2007 NASA Academy Summer Research Projects

Project (ID: 0-4) - Webmaster for NASA Robotics Academy
Min. Level: High School - Freshman
Max. Level: Undergraduate - Senior

Disciplines:
• Computer Science
• Graphics
• Image Processing
• Info. Tech.
• Software Engineering
• Web Development
• Robotics Engineering

Skills:
• HTML
• Flash is a plus, but not required
• Dreamweaver is a plus, but not required
• Java is a plus, but not required
• Photoshop or PaintShop Pro is a plus, but not required

Location: Goddard Space Flight Center

Project Abstract: The NASA Robotics Academy is an intensive resident summer program of higher learning for college undergraduate and graduate students interested in pursuing professional and leadership careers in robotics-related fields.
The NASA Robotics Academy program is designed to present a comprehensive package of information and experiences about the organization of the NASA Agency, some of its most important current and planned science, engineering, education, and technology enterprises, as well as a number of non-technical areas of critical significance. Besides attending lectures and workshops with experts in their field, the Robotics Academy students are involved in supervised research in GSFC laboratories, private companies, and universities, and will participate in visits to other NASA Centers, the Applied Physics Laboratory, the Massachusetts Institute of Technology (MIT) and a number of robotics-related academic laboratories and industries.

Intern's Project Activities: The intern will create and maintain the website for the NASA Robotics Academy and assist in the creation of maintenance of the NASA Academy website.

Essay Question: List any websites you've created in the past, if any. Additionally, what are your interests in Robotics?

Project (ID: 1-5) - Other
Min. Level: Undergraduate - Freshman
Max. Level: College/University Faculty

Disciplines:
• Astronomy
• Astrophysics
• Planetology
• Biology
• Astrobiology
• Botany
• Cellular Biology
• Genetics
• Human Biology
• Marine Biology
• Microbiology
• Chemistry
• Analytical Chemistry
• Biochemistry
• Org. Chemistry
• Computer Science
• Artificial Intelligence
• Computer Hardware
• Computer Security
• Databases
• Graphics
• Image Processing
• Info. Tech.
• Networking
• Software Engineering
• Web Development
• Earth Sciences
• Atmospheric Science
• Environmental Science
• Geosciences
• Meteorology
• Mineralogy
• Oceanography
• Soil Science
• Education
• Engineering
• Aero/Astronautics
• Bioengineering
• Chemical Engineering
• Civil Engineering
• Computer Engineering

- Control Systems
- Design Engineering
- Electrical Engineering
- Environmental Engineering
- Materials Engineering
- Mechanical Engineering
- Nanotechnology
- Nuclear Engineering
- Ocean Engineering
- Optical Engineering
- Robotics Engineering
- Space Engineering
- Humanities and Arts
- English
- Languages
- Photography
- Mathematics
- Analysis
- Statistics
- Physics
- Applied Physics
- Fluid Dynamics
- Nuclear Physics
- Optics
- Particle Physics
- Quantum Physics
- Relativity
- Thermal Physics
- Professional Sciences
- Administration
- Architecture
- Business
- Finance
- Health/Medicine
- Journalism
- Law
- Library/Info. Science
- Management
- Marketing
- Social Sciences
- Anthropology
- Communications
- Economics
- Political Science
- Psychology
- Public Affairs

Locations: Goddard Space Flight Center & Glenn Research Center

Project Abstract: If you have a project in mind, which does not already appear in this application, you may create your own position description. We will try to match you with the position if you are selected into an internship program. As with all positions, we cannot guarantee you a placement with the project of your choice.

Intern's Project Activities: TBD

Essay Question: Please enter the name of the project, a description of the work the office, project, or program does, the name of a contact person for the project, and what duties you would perform.

