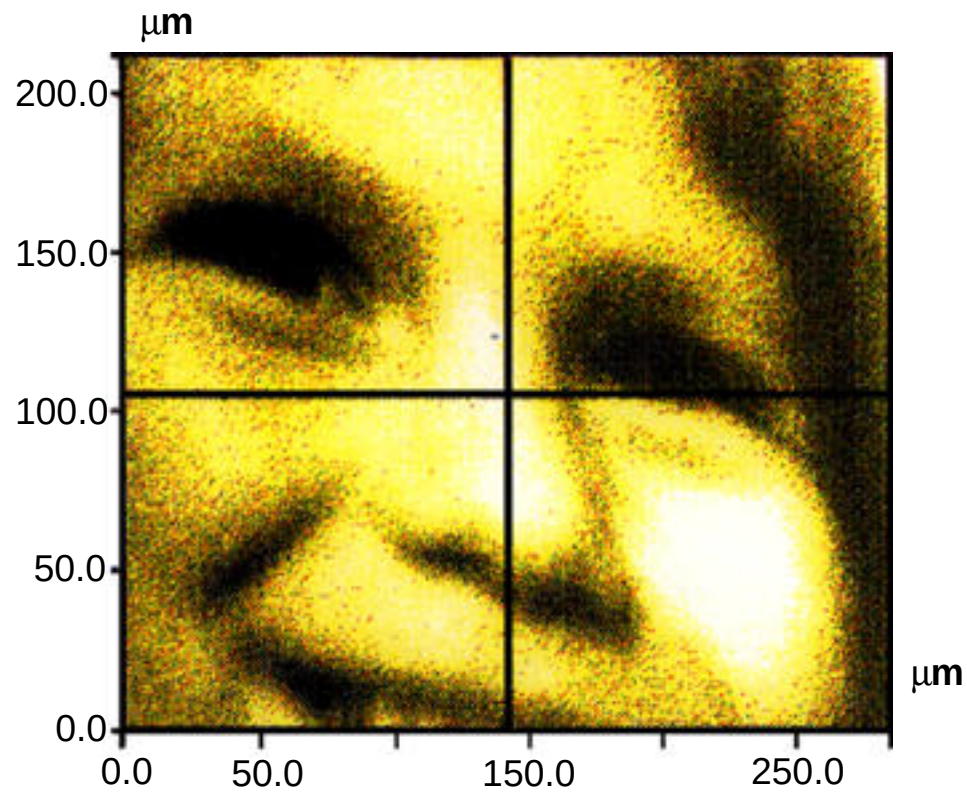
Flow Cytometer



High-Density Read-Only Memory

HD-ROM Produced by Focused Ion Milling

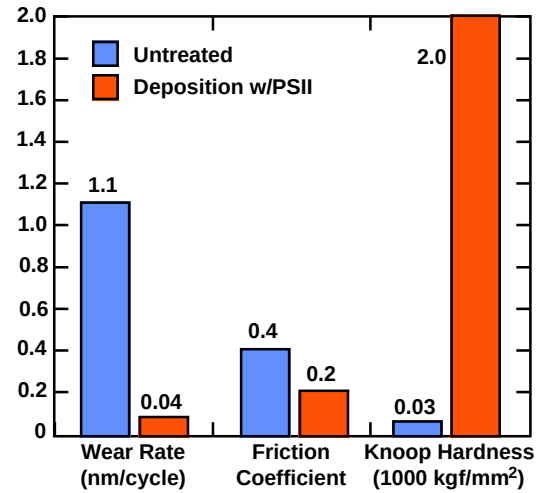
- **Digital, alpha, and graphic formats on same medium**
- **Variable depth milling gives analog or grayscale info**
- **~4×10^{12} bits/cm^2**
- **Survivable media; e.g., Si, Ir, Cu, Au**
- **NorSam Technologies will commercialize HD-ROM as microfilm replacement**



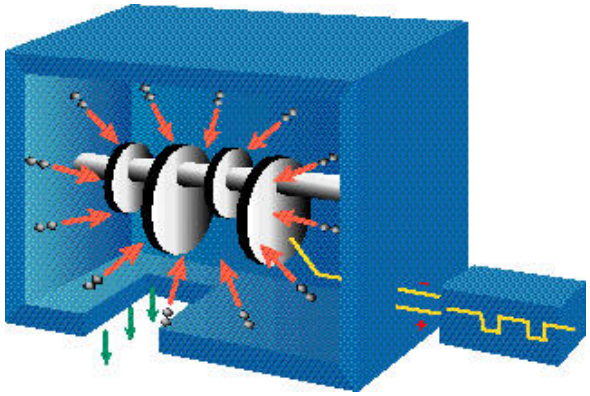
Mirau interferogram of ion-milled photo. Material: Au/Si

