SPACE SCIENCE INSTITUTE

2013 - 2016 Strategic Plan

Inspire – Explore – Discover

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When we try to pick out anything by itself, we find it hitched to everything else in the universe."

John Muir
"My First Summer in the Sierra" 1911

Images courtesy Space Science Institute and NASA unless otherwise noted.

1. Executive Summary

The Space Science Institute (SSI) is a nonprofit, public benefit 501(c)(3) corporation founded in 1992. SSI has five major branches: Research, Cassini Flight Operations, the National Center for Interactive Learning (NCIL), Business Operations, and Information Systems and Technology (IST). SSI is on the leading edge of creating cost effective and far-reaching models for earth and space science research and science, technology, engineering, and mathematics (STEM) education. In the coming years, our potential to make science accessible to large numbers of people, including underserved communities, is enormous. The key to our approach is that we offer the full continuum of discovery and education – we conduct world-class scientific research and we make it accessible to a broad population.

SSI's scientific Research Branch includes scientists participating in robotic missions such as the Mars Science Laboratory and in-flight missions such as Cassini, Hubble, NuSTAR, Fermi, and SOFIA. They are also involved in ground-based observation programs using national and international facilities such as the observatories on Mauna Kea, Hawaii and the high plains of the Atacama Desert in Chile. The science we do reaches beyond our own solar system, from exoplanets around other stars to dark energy and the fate of the universe.

SSI has been *a pioneer in remote employment of scientific researchers* who fund themselves through a combination of grants and contracts, primarily from NASA and the National Science Foundation (NSF). By providing high quality organizational, legal, and administrative support, SSI makes it possible for researchers (and education PIs) to conduct research outside traditional universities and research institutes, including long-distance collaborations with colleagues in the U.S. and abroad.

Providing effective STEM learning opportunities for all Americans is essential to creating an educated citizenry who understand the complex issues confronting our nation and the world. STEM professions and the pipelines that produce those professionals lack ethnic diversity, even as the nation is undergoing a significant demographic shift. SSI's NCIL is leading the way for a new generation of STEM education platforms that will make science accessible to new audiences. We foster collaboration between scientists and educators to bring the wonder of discovery directly to people wherever they are. We bridge the worlds of public schools, public libraries, museums, and the Internet. Our programs span a range of audience needs and delivery methods, including traveling museum and library exhibitions; award-winning educational films, videos, and websites; hands-on teaching resources and activities; and educator workshops.

The SSI Roadmap

Over the next four years SSI will place an increased strategic focus in particular research and education areas. We summarize our strategic goals below, followed by specific actions to reach them.

I. Strengthen and Expand SSI's Scientific Research Program

SSI's Research Branch scientists investigate physical phenomena in a broad range of earth and space science fields: earth science, space physics, planetary science, exoplanetary science, and astrophysics. We will focus on expanding those science research areas that meet the highest priorities set in field-specific Decadal Surveys conducted by the National Academy of Sciences.

We plan five key actions:

1) **Recruit in** strategic **research fields** (e.g., Earth science, Mars science, and astrobiology).

2) **Pursue scientific research using new and upcoming missions and facilities** (e.g., new NASA Explorer and Discovery class missions; the new Atacama Large Millimeter Array).

3) **Use strategic initiatives to focus effort in specific, high-priority, and timely fields**. SSI created two Research Centers in 2013 (the Center for Space Plasma Physics and the Center for Extrasolar Planetary Systems) and will create a third in 2014 (the Center for Mars Research). See Section 3 for more details on these programs.

4) **Carry out Cassini Imaging Operations at SSI** (see Section 4 for more information about this program).

5) **Contribute to the SSI fundraising and development effort** (e.g. provide timely input to requests from SSI's Development Office).

II. Expand and Strengthen SSI's STEM Education Program

In order to increase the understanding and participation of families, students, teachers, and citizens in science and engineering, SSI's NCIL will develop new programs that grow out of our existing efforts: traveling exhibitions (for museums and public libraries); educational websites; hands-on teaching resources and activities; educator workshops and webinars, and education research/evaluation projects. We will continue to expand our national library STEM education network that is reaching underserved communities (urban and rural) as well as underrepresented audiences. We will also take advantage of the popularity of Facebook games and educational apps for smart phones and tablets, to develop a suite of digital learning programs that will reach students and the public.

We plan four key actions:

1) **Build the NCIL Infrastructure** (e.g., develop an NCIL staffing model, including decision points for growth (such as funding and workloads) for hiring, key competencies and job descriptions; continue to update the NCIL website).

2) **Respond rapidly to new opportunities for public engagement and outreach**.

3) **Use strategic initiatives to focus effort in high-priority and timely education fields**. SSI's strategic initiatives in education include *Transforming Communities* and *Frontiers of Digital Learning* (see Section 5 for more details on these programs).

4) **Contribute to the SSI fundraising and development effort** (e.g. provide timely input to requests from SSI's Development Office; identify 10-15 corporations and foundations yearly and submit a minimum of 5 proposals per year for additional program support).

III. Provide an Effective and Efficient Infrastructure to Support SSI's Mission

SSI must continue to strive for operational efficiency for both on-site and off-site staff while expanding its scope of research, flight operations, and education projects. Our programs must be innovative, foster collaboration, and have strategic impact. As a business, SSI will maintain the highest standards for grant and contract administration, maintain and enhance its financial accounting system, and continue to implement effective employment policies.

As an additional means of achieving our broad research and education goals, we will target new sources of funding, both federal and private. SSI currently works on projects funded primarily by NASA and NSF. In addition to expanding its research base, SSI will submit proposals to federal agencies such as the Department of Energy, the Department of Defense, and the Department of Education. SSI will seek out new opportunities to work with nonprofit corporations and private foundations.

We plan three key actions:

1) **Offer streamlined, cost-effective services** (e.g. online resources, digital time sheets; online budget reports).

2) **Improve communications with key stakeholders through increased media coverage and direct communications** (e.g., launch a public newsletter, improve media relations, exhibit at relevant professional society meetings, and enhance our company website).

3) **Expand fundraising success beyond federal sources** (e.g. evaluate and understand regulations, requirements, and impacts of new funding sources).

2. Company Description

Humans are driven to explore. We are inspired by fundamental questions: *Are we alone? Could we live on other planets? How does our amazing planet change and evolve?* Few things capture our imaginations more than the mysteries of space and the wonders of our own planet. Society benefits from the pursuit of new knowledge. The search for life beyond Earth begins with understanding how our own planet works. The excitement of earth and space science offers a compelling hook for engaging the public in science and inspiring a new generation of innovators.

Mission

As a nonprofit organization, SSI's mission is to address 21st Century challenges by advancing scientific understanding of Earth and the Universe; engaging the public in science-technology learning opportunities; and inspiring youth to pursue science-technology careers.

Core Values

These characterize our behavior and strategies in our day-to-day interactions among SSI staff and with all our partners and collaborators.

They are summarized via the mnemonic PARTNER:

- **Personal & Professional Development** – SSI is a learning organization, promoting the personal and professional development of its employees and those who are touched by its research and education programs.
- **Appreciation** – SSI promotes a spirit of appreciation for good work and contributions from its employees and its partners.
- **Respect** – SSI operates with respect and professional courtesy for all employees and its partners.
- **Trust/Teamwork** – SSI cultivates an environment of mutual trust and teamwork among employees and with our partners.
- **Needs** – SSI operations adapt to the professional needs of employees, and SSI programs respond to identifiable needs in the science and education communities.
- **Exploration/Enjoyment** – SSI cultivates an environment where employees are encouraged to explore innovative approaches and to enjoy their work.
- **Responsibility** – SSI's team of innovators act responsibly in service to our stakeholders and to society.