Project (ID: 10-13) - Observations and Simulations of the Turbulent Solar Wind

Min. Level: High School - Senior
Max. Level: Undergraduate - Senior

Disciplines:
• Astronomy
• Computer Science
• Graphics
• Info. Tech.
• Robotics Engineering
• Mathematics
• Analysis
• Physics
• Applied Physics
• Fluid Dynamics
• Space Physics

Skills:
• Math ability
• Physics background

Location: Goddard Space Flight Center

Project Abstract: We study the solar wind structure and evolution from near the Sun to the outer heliosphere. The work involves data from all the heliospheric spacecraft and modeling using simulations run on supercomputers. Our focus has been on the evolution of the turbulence in the solar wind which is important because it affects how energetic (and thus potentially harmful) particles propagate to us from the Sun and from outside the heliosphere. More recent work has considered the structure of the wind on various scales, including the difficulties in tracing magnetic field lines back to their solar origin. The work involves 2- and 3-D visualization of both the data and models, as well as theoretical and computational analysis.

Intern's Project Activities: The intern will participate with an active research group, learning basic information about the field, identifying problems, gathering data, learning to use analysis and visualization tools, and forming scientific conclusions. The details will depend on the student and the project. This project will involve students in deepening our understanding of the solar wind, either by the careful analysis and visualization of data from many spacecraft, or by the use of computer simulations, or both. Typical projects have included examining data from Helios, Wind, Voyager and other spacecraft to understand aspects of solar wind turbulence, or the use of magnetofluid simulation codes to model the structure and evolution of the wind. The development of new routines for data analysis (e.g., using IDL) can also be part of the work.

Project (ID: 11-14) - In Situ Resource Utilization

Min. Level: Undergraduate - Junior
Max. Level: Post Graduate

Disciplines:
• Planetology
• Chemistry
• Geosciences
• Mineralogy
• Engineering
• Robotics Engineering
• Applied Physics

Location: Goddard Space Flight Center

Project Abstract: Students are needed for the development of techniques to melt and vaporize the lunar regolith. Techniques have been developed to produce oxygen using vacuum pyrolysis, as well as reduction techniques. Students will also work on dust mitigation techniques.

Intern's Project Activities: The students will be involved in the development and testing of various furnaces and other advanced heating techniques, as well as the development of instrumentation. The students will also operate prototype devices, and conduct tests of operational equipment to test performance.

Essay Question: What is your interest in ISRU, and what can you bring to this project?

Project (ID: 12-15) - Development of A Zero-Leak One-Time-Actuating Normally-Closed Valve

Min. Level: Undergraduate - Freshman
Max. Level: Graduate - Second Year

Disciplines:
• Aero/Astronautics
• Bioengineering
• Control Systems
• Robotics Engineering
• Physics

Skills:
• Machining

Location: Goddard Space Flight Center

Project Abstract: The below abstract is for a year of work. The intern will be joining the project at the middle/end of that year.

This project intends to take five conceptual designs for a replacement for a normally-closed pyrovalve and create at least two functioning prototypes. The chosen design must demonstrate compliance with key requirements of leakage and flow rate and also must be designed to meet typical environmental and reliability requirements. Normally-closed pyrovalves are used to permanently break zero-leakage seals in the propulsion lines. They use an explosive charge to move a ram to open the flow path for propellant or pressurant gas. Past issues with the pyrovalves include "blow-by" of flaming particles from the combustion chamber into the propellant stream, misfiring of booster after ignition of the igniters and pyroshock affecting the output of nearby pressure transducers. The developed valves would replace normally closed pyrovalves without the use of pyrotechnics. These valves are all different from the pyrovalves in that the actuation is initiated entirely outside of a hermetically sealed flow path. This eliminates the possibility for external leakage and simplifies the design in some ways. It creates entirely new challenges as well, which this project will address.

Intern's Project Activities: The intern will be developing a design for a valve and testing any prototypes for functionality. He/She may also be responsible for iterating on a previously tested prototype design. Because this project it starting from the conceptual design level it is very difficult to say specifically what will need to be done come summer. However, the fact that the design is still conceptual means that the student will be able to contribute greatly to the design and think creatively.

Some designs use heat, and others magnetic fields to actuate the valve. For the magnetic actuation, an electrical engineer or physicist would be preferred. Otherwise someone with machining skills will be preferred (probably a mechanical engineer).