Plasma Source Ion Implantation (PSII) Improves Surface Wear

- **Technology: Plasma ions are pumped into car parts and tool surfaces to harden and reduce friction.**
- **Automotive Payoff: Increased lifetime of tools, dies, and powertrain components.**
- **Status: Large batches of pistons and tools treated through GM-LANL CRADA. First commercial system now under construction. Vertically-integrated ATP consortium formed.**
- **Next Step: Continued large-scale validation (through PNGV) with Chrysler, Ford, GM, + suppliers.**
- **CRADA: PNGV joint work statement in preparation.**
- **Partners: Chrysler, Ford, GM**
- **FY95 Funding: $1,625 K (GM-LANL CRADA)**



PSII aluminum treatment reduces friction, increases surface hardness

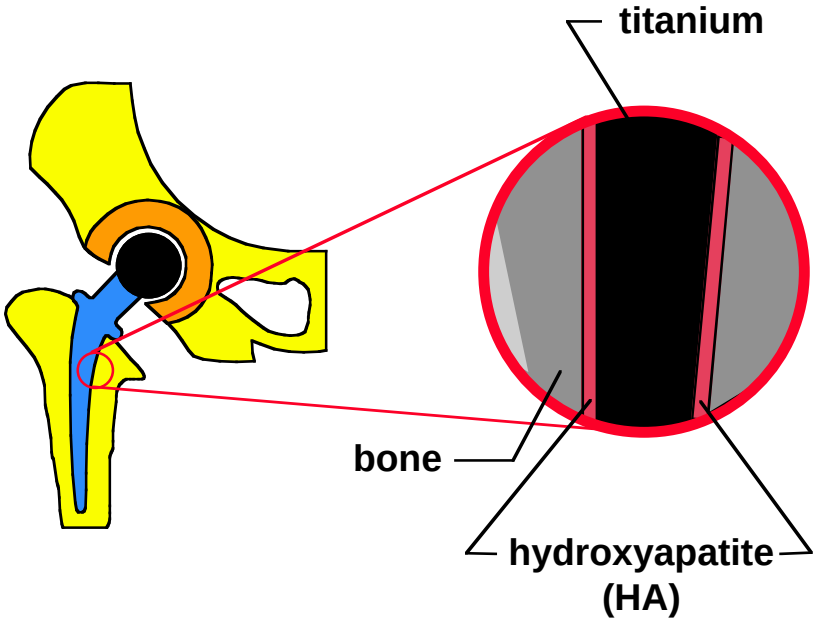


PSII is economical, non-line-of-sight method, practical for large-scale production

Ion Beam Bonding

Ion Beam Surface Treatment

- HA converted into ceramic
- HA to prosthesis bond stronger
- Bone to HA bond stronger
- Longer life for artificial joints



