

CSES FY21 Call for Proposals

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1 Introduction

The Center for Space and Earth Science (CSES) at Los Alamos National Laboratory (LANL) is one of the six Science Institutes in the Lab's National Science Education Center (NSEC). It covers six specific science disciplines, each directed by a focus leader:

- Astrophysics (Chris Fryer; fryer@lanl.gov)
- Space Science (Vania Jordanova; vania@lanl.gov)
- Planetary Science (Lisa Danielson; ldanielson@lanl.gov)
- Geophysics (Char Rowe; char@lanl.gov)
- Earth Systems (Sanna Sevanto; sanna@lanl.gov)
- Biological Systems (Jeanne Fair; jmfair@lanl.gov)

1.1 CSES Science Discipline Portfolio

Astrophysics - with the goal of advancing theoretical, modeling, computational and experimental sciences that map to capabilities needed in divisions involved in weapon simulation (e.g., nuclear physics, radiation hydrodynamics, plasma physics, Magneto HydroDynamics (MHD), uncertainty quantification) and national security (e.g., nuclear detection, transients, sensing, imaging, space weather).

Space Science - with the goal of advancing our understanding of the space environment from the Sun to the Earth and beyond - with the particular goal of understanding how the space environment affects the systems in space that support security and quality of life in our increasingly technological society. We include here development of heliophysics mission concepts.

Geophysics - with the goal of advancing theoretical, experimental, modeling, and simulation studies in basic Earth processes as well as promoting capabilities needed for a better understanding the perturbation of natural geologic systems in response to human actions. These perturbations include changes in pore pressure, temperature, permeability; fluid/gas chemistry; as well as density, rigidity, compressibility, electromagnetic properties and seismic propagation characteristics.

Earth Systems - with the goal of advancing and integrating theoretical, modeling, and simulation with sensing, observational, and experimental sciences that push the frontiers of predictability of weather and climate, their variability and their responses to anthropogenic forcing, and to understand how to strengthen the resilience of interdependent infrastructures, both in today's and in future climate states.

Planetary Science - with the goal to advance our knowledge of planetary bodies beyond Earth, including surface properties and processes, internal structures, atmospheres, and evolution over time. We seek to advance our abilities to design, build, and operate remote instruments in extreme environments. Planetary Science utilizes data from a broad swath of platforms, including satellite, airborne, in situ, and laboratory measurements.

Biological Systems - with the goal of advancing the study of biological systems as part of complex natural systems, and addressing the signatures of natural or human-induced phenomena on such biological systems, including disease dynamics at the human/environment interface. This includes observational, experimental and modeling approaches.

1.2 CSES Strategy

As one of the six strategic centers organized under NSEC, CSES is chartered to foster high quality research efforts, specialized recruiting, and strategy development within its assigned scientific discipline areas.

The main purpose of strategic centers is to:

1. Focus on laboratory wide strategically important areas of science, engineering, or technology that span areas of expertise beyond that residing in any single management structure,
2. Provide external visibility and collaboration in strategic areas of need, that require a single laboratory voice,
3. Provide education for present and future scientists and engineers that are required to maintain LANL competency,
4. Help with recruitment or retention of technical talent.

This call supports initial research through student, postdoc and staff opportunities that build new capabilities or explore new approaches for the LANL mission, or that support anticipated future mission needs and new mission areas, in the science disciplines supported by CSES. The science goals for the CSES disciplines are in support of the broader strategic goals of the Laboratory (“Proud Legacy, Bold Future”) and the Science Pillars that map to it. The Laboratory’s Signature Science goals encapsulated in the Science Pillars is the LANL response to a range of national strategic plans that cover LANL’s mission area, such as the DOE/NNSA “Prevent, Counter, and Respond—A Strategic Plan to Reduce Global Nuclear Threats (FY 2016–FY 2020)” report along with the DOE/NNSA “Stockpile Stewardship and Management Plan”, the DOE “Strategic Plan 2014-2018”, and the science research priorities as set out by the DOE Office of Science Funding Calls.

For CSES there is also a large overlap in the CSES science disciplines with NASA’s Science Mission Directorates in the areas of Planetary Science, Earth Science, Astrophysics and Heliophysics, and CSES is interested in supporting capability that would enable LANL participation in the NASA mission arena. LANL’s involvement with NASA is an invaluable recruiting tool, helps retain highly qualified staff, pushes LANL technology to perform in extreme environments and provides a visible outlet for LANL excellence not available in other programmatic areas.

While the CSES discipline areas contribute to many of the Los Alamos National Laboratory Science Pillars, they are particularly applicable to the Science of Signature (SoS) Mission:

“Characterize measures, signals and properties in or of complex systems. Detect or attribute change and predict behavior and impact across scales of space (subatomic to astronomic) and time (femtosecond to geologic)”

Signature Science addresses emerging challenges in the CSES disciplines by developing the scientific underpinning of signatures and backgrounds, new measurement techniques and

strategies for signature identification, the discovery of alternate or nontraditional signatures, and new analysis and interpretation tools for development of knowledge from these signatures.

Each CSES call for proposals highlights a set of focused science topics for each of the five discipline areas, which will change from year to year. These topics are selected based on challenges facing the international scientific community as well as on the strategic need to extend scientific excellence supporting the Los Alamos National Laboratory mission (See Section 0).

We particularly encourage young staff scientists to submit proposals that will help them build research programs and establish productive collaborations with universities.

In order to encourage highly creative and innovative ideas and concepts, CSES encourages revolutionary and moderate to high-risk research. CSES funds collaborative research involving Laboratory staff members, postdocs, university PI's and their students. A small amount of funding may be provided to conduct a technical feasibility analysis of a revolutionary concept. While many collaborative projects extend up to three years duration, funding in each successive year is contingent upon adequate progress in the previous year and the availability of LANL funding.

1.3 Changed in this call

Please pay particular attention to the following new or changed items in this year's call.

1.3.1 New: Biological Systems Focus Area

Starting with the Center's new R&D LDRD funding cycle in FY21, we are introducing a 6th Focus Area in CSES: Biological Systems (Section 2.6). The first CSES program that Biological Systems can compete in is the upcoming Rapid Response (Section 3.3) call: Round one - September 1, 2020 submissions for October 5, 2020 project start.

1.3.2 New: PostBaccs and PostMasters Students

The existing Student Fellow Program (Section 3.1) has been updated to also provide support for PostBacc (Section 3.1.2) and PostMasters (Section 3.1.3) Students. (Closed 04-30-2020)

1.3.3 New: Research Associate PostDoc Program component

We have created a second Postdoctoral appointment category in CSES – The CSES Research Associate. This is aimed at candidates that do not make the Postdoc's office cut for the Fellow program (such as the CSES CK fellowship) but are nonetheless a good fit for CSES.

1.3.4 New: "Special" Rapid Response (SRR-R&D) program

Based on the FY20 trial SRR on Microgravity we will add the SRR concept as part of the standard CSES offerings this year (Section 2.6 and 3.3.4).

1.3.5 Updates: Chick Keller, Large University Program and Focused Science Topics

1. The *Chick Keller Postdoctoral Fellowship* (Section 3.2), will accept nominations at the December and May PostDoc Program Quarterlies.
2. The *Large University Program* (Section 3.4) was offered (Closed 04-30-2020).
3. Small updates to the focused science topics (Sections 2.1 to 2.5).

2 Focused Science Topics

All CSES Proposals need to address the focused topics for FY21 in their science discipline area as outlined below.

Exception: for the Rapid Response Program (Section 3.3). While proposals along the lines of this call's focused science topics are encouraged, the program element is open to all new ideas relevant to the CSES discipline areas.

Exception: for the Special Rapid Response Program (Section 3.3.4). Proposals MUST address the relevant Special Rapid Response Topic as outlined in Section 2.6.

2.1 Astrophysics

Astrophysics and Cosmology in CSES is closely aligned with two of the focus areas of the Nuclear and Particle Futures (NPF) Pillar - Nuclear, particle, Astrophysics and Cosmology (NPAC) and High Energy Density Physics and Fluids (HEPF&F). Furthermore, Astrophysics and Cosmology are relevant to some of the goals described in the Science of Signatures Pillar as well.

See <http://www.lanl.gov/science-innovation/pillars/sos/index.php> and <http://www.lanl.gov/science-innovation/pillars/sos/index.php> for details.

Focus area

We emphasize advanced research in observation, theory, simulation, and instrumentation that strives to achieve fundamental understanding of the universe. In addition, this focus area benefits from and in turn strengthens its strong overlap with many on-going Laboratory programs in areas such as nuclear physics, particle physics, weapon physics, plasma physics, and condensed matter physics. It further utilizes and leverages the facilities and observatories both inside and outside of the Laboratory. We are interested in proposals that are innovative and forward-looking, especially those with strong potential leading to new capabilities and research directions.