Guiding Principles

The Guiding Principles outlined below are of a general, organization-wide nature. They provide guidance as we develop an effective and cohesive enterprise — one we can all be proud of.

- Build programs with coherence and integration;
- Actively seek ways in which new endeavors can build on, or otherwise fruitfully connect to, the experience of current or past efforts (e.g., re-purposing, efficiency of effort, taking fullest advantage of large projects for spin-off opportunities);
- Make every proposal development effort a capacity building, learning experience so that it has value whether or not the proposal is selected for funding;
- Seek opportunities to participate on the proposals of external partners (i.e., SSI should have a balanced portfolio of grants and contracts where it is the primary awardee as well as a secondary awardee);
- Take advantage of current science events (e.g., Mars rover missions, Cassini mission to Saturn, discovery of new extrasolar planets) to enhance the visibility and stature of the organization;
- Conduct annual reviews of the Strategic Plan to see how well our operations are on track and to make mid-course corrections if needed; and
- Continue to recruit board members that are well connected to the aerospace, education, non-profit development, and business communities.

Our Vision for the Future

The nature of STEM education is undergoing profound changes. Discovery and invention are the keys to a healthy and prosperous future, and science research has a critical role to play in that future. Science and engineering in the United States rest on three pillars:

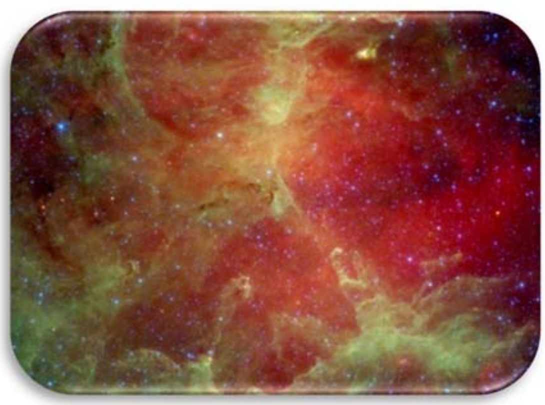
1) A strong research infrastructure;
2) A scientifically literate populace that supports investments in research; and
3) A pipeline of future research scientists and engineers.

We INSPIRE

SSI is in the "inspiration" business. The impact of our research and education programs is increased access to STEM learning for an audience that is cross-generational and often underserved. We don't know who will be inspired to be a scientist, engineer, flight operations specialist, educator, or maybe just a person who is interested in STEM topics. What we do know is that our programs have the potential to ignite their curiosity and motivate them to continue learning.

By providing high quality organizational, legal, and administrative support, SSI makes it possible for researchers to conduct research outside traditional universities and research institutes, including long-distance collaborations with colleagues in the U.S. and abroad. Traditional research institutions and public universities are struggling under the pressures of a poor economy and aging research facilities. SSI provides a non-traditional research structure, namely, the ability to work remotely from the "bricks and mortar" institution. This offers a unique personal and professional flexibility to top-notch scientists, who might otherwise leave research entirely.

The public's overall science literacy is shockingly low. Over half of American adults do not know how long it takes Earth to go around the Sun. In 2011, our children ranked 32nd out of 65 countries in mathematics, and only 32% of American high school graduates were proficient in mathematics. In the U.S. science and engineering workforce, 27% of the workers are Baby Boomers who will reach a retirement age of 66 in the next ten years. The percentage of engineers graduating in the United States has stagnated at 4.5% (74,000 graduates annually), while India and China surpass us with rapid progress. This disparity threatens to slow our economic recovery and leaves technology firms in a skills crisis. In short, *we are no longer leading other nations; instead, we are falling behind them.* SSI is responding to this crisis in research, public science literacy, and STEM education.



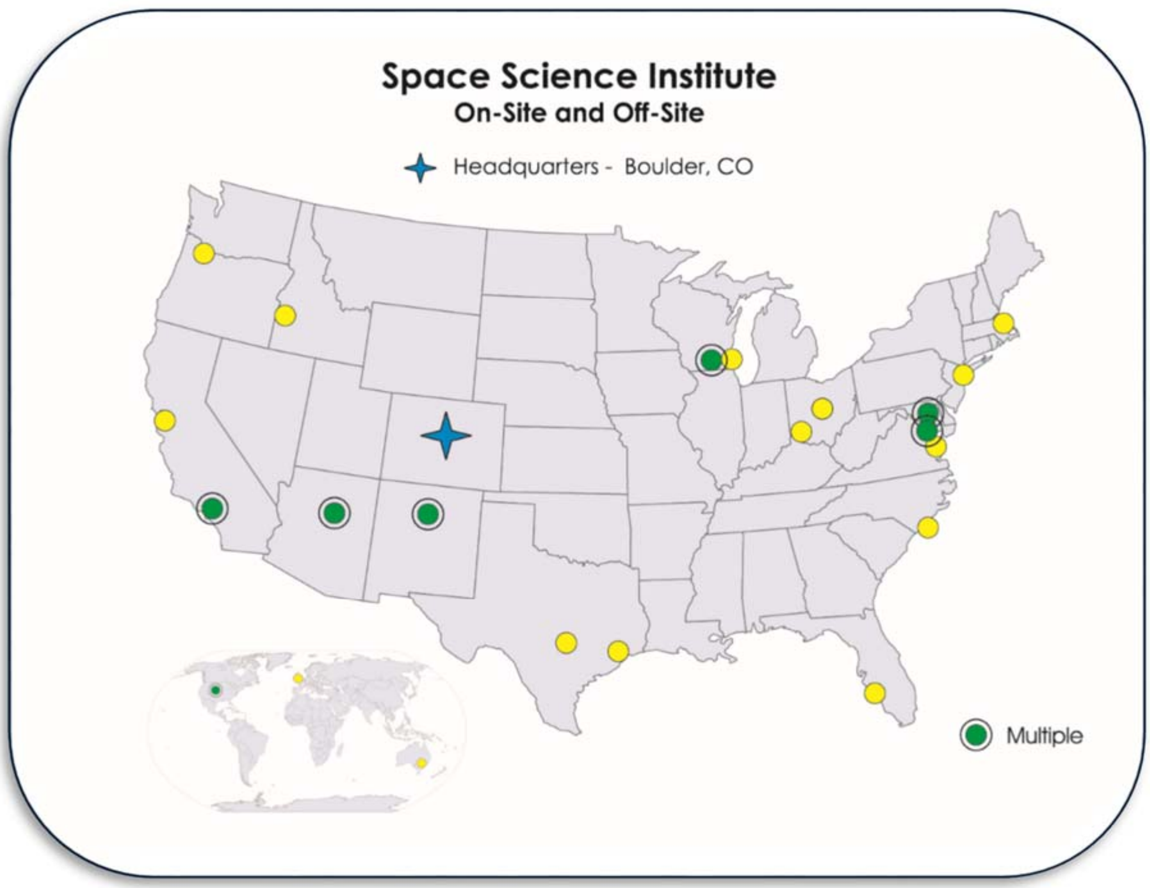
Providing high quality STEM learning opportunities for all Americans is essential to creating an educated citizenry who understand the complex issues confronting our nation and the world such as climate change and national security. STEM professions and the pipelines that produce those professionals lack ethnic diversity, even as the nation is undergoing a significant demographic shift. To attract a diverse body of students, STEM programs must be culturally sensitive. There are troubling gaps in understanding how people develop an interest in STEM, how they then become motivated to pursue a STEM education, and why so many drop out of STEM majors. Finally, we feel that STEM professionals can play a more active role in improving both formal (classroom-based) and informal (outside the classroom) STEM education.