The Índigo-830

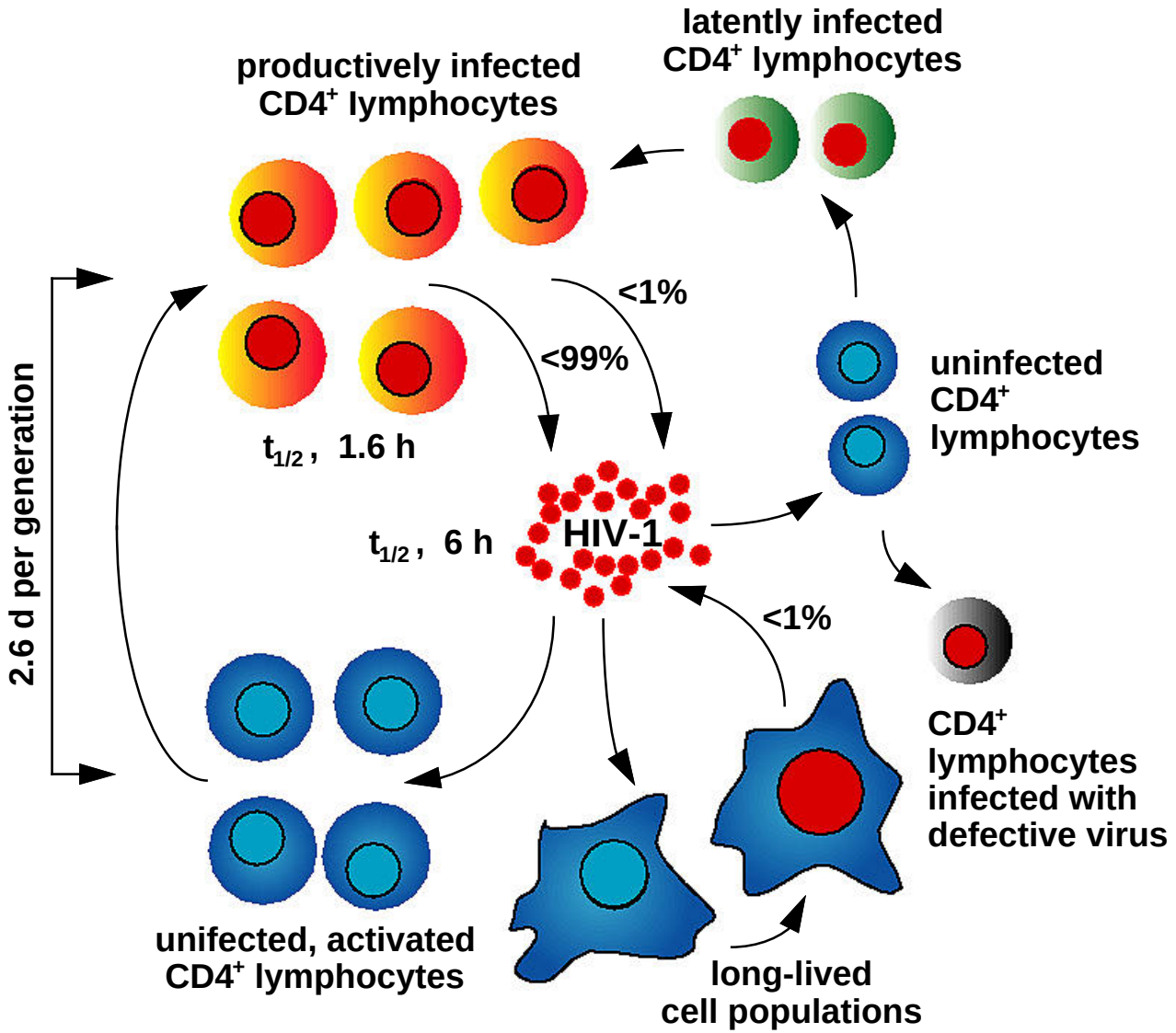
- Minimally invasive treatment for enlarged prostate
- Less patient discomfort
- Results from European clinicians report much faster recovery
- Reduced cost to the patient
- Private partner: Índigo Medical, Inc.

Índigo 830 Medical Laser

- Now sold commercially in several countries
- In Phase II FDA trials in U.S. – final approval expected this year
- Los Alamos expertise in biomedical optics attracted industrial partner
- 1996 Federal Laboratory Consortium Award for Excellence in Technology Transfer

Prostate Treatment	Current Procedure	Índigo 830
Procedure	Inpatient, surgical	Office or outpatient
Anesthesia	Spinal or general	Local
Discharge time	2-5 days	Immediate
Convalescence	4-6 weeks	2-3 days
Patient cost	~ $6,000+	~ $3,000
Preserves urethral integrity	No	Yes
Specialized training	Extensive	Simple