Project (ID: 13-16) - Mars Dust Cyclone Instrument Development

Min. Level: Undergraduate - Freshman
Max. Level: Graduate - First Year

Disciplines:
• Astronomy
• Planetology
• Image Processing
• Software Engineering
• Earth Sciences
• Meteorology
• Engineering
• Robotics Engineering
• Physics
• Optics

Skills:
• Computer programming
• IDL/Matlab experience

Location: Goddard Space Flight Center

Project Abstract: To understand the ambient dust environments on the Moon and Mars and design hardware to protect the astronauts that may go there, instrumentation is required to measure suspended dust concentrations, dust transportation and particle size distributions. Sensor architectures exist to do these types of measurements in terrestrial environments but rely on particle capture, typically by creating pressure differentials to direct particle-laden airflows into sensor chambers. Such sensors will not function in the low pressure atmospheres of the Moon and Mars and are incapable of monitoring dust trajectories. We are developing a large depth-of-field particle image velocimeter that measures dust concentrations, dust trajectories and particle size distributions without relying on dust capture. This year's development effort will concentrate on completing an optical analysis and design trade of the instrument's illumination system, building an improved illumination system and conducting a field demonstration to confirm the instrument's improved performance. We expect that a student will be able to make significant contributions to the field experiment and data analysis.

Intern's Project Activities: The intern will be expected to assist the research principal investigator during the instrument's week long field test in southern Arizona in June 2006. This will involve assisting in instrument set up, experiment documentation and running various instruments during the experiment.

After the field experiment has been completed, the bulk of the student's work will be field experiment data analysis.

Project (ID: 14-17) - Prototype tools that implement mathematical methods for deriving code from system requirements

Min. Level: Graduate - First Year
Max. Level: College/University Faculty

Disciplines:
- Software Engineering
- Robotics Engineering
- Mathematics
- Analysis

Skills:
- Mathematical notation
- Formal Methods
- Java
- C++
- Software design

Location: Goddard Space Flight Center

Project Abstract: This intern activity will develop prototype software tools that implement NASA patent-pending methods for generating system implementations (code) from natural-language specification of system requirements. These methods are based on formal mathematical techniques and specification languages. Envisioned tools could eventually represent a breakthrough in engineering safety-critical and dependable systems through automated means. Such tools eventually could be applicable in all NASA system development efforts, and could enable much greater levels of cost-effectiveness of systems-engineering processes.

Intern's Project Activities:

(a) Study and analyze the NASA patent-pending methods.
(b) Formulate alternative approaches to implementing the methods as a set of software tools.
(c) Analyze these alternatives to assess feasibility and effectiveness.
(d) Design tools to implement a selected alternative.
(e) Develop the tools in software. (Language to be used is negotiable.)
(f) Test and demonstrate the implementation of the tool(s).
(g) Write a report or paper on the results.

Project (ID: 15-18) - Future missions onboard navigation analysis

Min. Level: Undergraduate - Junior
Max. Level: Post Graduate

Disciplines:
• Computer Science
• Software Engineering
• Engineering
• Aero/Astronautics
• Robotics Engineering
• Mathematics
• Analysis
• Statistics

Skills:
• Astrodynamics
• Estimation & Control theory
• Computer programming (Java, Matlab, etc)
• Advanced math

Location: Goddard Space Flight Center

Project Abstract: The Flight Dynamics Analysis Branch is seeking highly motivated students in the Aerospace Engineering or similar disciplines. The intern will work with engineers from the Flight Dynamics Analysis Branch, performing analysis of onboard navigation solutions for future formation flying and/or autonomous rendezvous and docking missions using the GPS Enhanced Onboard Navigation System (GEONS).

Intern's Project Activities: The intern will work directly with spacecraft Guidance, Navigation, and Control (GNC) experts to perform analysis of onboard navigation systems for future missions, possibly including formation flying, autonomous rendezvous and docking, and manned missions. The intern will be part of the GPS Enhanced Onboard Navigation System (GEONS) Ground Support System (GGSS) development team, providing feedback to software developers of a User Interface for GEONS. The intern will also work with senior Flight Dynamics Analysts and GNC systems engineers in the space mission proposal phase to analysis onboard navigation concepts for future missions.