It is strongly encouraged that proposals exploit unique and/or underutilized resources at Los Alamos National Laboratory, for example:

1. Facilities such as the HAWC, Raptor, ZTF, HET, LSST, LANSCE, NIF, Omega, etc.
2. Computational techniques, codes and resources, such as VPIC, FLAG, RAGE, Ristra, etc.
3. Broad knowledge base in a full range of physics that tie together theory, simulation, experiments, and observations

Specific Topics for new projects starting in FY21:

Overall theme is to conduct cutting-edge research that enables breakthroughs in our understanding of Astrophysical Transients through innovative uses of unique LANL observational, theoretical, numerical and experimental capabilities. The area of Astrophysical

Transients is a rapidly developing field in astrophysics, e.g., discoveries of gravitational wave sources, fast radio bursts, etc. Transients dominate discussions of multi-messenger astronomy, an emerging theme in astronomy. LANL is ideally suited to dominate this astronomy theme, especially with its expertise in integrated systems (combining physics studies, experiment, computational work and detector development). This also ties well with multi-physics efforts within LANL's Advanced Simulation and Computing effort. The likely engines for such transients are astrophysical compact objects such as black holes, neutron stars and stellar explosions. Most of these subjects are tied closely to LANL expertise. Transients connect much of the natural phenomena observable in our universe to similar physical processes in LANL programmatic areas of the high temperature and pressure, often turbulent physical regimes, while being at the forefront of current astrophysical research, and having the capability of attracting the brightest minds to Los Alamos.

1. **Advancing theory and modeling capabilities.** *Development that sheds light on understanding Astrophysical Transients will be emphasized:*
 - a. *Applications of ASC codes to problems focused on astrophysical transients. Simulation codes in general that are suitable for Exascale Computing platforms to study systems with radiation magnetohydrodynamics, charge particle energization and transport connecting fluid and kinetic regimes*
 - b. *Applications include neutron stars, pulsar wind nebulae, supernovae, fast radio bursts, gamma-ray bursts, gravitational wave sources, black hole formation, jets and flares, signatures from exoplanetary systems and protoplanetary disks.*
2. **Developing new technologies and tools.** *Support activities that will develop new technologies and tools that contribute to new missions and facilities. These new missions and facilities should be strongly connected with Astrophysical Transit sciences. Some examples include:*
 - a. *Data mining and machine learning for ground- and space-based detectors*
 - b. *Optical, X-ray and gamma-ray transient detections (possible NASA missions)*
3. **Supporting upcoming NASA Astrophysical Mission participation.** *Work that builds the capability for mission participation from either a theoretical or preferably an instrument development angle, for upcoming missions of interest to LANL (e.g., the All-sky Medium Energy Gamma-ray Observatory, the Transient Astrophysics Probe, the Lunar Occultation Explorer, Astrophysical Transient Probe).*

In addition, proposals that demonstrate strong collaborations (both internally and externally) as well as branch out to new Astrophysical Transient science areas are particularly encouraged.

2.2 Space Science

Space is one of the six leadership areas of the SoS pillar. The SoS strategy document lists goals for Space, and the topics chosen should relate to them. Space is also relevant to some of the goals of the Nuclear Event Characterization leadership area of the SoS pillar.

Refer to <http://www.lanl.gov/science-innovation/pillars/sos/index.php> for details.

The overarching research goals for this call in the Space Science focus area are to advance our understanding of the space environment (from the Sun to the Earth and beyond) and to advance

our ability to operate systems in space that protect life and society. Space Science is distinct from other field, such as astrophysics or cosmology, in that Space Science utilizes in-situ measurements from high altitude rockets, balloons and spacecraft or ground-based measurements of objects and conditions in space.

Focus area

We particularly encourage proposals that: enhance LANL participation in future space science missions; make use of unique LANL datasets and modeling capabilities to enhance scientific analyses of past and ongoing missions; and develop advanced cross-disciplinary capabilities that combine simulation, modeling, machine learning, data assimilation and data analysis concepts. The latter is particularly appropriate as some of the relevant models evolve toward exascale computing environments. The broad topic areas encompassing either existing or desired expertise at LANL in space science are: in-situ measurements and remote sensing capabilities, use of novel observing locations, active experiments in space, development of multi-scale modeling capabilities, exploration of short term (e.g. geomagnetic storms and substorms) and long-term (e.g. solar cycle) trends in LANL and other complementary datasets, and naturally and artificially disturbed ionospheres and magnetospheres.

It is strongly encouraged that proposals exploit unique resources at LANL which include:

- a. LANL satellite experiments and data
- b. LANL remote sensing experiments and data
- c. LANL space science computer simulation codes and algorithms.

Specific Topics for new projects starting in FY21:

The overall theme is to conduct cutting-edge research that enables fundamental breakthroughs in our understanding of the space environment through new missions, advanced cross-disciplinary modeling capabilities and innovative uses of unique LANL data or numerical modeling resources. From the above topic areas, the following focused science topics are chosen for FY21:

1. ***New Missions.*** *Exploration and support for LANL participation in future space-based missions. Specifically, work that explores novel new mission concepts that could include LANL participation or work that supports LANL mission involvement in upcoming missions or mission proposals.*
 - a. *Active experiments in space exploring applications beyond the current CONNEX and HANE remediation applications.*
 - b. *Remote sensing of the ionosphere, magnetosphere and heliosphere.*
2. ***Advance Simulations.*** *Cross-disciplinary simulation, modeling and data analysis for space plasmas.*
 - a. *Development of hybrid modeling capabilities (e.g., first principles models with data assimilation, MHD + particle models).*
 - b. *Development of cross-disciplinary capabilities (e.g., in-situ visualization, inference, machine learning, and model steering).*

3. ***Innovative uses of unique LANL data or numerical modeling resources.***
 - a. *Use of LANL energetic particle measurements to compliment other scientific studies using Van Allen Probes (RBSP), Arase, LEO, and Magnetospheric Multi-Scale (MMS) data.*
 - b. *Building reduced-complexity and empirical models.*

2.3 Planetary Science

Planetary Science is an interdisciplinary field that overlaps with many of the six leadership areas of the Science of Signatures (SoS) pillar, in particular Space Signatures and Chemical and Materials Signatures. The SoS strategy document lists goals for each of the six leadership areas, and the topics chosen should relate to them.

Refer to <http://www.lanl.gov/science-innovation/pillars/sos/index.php> for details.

Planetary Science represents a high visibility area for LANL with high-profile ongoing and future NASA mission participation, and has been an exciting growth area at LANL. This focus area is a hybrid since the technology used is similar to the Space Focus area, while the scientific topics of planetary evolution and geology relate to the Geophysics Focus area.

The goal of the Planetary Science focus area is to advance our knowledge of planetary bodies beyond Earth, including surface properties and processes, internal structures, atmospheres, and evolution over time. We also seek to advance our abilities to design, build, and operate remote instruments in extreme environments. Planetary Science utilizes data from a broad swath of platforms, including satellite, airborne, in situ, and laboratory measurements.

Focus area

We encourage research in observation, measurement, instrumentation, and data analysis to understand planetary environments and processes. Projects should primarily address planetary bodies within the Solar System, although research on exoplanets will be considered. This focus area has significant overlap with other laboratory-relevant programs that may provide new techniques or novel applications of existing techniques or instrumentation for planetary problems. Although research that deals primarily with the Earth environment are not solicited, projects that utilize Earth analogs (including field studies) and laboratory experiments for planetary applications are encouraged. All NASA planetary missions make their data available to the public; projects that develop new analysis methods for these data are relevant to this focus area. Also of interest are projects that leverage unique Los Alamos facilities or capabilities. We strongly encourage proposals that pursue new, innovative scientific research and that enable future planetary missions.

Specific Topics for new projects starting in FY21:

1. ***Enabling planetary exploration.*** *We invite teaming and strategy proposals that aim to partner LANL with other institutions to produce the technical basis to respond to*

upcoming NASA program calls. Proposed work may include laboratory, terrestrial analog, and/or data analysis projects. Proposals are encouraged in the following topics:

- a. Advanced computation techniques – this includes modeling of large-scale planetary processes as well as novel interface tools and uses of large planetary mission data sets to solve planet formation and evolution science questions, including chemical and physical states of planets. This also includes planetary dynamic processes, such as impacts.*
 - b. Next generation instruments – this includes experiments to validate transformation of ground-based technology to mission platforms, particularly for detection of water and organics, both remote sensing and in situ analyses.*
 - c. Projects that enhance the lab’s ability to compete in planetary science cubesat/smallsat missions for future calls in Small Innovative Missions for Planetary Exploration.*
- 2. Sustainability and Science - Lunar Exploration Analysis Group (LEAG).** *We encourage proposals that leverage interaction within the local New Mexico Space Valley (NMSV) corridor, including universities, commercial space companies, and national laboratories to investigate Science and/or Sustainability goals as posed by LEAG. Proposals relevant to this topic include:*
- a. Projects that enhance long duration human spaceflight and lunar exploration and are relevant to the Lunar Discovery and Exploration Program, as well as Commercial Lunar Payload Services. This includes technologies for human operations in space and on the moon that will enhance human operations in extreme environments on earth. Projects may also support payload concepts and development for lunar exploration and operations that are relevant to the Science of Signatures pillar.*
 - b. Novel materials and space manufacturing – this includes in situ resource utilization projects and manufacturing and synthesis of materials in a microgravity/orbital environment.*

2.4 Geophysics

The Geophysics Focus Area is grounded in two of the lab’s science pillars – *Integrating information, science, and technology for prediction (IS&T), and Science of Signatures (SoS)*. The integration of information science and the evaluation of signatures provides an avenue for improving LANL’s capability in *sensing* (improved extract of useful information from data and detection of small events in noisy data sets) and *predicting* (improved understand of the behavior of complex Engineered Natural Systems despite inherent uncertainty) - informed by observational efforts over variations in spatial or temporal scale.