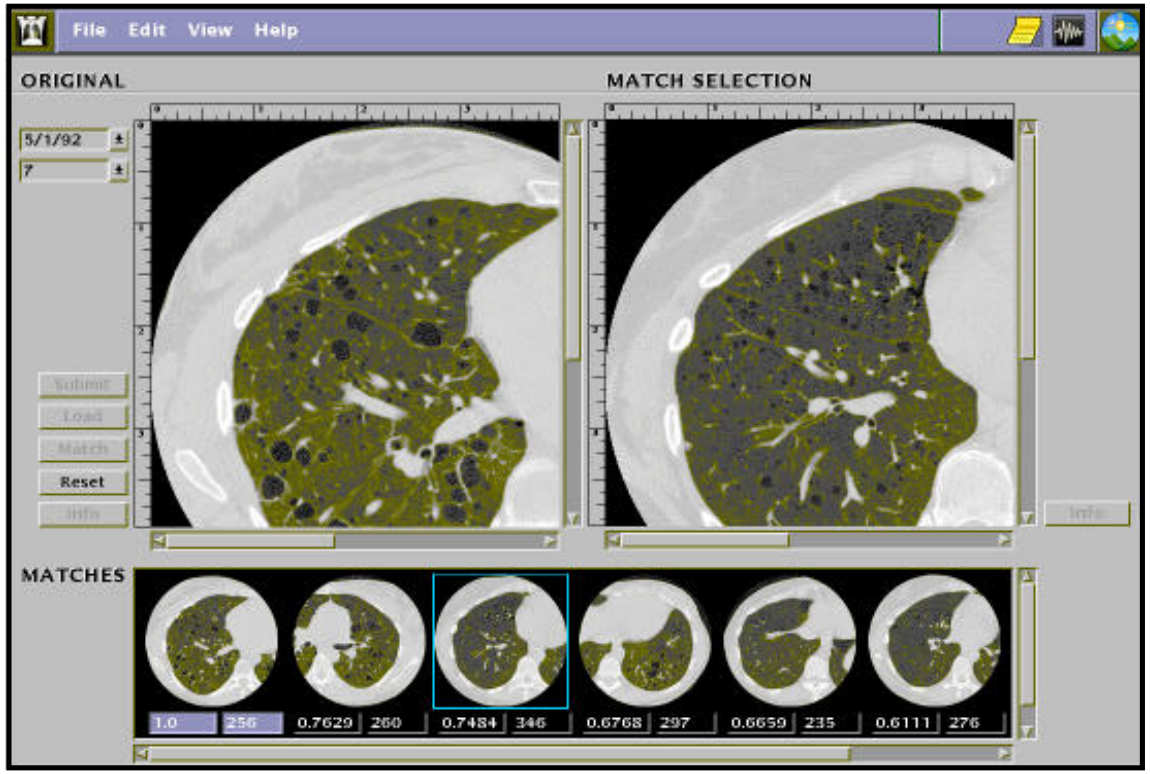
HIV Cell Dynamics



TeleMed

Distributed Radiographic Databases and Image Matching with Wide Area Access

- Completed full architecture
- Shipped to NIH and National Jewish Center for clinical evaluation
- Began to apply technology to weapons program



Anomaly Detection

Lab Helps Find Medicare Fraud

BY JOHN FLECK
Journal Staff Writer

Los Alamos National Laboratory scientists are turning their computer skills to helping the federal government root out Medicare fraud, lab officials have announced.

Under a $6 million, two-year deal with the federal Health Care Financing Administration, the lab will help set up a comprehensive repository of computer data for the federal agency, said Charles Slocomb, deputy director of the lab's computer program.

The lab is also discussing a similar project with New Mexico state officials, Slocomb said.

The project should "have an immediate impact in helping to reduce Medicare fraud," Financing Administration director Bruce Vladeck said in a statement issued this week announcing the project.

The HCFA came to Los Alamos because of the lab's experience in finding patterns in data in large computer databases, Slocomb said.

For years, Los Alamos specialists have studied techniques for finding patterns in large databases, techniques that have been valuable in the U.S. nuclear weapons program.

Now, those same techniques will be applied to finding patterns of Medicare fraud, Slocomb said.

The computers will be programmed to identify questionable Medicare claims by comparing them to specific characteristics found in fraud cases.

The computer will not directly identify fraud.

Medicare Fraud Detection

- **Funded for 1996**
  by Federal Health Care Financing Administration
- **Developed in 1995**
  building on Lab's expertise and related projects

LANL To Help Root Out Medicare Fraud

from **PAGE 1**

Instead, it will single out questionable cases for further investigation, Slocomb said.

Currently, Medicare checks are sent out quickly, and investigators try to track down fraud after the fact. With the new system, HCFA will "use high-performance computers to identify fraudulent claims before they are paid," Vladeck said.

The problem de
amounts of comp
because of the larg
claims processed —
1994 and rising ye

said.

"It's going to be huge," Slocomb said of the Medicare database.

The Los Alamos work is part of a larger effort by the Health Care Financing Administration to streamline its computer operations. Currently, the information on individual claims is spread out across many computer databases.

Los Alamos, with extensive expe-

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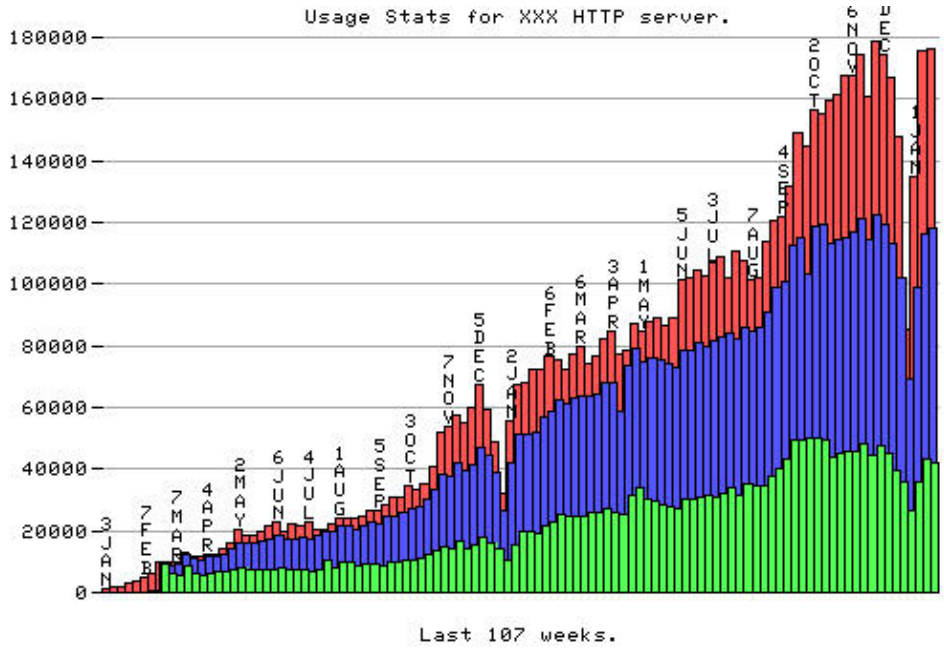
E-Print