Project (ID: 19-40) - Formation Flying Analysis and Engineering

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Engineering
• Aero/Astronautics
• Control Systems
• Robotics Engineering
• Mathematics
• Analysis

Skills:
• Orbital Mechanics
• Control Systems
• Navigation Systems
• Analytical Mechanics
• Communication Networks

Location: Goddard Space Flight Center

Project Abstract: In support of several near and far-term formation flying missions and mission concepts, the formation flying technology team at NASA GSFC is advancing analytical and numerical capabilities in a number of areas in guidance, navigation, control, flight dynamics, and communication. The problems of interest all involve relative motion of multiple spacecraft in Earth-orbiting, lunar or planetary orbiting, or libration point regimes. Some areas of high interest include (1) relative navigation using GPS, crosslink ranging devices, or other spacecraft sensors; (2) design of relative motion trajectories combining science quality metrics and fuel consumption constraints; (3) design of control laws for practical implementation in a range of orbital environments; and (4) design of communication and network architecture for a collection of spacecraft flying in precise formation. Most studies will involve analysis and simulation and, in some areas, hardware in the loop demonstration in the GSFC Formation Flying Testbed.

Intern's Project Activities: One or more of the following:

1. Analysis of relative navigation performance using GPS, crosslink devices, or other spacecraft sensors and possible hardware in the loop implementation.

2. Design of relative motion trajectories combining science quality metrics and fuel consumption constraints. Includes formulation of equations of motion, optimization using Matlab or other computer codes, establishment of fuel consumption metrics, incorporation of science quality metrics.

3. Design of relevant formation flying control laws. Includes development of equations of motion, selection or development of control design models and simulation models, synthesis of control laws, and analysis and characterization of closed-loop performance with practical spacecraft implementation considerations.

4. Design of communication and network architecture for a formation of several spacecraft. Includes selection or design of a intersatellite communications device, development of a network architecture, characterization of performance, selection of appropriate frequency(ies), implementation in closed-loop simulation and/or in hardware in the loop testbed.

Project (ID: 22-41) - GOES N-P Weather Satellite System Data Analyses

Min. Level: Undergraduate - Sophomore
Max. Level: College/University Faculty

Disciplines:
• Astronomy
• Astrophysics
• Earth Sciences
• Education
• Engineering
• Aero/Astronautics
• Control Systems
• Robotics Engineering

Skills:
• Microsoft Office
• Matlab (Preferred)
• Self-motivated

Locations:
• Goddard Space Flight Center
• NOAA Satellite Operations Control Center Suitland, MD

Project Abstract: Interns will analyze the performance of the latest generation of NOAA geostationary weather satellites in preparation for an upcoming launch as early as late fall 2007. Assessments will include both on-orbit and ground test results and will contribute to the flight readiness preparations of the GOES Systems Engineering team for the GOES-O Observatory.

A variety of engineering and scientific disciplines depending on the specific background/interest of the intern are available to tailor the experience to meet individual training needs. Including teachers/professors trying to combine classroom instruction with real-life situations.

For more information about our program, see the following websites:
GOES Project Office http://goespoes.gsfc.nasa.gov/goes/index.html
GOES Project Science http://goes.gsfc.nasa.gov/, or
NOAA's GOES website http://www.goes.noaa.gov/

Intern's Project Activities: Using data analysis capabilities of the GOES system engineering team, the interns will assess the health, safety, and overall performance of a variety of spacecraft subsystems, instruments, and ground system components in preparation for an upcoming launch campaign.

Using data analysis capabilities of the operation NOAA Satellite Control Center, the interns will assess the health, safety, and overall performance of a variety of spacecraft subsystems, instruments, and ground system components in operational weather service satellites.

Assessments will include participating in anomaly investigations, including root-cause determinations, on both operational satellites as well as satellites being prepared for launch.

Essay Question: What areas of the GOES engineering and scientific disciplines would be most appealing to you? Why? What would you hope to gain/take from this internship for your future?

Project (ID: 25-44) - LRO Flight Dynamics

Min. Level: Undergraduate - Sophomore
Max. Level: Post Graduate

Disciplines:
• Aero/Astronautics
• Robotics Engineering

Skills:
• MATLAB experience
• STK experience (opt)

Location: Goddard Space Flight Center

Project Abstract: The Lunar Reconnaissance Orbiter (LRO) will be the first NASA mission to the Moon as part of the new Exploration Initiative. Code 595 is developing the mission design, reference trajectory, launch window and station keeping strategy for LRO.