See <http://www.lanl.gov/science-innovation/pillars/ist/index.php> for details; and *Science of Signatures (SoS)*, refer to <http://www.lanl.gov/science-innovation/pillars/sos/index.php> for details.

The overall theme for the Geophysics Focus Area is research to help expand capabilities related to national security. Newly emerging interests among Federal agencies include geophysical techniques to address border security, shallow subsurface characterization relevant to military operations, robust data acquisition using remote methods in hazardous regions, and extending the footprint of our sensing capability by leveraging new sensor technology, new data extraction methods and improved access for hazardous or traditionally denied regions. Studies that integrate theoretical, observational, experimental, modeling and simulation efforts to address technical challenges in understanding the earth's surface and/or subsurface are of particular interest. Geoscience topics that play a fundamental role in supporting LANL's core mission include change detection for surface or subsurface signatures (temporal, chemical, biological, physical, geodetic), and anomaly detection for these signatures. Particularly important is building our capacity to integrate the independent signatures and apply their combined interpretation in novel environments to extend the reach of our models and detection capability.

Focus Area

The Geophysics focus area supports basic and applied research concerning the Earth's surface and lithosphere. This research includes numerical, experimental, and field studies of the structure, properties, processes, and dynamics of the Earth. It is strongly encouraged that proposals exploit unique resources at Los Alamos National Laboratory which include:

- a) Sensor technology capabilities resident in C, EES, ISR, and N divisions
- b) Los Alamos National Laboratory high-performance computing resources and/or innovative exploitation of LANL interfaces with modern cloud computing resources
- c) Geochemical analyses facilities resident in EES and C divisions
- d) Emerging field surveying advances such as UAV data acquisition

Specific Topics for new projects starting in FY21:

1. ***Exploiting advances in robotics and automation for geophysical, geochemical or surface feature data.***
 - a. *New techniques in remote sensing, data acquisition and digital data analysis that provide information used in modeling of surface or subsurface characteristics.*
 - b. *Extending our understanding of traditionally inaccessible areas as well as improving the efficiency and cost-effectiveness of surveys for dynamic change detection at multiple time scales.*
2. ***Complementary or joint multiscale parameter evaluation - exploitation of combined independent signatures to inform static and dynamic geophysical and geological models.***
 - a. *Leveraging novel combinations of data types (for example, LIDAR images and subsurface resistivity derived from EM methods, combined to identify underground geological, anthropogenic or fluid-generated anomalies).*
 - b. *Investigating both spatial and temporal relationships can inform new understanding of Earth processes.*
3. ***Advancing data acquisition, analysis and modeling - by exploiting efficiencies in distributed computing, deep learning and novel data transmission or communication***

techniques. High data-rate surveying and improving the density, precision, and timeliness of analyses requires innovative leveraging of cutting-edge technologies.

2.5 Earth Systems

The Earth Systems focus area advances understanding and predictability of complex natural systems and the use and interaction of these systems by/with humans from sub-surface to the top of the atmosphere. It contributes to two of LANL's capability pillars: The Science of Signatures (SoS), and The Information Science & Technology (IS&T). It addresses signatures of natural phenomena to national security (SoS Challenge #3) with climate, biological and energy science as the three leadership areas within SoS. The main areas within IS&T are complex biological and subsurface networks, as well as acquisition, use, and modeling of large datasets for energy security, climate modeling, and understanding biological systems are. For more detail, please refer to <http://int.lanl.gov/science/science-pillars/index.shtml>.

Focus Area

The Earth Systems focus area emphasizes invention promoting progress from understanding to predictive capability, and process integration that allows up- and down-scaling within or between phenomena in complex natural systems. It promotes understanding of interactions between natural and human systems, and developing capabilities to strengthen system security and resilience. Integration of experimental science and modeling to fill outstanding gaps in prediction of environmental responses of sensitive and high-impact regions, or biological and environmental responses affecting energy security, human health, security and resilience are encouraged.

It is encouraged that proposals exploit unique LANL resources such as:

- a) LANL high performance computing
- b) DOE-sponsored models such as HiGrad/Firetec, Amanzi-Advance Terrestrial Simulator, CICE and E3SM
- c) LANL experimental, and user facilities such as LANSCE, the High Magnetic Field Laboratory, the Geochemistry and Geomaterials Research Laboratory (GGRL), radiological chemistry, and greenhouse capabilities
- d) LANL 'omics capabilities and DOE-sponsored 'omics datasets
- e) DOE-sponsored environmental datasets such as NGEE Arctic, NGEE Tropics and ARM
- f) Climate monitoring systems such as SUMO, LTER-network and CAFÉ.

Specific topics for new projects starting in FY21:

1. **Signatures:** Revolutionary sensors, indicators, or approaches to identify signatures of change that allow prediction of rate of change or identification of potential system tipping points:
 - a) *in and between single or multicellular organisms in response to an extreme event or significant change in their environment.*

- b) *in sensitive regions during and after extreme or catastrophic events such as drought, fire or epidemics.*
- 2. **Complex coupled processes:** *Integration of models and observations, or experimental studies at different scales to improve capability to predict system responses to change at multiple scales in response to catastrophic events such as drought, fire or epidemics.*
- 3. **System security and resilience:** *Novel experimental, modeling and data science tools to quantify system security and resilience, recovery rates or acclimation capacity after extreme, or catastrophic events.*

2.6 Biological Systems

The Biological Systems focus area advances the study of biological systems as part of complex natural systems. It transcends three of LANL's capability pillars: Science of Signatures (SoS), Complex Natural and Engineered Systems (CNES) and Information Science & Technology (IS&T) by addressing signatures of natural or human-induced phenomena on biological systems. This includes developing data-intensive computing approaches to advance a fundamental understanding of the behavior of microbial systems (across all scales) in response to environmental perturbations as well as their roles in bioenergy, bioremediation, carbon cycling, and the health of the human/environment interface. Many of the approaches rely on LANL's long-standing expertise and established strengths in microbiology, genomics, and bioinformatics. Furthermore, understanding the contribution of environmental reservoirs to the transmission of human disease could help to predict hot spots for emergence of microbial infections. For example, there is currently great interest in the survivability of viruses, such as the SARS-CoV2 virus, for understanding mechanisms of transmission and establishing disease detection methods in a community.

Focus Area

We emphasize approaches that integrate computation and experiment with independent data analysis approaches that can leverage advances in areas such as artificial intelligence and machine learning.

It is encouraged that proposals exploit unique LANL resources such as:

- a) LANL high performance computing
- b) DOE-sponsored climate models
- c) LANL experimental capabilities in genomics and bioanalytical chemistry such as mass spectrometry, NMR etc.
- d) Synthetic biology approaches to regulate biological systems for a re-directed purpose

Specific topics of interest for new projects starting in FY21:

- 1. **Metagenomics:** *new approaches to elucidate interspecies interactions.*
 - a. *Between single or multicellular organisms in response to significant change in their environment. Identifying unique species-independent signatures.*
 - b. *Algorithm development and novel data analysis routines exploiting HPC*
- 2. **Impacts and consequences:** *approaches for understanding impacts of significant events or environmental change.*

- a. *growth of harmful algal blooms as a result of adjacent agricultural practices or effluents; biofuel algal cultures and ponds as a result of microbial invasion.*
- b. *extreme patterns of carbon flow under varied N-deposition scales;*
- 3. ***Disease dynamics at the human/environment interface:***
 - a. *Establish methods of environmental testing to include highly complex environmental matrices. (e.g. genetic characterization and quantification of SARS-CoV-2 genomes present in wastewater to define viral genotypes currently being transmitted). Understand persistence of pathogenic microbes in the environment and subsequent risks to the human population.*
 - b. *Visualizing, forecasting and understanding epidemic and outbreak dynamics.*

2.7 Special Rapid Response Topics

For FY21 CSES has defined two Special Rapid Response (SRR) topics (see Section 3.3.4 for program description).