Our work is what the future of discovery and learning looks like:

- We are implementing an entrepreneurial approach to earth and space science research that is yielding important discoveries that will change our understanding of the Universe.

- We are connecting the public to the wonder of science and building their understanding of the importance of new discoveries.
- We are building on a national momentum in support of STEM education to harness the power of discovery to inspire and educate the next generation of innovators.

Great Balls of Fire exhibit.
Courtesy NCIL @ SSI.



3. Earth and Space Science Research

Illustration of solar system formation. Courtesy NASA.

SSI's Research Branch scientists participate in a broad array of science activities, including earth science, space physics, planetary science, and astrophysics. Our research team's expertise continues to expand, and now encompasses investigations of phenomenon on Earth, on the Sun and in the solar wind, as well as the atmospheres and surfaces of other bodies in our solar system. They are exploring the early stages of the life cycles of stars and nascent planetary systems around other stars in our galaxy and they are looking far beyond the confines of our own galaxy to study strange and powerful quasars and other types of distant galaxies.

SSI researchers are closely connected to the operations of current astrophysical space facilities such as the SOFIA airborne observatory, and the Fermi, NuSTAR, Spitzer, and Hubble Space Telescopes. Closer to home, several SSI researchers focus on Mars research through active participation in the Mars Curiosity rover which successfully landed on Mars in 2012, as well as the ongoing Mars Exploration Rovers and Mars Reconnaissance Orbiter missions.

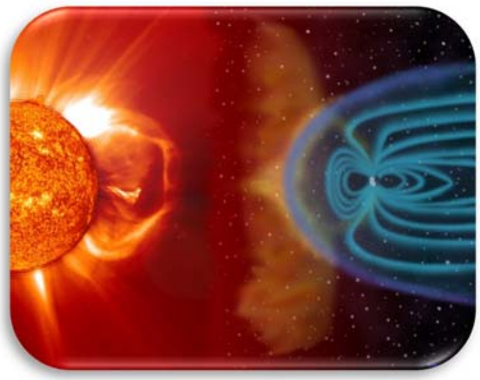
SSI has been a pioneer in remote employment of scientific researchers who fund themselves through a combination of grants and contracts awarded through competitive peer review of proposals, primarily to NASA and NSF. By providing high quality organizational, legal, and administrative support, SSI makes it possible for researchers to conduct research outside traditional universities and research institutes, including long-distance collaborations with colleagues in the U.S. and abroad. Their work can go on no matter the time or place, while affording a unique degree of professional and personal flexibility. Whether snowbound, home with a sick family member, on an airplane, or even simply "in the office", SSI scientists engage in activities such as accessing data that was just obtained from a rover on Mars or a telescope in South America, or collaborating with scientific colleagues from all over the world using teleconference technologies. Substantial multi-year funding comes primarily from NASA mission science team membership or from 3-year NSF grants to an individual investigator. In astrophysics and planetary astronomy, approximately 80% of the research funding comes from NASA, the remaining 20% from NSF.

The scientific community reviews the following research fields every ten years to identify the highest national priorities for research: astrophysics, earth science, planetary science, and solar/space physics. The "decadal reports" are sponsored by NASA and NSF, and conducted through the National Academy of Sciences/National Research Council. SSI will focus on expanding those science research areas that meet the highest priorities set in these field-specific Decadal Surveys.

SSI created two new Research Centers in 2013: the *Center for Space Plasma Physics* and the *Center for Extrasolar Planetary Systems*. It will create a third in 2014: the *Center for Mars Research*. These centers focus effort in specific, high priority and timely fields. We describe the first two Centers and their anticipated activities below.

Center for Space Plasma Physics

Humankind has been fascinated since the dawn of recorded history with the Sun and its relationship to Earth. Virtually all civilizations have speculated about the place of our planet in the realm of the Solar System and the stars of our galaxy. Only within the past few hundred years has the changing face of the Sun been known. The role of the Sun in driving disturbances in Earth's magnetic field has come to be appreciated within the last century or so.



Schematic diagram of the Sun-Earth environment. Courtesy NASA.

The mission of SSI's *Center for Space Plasma Physics* (CSPP) is to carry out scientific research that will increase our understanding of fundamental and applied aspects of space plasmas. Space plasmas consist of the ionized material of the terrestrial and planetary ionospheres and magnetospheres, the solar wind, and the solar atmosphere and corona. CSPP researchers use their broad expertise in plasma microphysics and macrophysics to understand the origin and evolution of the solar wind, to identify and understand the physical processes that operate in the solar wind and magnetosphere, to quantify the coupling between the solar wind and the magnetosphere, and to understand the behavior of the solar wind-magnetosphere-ionosphere system.

CSPP researchers seek support to make important, compelling contributions to space science in several crucial areas to improve our basic understanding of plasma physics and to develop space weather applications, such as models that describe the impact of space plasma on Earth's environment. The key research areas are:

Solar wind – Magnetosphere Interactions

The coupling between the solar wind plasma and the magnetosphere governs mass, momentum, and energy transfer to the terrestrial magnetosphere-ionosphere system. The variations in the solar wind plasma and the accompanying interplanetary magnetic field are the main drivers of magnetospheric activity. The key process is magnetic reconnection at Earth's magnetopause. Exploring the efficiency of this process, and the solar wind-magnetosphere interaction as a whole, is the key to understanding and quantitatively describing the energy flow into the magnetosphere and the geoeffectiveness of solar wind coupling.

Magnetotail Dynamics and Particle Acceleration

Governed by its interaction with the solar wind, the magnetotail acts as a reservoir of energy stored in magnetic fields. This energy is sporadically released through rapid magnetic reconnection and converted to particle energy in the form of heating and energetic particle generation. These processes have a major impact on space assets as well as ground-based technological systems. Our main goals are the exploration of the dynamics of the release process, the particle acceleration, and the energy conversion and transfer mechanisms.

The Aurora Borealis, or Northern Lights, shines above Bear Lake, Eielson Air Force Base, Alaska. Photo courtesy J. Strang.

Turbulent Energy Transfer and Dissipation

Large-scale dynamic processes are often accompanied by turbulence which is ubiquitous in space plasmas throughout the heliosphere. Turbulence causes energy to cascade to smaller and smaller scales until kinetic mechanisms dissipate the energy cascade and heat the plasma. Turbulence plays an important role in plasma heating and particle acceleration that is at the forefront of solar wind research. One of our goals is to explore, through particle simulations, the transition regime between MHD and kinetic waves. Another is to understand the structure of the solar wind and the information it may carry about physical processes going on in the solar chromosphere and corona.

Magnetospheric System Science

The Earth's magnetosphere encompasses numerous different plasmas and electromagnetic waves, all of which interact and couple to produce the dynamic behavior we observe in satellite, ground-based, and image data. To gain further insight into this complex interaction we take a "systems" based approach to the entire magnetosphere and aim to understand the system-reaction to a variety of solar-wind drivers. Our goal is to understand the coupling of the different plasmas and waves, and deduce the timescales that this coupling occurs across.