Intern's Project Activities: Intern will work with the LRO Flight Dynamics Lead to update LRO mission design based upon launch vehicle analysis, updated spacecraft design or concept of operation changes. Intern should have basic understanding of orbital mechanics.

Project (ID: 26-45) - Eta Carinae: a Rosetta Stone of Massive Star Evolution

Min. Level: Undergraduate - Junior

Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astrophysics
• Optics
• Analysis

Skills:
• Computer knowledge
• Atomic Spectroscopy
• IDL experience desired

Location: Goddard Space Flight Center

Project Abstract: Eta Carinae, a Luminous Blue Variable, now a massive binary stellar system with historical mass ejection, aka the Homunculus, is a key to understanding how massive stars eject their processed material and provides clues to how the first stars enriched the primordial gas of hydrogen and helium with carbon, nitrogen, oxygen and iron-peak elements.

We have Hubble Space Telescope spatially-resolved spectroscopy, Very Large Telescope spectroscopy and spectrointerferometry, CHANDRA spectra, FUSE spectra and other information that are being analyzed to measure the metal abundances and to understand the modes of ejection. More recently we are following the wind-wind interactions from the 2003.5 periastron and preparing for new observations centered on the 2009.0 event.

Intern's Project Activities: The students will work interactively with spatially-resolved spectra of Eta Carinae and the Homunculus. Data of other, similar systems may also be available. Considerable software is in place on Sun and Mac computers written in Interactive Data Language (IDL).

Project (ID: 28-46) - Mars organics experiment

Min. Level: Undergraduate - Junior

Max. Level: Graduate - First Year

Disciplines:
• Astrobiology
• Analytical Chemistry
• Org. Chemistry
• Robotics Engineering
• Analysis

Skills:
• Operation of analytical instrumentation
• Data analysis skills
• Some knowledge of organic chemistry

Location: Goddard Space Flight Center

Project Abstract: The 2009 Mars Science Laboratory will search for carbon compounds on Mars as in indicator of past or present habitability. Goddard Space Flight Center is developing the primary tool, a gas chromatograph mass spectrometer, to detect organic compounds on Mars. Mars analog materials are being analyzed in our laboratory to better understand protocols for organic extraction and detection. The summer program will contribute to this development

Intern's Project Activities: Summer activities will involve hands-on operation of a gas chromatograph mass spectrometer to analyze Mars analog materials, analysis of this data, and evaluation of the factors that might impact our ability to successfully conduct similar experiments on the surface of Mars.

Essay Question: Describe two different experiments that might help answer the question of the possibility of microbial life on Mars.

Project (ID: 3-7) - Optical designs for NASA

Min. Level: High School - Freshman
Max. Level: Graduate - First Year

Disciplines:
• Astronomy
• Earth Sciences
• Optics

Skills:
• Excel
• Interest in telescopes
• Interest in astronomy
• Outgoing and willing to talk to people on the telephone

Location: Goddard Space Flight Center

Project Abstract: The purpose of this project is to collect optical designs to form a database of existing telescopes and optical instrumentation for rapid concept development of future NASA missions. Many telescopes and instruments currently are in being used both on the ground and in space, so this project is to assemble a readily available archive of the many existing designs for quick look-up. This will be a great opportunity for someone interested in astronomy or optics that would like to get the "big picture" of all that NASA has done, and is currently doing.

Intern's Project Activities: You, the intern, will find out the many NASA missions of the past and present, and will collect the optical designs from these missions to build a simple database, most likely in Excel (but I'm open to alternatives if you have some ideas). I'll encourage you to learn as much as you like about each of them as you gather this data, to get the "big picture" of space and earth science. You'll most likely have to track down the appropriate people from each project who have the design data via email or telephone, so people skills are a plus. If you are interested in optical design, I will gladly mentor you in optical design software as we gather these designs.

General interest in NASA missions and the goal to get the "big picture" is the main requirement I have for you, as well as the desire to make a tool that others will find useful.