- Faster access to research results
- ~30 subfields of physics, math, nonlinear science
- 13,000 papers automatically processed in 1995
- 70,000 accesses/day to Los Alamos server
- Wide recognition in media

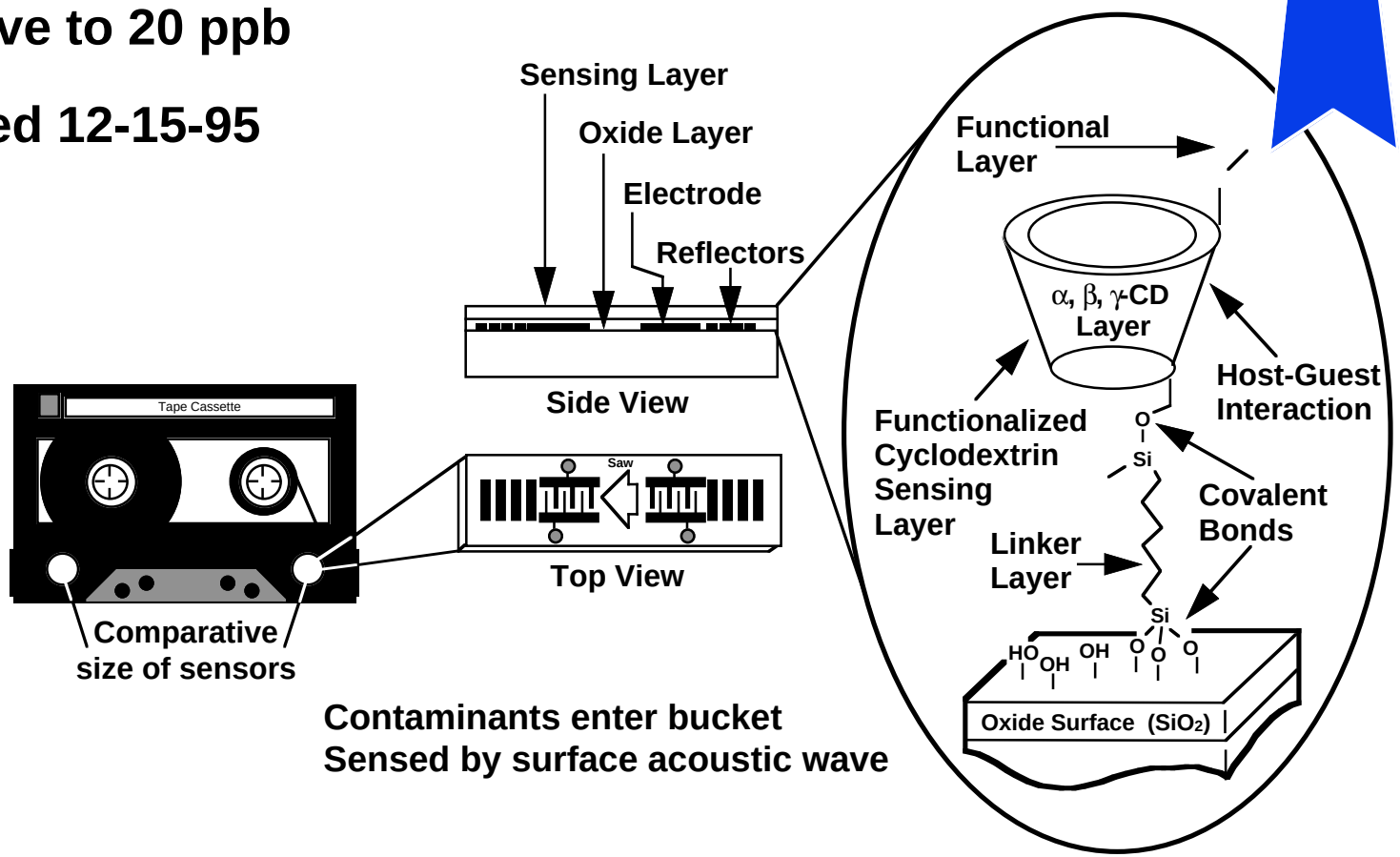


Two Years of Growth

Microsensor for Volatile Organics

Smart-Film Chemical Microsensor

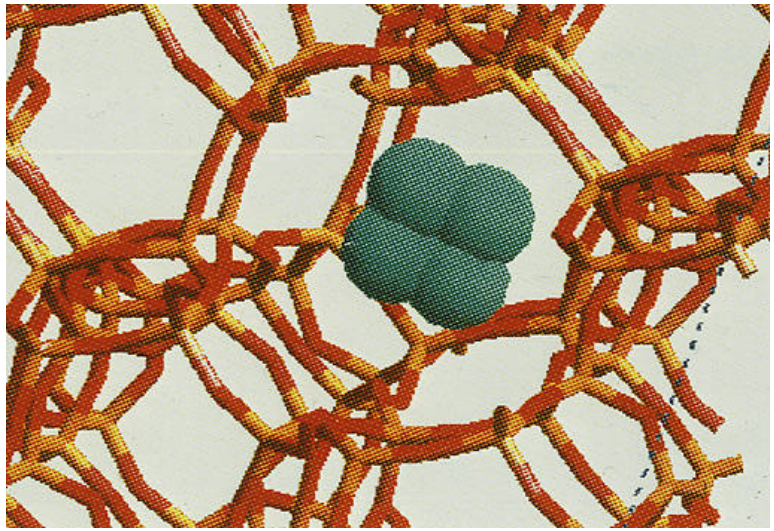
- Sensitive to 20 ppb
- Patented 12-15-95



Contaminants enter bucket
Sensed by surface acoustic wave

Development of Catalytic Processes

- **Homogeneous Catalysis**
  - **Asymmetric lanthanide complexes for polymerizations**