2.7.1 SRR Call for Biogeochemistry at Terrestrial-Aquatic Interface (BTAI)

The terrestrial-aquatic interface is a highly dynamic component of the Earth system where two different ecosystems exchange materials and energy. This exchange plays a critical role in the function of both ecosystems with feedbacks to local, regional and global climate as well as human resources.

This call aims at increasing understanding and detection capabilities of biogeochemical processes in the terrestrial-aquatic interface. We specifically call for proposals for observational, experimental and process-level modeling studies that address knowledge or technology gaps in the biogeochemistry of terrestrial-aquatic interfaces. The call is divided into three topical areas:

1. **Biogeochemical interactions between terrestrial and aquatic systems:** The theme aims at improving understanding and developing missing parameterizations of materials and energy transport at the terrestrial-aquatic interface. Examples of such processes include transport of microbes, nutrients, sediments or pollutants between the terrestrial and aquatic environment, impacts of this transport on the health of the coastal boundary zone, and interdependencies of these interface environments
2. **Multi-scale effects on the coastal zone environment:** The goal of this focus area is to address the challenge of scaling process understanding at one temporal or spatial scale to explaining phenomena observed at a different scale. An example of such scaling is the influence of coastal or terrestrial microbiomes and micronutrients on food production, clean water availability and ecosystem-scale health.

New technologies for detection and mitigation of change: This focus area calls for development of technologies and signatures for detection of biogeochemical transport between the aquatic and terrestrial ecosystems, the influence of this transport on large-scale phenomena, as well as technology for mitigation of undesired phenomena.

Examples of mitigation technology could be ways of limiting or reprocessing transported materials so that harmful fertilization, or salinity effects are reduced.

2.7.2 SRR Call for Targeted Research in Plasma Physics (TRPP)

This special research call is motivated by upcoming opportunities in high-energy astronomy and space plasma physics. Leveraging advances in plasma-physics modeling, LANL is in a unique position to play a leading role in these applications. We have identified targeted application areas that correspond to upcoming needs in the astronomy and space physics communities.

Proposals are sought for the development and application of advanced methods to improve our understanding of the plasma physics properties in the targeted research areas. These proposals should address applications that tie to experimental or satellite opportunities, bridging the scales between the microphysics and the global application. The call is divided into three topical areas:

1. **Cross-Scale Coupling in the Sun-Earth System:** Resolving microscopic (kinetic) scales accurately while capturing the macroscopic (large scale) behavior of the system remains a formidable challenge in space physics in general and magnetospheric physics in particular, since it requires resolving physical phenomena occurring over spatial and temporal scales separated by several orders of magnitude. This call seeks proposals that develop methods enhancing our understanding of cross-scale coupling in the Sun-Earth system. An example is the development of new computational methods for micro-macro coupling in plasmas that could potentially lead to the next generation of space weather models.
2. **Particle Acceleration in Shocks:** The interaction of astrophysical shocks (active galactic nuclei, gamma-ray bursts, supernovae) with their surroundings is believed to be the source of both high-energy particles (neutrinos, cosmic rays) and high energy photons (X-rays, gamma-rays). Both ground-based and satellite missions are either on-going or proposed to observe this emission and enhance our understanding of this acceleration process. Proposals must develop methods to produce global calculations that either maximize the science learned for existing missions or build the science case for future missions. Proposals focused on mission-designs leveraging these models are also requested.
3. **Laboratory Experiments for Plasma Physics:** Laboratory physics experiments can be used to test new methods in plasma physics. Proposals are sought that connect the laboratory physics and plasma theory community to test novel methods in plasma physics. These proposals can be focused on experiment or theory, but ideally contain aspects of both.

3 Program Elements

New/changed in the FY21 call:

1. The *Student Fellow program* (Section 3.1) has been extended to also include PostBacc (Section 3.1.2) and PostMasters (Section 3.1.3) students.
2. The *Rapid Response Program* (Section 3.3) has been extended to include Special Rapid Response Calls (Section 3.3.4).
3. The *Chick Keller Postdoctoral Fellowship* (Section 3.2), will accept nominations at the December 2020 and May 2021 quarterly.
4. The *Large University Program* (Section 3.4) **IS** offered in this call.

Current CSES program elements:

1. **Student Fellow Program.** Needs to address the CSES Focused Science Topics for this call. One selection per year.
2. **Chick Keller Postdoctoral Fellow Program.** Needs to address the CSES Focused Science Topics for this call. Submissions through LANL PostDoc Program, two times a year.
3. **Rapid Response Program.** While alignment to the CSES Focused Science Topics is encouraged, this program element is open to all emerging scientific ideas in the CSES science disciplines. Several selections during the FY.
4. **Large University Program.** Needs to address the CSES Focused Science Topics. One call every three years, **including FY21.**

Each program element is described below and lists the typical maximum budget and the anticipated number of awards that can be made. Proposals requesting less than the maximum budget will have a competitive advantage.

All R&D programs described below are funded through a LDRD-DR project managed by CSES and are administered as tasks of this DR. As such, all work must adhere to LDRD rules as dictated by DOE Order 413.2C, particularly:

- All Tasks must be in the forefront areas of science and relevant to DOE/NNSA missions
- Tasks must not require the addition of non-LDRD funds to accomplish their goals – i.e. augmentation is not permitted

Details of the proposal writing and submission process are in Section 4.

3.1 Student Fellow Program

University and LANL collaborative research program. *Open to PostGraduate, PostBacc and PostMasters Students.* Frequency of call: Once a year.

Submission: April 30, 2020

Selections: May 20, 2020

Program New Starts: at start of FY21

The number of new starts anticipated in the CSES Student Fellow Program is approximately 4-6 across all Student types and all CSES discipline areas.

CSES will organize a CSES Focus area symposia in the October timeframe for presentation of all projects in a given focus area. Presentations and copies of any resulting proposals submitted need to be sent to CSES.

3.1.1 PostGraduate Program Outline

- Each proposal is required to have a University Student Researcher, a University Principal Investigator (PI) and a Los Alamos National Laboratory PI/Mentor.
- The University Postgraduate Student Researcher needs to be enrolled in a Ph.D. program, and ready to embark on their Thesis project (passed their qualifiers).
- The University PI may be any university scientist entitled by the university to be a Ph.D. program supervisor.
- Visiting scientists, adjunct faculty and postdocs do not qualify as University PIs.
- A Los Alamos National Laboratory PI/Mentor is any Los Alamos Staff Member.
- The collaborative University-LANL research project will typically consist of a jointly agreed Ph.D. thesis research project.
- **Projects can be up to 3 years in length.**
- **The Los Alamos National Laboratory PI/Mentor must submit the proposal.**

The objective of this program is to support a University Student Researcher to perform part of their Ph.D. thesis work at Los Alamos National Laboratory in close collaboration with their Los Alamos PI.

The funding profile for this program is flexible, but typically consists of four parts:

1. Support for the University Student Researcher to spend a significant fraction of the year at Los Alamos. GRA support and travel for a 16-week stay at LANL cost ~\$30K. Note that the student can be at LANL at any time(s) during the year, and while summers are typical, we encourage other times as much as possible. Preferred by CSES would be a spring or fall timeframe.
2. Support for the Los Alamos PI to devote a significant fraction of their time to the collaborative research project and student mentoring (~\$10K).

3. Support for the Los Alamos PI to visit the University for periods of 1-2 weeks/year (~10K travel and subsistence).
4. Support to the University PI to visit LANL for periods of 1-2 weeks/year (~10K travel and subsistence).

The individual funding items are negotiable with a total cap for this program not to exceed \$60K/year of LDRD-type funding.

No direct funding support to a University is envisaged under this program. Note that while no direct funds flow to a LANL University partner, there are benefits to the University PI and the student:

- a. The University Student Researcher requires no University financial support during the time spent at LANL (typically ~4 months/year).
- b. LANL Graduate Assistant Student rates may be higher than many Universities' postgraduate salaries, helping to attract students to both the University and the CSES Student Fellow Program.
- c. Exposure of student to an outside organization with many career opportunities for post-doctoral work and beyond.
- d. University PI travel support for extended LANL visits.

Only under exceptional circumstances, when some of the required Ph.D. thesis work cannot be done at LANL (e.g. use of a unique University facility), will CSES be prepared to write a University subcontract for that part of the work. This must be clearly motivated in the proposal.

Successful proposals need to include some form of matching support for the student from their universities or other institutions. Acceptable forms of matching support are the same as, but not restricted to, those accepted by the National Science Foundation or other Federal research funding agencies. This can include waived or reduced academic fees, and travel or conference support.

Note that "matching support" here refers to university support for the student at and from his university, to support the student outside of the time covered by his/her Student Fellow project at LANL.

Proposals may be submitted for collaboration with any national or international university. Collaborations with New Mexico universities are particularly encouraged and may qualify for support through The New Mexico Consortium, such as housing help, travel help or sabbatical funds for the student's university mentor.