Any education level is appropriate for this work, but some familiarity with telescopes is desired. Graduate students are welcome to apply, but please note that this work is not too technical.

Essay Question: How many NASA telescopes are in space at this time? How many look down at the Earth to understand how climate is changing? What do they all do? If you're interested in learning the big picture here at NASA, and would like to create a tool to help optical designers reference existing missions in their preparation of future missions, then you should consider this project.

Project (ID: 30-48) - Studies in Solar and Space Physics

Min. Level: Undergraduate - Sophomore
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Earth Sciences
• Robotics Engineering
• Solar Physics
• Space Physics
• Sun-grazing Comets

Skills:
• Minimum: High comfort level with standard computer programs (IE, Excel, Word)
• Preferred: Programming skills in IDL or other language(s)
• Required: Ability to work independently

Location: Goddard Space Flight Center

Project Abstract: We have a variety of scientific projects in progress that are based on both archival and new data from ground based telescopes and from spacecraft. These include searches for sun-grazing comets; analysis of spectroscopic data from solar eclipses; 3-D reconstruction of coronal imagery; and improving the prediction of space weather conditions. We are also involved in collaborative studies seeking to understand the economic impacts of space weather.

Intern's Project Activities: Depends on the skill level and interests of the student, as well as on their long-term goals.

Essay Question: From the topics listed in the Abstract, which interests you the most? Explain why.

Project (ID: 31-543) - Buried Basins on Mars

Min. Level: High School - Junior
Max. Level: Post Graduate

Disciplines:
• Planetology • Geosciences

Location: Goddard Space Flight Center

Project Abstract: The discovery of a very large population of buried impact basins on Mars has led to a complete revision of the timescale of early events in the history of that planet. Originally found in MOLA topographic data, it now appears that additional even more deeply buried basins can be seen in crustal thickness data. Investigation of these buried features provides important constraints on the age of the buried basement in different parts of Mars, the relative sequence of bombardment by very large, asteroid-size impactors, when the global magnetic field died, and how and when the fundamental highland/lowland crustal dichotomy and large Tharsis volcanic center formed. Buried basins can also be used to infer the thickness of the materials which bury them, which helps constrain the resurfacing history of Mars.

Intern's Project Activities: Map the size and distribution of buried impact basins as revealed in MOLA topographic data and in crustal thickness model data, using a specialized interactive graphics program called GRIDVIEW. Once mapped, the size frequency distribution and density of basins is used to determine the relative crater retention age on a global and regional basis. This is done by plotting cumulative frequency curves (cumulative number larger than a given diameter per unit area versus diameter), and converting the relative cumulative density to an absolute age using published chronologies for Mars. It may also be possible to compare the derived distribution with independent data, such as that from the ESA MARSIS radar system.

Essay Question: This work could go on beyond the summer internship, perhaps for a senior thesis. Is this of possible interest to you? Also, we normally fund our students to present their results at the Lunar and Planetary Science Conference. Would you be interested in doing that?

Project (ID: 36-548) - Systems Engineering Process Improvement

Min. Level: Undergraduate - Senior
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Computer Science
• Software Engineering
• Engineering
• Aero/Astronautics
• Space Engineering
• Management
• Systems engineering

Location: Goddard Space Flight Center

Project Abstract: The recent CMMI assessment of the systems engineering capabilities at Goddard uncovered a number of important areas in the practice of systems engineering at Goddard that need attention. Based on the pre-assessment results, the Mission Systems Engineering Branch (code 599) of the Mission Engineering and Systems Analysis Division is planning to improve the generic goals and generic practices throughout the 13 systems engineering process areas which were the subject of the assessment. The goals of the improvement are to increase the organizational commitment and consistency across all systems engineering efforts, and to leverage commonality of system engineering products/deliverables so that less time will be spent to re-invent the wheel and more time will be spent on mission specific functions.

Intern's Project Activities: The primary focus of this task will be on systems engineering process improvement. There are several areas of concentration listed below. The decision on the specific area(s) that can be accomplished during the time frame of this task will be mutually decided by discussions between the 599 branch head (Maria So) and the summer intern.