The main tools to explore these fundamental processes within the *Center for Space Plasma Physics* are state-of-the-art MHD simulations and theory as well as particle-in-cell (PIC) and test particle simulations. In addition, existing satellite datasets of the electron and ion plasmas and ground-based plasma and field observations are heavily utilized within CSPP. The subjects of our investigations are particularly timely in view of the recent launch of the Radiation Belt Storm

Probe (RBSP) in August 2012, which will lead to unprecedented observations of the particles and fields of Earth's inner radiation belt, as well as the planned Magnetospheric Multiscale (MMS) mission, specifically dedicated to explore the physics of reconnection, particle acceleration, and turbulence in the magnetosphere. CSSP personnel are involved directly in MMS modeling and theory and have continuing strong connections to Los Alamos National Laboratory (LANL) RBSP Co-Investigators.

Center for Extrasolar Planetary Systems

The belief that planets exist around stars other than our Sun may be found in philosophical and scientific writings going back several centuries. Nevertheless, the realization that such planets appear to be the rule rather than the exception has only occurred in the last 5-10 years. As of late 2012, nearly 900 planets have been discovered outside of our solar system. While the initial exoplanet discoveries were of gas giants as massive as Jupiter, data from the Kepler mission indicate that smaller planets are more common than Jupiter-sized planets. Scientists are continuing to discover more Earth- and Mars-sized planets, including a few in the so-called "habitable zone" of the host star. These exciting developments suggest the potential of finding planets with conditions conducive for life. Yet it is important to recognize that the study of extrasolar planets and planetary systems is not the bailiwick of a single discipline. Rather, many aspects of such studies are best investigated with an interdisciplinary team that includes expertise in astrophysics, astronomy, chemistry, and planetary science.

Illustration of an extrasolar planet transiting its star. Courtesy Jeffrey Hall, Lowell Observatory

The mission of the SSI's *Center for Extrasolar Planetary Systems* (CEPS) is to capitalize on the need to combine multiple fields of study in order to carry out scientific research that characterizes the fundamental properties of extrasolar planets and the systems in which they are found. These properties include details on the chemistry, structure, and dynamics of the atmospheres of such planets, the connection of planetary characteristics to those of the host star, and the signatures of planetary formation processes such as debris disks, zodiacal light, the bulk elemental composition of the planets, and the possible orbital migration history of the planetary systems. The growing diversity of extrasolar planetary systems indicates that the processes governing their formation and evolution can differ significantly from those in our solar system. Continuing studies will help us better understand the behavior of our own solar system.

CEPS researchers (with backgrounds in atmospheric chemistry, stellar and planetary formation, radiative transfer, and remote sensing) seek support to make important, compelling contributions in several crucial areas that are relevant for both observational and theoretical aspects of extrasolar planets and systems. The strong interdisciplinary nature of such studies often leads to research being performed by teams of scientists, rather than one or two individuals.

Star forming region captured by the Hubble Space Telescope. Image courtesy J. Hester & P. Scowen, STScI, ESA, NASA

Consequently, CEPS scientists will actively collaborate to examine several key research areas:

Spectral Signatures of Extrasolar Planetary Atmospheres

Observations of extrasolar planets that transit in front of and behind their host stars (as seen from Earth) have provided insight into the planets' atmospheric composition, thermal structure, aerosol structure, winds, energy-transport efficiencies, and the spatial and temporal variations in atmospheric properties. Direct imaging of the extrasolar planets -- particularly of young, hot, self-luminous planets -- has also contributed to our knowledge about such atmospheric properties. However, these observations need to be understood from a theoretical basis. Our goal is to determine how various chemical and physical processes act to influence the observed spectra and other observational characteristics of these atmospheres. The extent to which parameters like planetary mass, orbital distance, bulk-element composition, evolutionary history, and stellar properties affect the planetary atmospheric characteristics will be investigated.

Star-Atmosphere Connections

The host star can influence the planet and its atmosphere in many ways. Energy from the star heats the atmosphere, driving winds that transport energy and redistribute various constituents such as water, dust, etc. The incident stellar ultraviolet radiation also impacts the planet through processes like photochemistry. We seek to better understand these complex coupled processes, including the specific influence of the star, on the observable properties of extrasolar planetary atmospheres. In addition, our simulations will lead to direct predictions on the detectability of these systems through various photometric and polarimetric observational techniques.

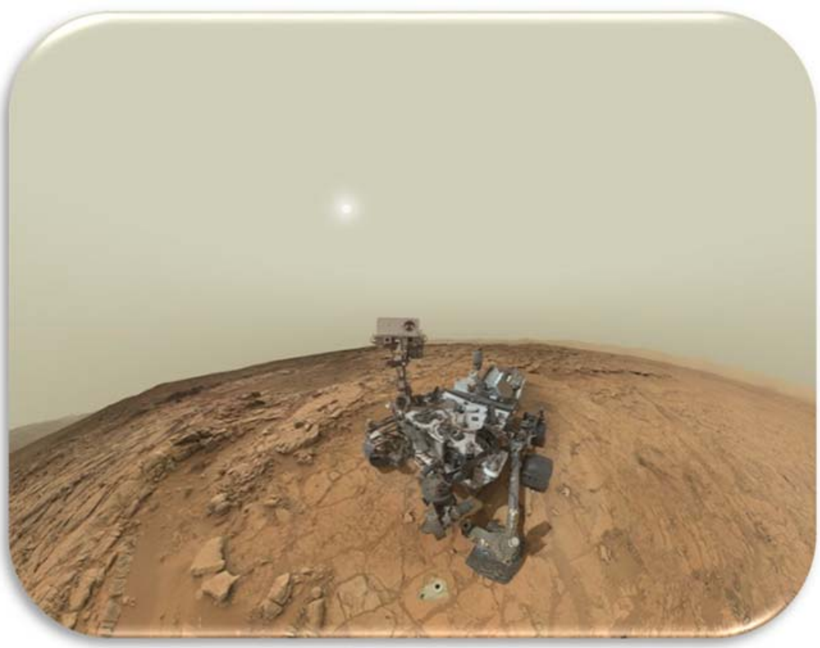
Formation and Evolution of Planetary Systems

Further insight into these systems can still be obtained via computer-based modeling of the observed extrasolar planetary systems. For instance, photo-dynamical modeling uses supercomputer simulations of exoplanets to rapidly scan a huge multi-dimensional parameter space to determine the tiny subset of planetary orbits and masses that are consistent with observations of planetary transit observations (e.g., from the Kepler mission). This type of analysis allows one to infer each planet's mass, radius, mean density, and orbital size, shape, and orbital tilt. With that information we can begin to infer that system's past history from their formation in the protostellar disk through their current orbital configurations.

Debris Disks

Circumstellar debris disks are generally interpreted as having been formed from the collisions among the planetesimal bodies ("unseen" comets or asteroids that also orbit the central star). The debris is in fact a large amount of very small particles that efficiently reflect the light from the central star. These disks are of particular interest because of their utility in characterizing planet formation. Through the synthesis of observations and computer models of the evolution of the primordial planetesimal swarm, we will determine if the system is still in the process of forming larger bodies or if one is viewing the "left-overs" from a recently assembled planetary system.

The main tools to explore these fundamental processes within the *CEPS* are state-of-the-art radiative transfer simulations, electro-dynamical light scattering algorithms, thermochemical and photochemical kinetics and transport models, and orbital dynamics calculations. The subjects of our investigations are particularly timely in view of the success of the NASA Kepler mission.



Curiosity Rover on the surface of Mars.
Courtesy NASA.