  - **Catalysis in supercritical fluids**
- **Microwave-Assisted Catalysis**
  - **NO_x, SO_x, and air toxics abatement technology development**
- **Zeolite Synthesis and Catalysis**
  - **Oxidation catalysis**
  - **Supported catalysts**
  - **Environmental catalysts**
- **Characterization Tools**
  - ***In situ* spectroscopies**
  - **Solid-state multinuclear NMR**
  - **Neutron scattering**
  - **Surface science**



TRansportation ANalysis and SIMulation System

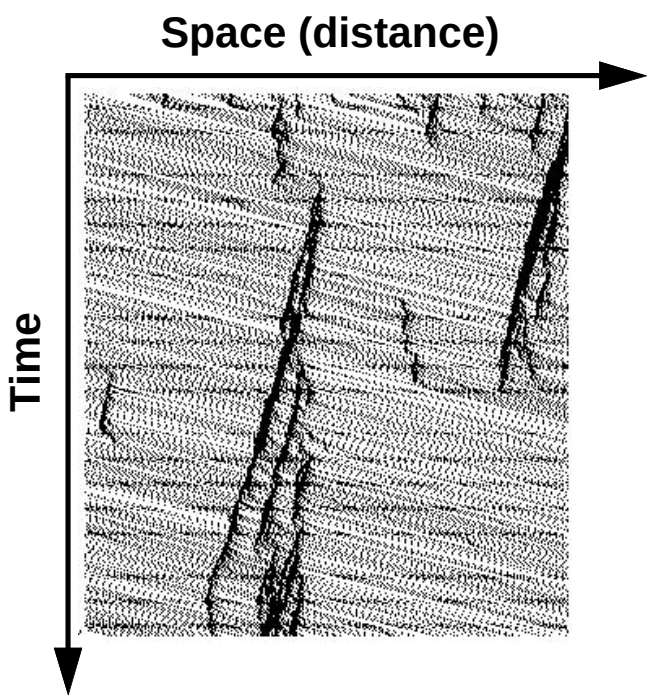
TRANSIMS

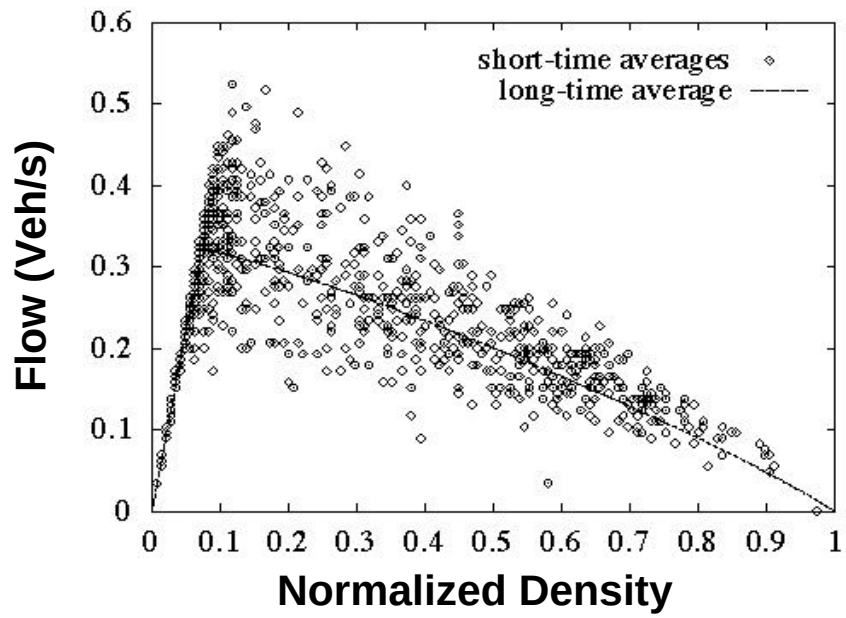
Cellular Automata Rules, Lattice, & Update