Expectations

The PostGraduate Program's aim is to build and foster new and/or long-term relationships with University Researchers. This program is to be viewed as a stepping-stone for both the student (as a prospective LANL postdoc) and the LANL and University PI to build a strong relationship.

The work performed here should be able to form the basis for a follow-on joint proposal by the LANL and University PI to a Lab internal or external funding source.

If offered and applicable, the student should be encouraged to participate in one of the CSES or other NSEC center's summer schools. The University PI should be encouraged to offer a lecture in a NSEC summer school as part of his/her visit to LANL. The university PI should also be encouraged to give a topical seminar on his research area during his visit to LANL.

3.1.2 PostBacc Program Outline

- Each proposal is required to have a Post Baccalaureate Student Researcher, and a Los Alamos National Laboratory PI/Mentor.
- The Post Baccalaureate Student needs to have expressed a desire to continue with PostGraduate studies after their PostBacc at LANL.
- The LANL PI / Mentor must be willing to use their academic connections to help place the PostBacc into a downstream academic PostGraduate Program.
- The LANL PI/Mentor and PostBacc student are encouraged to utilize other CSES programs for downstream PostGraduate work (e.g. the CSES PostGraduate program, Section 3.1.1)
- **Projects can be up to 2 years in length.**
- **The Los Alamos National Laboratory PI/Mentor must submit the proposal.**

The objective of this program is to support a PostBacc Student Researcher and to help them be placed into a graduate program of interest to LANL.

The funding profile for this program typically consists of two parts:

1. Support for the PostBacc Student Researcher for 50% of their annual cost (~\$35K). A 50% cost sharing from line or program is required.
2. Support for the Los Alamos PI/Mentor to devote a significant fraction of their time to the collaborative research project and student mentoring (~\$10K).

The total cap for this program is not to exceed \$45K/year of LDRD-type funding.

Expectations

The PostBacc Program's aim is to build and foster long-term relationships with Students that have shown an interest in working at LANL. This program is to be viewed as a stepping-stone for both the student and the LANL PI/Mentor or a continuing relationship that follows the student through down-stream PostGraduate studies and possible downstream Postdoctoral or employment opportunities at LANL.

If offered and applicable, the student should be encouraged to participate in one of the CSES or other NSEC center's summer schools.

3.1.3 PostMasters Program Outline

- Each proposal is required to have a Post Masters Student Researcher, and a Los Alamos National Laboratory PI/Mentor.
- The Post Masters Student needs to have expressed a desire to continue with Ph.D. studies after their PostMasters at LANL.
- The LANL PI / Mentor must be willing to use their academic connections to help place the PostMasters into a downstream academic PostGraduate Program.
- The LANL PI/Mentor and PostMasters student are encouraged to utilize other CSES programs for downstream Ph.D. work (e.g. the CSES PostGraduate program, Section 3.1.1)
- **Projects can be up to 2 years in length.**
- **The Los Alamos National Laboratory PI/Mentor must submit the proposal.**

The objective of this program is to support a PostBacc Student Researcher and to help them be placed into a graduate program of interest to LANL.

The funding profile for this program typically consists of two parts:

3. Support for the PostMasters Student Researcher for 50% of their annual cost (~\$45K). A 50% cost sharing from line or program is required.
4. Support for the Los Alamos PI/Mentor to devote a significant fraction of their time to the collaborative research project and student mentoring (~\$10K).

The total cap for this program is not to exceed \$55K/year of LDRD-type funding.

Expectations

The PostMasters Program's aim is to build and foster long-term relationships with Students that have shown an interest in working at LANL. This program is to be viewed as a stepping-stone for both the student and the LANL PI/Mentor for a continuing relationship that follows the student through down-stream PostGraduate studies and possible downstream Postdoctoral or employment opportunities at LANL.

If offered and applicable, the student should be encouraged to participate in one of the CSES or other NSEC center's summer schools.

3.2 Postdoctoral Program

3.2.1 Chick Keller Postdoctoral Fellow

LANL Named Postdoctoral Fellow program. Frequency of call: Twice per year; at the December and May LANL PostDoc program Quarterly meetings.

Submission: Conforming to the LANL PostDoc's Office Quarterly meeting schedule

December Review - Submit early November, outcome mid-December

May Review - Submit early April, outcome mid-May

<http://www.lanl.gov/careers/career-options/postdoctoral-research/postdoc-program/postdoc-appointment-types.php>

Selections: At the Quarterly meetings.

Program New Starts: As soon as PostDoc Candidate is available.

Program duration: 2-year maximum or 1 year for a 3rd year extension of an existing CK Fellow.

CSES strives to have a roster of ~8 CK Fellows at any one time, about 1-2 per focus area. Approximately 2-4 new CSES Postdoctoral Fellows can generally be funded each year, although this number will fluctuate with available funding.

CSES will organize a CSES Focus area symposia in the October timeframe for presentation of all projects in a given focus area. Presentations and copies of any resulting proposals submitted need to be sent to CSES.

Program Outline

This program is aligned with the Lab's prestigious named Postdoctoral Fellow Program (Director's, Distinguished, Agnew, Metropolis and now with the Chick Keller Fellows in Earth and Space Sciences). Candidates must meet the fellow's quality bar of the postdoctoral committee in order to be considered for the Chick Keller fellowship. CSES solicits postdoctoral research proposals from Los Alamos National Laboratory mentors for postdoctoral research on a new, independent, revolutionary scientific idea in the CSES focus areas. The emphasis here is on supporting new, emerging scientific areas rather than supporting postdocs in ongoing research areas.

- **Support is limited to 50% of the postdoc's salary in the first two years of the postdoc appointment. Third year support is limited to 25% of the postdoc's salary and is subject to a new proposal.**
- New postdocs or postdocs in their first year at Los Alamos are eligible. Preference will be given to new postdocs starting at Los Alamos.
- *While the proposed CSES work can be related to the research funding providing the balance of support to the postdoc, it cannot directly support tasks from the statement of work of that research funding.*
- **A Los Alamos National Laboratory Mentor must submit the proposal.** It is expected that the named postdoc provides a significant contribution to the writing of the proposal.

Expectations

The CSES postdoc program is designed to strongly align with LANL mission and downstream employability of the postdoc is a strong consideration.

The LANL mentor is expected to have identified funding from other program resources prior to submission to the CSES Postdoctoral Fellow Program. For 3rd year postdocs a viable path to

conversion is expected to be in place, with strong programmatic support, which is why the CSES support level drops to 25%.

Eligibility

The CK fellows follow the general eligibility rules for Fellows as set out by the LANL postdoc program (<https://int.lanl.gov/employees/postdoc-program/package-requirements/index.shtml>).

Note that while CK Fellow applications can be submitted for a current LANL Postdoc within one year of hiring on at LANL, for Fellow application the Postdoc Office Package submission deadline must still be within the 5-year limit of completing all requirements for the Ph.D.

3.2.2 Research Associate

All Chick Keller candidates submitted to the postdoc office undergo an additional review by an internal CSES panel. Candidates that pass the Postdoc Program's Fellow screening process and that are also selected by the CSES panel will be awarded Chick Keller Fellowships, candidates that do not pass the Postdoc program's Fellow screening process but are selected by the CSES panel will be awarded as CSES Research Associates (RAs).

The RA is only awarded in rare cases, where there are overriding programmatic considerations for a given candidate that make that candidate a particularly good fit for CSES. The RA operates in an analogous fashion to the CK fellow program. There is no special application process for the RA position; candidates should apply through the normal CK Fellowship (Section 3.2.1).

3.2.3 Rapid Response Program

Small LANL project support. Open to All LANL staff and PostDocs, and can involve Graduate, PostBaccs and PostMasters students.

Rapid Response Institutional Program Development Call (RR-IPD)

Rapid Response Research & Development (RR-R&D)

Frequency of call: twice per year, at the end of the FY for a Q1 start and in mid-February for a Q3 start.

FY21 Submissions:

Round one - September 1, 2020 for October 5, 2020 Start

Round two - March 15, 2021 for April 5, 2021 Start

Rapid Response NASA Mission Teaming and Planning

Submissions are open throughout the FY and will be evaluated on a case-by-case basis.

Special Rapid Response Research & Development (SRR-R&D)

Frequency of call: once per year, at the end of January for a mid-February for a Q3 start.

FY21 Submissions:

January 29, 2021 for February 15, 2020 Start

Selections: Two weeks after submission. Program duration: 3 or 6 Months, need to be completed in FY21.

At each selection date, proposals will be divided into three categories:

1. Fund Now – these will go forward immediately
2. Defer – these will remain on the books for this FY and be considered again at either the next selection date (together with any new proposals received), or if new funding becomes available. ***The deferred status expires at the end of the fiscal year.***
3. Do not fund – proposal is denied and can only be submitted again after a significant re-write.

We anticipate that 4-6 RR-IPD and 8-10 RR-R&D studies may be supported throughout the fiscal year across all focus areas, although this number will fluctuate depending on available funding.