4. Cassini Imaging Central Laboratory for Operations (CICLOPS)

Saturn during equinox, as imaged by the Cassini spacecraft. Courtesy NASA/JPL/SSI.

The Cassini Imaging Central Laboratory for Operations (CICLOPS) is located at SSI's Headquarters Office in Boulder, CO (www.ciclops.org). CICLOPS is the center for uplink and downlink operations for the imaging science experiment on the Cassini mission to Saturn. All images produced by the two powerful telescopic cameras onboard Cassini (the Imaging Science Subsystem) make their way across more than a billion and a half kilometers (1 billion miles) of space to be archived in databases at CICLOPS and made available to imaging team members across the globe, researchers, and the public.

The Cassini-Huygens mission continues to change our view of the Saturn system. Since arriving at Saturn in the summer of 2004, the intrepid spacecraft has completed numerous close flybys of Saturn's moons, providing new perspectives and a wealth of data about this unique collection of objects. Cassini has monitored powerful lightning-generated radio outbursts and cloud activity produced by giant storms on Saturn that dwarf those on Earth. The Huygens probe landing on haze-shrouded Titan and Cassini's continuing survey of this moon from space have provided tantalizing glimpses of a world that is at once remarkably earthlike yet also frigid and alien. The startling revelation that Saturn's small, icy moon Enceladus may possess underground reservoirs of liquid water has widened our perception of the range of environments that might be hospitable for life in the Solar System beyond our own planet.

Cassini's landmark exploration of the ringed planet, its mysterious moons, stunning rings, and complex magnetic environment will continue through 2017 when the spacecraft's third and final mission is scheduled to come to an end. CICLOPS team members and the Cassini mission scientists and engineers are now hard at work executing the seven-year Cassini Solstice Mission, the second extension beyond Cassini's prime mission (which ended in 2008).

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency, and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, CA, manages the Cassini-Huygens mission for NASA's Science Mission Directorate, Washington, DC.

Cassini/Saturn Research

Led by Cassini Imaging Team leader Dr. Carolyn Porco, CICLOPS came to SSI in August 2003. Fourteen scientists from the United States and Europe comprise the imaging team that uses Cassini's cameras to investigate many unique features of the Saturn system. The Imaging Team continues to publish findings from their investigations, deepening our knowledge about Saturn and the processes by which planets—and whole planetary systems—form and develop with time.

Saturn's small moon Enceldus. Courtesy NASA/JPL/SSI.

5. National Center for Interactive Learning

Great Balls of Fire exhibit. Courtesy NCIL @ SSI.

SSI's *National Center for Interactive Learning* (NCIL) is dedicated to expanding the understanding and participation of families, youth, teachers, and citizens in science and technology (www.nc4il.org). We foster collaboration between STEM professionals and educators to bring the wonder of science and engineering directly to people. We bridge the worlds of public schools, libraries, museums, and the Internet. Our programs span a range of audience needs and delivery methods, including traveling museum exhibitions (e.g. *MarsQuest*, *Alien Earths*, and *Giant Worlds)*; award-winning educational films (e.g. *Are We Alone?*), videos, and websites; hands-on teaching resources and activities; and educator workshops. Our programs are designed to be accessible to all, and to inspire the next generation of STEM innovators. More than 330,000 people visit our traveling exhibits every year and more than 425,000 use our educational websites. Our programs impact rural and urban communities nationwide as well as underserved audiences (e.g. Latinos, African Americans, and Native Americans). All of our education work is guided by a robust evaluation program that is developing best practices for interactive learning and enabling us to disseminate the most successful programs nationally.

Building on the success of a Colorado-wide tour of the *Discover Space* exhibition, we launched the *STAR Library Education Network* (STAR_Net) as a national hands-on learning program for libraries and their communities. Phase 1 of this NSF-funded program, in partnership with the American Library Association and the Lunar and Planetary Institute, will reach underserved youth and their families with informal STEM learning experiences. Through mid-2014, two exhibitions–*Discover Earth* and *Discover Tech*–will reach nineteen libraries across the United States. Librarians and STEM professionals across the country are joining STAR_Net's online community to build collaborations and share resources.

NCIL educators have been exploring the potential of digital media for over a decade, ranging from interactive experiences for museums and libraries, to online games, and now smartphone and tablet "apps". Digital media doesn't simply create more engaging experiences, it can allow learners to interact with data, explore simulations, and connect to each other through social media. For example, we're tapping into the enormous popularity of Facebook games by developing one that will teach players about the evolution of stars and planets. A simultaneous research and evaluation program will examine both the effectiveness of this game as a learning tool, as well as the broader potential of this gaming approach for the educational community.

Below, we describe NCIL's two strategic initiatives.

Transforming Communities

A science festival event. Courtesy Bob Russell.

From climate change to decreasing biodiversity to threats to human health and access to clean water, the majority of challenges facing society today – and their solutions – are rooted in STEM. Navigating these challenges successfully requires highly competent STEM professionals, students proficient in STEM content and processes (e.g., critical thinking skills, creativity and innovation, communication and collaboration), and a public that is sufficiently STEM literate to assess the choices before them. The fastest growing occupations in our nation – many related to the challenges facing our society – require high levels of proficiency in STEM; unfortunately, less than 20% of our high school students are ranked as proficient in these disciplines. Beyond addressing the challenges of today, STEM achievement is an investment in the innovations of tomorrow.

The education system in the United States is currently experiencing one of the largest shifts in recent memory. Continuing well into the future, there will be a transformation away from traditional classroom environments, toward a more engaging, "learning-by-doing" approach to youth education. Skills such as problem solving, information management, collaboration, self-direction, or *21st Century skills*, are highly related to student success and are beginning to appear in curricula across the nation (in both formal and informal learning environments like science centers, museums, and public libraries).The U.S. will not be able to meet the STEM workplace demands of the future if we are not able to engage, inspire, and educate our growing ethnically diverse populations in a variety of STEM disciplines. While non-white ethnic populations are increasing, most continue to be severely underrepresented in STEM fields. Gender disparities in many STEM fields, such as engineering, are also a serious problem. Over the past couple decades, our formal education system has been leaking students interested in pursuing STEM careers (the so-called STEM pipeline problem). The leakage begins in middle school and continues into high school and college. We all lose when students leak out of the STEM pipeline and take their creative potential with them. Our STEM education system must do better.

We believe that America has a strong foundation of scientific inquiry and innovation on which to build. But it is the workforce of tomorrow that must meet these 21st Century challenges. The key to improving our STEM workforce is not to focus solely on an individual student, or teacher, or even an individual classroom, but to explore how we can begin to transform whole communities in how they view and support STEM. NCIL has adopted a strategy of ***transforming communities*** as a way of addressing two critical needs facing our country: 1) Increasing the number of young people pursuing STEM careers by providing opportunities and encouragement to those who are underserved and underrepresented and 2) Enhancing general STEM literacy because public policy matters often involve complex STEM-related issues. The public square, where citizens meet to discuss issues of the day, needs to include informed discussions of STEM issues affecting us all.

By transforming communities, we can transform lives.

The word "community" can mean a social group living in a particular place and sharing a culture and values. Such communities support families and individuals and are important influences on children. But "community" can also refer to a group of people with a common interest who don't necessarily live in the same area but who nonetheless help one another. For example, a professional community that creates networks and shares resources. We particularly want to reach people who live in areas that are underserved (e.g. rural and urban communities), and to develop programs that successfully impact groups that are underrepresented in STEM professions (e.g. Latinos, African Americans, Native Americans).