Traffic Jam Production

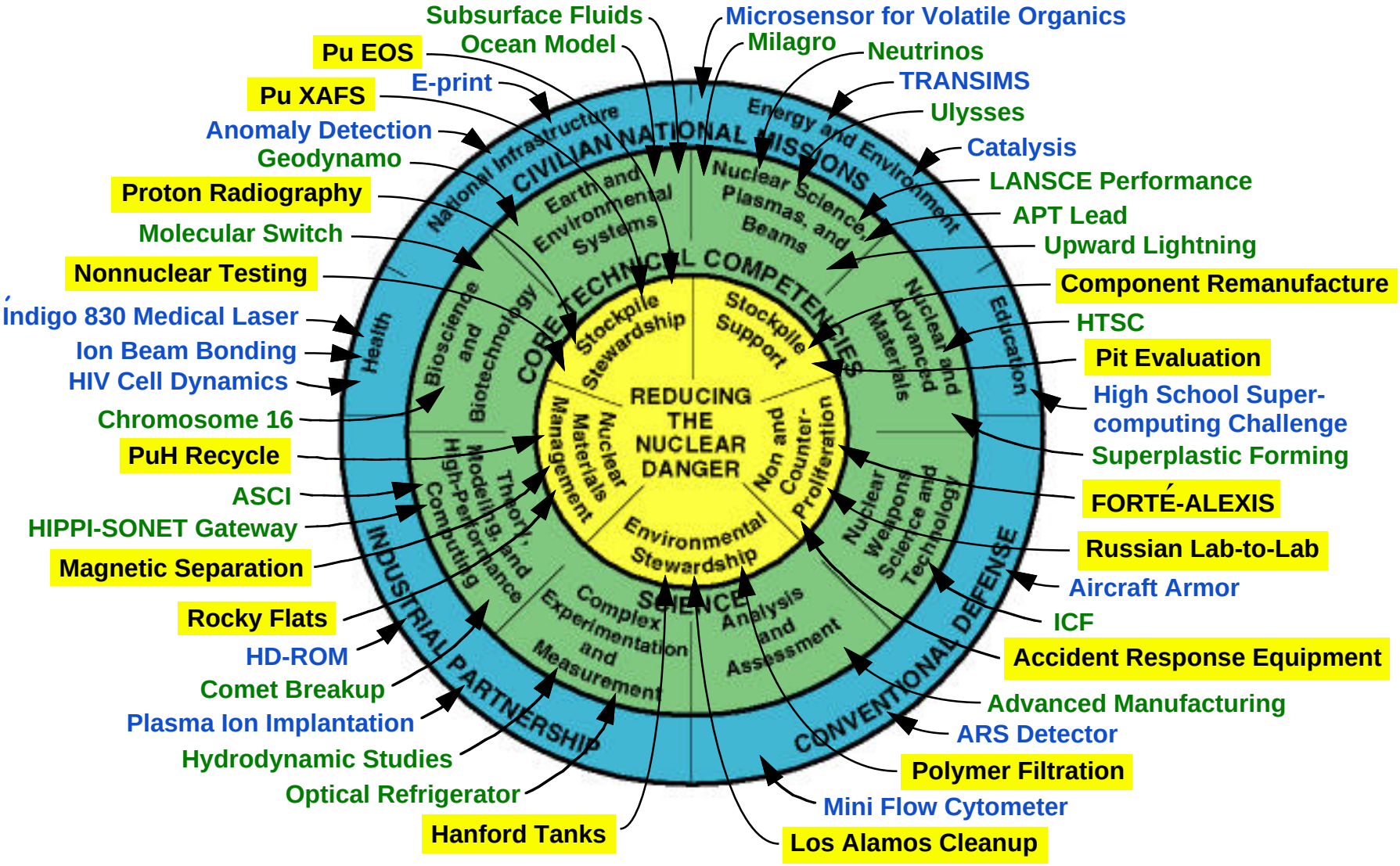
Connected to Traffic Theory and Extensions