We anticipate to run ~2 SRR-R&D topics per year with ~3 selections per topic, although this number will fluctuate depending on available funding. If deemed of sufficient quality and promise, one of the projects in each SRR-R&D topic may be considered for follow-on funding in the next FY.

CSES will organize a CSES Focus area symposia in the October timeframe for presentation of all projects in a given focus area and for each SRR-R&D topic. Presentations and copies of any resulting proposals submitted need to be sent to CSES.

While proposals along the lines of this call's focused science topics are encouraged, the program element is open to all new ideas relevant to the CSES discipline areas.

3.2.4 Rapid Response Institutional Program Development

The Rapid Response Institutional Program Development Program (RR-IPD) is funded out of the CSES G&A (Funding type: Indirect) portfolio and **cannot** be used to support technical work.

Program Outline

CSES solicits proposals for three or six-month studies that support activities such as proposal writing, white paper idea development, literature searches, small equipment purchases, publication costs, and collaborative visits.

We further invite proposals that meet the requirements laid out in the TED (Technology Evaluation and demonstration) Fund Call, specifically projects that catalyze innovation in the CSES Science discipline areas. This includes technology assessments; activities performed to evaluate and assess the applicability of capabilities and existing technologies for institutional or

multi-program use. Exploring whether known scientific or engineering technologies, approaches or techniques are applicable to current and emerging needs:

1. Analysis of practicality
2. Technology evaluation – assessing capabilities of existing technology, including reuse in new applications or at extended scales
3. Demonstrations where the cost and benefits of a system are being validated for a specific use case.

Again, no research development can be undertaken in these projects, as the objective is to demonstrate performance for existing technologies, not to develop new technologies.

Funding maximums are \$20K for a 3-month and \$40K for a 6-month study, and the program is open to Los Alamos National Laboratory Technical Staff Members and/or Los Alamos National Laboratory postdocs.

Expectations

The PD work is expected to be strongly aligned with upcoming proposals opportunities.

3.2.5 Rapid Response NASA Mission teaming and planning

CSES received a small windfall in the form of donated prize money from Michelle Thomsen’s (ISR-1, retired, Lab fellow) 2019 National Academy of Sciences (NAS) Arctowski Medal. Award. Michelle set up the following statement of work for these funds:

“The incoming funds from the National Academy of Sciences will be used to support conference, workshop and seminar travel for scientists and instrument engineers in the field of Space and Planetary Science, with the aim of fostering new and existing collaborations to eminent research universities and institutions. The funds will be administered through NSEC at the Center for Space and Earth Science supporting CSES workshops, conferences and seminar series.”

We invite here special Rapid Response Institutional Program Development (RR-IPD, see Section 3.3.1) proposals specifically aimed at teaming and brainstorming activities with outside institutions with the aim of positioning and partnering LANL for new opportunities Heliophysics and Planetary Missions.

The NAS funds can be used for inviting and supporting travel by external SME’s to LANL, particularly for small workshop attendance.

RR-IPD funds can be used to support the organizational activities by the LANL proposer/team.

Funding maximums per workshop are up to 5K of RR-IPD funds for the LANL proposer/team and up to 20K of the NAS funds for inviting and supporting external SMEs.

Proposers are asked to prepare a normal RR-IPD proposal in which they specifically list and cost the set of external SME’s supported by NAS funds.

3.2.6 Rapid Response Research and Development

The Rapid Response Research and Development Program (RR-R&D) is funded out of the CSES LDRD (Funding type: LDRD) portfolio and can be used to support technical work.

Program Outline

CSES solicits proposals for three or six-month studies that support small but crucial projects in support of new, high-risk ideas, feasibility studies or other basic R&D in support of upcoming proposal opportunities across the spectrum of LANL programs, and in the CSES Focus Areas. Scientific feasibility analyses are reserved for revolutionary scientific ideas that are mission relevant, at their early stage of development, and involve a multi-disciplinary approach.

Funding maximums are \$30K for a 3-month and \$60K for a 6-month study, and the program is open to Los Alamos National Laboratory Technical Staff Members and/or Los Alamos National Laboratory postdocs.

Expectations

We encourage new ideas and high-risk concepts – and here failure (showing what will not work) is considered a success. Work should be aimed at upcoming new proposal opportunities.

3.2.7 Special Rapid Response R&D

The Special Rapid Response Research and Development Program (SRR-R&D) is funded out of the CSES LDRD (Funding type: LDRD) portfolio and can be used to support technical work.

Program Outline

This is a special subset of the normal RR-R&D program designed to address special, narrow, topical and strategic opportunities for which there is a desire to nucleate LANL capability. Topics are narrowly defined and typically multi-disciplinary and straddling more than one of the CSES science disciplines or related disciplines.

CSES will define a few SRR-R&D topics in each call for proposals, but is open for new SRR topics that may arise throughout the FY and for which new funding can be identified.

All projects in an SRR-R&D topic will report their results in a Special CSES Symposium at which time a special committee will evaluate the projects and select a “winner” - if a project shows sufficient promise CSES will provide follow on funding for the project in the next FY. We would anticipate the follow on funding to be in the \$80-\$100K range. The intent here is to support new and promising research topics/ideas to the point of maturity that makes them eligible for other, larger funding opportunities outside of CSES.

The SRR-R&D program is administered in the same way as the standard RR-R&D program (Section 3.3.3).

3.3 Large University Program (OFFERED IN THIS CALL!)

Frequency of call: Three yearly in step with CSES LDRD cycle (FY21, FY24, FY27...)

Submission: April 30, 2020

Selections: May 20, 2020

Program New Starts: at start of FY21

PI's are encouraged to plan ahead for a submission to this program element by building new relationships with prospective university partners through the Student Fellow PostGrad Program (Section 3.1.1).

Program Outline

Each CSES discipline will have the opportunity in this program to propose for a single, large three-year project that addresses a discipline science thrust area as identified in Section 0. This large program will be structured around 2-3 Student Fellow PostGrad Programs (See Section 3.1.1) involving an intensive collaboration with a single university. Total budget is not to exceed 180K/year. This project can involve up to three LANL Investigators (one of them identified as Project Lead, PL) and up to three University Investigators.

It is anticipated that at most 1-2 Large University Programs will be awarded in each 3-year cycle, with at most one Large University Program per CSES focus area. *Note that for the focus area that gets awarded a Large University Program no normal Student Fellow Programs will be awarded in the same year.*

Expectations

The main purpose for this program element is to establish new and significant university partnerships in new areas of research that LANL wants to develop. The goal is to provide access to LANL to areas of scientific expertise that are weak or lacking at the lab but for which there is a clear strategic need.

The Project Lead is expected to present progress in the form of a presentation per year, given as part of the Focus Area Symposium, typically held in October. Talks presented by the Student Fellows are preferred, and depending on the scope of the project more than a single talk is encouraged.

The seminar presentation need to be submitted to CSES and serve as the technical report on the project.

4 Proposal Process

4.1 Proposal Preparation

4.1.1 Student Fellow Program

Cover Sheet. Please use the CSES fillable PDF cover sheet, available at https://www.lanl.gov/projects//national-security-education-center/space-earth-center/_assets/docs/FY21-CSES-Proposal-Cover-Sheet_Final.pdf

Main Body Use the following formatting outline for the main body; *please limit to five total pages* of text and figures (for Sections I through VIII), plus one budget page and biographical sketches:

- I. Theoretical, numerical, or experimental activity. Methods used, history of problem, scientific debate, hypotheses to test
- II. Any relevant leveraging or necessary coordination, e.g., other projects or facilities
- III. Resources to be used in the project such as resources at Los Alamos National Laboratory, at the University, if relevant
- IV. Statement of Work (Tasks to be performed, Milestones)
- V. Proposing Team
 - i. Role of LANL PI, including efforts at mentoring
 - ii. Role of University Principal Investigator, if applicable
 - iii. Role of student
 - iv. Other participants
- VI. Significance and timeliness
 - i. How does this research support the CSES focused science topics?
 - ii. What is the significance of the project? Why Now? Who will use the results?
- VII. References
- VIII. Budget summary (1 page max). *PEM sheets not required.* Totals by fiscal year and cumulative for multiyear projects. See [Appendix A: Scientist/Researcher Student Salary Structure](#) and [Appendix B: Indirect and LDRD Salary Rates](#) for budget information to help you estimate your T&E on your project.
 - i. Support for the University Student Researcher to spend a significant fraction of the year at Los Alamos.
 - ii. Support for the Los Alamos PI to devote a significant fraction of his time to the collaborative research project.
 - iii. Support to the University PI to visit LANL, if applicable
 - iv. Other Travel
 - v. Supplies & Equipment
- IX. Biographical sketches of PIs including already identified student, ~1 page each. Note: Identification of a named student is desirable but not essential for top tier selection.