NCIL is approaching these two systemic problems through the following community efforts:

1) **Engage families and their communities in STEM learning and inspire adults to foster and support their children's interests in STEM**. There is now a large body of research showing the importance of parental involvement in supporting student achievement and impacting career choices. Families can support a child's emerging identity as a STEM learner in many ways. A parent can find out-of-school programs, such as a robotics club. Also, both parent and child can participate in STEM activities, such as joining a citizen science project that collects data. But family is not the only influence on a child's development. Research also shows the importance of approval from adults who are outside of a child's family on that child's positive development and achievements. In other words, as common sense tells us, family and community together influence a child's development.

The Discover Tech exhibit.
Courtesy NCIL @ SSI.

2) **Support the professional communities that provide informal STEM programming to adult and youth audiences across the country**. Over 18 years of evidence-based research strongly suggests that extended networks of professionals are effective tools for organizations striving to improve performance. Communities of practice (CoPs) are "groups of people who share a common concern or passion for something they do and learn how to do it better as they interact regularly." (E. Wenger). Evidence shows that extended networks of professionals forming a CoP can play an important role in developing an individual's professional skills and building capacity in all kinds of institutions. Moreover, in recent years, CoPs in many successful organizations have evolved from "informal groups" to "supported groups" sponsored by management to build knowledge among a team, to "structured groups" that an organization intentionally initiates and manages to advance its strategic concerns.

NCIL Actions. Based on our two overarching efforts to transform communities, NCIL has identified several specific actions.

1) Expand NCIL's *STAR Library Education Network* (STAR_Net) to bring STEM library education programs such as *Discover Space*, *Discover Earth*, *Discover Tech*, and *Discover Health* to rural and urban communities nationwide. The programs are created to inspire lifelong learning through inquiry and play. Partners include the American Library Association, Lunar and Planetary Institute, the National Girls Collaborative Project, IEEE-USA, American Geophysical Union, the National Weather Service, the National Academy of Engineering, Engineers Without Borders-USA, the National Renewable Energy Lab, FIRST Robotics, and many more organizations. Phase 1 is supported by a grant from NSF through 2014.

Exploring the Discover Tech exhibit. Courtesy Huntsville-Madison County Public Library.

2) Develop community collaborations that support access to STEM for all Americans. NCIL's *Community Outreach Group* works with project partners to design networks that are based on the latest research concerning collaboration and CoPs. For these efforts, NCIL uses state-of-the-art web infrastructure and social networking resources (e.g. Facebook and Twitter). Network-based projects rely on contributions from NCIL's *Exhibit Development Group*, the *Professional Development Group*, and the *Learning Research and Evaluation Group*. In 2014 NCIL will seek funding for a conference called *STEM Learning in Libraries*. The conference's overarching goal is to facilitate strategic partnerships between the community of public libraries and STEM organizations. The conference will bring together researchers, practitioners, funders, and STEM and library leaders.

3) Evaluate collaborations and CoP networks across all active NCIL programs. NCIL brings special expertise in structuring and leading CoP networks. For example, NCIL's STAR_Net project (www.STARnetLibraries.org) is conducting a pilot research study examining the effectiveness of its CoP for librarians and STEM professionals in building both individual and organizational capacity. This project will provide a foundational study for this program-wide evaluation activity.

"Today I had the most fun and awesome day of my life. I loved coming and seeing everything. I LOVE everything about today." From a young patron in Diboll, TX during her visit to the *Discover Earth* exhibit

Frontiers of Digital Learning

The Giant Worlds exhibit. Courtesy NCIL @ SSI.

NCIL educators have been exploring the potential of digital media for over a decade, ranging from interactive experiences for museums and libraries to online games and now smartphone and tablet "apps". The potential of digital media only increases as portable, connected devices become more commonplace, allowing us to reach people in a variety of different environments and contexts. This means an increased opportunity not just to impact formal education, but to reach people in all walks of life and raise the general science literacy of the public. Our approach is reinforced by NSF's Cyberlearning Task Force, which recently recommended that they "emphasize the transformative power of information and communications technology for learning, from K to grey", and explore technologies that allow interaction with scientific data and visualizations while bridging multiple learning environments.

Here are some examples of the directions NCIL is currently pursuing:

1) **Exploring new and evolving digital technology**. While some technological advances are incremental, others create opportunities to provide new, improved, or expanded ways of learning science. One example of this is the Microsoft Surface, a device that is currently unique in combining a touch table experience with the ability to recognize objects placed on top of it. We have developed a prototype "magnet table" that includes objects painted to look like magnets. When these "magnets" are placed on the Surface, the appropriate magnetic field lines are drawn on the table. Magnetic fields combine, a "compass" piece can be used to see the direction of the fields, and charged particles can be launched into the system. This "augmented reality" approach creates an excellent opportunity to allow

visitors to explore the behavior of magnetic fields and their interactions with charged particles, a key element of Space Weather and Sun-Earth connections, and a topic that is not well covered in standard curricula. We are building on this early piece using testing and evaluation to create a tool that could be used in multiple environments to introduce people to the fundamentals of electric and magnetic fields.

The Space Weather Experience.
Courtesy NCIL @ SSI.

2) **Physics and simulation based gaming**. There has been a groundswell of interest in educational games over the last few years, and for good reason. Games have a demonstrated ability to engage their players while using careful scaffolding to allow the player to develop the skills necessary to succeed in the game. What remains to be demonstrated is the extent to which games can be used to teach specific educational content, and in what circumstances. We believe one of the stronger opportunities for educational gaming lies in games based on simulations or physics frameworks. The potential here lies in the underlying environment of the game: by building on physics engines, the game demonstrates physical behaviors in an accurate, but controllable way. This allows the designer to emphasize specific physical behavior in a way which might be clearer than the real world provides. For instance, rather than asserting to a student that objects fall at the same rate neglecting air resistance, game worlds can actually remove air resistance or make it controllable by the player. Players can work and solve problems in an environment which preserves physical accuracy while eliminating the distractors which lead to misconceptions. Our early work in this has involved the exploration of gravity misconceptions through an asteroid game. Players push on asteroids to keep them from colliding with Earth. As they play the game they are also are working with gravity and Newton's laws in ways that have been designed to confront documented misconceptions. Future work will explore the extent to which such games can actually shift player misconceptions and what additional reinforcements might enhance the game's effectiveness.

The Great Balls of Fire exhibit.
Courtesy NCIL @ SSI.

3) **Exploring new gaming environments**. A second educational game strategy being pursued by NCIL focuses on a very different type of gaming: "sporadic" or "passive" play combined with social components, as modeled by Facebook games such as Farmville. These games are unusual in that a player might only take one or two actions in a given session (e.g., plant a crop). They are then forced by the game to wait hours or days before they can follow up on that action. While this might seem like an uninteresting form of gameplay, these games have been wildly successful, with tens of millions of monthly active players. From an educational perspective these games are of interest for several reasons. First, the learning potential of sporadic play games may be very different than traditional games, since players are exposed to the content repeatedly over long periods of time (weeks, months or even years). In addition, both the reach and demographics are compelling (a disproportionate number of the players are women). NCIL is currently in development of a stellar and planetary evolution game, to be deployed both over Facebook and through a standalone site, in which players build stars and planets. This project has tremendous potential on multiple fronts: not only is it a new way to reach informal audiences with astronomy content, but it opens up new opportunities for learning research. And the model is extensible: there are many other areas of science that could use a similar approach (physics, Earth science, health, etc.).