1. Develop generic versions of key systems engineering documentation that can be used to assist the mission systems engineers in producing the products and deliverables for a new mission. The highest priority should be given to a generic version of the Systems Engineering Management Plan (SEWG) which shall be developed in accordance with the new NASA Processes and Requirements (NPR) for Systems Engineering (NPR 7123).
2. Working under the direction of the branch head or a senior systems engineer, develop processes for areas that have been identified for improvement and document the processes. An example of one such area is the need for guidelines for decision analysis and resolution.

Essay Question: Are you familiar with CMMI or NASA systems engineering processes and requirements (NPR7123)?

Project (ID: 37-549) - A MEMS- and Nanotechnology-enabled Ion Source for the MEMS Time-of-Flight Mass Spectrometer for Solar System Exploration

Min. Level: Undergraduate - Sophomore
Max. Level: College/University Faculty

Disciplines:
• Chemistry
• Engineering
• Chemical Engineering
• Electrical Engineering
• Materials Engineering
• Mechanical Engineering
• Nanotechnology
• Physics
• Applied Physics
• Optics
• Quantum Physics
• Thermal Physics

Skills:
• Introductory physics class
• LabView programming
• Demonstrated lab experience
• Clean room experience

Location: Goddard Space Flight Center

Project Abstract: We will advance the technology readiness of two components of a MEMS reflectron time-of-flight mass spectrometer (MEMS RTOF MS): the electron-impact ionization source that uses a carbon nanotube (CNT) field emission electron gun, and a micromachined assembly of silicon lenses that constitute the ion acceleration and focusing structure. The proposed work also supports integration of these components into a unified ion source for performance evaluation and further integration into the MEMS RTOF MS instrument.

Intern's Project Activities: The intern will be responsible for growing multi-walled carbon nanotubes (CNTs) by a vapor-liquid-solid (VLS) mechanism. This includes substrate preparation, thermal evaporation of thin film catalyst, and operation of a VLS growth furnace. In addition, the intern will participate in field emission studies of the CNT source, integration with electrostatic optical elements, and installation into the core mass spectrometer instrument.
(Note: special skills are desired but not required)

Essay Question: Have you heard about nanotechnology in your classes or in the news, and if so, what do you find most exciting about the potential applications?

Project (ID: 39-551) - The Circumstellar Environments of Massive Stars

Min. Level: Undergraduate - Freshman
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy • Astrophysics

Skills:
• Unix/Linux experience
• IRAF/IDL experience (or willingness to learn)
• computer programming (Fortran, C++, etc)

Location: Goddard Space Flight Center

Project Abstract: Circumstellar disks play an integral role in the evolutionary lifecycle of stars. They guide the star formation process, serve as the birthplace of planetary systems, affect the evolution and mass-loss of massive stars, and direct the outflow of material in the later stages of stellar evolution. The physics of circumstellar disks is also related to other types of disks in the universe, including accretion disks and active galactic nuclei. Hence, understanding the mechanisms that guide the formation and evolution of these disks has wide ranging applications throughout astrophysics.

For this project, we will analyze portions of a large observational dataset (comprised of Hubble Space Telescope imaging data, CTIO 4m multi-object spectroscopy, and ancillary photometric and polarimetric catalogs) in an effort to investigate the formation and evolution of circumstellar disk systems in the Local Group galaxy, the Small Magellanic Cloud.

Intern's Project Activities: Students will assist in the analysis of space- and ground-based observations of circumstellar disk systems in the Small Magellanic Cloud. Portions of the analysis of these data will require the use of either the IRAF or IDL software programs. If the student does not have prior experience using these programs, the initial portion of the research experience will be devoted to learning their basic use. It is expected that students will also assist in the preparation and presentation of these results for publication in a refereed science journal.