4.1.2 Chick Keller Postdoctoral Fellow Program

New CK Fellow Applications

New Chick Keller Fellowship application will be administered through the Los Alamos Postdoc Program in an analogous manner to the already existing named Postdoctoral Fellow programs (Director's, Agnew, Metropolis). Please prepare a normal Postdoc Named Fellows package as outlined by LANL's PostDoc program.

<https://www.lanl.gov/careers/career-options/postdoctoral-research/postdoc-program/postdoc-application-process.php>

A LANL mentor needs to submit the package, together with the CSES memo (see below).

CSES memo

As part of your submission you are required to submit a one-page CSES justification memo. This memo needs to address the following:

- How the proposed research contributes to the focused science topics of CSES
- How the proposed CSES 50% work differs from the main Postdoc Research proposal
- What the envisaged funding mix is for the postdoc

Because of the 50% CK / 50% Other dual funding nature of the CK Fellowship Proposers MUST exercise care in differentiating the work scope between the work performed for the two funding sources. In the required CK memo, the distinct work scope of the CSES related work must be clearly identified and be distinct from the general Postdoctoral research statement. Topics may be related, but cannot have overlapping work statements.

As one of the objective of the CK Fellow Program is pipelining for staff conversion, CSES also looks at the particular mix of funding, which should be highlighted in the memo. The 50/50 funding objective is to have one half of the funding come from somewhat more programmatic and more long-term source at LANL, which ideally should help with conversion prospects for the PostDoc, while the CSES funding covers more basic research aspects. A double basic research funding split may be considered for exceptional PostDocs.

Third year CK Fellow Applications:

Follow the normal PostDoc program directions for submitting the third year extension memo (<http://int.lanl.gov/employees/postdoc-program/mentors/extensions/third-year-extensions.shtml>), and submit this memo to both the postdoc office and to cses@lanl.gov.

In addition, a CSES memo as outlined above also needs to be submitted to CSES. Third Year CK funding is generally intended for PostDocs that have a clearly identified path towards conversion.

4.1.3 Rapid Response Program

Cover Sheet. Please use the CSES fillable PDF cover sheet, available at https://www.lanl.gov/projects/national-security-education-center/space-earth-center/assets/docs/FY21-CSES-Proposal-Cover-Sheet_Final.pdf

Please download the PDF to fill in and submit, do not fill in on the browser.

Main Body Use the following formatting suggestions for the main body; *please limit to two total pages* of text and figures (for Sections I through V), plus one page biographical sketches:

- I. Statement of problem to be addressed (please indicate any time constraints, e.g. proposal deadlines).
- II. Statement of Work
- III. Significance and Timeliness
- IV. Which targeted funding opportunity does this work support (outside of CSES)
- V. Short budget justification. *PEM sheets not required.* See [Appendix A: Scientist/Researcher Student Salary Structure](#) and [Appendix B: Indirect and LDRD Salary Rates](#) for budget information to help you estimate your T&E on your project.

NOTE:

RR-R&D and SRR-R&D proposals should be priced with LDRD labor rates

RR-IPD proposals should be priced with Indirect labor rates

4.1.4 Large University Program

Since this program element consist of essentially three bundled Student Fellow Programs, the proposal guidelines are the same as for the Student Fellow Program, with the following changes / additions:

1. The main body of the proposal can be up to 10 pages.
2. Budget justification can be up to 2 pages
3. The project should have a LANL and University Lead PI but can include up to two additional LANL and two additional University Co-Is.
4. The LANL lead PI takes responsibility for the overall execution of the program and submits the proposal.

4.1.5 General Instructions

While CSES supports publication page charges, such charges are NOT to be included in the proposed budget. PI's are asked to send an email to the CSES director requesting funds on an as needed basis to cover publication page charges.

4.2 Submission process

Proposals (one PDF for cover page, one PDF for main body including budget) must be submitted by email to be received by the proposal's program element deadline.

1. Student Fellow program Apr 30, 2020

2. Chick Keller Postdoctoral Fellow Program
Follows the December and May Quarterly Postdoc Committee Meeting Schedule.
Upcoming deadlines:

May 2020 Quarterly:	Apr 8, 2020
Dec 2020 Quarterly:	November 4, 2020

3. Rapid Response Program

RR-R&D and RR-IPD Round one:	September 1, 2020
SRR-R&D:	January 29, 2021
RR-R&D and RR-IPD Round two:	March 15, 2021
RR-NASA Mission Teaming & Planning:	Open throughout FY

4. Large University Program Apr 30, 2020

NOTE: All Student Fellow, Rapid Response and Large University proposals must be submitted to CSES through the Los Alamos Principal Investigator. Chick Keller Postdoc packages are submitted to the LANL postdoc office, including the required CK CSES memo.

Please mark the subject line of your email with the program element and science discipline area, for example:

Subject: CSES Graduate Student Fellow/Astro Proposal Submission

Send to: cses@lanl.gov with copies to the appropriate discipline leader:

- Astrophysics and Cosmology (Chris Fryer; fryer@lanl.gov)
- Space Science (Vania Jordanova; vania@lanl.gov)
- Planetary Science (Lisa Danielson; ldanielson@lanl.gov)
- Geophysics (Char Rowe; char@lanl.gov)
- Earth Systems (Sanna Sevanto; sanna@lanl.gov)
- Biological Systems (Jeanne Fair; jmfair@lanl.gov)

A confirmation of receipt will be sent by email to the Principal Investigators of each proposal.

4.3 Review Process

All proposals undergo peer review. There is a separate review panel for each discipline area or Special Rapid Response Call, which consists of the Focus Lead or SRR coordinator and his/her team (typically ~5 LANL staff), and which is augmented by external review members of subject matter experts primarily from academia when needed.

4.3.1 Review Criteria

For R&D proposals, we follow here a similar set of criteria in the spirit of the Laboratory’s LDRD Reserve process, scaled and adjusted to the size and scope of CSES projects and programs, see Table 1.

Table 1: RR-R&D Criteria

	Mission Agility (15%)	Technical Vitality (50%)	Research Approach (20%)	Follow on (15%)
	<i>Will the proposed work create new S&T approaches and capabilities that are relevant for Los Alamos emerging missions?</i>	<i>Is the proposed work innovative and creative? Will it make an impact on its technical field as appropriate for the scale of the investment?</i>	<i>How well qualified is the proposer (individual or team) to conduct the project? How well conceived and organized is the proposed activity?</i>	<i>Is there a well identified and feasible sponsor for follow on proposals?</i>
3	High quality in nearly all respects, should be supported if at all possible.	Potential for fundamental advance and/or a new approach to expanding our knowledge; and/or new methods, processes, tools or devices.	Clear and well-designed research approach.	Appropriate follow on sponsor identified, good chance of success
2	Very Good proposal with important objectives	Work may need to be distinguished more clearly from previous efforts. Innovation less than striking.	Research approach may be somewhat unclear, or of incompatible scope.	Some follow on sponsors mentioned, moderate chance of success
1	Lacking in one or more critical aspects. Lack of Innovation, key issues not addressed, no follow on, unclear plan - rendering the proposal uninteresting.			

For Institutional Program Development proposals (i.e. RR-IPD) we use the criteria as listed in Table 1 below, again using the 1-3 scale for ranking.

Table 2: RR-IPD Criteria

1 to 3 Scale	Overall	Application / Impact on Mission	Project Approach
3	Excellent with at most minor strategic weaknesses, deserves highest priority for support	Potential for high impact on mission, Targets an important opportunity	Clear and well-designed demonstration approach
2	Very Good proposal with important objectives	Potential impact clear but limited	Approach may be somewhat unclear, or of incompatible scope.
1	Lacking in one or more critical aspects. Approach not feasible, or impact lacking, rendering the proposal uninteresting.		

In particular, reviewers are asked to judge proposals on these additional points specific to CSES:

- This call establishes the Mission relevance of the CSES focused science topics, and the proposal must clearly address these topics and show relevance to CSES goals.
- CSES programs are intended to be innovative, and risk tolerant. Proposals clearly need to address a new and innovative aspect, and while high risk is tolerated, the proposal needs to clearly outline these risks.
- CSES programs support NSEC’s goals of growing university interactions, educating present and future scientists and engineers, and to help with recruitment or retention of technical talent.
 - **Student Graduate Fellow / Large University Proposals** – show how the project will be used to build university interactions and if there is a viable onward path for the students into LANL PostDoc programs.
 - **Student PostBacc and PostMasters Fellow** – show path towards into a downstream academic PostGraduate Program
 - **Rapid Response** – show how this project aides the career development of its PI.
 - **Chick Keller PostDoc** – show that the PostDoc’s work is in an area that could provide a “landing zone” for conversion.
- While for Rapid Response program relevance to the CSES focused science topics *is desired, it is not required*. Highly innovative and new proposals that go beyond the specific topics identified in this call are encouraged, but have additional requirements:
 - The proposal needs to outline why the proposed work is, or should be, mission and CSES relevant.
 - The proposal needs to address “why LANL” and “why now”.