> *"Technology, like art, is a soaring exercise of the human imagination."* Daniel Bell

4) **Exploring formal/informal education connections**. Another aspect of gaming that is of particular interest to NCIL is its role as a supplement to classroom education. NCIL and BrainPOP (www.brainpop.com) formed a collaboration in 2011, which has been instrumental in getting NCIL-developed digital games into classrooms nationwide (e.g. 75,000 loads of our games came from BrainPOP). BrainPOP creates animated, curriculum-based content that supports educators and engages students – in school, at home, and on mobile devices. BrainPOP's educational apps have been downloaded millions of times and are a great fit for mobile learning and "bring your own device" (BYOD) classrooms. Over 100,000 teachers and educators are part of the BrainPOP network. NCIL plans to expand this valuable partnership in 2013-2016 to include more of its educational games (e.g. *Rubble!* and *Magneto-Golf*), as well as participate in various webinars offered by BrainPOP for its teacher network. While the traditional "computer lab" model has always provided a challenge for educational games (access is limited for the students, external software and websites are often blocked), the popularity of smartphones and tablets combined with a BYOD model in schools creates new pathways for connecting students with educational software. In addition to our BrainPOP activities, our current efforts on this front include MyStar, which was tested in a classroom environment to determine the extent to which students would engage with the game beyond the classroom, as well as educational games currently in development for mobile devices. In 2014/2015 our new solar system evolution game (described above) will be made available to non-Facebook players, with a focus on using it as a tool in middle school classrooms studying astronomy.

In addition to these examples, NCIL continues to develop digital media components for traditional websites, museum kiosks, interactive touch tables, and has successfully expanded into smartphone apps in 2013. App development will continue in 2014 and beyond. In all cases we strive to preserve a focus on research and evaluation, so that as we educate students and the public about science we can also inform the education community as a whole about new learning strategies and best practices.

The Great Balls of Fire exhibit.
Courtesy NCIL @ SSI.

6. Key Actions and Metrics (2013-2016)

As covered earlier, SSI has a number of key goals and actions. We discuss them here in further detail. We also list the metrics associated with our strategic goals and specific actions to reach them. Metrics may be informal (non-quantitative) or formal (quantitative).

I. Strengthen and Expand SSI's Scientific Research Program

SSI's Research Branch scientists investigate physical phenomena in a broad range of scientific fields: earth science, space physics, planetary science, exoplanetary science, and astrophysics. These scientific fields are constantly changing, reflecting new opportunities, growth and maturity of the science. In cost-constrained times, funding for new fields expands while that for older fields shrinks. We will focus on expanding those science research areas that meet the highest priorities set in field-specific Decadal Surveys conducted by the National Academy of Sciences. We plan five key actions and associated metrics:

1) **Recruit in strategic research fields.** Earth science is poised to recover from previous years' NASA budget cuts; in particular, it will be important in studying climate change. The U.S. space program currently has a strong emphasis on Mars science for a number of programmatic reasons, including possible manned missions in the coming decades. Astrobiology has captured the public imagination. Considerable advances in exploring the possibilities for life on planets under alien stars are being made with various observing platforms, including Kepler, Spitzer, and Hubble missions. Scientists are attracted to these fields because exciting breakthroughs can be made.

    - In 2013/2014, SSI's website will be enhanced. It will be an important resource for recruitment.

    - During 2013-2016, SSI will actively recruit scientists at the following annual meetings: American Astronomical Society (AAS), Division of Planetary Sciences (AAS), and American Geophysical Union (AGU).

2) **Pursue scientific research using new and upcoming missions and facilities.** The pace of new missions (e.g. Explorer and Discovery) is set by NASA funding levels. Over the next few years, we expect that small, medium, and large missions will be called for, as recommended in all four Decadal Surveys. New ground-based facilities, such as the Atacama Large Millimeter Array in Chile, are designed to enable new topics of research that can be funded by the NSF through highly competitive individual investigator grants.

    - In 2013-2016, SSI scientists will seek to join mission teams as Co-Investigators, Project Scientists, or Senior Project Personnel.

- In 2013-2016, SSI scientist involvement in ground-based programs will be encouraged and tracked.

3) **Use strategic initiatives to focus effort in specific, high-priority and timely fields.** SSI initiated two Centers in 2013 (see Section 3 for details) and will create a third in 2014. These Centers focus effort in specific, high priority, and timely fields. Scientists in each center can collaborate on joint proposals and publications. The Centers can also raise visibility by holding topical workshops for the science community.

Center for Space Plasma Physics (CSPP)

- In 2013, CSPP was formed with approval of SSI's Board, the members were selected, and the Director (Dr. Joe Borovsky) was appointed.
- SSI provided seed funding for CSPP's first topical workshop in September 2013, which was held in Santa Fe, New Mexico. CSPP may hold additional workshops annually.
- In 2013-2016, members of CSSP will continue theoretical modeling using simulations, space-based data and ground-based data, writing papers and presenting talks at conferences.
- Members will respond to annual science opportunities such as the NASA "ROSES" (Research Opportunities in Space and Earth Sciences) omnibus announcement and the NSF GEM (Geospace Environment Modeling) program.

Center for Extrasolar Planetary Systems (CEPS)

- Extrasolar planets are the fastest growing proposal area for the NSF. Recognizing the timeliness of the field, in 2013 SSI's Board approved CEPS's formation. The CEPS Director (Dr. Julianne Moses) currently leads a group of seven members.
- In 2013-2016, CEPS members will analyze data from space-based and ground-based observatories, perform modeling calculations, and write journal papers and present talks at conferences (e.g., AGU).
- Observing and funding proposals will be submitted to various NASA programs such as Hubble and the ROSES programs, including the Astrophysics Data Analysis Program, and to the annual NSF AAG program.

Center for Mars Research (CMR)

- SSI plans to form this Center in 2014.
- CMR's staff will work both together and independently on theoretical modeling and analysis of data from current Mars missions.

- A subset of the CMR members will be active in developing instrument concepts and proposals for upcoming Mars mission opportunities (e.g., the 2020 Mars Rover mission). Since no U.S. missions are planned for the 2016 and 2018 launch opportunities, participation in the 2020 misison is crucial for continued success in supporting this cutting-edge work.

4) **Carry out Cassini Imaging Operations at SSI**. During 2013-2016, Cassini will continue to execute the Solstice Mission which enables the study of the Saturn system during a complete season (4 earth-years long). Highlights include flybys of Saturn's moons Titan, Enceladus, Dione, Tethys, and Epimetheus to compare their geological histories, and high resolution imaging of the rings. The projected end of mission is currently September 15, 2017.

5) **Contribute to the SSI fundraising and development effort.** The Research Branch will provide timely input to requests from SSI's Development Office. While the focus of SSI's Development Office will be on education program support in 2013/2014, staff will also identify foundations that fund earth and space science programs.

II. Expand and Strengthen SSI's STEM Education Program

In order to increase the understanding and participation of families, students, teachers, and citizens in science and engineering, SSI's NCIL will develop new programs that grow out of our existing efforts: traveling exhibitions (for museums and public libraries); educational websites; hands-on teaching resources and activities; educator workshops, and education research/evaluation projects. We plan four key actions and associated metrics:

1) **Build the NCIL Infrastructure.**

   - 2013/2014: Define key competencies and job descriptions.
   - 2014: Develop an NCIL staffing model, including decision points for growth (such as funding and workloads).
   - 2013-2016: Continue to update and expand the NCIL website, www.nc4il.org.