Flow-Density Relations





Summary—Selected 1995 S&T Accomplishments



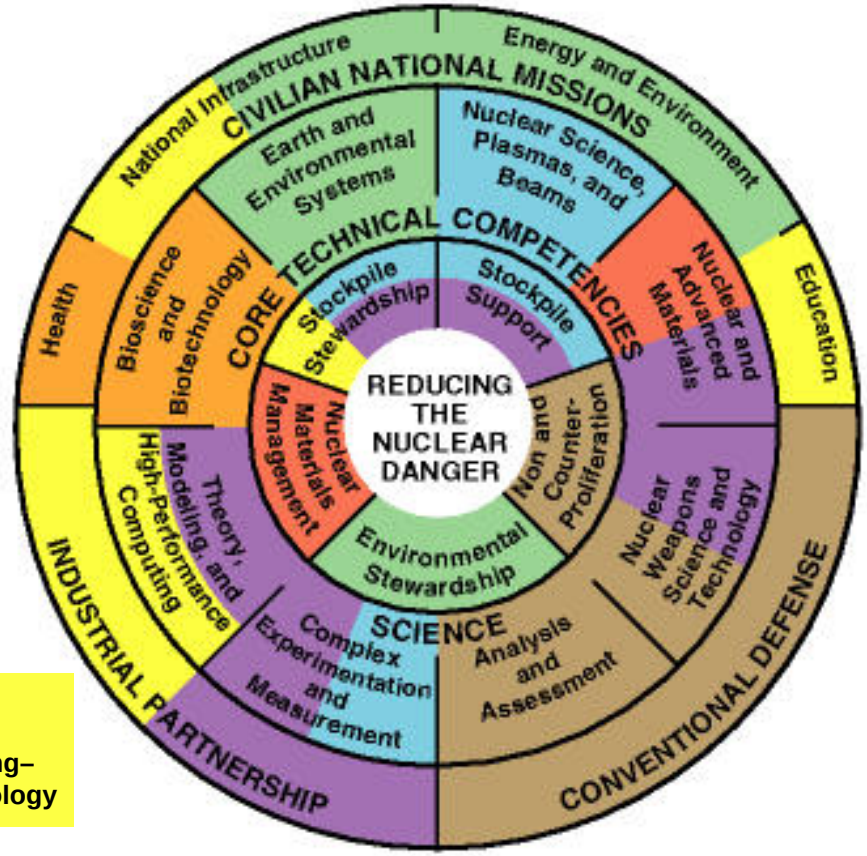
Tactical Goals FY96–97

SBSS
Science-Based Stockpile Stewardship

Genome and Beyond

Pu Future

HPC–IS&T
High-Performance Computing–Information Science & Technology



Environmental Science

Neutron Lab

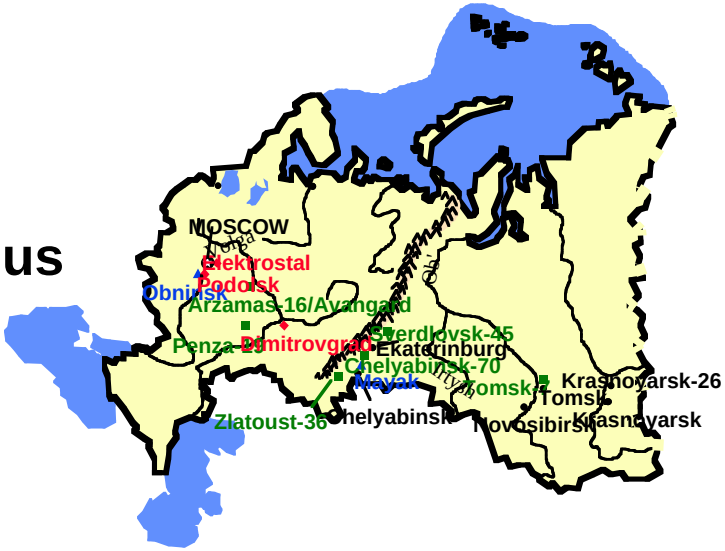
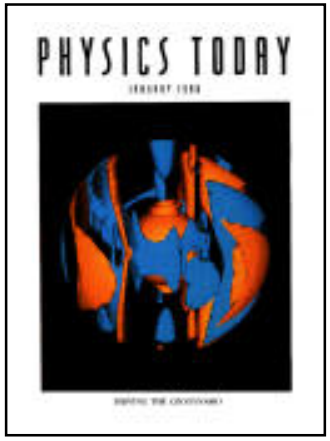
NBC
Nuclear-Biological-Chemical Nonproliferation

Strategies

- National defense with nuclear focus
- Emphasize science, strengthen technical competencies within defense core
- Multiprogram environment feeds S&T competencies

Los Alamos Must Continue to Play a Vital Role in the Nation's Security and Well-Being

- **Compelling mission**
  John Barry–*Newsweek* Feb. 12, 1996–
  "Arzamas-16 was once a very dangerous place. Its ties to Los Alamos offer the best hope that it will never be again."



- **Great Science**