Notification of proposal award will be made according to the schedule for the program element as outlined in Section 3. For proposals utilizing the following fiscal years funding, please be aware of the budget caveats (Section 4.4).

In preparing proposals, PIs should be aware of these factors that contribute to successful proposals:

- Proposals that are genuinely new, innovative and not incremental.
- Willingness for risk – even the answer “now we know we can’t do it this way” is a successful outcome.
- Great university interaction as evidenced by significant student time at LANL, PI visits to the university (present seminar), university Mentor visits to LANL (present seminar).
- Good use of unique LANL facilities.

4.3.2 Conflict of Interest

CSES is committed to a fair review process and will adopt guidelines similar to those used in the Lab’s LDRD proposal review process. In addition:

1. CSES Director and Focus leads are not allowed to submit or be PI of CSES proposals.
2. CSES External Review Committee Members may not be external reviewers if their institution is a University partner on any of the CSES proposals in a given discipline area.
3. LANL reviewers may not be PIs, Co-PIs on proposals they review.

4.3.3 Written Proposal Feedback

All CSES proposal will receive a short written email feedback within a few weeks of review. Unsuccessful PIs are encourage to discuss their proposal with their respective Focus lead to develop strategies that can lead to a successful future CSES submittal.

4.4 Budget Caveats

CSES will make every effort to honor the budget requests in the original proposal. However, CSES is dependent on budget resources that at most are known for the current fiscal year only. The CSES research portfolio is funded by the Lab’s Laboratory Directed Research and Development Program (LDRD), which is subject to Congressional approval. Thus, CSES project funding will always be subject to available funding to the Center.

New or renewal proposal awards will always be subject to some uncertainty on the available funding. This can lead to awards with a reduced budget, or in the worst-case award cancellation. CSES will inform awardees of final proposal budget as soon as the next year’s budget is known, typically within a few weeks of the start of the fiscal year (October).

CSES assumes that the proposal cost is accurate and when a project is approved for funding CSES expects the out year budgets to be as originally proposed and approved. Requests for changes in funding must be well justified and will be considered on a case-by-case basis.

4.5 Miscellanea

4.5.1 Authority to start work

Because all CSES funding is dispersed at LANL any work by A LANL PI or postdoc can only start once a valid program code has been established for the project. University student visits cannot commence before that time.

For the rare cases where a project involves a University subcontract work cannot begin until the Los Alamos contracting officer formally authorizes the initiation of work. There will likely be a delay of about two months (no earlier than December 1 of a given year) when the “start work” order is issued. Invoices submitted for work conducted prior to the “start work” order will not be reimbursed.

If your Student Fellow / Large University project involves a subcontract you are encouraged to start the subcontract process as soon as possible in order to have the subcontract in place at the beginning of the fiscal year.

4.5.2 Security considerations

Classified work is not supported under the Student Fellow Program or the University Large Program.

4.5.3 Policy regarding prejudice and bias

There is no prejudice based on race, gender, or nationality, for PI’s, postdocs, and students.

4.5.4 Further information

CSES Center: <http://cses.lanl.gov>

CSES general email: cses@lanl.gov (preferred)

Sarah Balkey, Professional Staff Assistant, slbalkey@lanl.gov, 505-667-8777

Reiner Friedel, Director, rfriedel@lanl.gov, 505-695-889

Appendix A: Scientist/Researcher Student Salary Structure

This table is current as of February 2020. A current version can be found at <http://int.lanl.gov/employees/education/mentors-liaisons/index.shtml>

Scientist/Researcher Salary Structure

High School Internship Program		Annual	Hourly
High School/Post High School	High School Senior	\$29,111	\$14.00

Undergraduate Program: Students pursuing Associate's and/or Bachelor's Degrees		Annual	Hourly
HS+0	HS Grad & Acceptance to College	\$31,000	\$14.90
HS+1	Completion of first academic year and a minimum of 24 semester hours	\$33,000	\$15.87
HS+2	Completion of second academic year and a minimum of 48 semester hours (salary cap for students pursuing an Associates Degree)	\$35,990	\$17.30
Post Associates	Post Associates Completion of an Associate's Degree, not continuing onto a Bachelors program (Limited to a 2-year appointment)	\$38,000	\$18.27
HS+3	Completion of third academic year and a minimum of 72 semester hours (15 hours must be upper-division coursework)	\$40,980	\$19.70
HS+4	Completion of fourth academic year and a minimum of 96 semester hours	\$45,000	\$21.63
Post Baccalaureate	Bachelors Degree Awarded (Limited to a 2-year appointment)	\$49,847	\$23.96

Graduate Program: Students pursuing Masters and/or PhD Degrees		Annual	Hourly
BS+0	Bachelors Degree Awarded Accepted/Enrolled in a Graduate Program	\$52,852	\$25.41
BS+1	Completion of first academic year and a minimum of 12 hours of Graduate coursework	\$56,014	\$26.93
BS+2	Completion of second academic year and a minimum of 24 hours of Graduate coursework (salary cap for students pursuing a Masters Degree)	\$59,384	\$28.55
Post Masters, BS+3, MS+0	Masters Degree Awarded or completion of third year in a PhD program (Post Masters, limited to a 2-year appointment)	\$62,940	\$30.26
BS+4 or MS+1	Satisfactory progress towards doctoral degree (e.g. dissertation/thesis work --1hr. minimum credit per semester)	\$66,726	\$32.08
BS+5 or MS+2	Satisfactory progress towards doctoral degree (e.g. dissertation/thesis work-- 1hr. minimum credit per semester) (Salary cap for PhD students)	\$70,720	\$34.00

PPO 11/20/19

Appendix B: Indirect and LDRD Salary Rates

This table is current as of February 2020. Indirect rates are used for the Rapid Response IPD program, LDRD are used for all other programs.

Use your salary and your student's / postdoc's salary from Appendix A to find the corresponding salary range in the "Funding Type" Column below. Read across to find the corresponding cost for indirect / LDRD projects.

Example: A postdoc that earns 84K a year puts in for a \$60K RR R&D project, of which 20K are for the PostDoc. His hourly rate on LDRD is \$71.12 and he can thus spend 281 hours (~7 weeks) on the project.

FUNDING TYPE Resource Name	FTE	Hours	INDIRECT		LDRD RAD/NON-RAD	
			ANNUAL	PER HOUR	ANNUAL	PER HOUR
HS COOP 20000 - 34999.99	1.00	1,828	32,355.60	17.70	37,620.24	20.58
Student 20000 - 34999.99	1.00	1,828	40,874.08	22.36	47,509.72	25.99
Student 35000 - 49999.99	1.00	1,828	57,874.48	31.66	67,270.40	36.80
Student 50000 - 64999.99	1.00	1,828	77,324.40	42.30	89,882.76	49.17
Student 65000 - 79,999.99	1.00	1,828	91,363.44	49.98	106,206.80	58.10
Student - 80,000 - 94,999	1.00	1,828	109,040.20	59.65	126,753.52	69.34
Postdoc 65000 - 79999.99	1.00	1,828	103,592.76	56.67	120,428.64	65.88
Postdoc 80000 - 94999.99	1.00	1,828	111,837.04	61.18	130,007.36	71.12
Postdoc 95000 - 109999.99	1.00	1,828	129,038.52	70.59	150,005.68	82.06
Postdoc 110000 - 999999.99	1.00	1,828	150,608.92	82.39	175,085.84	95.78
35000 - 49999.99	1.00	1,757	72,739.80	41.40	138,504.31	78.83
50000 - 64999.99	1.00	1,757	89,290.74	50.82	170,007.32	96.76
65000 - 79999.99	1.00	1,750	110,565.00	63.18	210,507.50	120.29
80000 - 94999.99	1.00	1,750	132,947.50	75.97	253,137.50	144.65
95000 - 109999.99	1.00	1,750	154,735.00	88.42	294,612.50	168.35
110000 - 124999	1.00	1,750	178,167.50	101.81	339,237.50	193.85
125000 - 139999	1.00	1,737	199,581.30	114.90	380,003.49	218.77
140000 - 154999.99	1.00	1,737	222,058.08	127.84	422,803.17	243.41
155000 - 169999.99	1.00	1,737	245,594.43	141.39	467,617.77	269.21
170000 - 184999.99	1.00	1,737	267,741.18	154.14	509,774.76	293.48
185000 - 199999.99	1.00	1,737	291,138.57	167.61	554,328.81	319.13
200000 - 214999.99	1.00	1,737	305,920.44	176.12	582,468.21	335.33
215000 - 229999.99	1.00	1,737	327,268.17	188.41	623,114.01	358.73
230,000-244,999	1.00	1,750	352,747.50	201.57	671,632.50	383.79
Non manager >=245,000	1.00	1,750	412,090.00	235.48	740,932.50	423.39
Management >= 245,000	1.00	1,750	449,732.50	256.99	808,622.50	462.07