2) **Respond rapidly to new opportunities for public engagement and outreach**.

   - A consistent stream of communications will provide important information about NCIL programs. In 2013-2016, NCIL will continue to publish two electronic newsletters monthly: *NCIL News* and *STAR_Net News*.
   - Active outreach through social media is also important. SSI will leverage the enormous popularity of Facebook and educational apps for its game releases through NCIL (e.g., *Star Maze* and *Asteroids* apps in 2013, the launch of the *Planet Families* app in 2014, and the launch of the Facebook game in 2014).

3) **Use strategic initiatives to focus effort in high-priority and timely education fields**.

Transforming Communities. NCIL has adopted a strategy of *transforming communities* as a way of engaging families and their communities in STEM learning, and inspiring adults to foster and support their children's interests in STEM.

- 2013-2015: Expand NCIL's *STAR Library Education Network* (STAR_Net) to bring STEM library education programs such as *Discover Space*, *Discover Earth*, *Discover Tech*, and *Discover Health* to rural and urban communities nationwide.

- 2013-2016: In partnership with selected organizations (e.g. the Association of Science-Technology Centers), develop science center/library collaborations that support access to STEM for all Americans.

- 2014/2015: Design partnership networks that use state-of-the-art web infrastructure and social networking resources (e.g. Facebook and Twitter). Evaluate these networks based on the latest research concerning collaboration and communities of practice.

- In 2014, hold the *STEM Learning in Libraries* conference in Colorado. The conference's overarching goal is to facilitate strategic partnerships between public libraries and STEM organizations. The conference will bring together researchers, practitioners, funders, and STEM and library leaders. NCIL is seeking conference support from NSF and private corporations.

Frontiers of Digital Learning. Digital media can create more engaging experiences, allowing learners to interact with data, explore simulations, and connect to each other through social media.

- **Exploring new and evolving digital technology.** During 2013-2016, we will continue to develop digital media components for traditional websites, museum kiosks, and interactive touch tables. In 2013, we will pilot 3 smartphone apps (both Android and iOS versions of *Star Maze*, *Planet Families*, and *Rubble!*). Given sufficient funding, we will continue developing educational apps during 2014-2016. These will be disseminated through NCIL and partner websites and NCIL newsletters. In 2014/2015, we will continue the development of an interactive electromagnetic experience using an augmented reality device such as the Microsoft Surface.

- **Physics and simulation based gaming.** We believe one of the stronger opportunities for educational gaming lies in games based on simulations or physics frameworks. During 2014-2016, we will explore the extent to which games like *Rubble!* can actually shift player misconceptions and what additional reinforcements might enhance the game's effectiveness.

- **Exploring new gaming environments.** NCIL is currently in development of a stellar and planetary evolution game, to be deployed both over Facebook and through a standalone site, in which players build stars and planets. The beta version will be available in early 2014, with the final version launching that summer.

- **Formal/Informal Connections.** In 2013-2016, NCIL will continue its partnership with BrainPOP (begun in 2011). BrainPOP is an online education portal that delivers curriculum-based content which supports educators and engages students - in school, at home, and on mobile devices. In 2014, NCIL will collaborate with BrainPOP on several webinars on digital games for classroom educators.

4) **Contribute to the SSI fundraising and development effort.** NCIL will provide timely input to requests from SSI's Development Office; identify 10-15 corporations and foundations yearly; and submit a minimum of 5 proposals per year for additional program support.

III. Provide an Effective and Efficient Infrastructure to Support SSI's Mission

SSI must continue to strive for operational efficiency while expanding its scope of research, flight operations, and education projects. Our programs must be innovative, foster collaboration, and have strategic impact. As a business, SSI will maintain the highest standards for grant and contract administration, maintain and enhance its financial accounting system, and continue to implement effective employment policies.

As an additional means of achieving our broad research and education goals, we will target new sources of funding, both federal and private. SSI currently works on projects funded primarily by NASA and NSF. In addition to expanding its research base, SSI will submit proposals to federal agencies such as the Department of Energy, the Department of Defense, and the Department of Education. SSI will also seek out new opportunities to work with nonprofit corporations and private foundations. We plan three key actions and associated metrics:

1) **Offer streamlined, cost-effective services**

- 2013/2014: Enhance online resources using SSI's SharePoint site;
- 2014: Provide digital time sheets;
- 2014/2015: Enhance online budget reports and other award reporting tools.

2) **Improve communications with key stakeholders through increased media coverage and direct communications**

- 2013/2014: launch an electronic newsletter for the public;
- Improve media relations by offering media events and press releases throughout the year;

- 2013-2016: Exhibit at professional society meetings; and
- 2013/2014: Enhance and strengthen our company website.

3) **Expand fundraising success beyond federal sources**

- 2013/2014: Evaluate and understand new or additional regulations, requirements, and impacts of new funding sources.

The SSI website will be enhanced in 2013/2014 to include easily accessible information for potential donors and representatives of philanthropic organizations. We will develop a specific list of projects and funding priorities for large donors, and establish a menu of giving opportunities that offers multiple entry points for donors of all sizes (for example, sponsorship of a travelling library exhibit or a smartphone app). SSI staff will investigate foundations and corporations with philanthropic programs to identify those with an interest in STEM literacy and education. We will work with appropriate contacts at those institutions to develop proposals for funding specific projects and general support.

Earth and the Moon.
Courtesy NASA.

7. Financial Report — 2012

Space Science Institute
Summary Statement of Financial Position
as of December 31, 2012 and 2011

		2012	2011
Assets			
	Assets		
	Cash and cash equivalents	$ 137,474	$ 752,768
	Accounts receivable	1,264,949	1,027,440
	Prepaid expenses and deposits	88,591	77,543
	Net furniture, equipment, and property	25,351	35,431
	Total assets	$ 1,516,365	$ 1,893,182
Liabilities and Net Assets			
	Liabilities		
	Accounts payable and accrued liabilities	$ 634,477	$ 489,474
	Deferred revenues	490,108	687,390
	Line of credit	-	365,000
	Total liabilities	1,124,585	1,541,864
	Net assets		
	Unrestricted	384,733	346,318
	Temporarily restricted	7,047	5,000
	Total net assets	391,780	351,318
	Total liabilities and net assets	$ 1,516,365	$ 1,893,182

Summary Statement of Activities
for the years ended December 31, 2012 and 2011

		2012	2011
Support and revenue			
	Grants, contracts, and cooperative agreements	$ 5,723,764	$ 5,943,200
	Contributions	6,960	9,950
	Exhibit income	216,500	137,000
	Interest income	259	364
	Other income	99	267
	Total support and revenue	5,947,582	6,090,781
Expenses			
	Program services	5,932,230	6,020,806
	General and administrative	(25,110)	34,548
	Total expenses	5,907,120	6,055,354
	Change in net assets	40,462	35,427
	Net assets, beginning of year	351,318	315,891
	Net assets, end of year	$ 391,780	$ 351,318

The summary financial information does not include sufficient detail or disclosures to constitute presentation in conformity with accounting principles generally accepted in the United States of America. If the omitted detail or disclosures were included, they might influence the user's conclusions about the Organization's financial position, changes in net assets, and cash flows. Accordingly such information should be read in conjunction with the Organization's audited financial statements for the years ended December 31, 2012 and 2011, from which the summarized information was derived. A copy is available upon request.

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