Project (ID: 4-8) - Exploration Vision Trajectory Design

Min. Level: Undergraduate - Junior
Max. Level: Post Graduate

Disciplines:
• Graphics
• Engineering
• Aero/Astronautics
• Control Systems
• Robotics Engineering
• Analysis
• Statistics
• Physics
• Applied Physics

Skills:
• Matlab
• STK
• ODEs
• Problem Solving
• Communication

Location: Goddard Space Flight Center

Project Abstract: What are the optimal trajectory designs for exploration of the moon, Mars, NEOs, and other unique locations such as libration orbits? What are the best lunar orbits for communication and coverage? Can we identify all the low lunar frozen orbits? How can I impact NASA decisions? Interested? Over the summer you will be exposed to the state-of-the-art lunar and planetary trajectory design and its applications to NASA's exploration programs. Your results will be used by upcoming projects to determine fuel and critical mission drivers.

Intern's Project Activities: Perform trajectory analysis for lunar, Mars , and other exploration missions. Run simulations on high fidelity software, - GSFC's GMAT, STK/Astrogator, Matlab, etc. Develop algorithms for optimal control or targeting Research new trajectory theories

Essay Question: How would you like to make an immediate impact to lunar and planetary mission design?

Project (ID: 57-1187) - Search for the missing CO2 sink

Min. Level: Undergraduate - Sophomore
Max. Level: Undergraduate - Senior

Disciplines:
• Planetology
• Analytical Chemistry
• Atmospheric Science
• Electrical Engineering
• Optical Engineering
• Optics

Skills:
• familiarity with windows based computers

Location: Goddard Space Flight Center

Project Abstract: Carbon dioxide is the principal anthropogenic greenhouse gas. Despite considerable effort the annual budget for CO2 is not understood. Only half of the estimated CO2 generated each year from burning of wood and fossil fuels appears in the atmosphere. Where does the rest go? We are developing instruments capable of very high precision measurements of CO2. We hope to use these instruments to find the missing sink.

Intern's Project Activities: Intern will help operate the instruments in field environments--mostly on the rood of buildings at Goddard. He/she will aid in the calibration of instruments and the processing of data using commercial data analysis programs.

Essay Question: Do you think that global warming is controversial? If so, why? If not, why not?

Project (ID: 58-1188) - NPP Mission Readiness, Operations Assessment

Min. Level: Undergraduate - Freshman
Max. Level: Undergraduate - Senior

Disciplines:
• Astronomy
• Computer Science
• Earth Sciences
• Engineering
• Mathematics
• Physics

Skills:
• Structured programming
• Word processing
• Spreadsheets
• Technical writing
• Database applications

Location: Goddard Space Flight Center

Project Abstract: The NPP Mission is the bridge mission between current NASA Earth Observing satellites and the next generation NPOESS environmental satellites. The NPP Project plays a key role in assuring the diverse team is ready to perform operations when the satellite is on orbit. The intern for the mission readiness group will assist in testing and assessing various operations products. The activities will also include initial preparation for mission readiness testing including rehearsals and operational readiness exercises.

Intern's Project Activities: The intern will assist in testing and assessing operational products including telemetry display pages, flight operations PROCS (executables), and standard operating procedures. This work will be performed on a local system representative of the operational ground system that will be used at the NOAA Satellite Operations Facility. The intern will also assist in initial planning and preparation for mission readiness exercises including mission rehearsals and operational readiness exercises.

Project (ID: 59-1188) - NPP Mission Readiness, Database Development

Min. Level: Undergraduate - Freshman
Max. Level: Undergraduate - Senior

Disciplines:
• Astronomy
• Computer Science
• Earth Sciences
• Engineering
• Mathematics
• Physics

Skills:
• Database applications
• Structured programming
• Word processing
• Spreadsheets
• Technical writing

Location: Goddard Space Flight Center

Project Abstract: The NPP Mission is the bridge mission between current NASA Earth Observing satellites and the next generation NPOESS environmental satellites. The NPP Project plays a key role in assuring the diverse team is ready to perform operations when the satellite is on orbit. The intern for the mission readiness group will assist the team in preparing database applications to manage action items and testing information. The intern will also assist in assessing operational products as time permits.

Intern's Project Activities: The intern for the mission readiness group will assist the team in preparing database applications to manage action items and testing information. These databases should be accessible via the World Wide Web and contain standard reporting features as well as email notification. These applications can be built in any standard database environment such as MS-Access or FileMaker Pro. The intern will also assist in testing and assessing operational products including telemetry display pages, flight operations PROCS (executables), and standard operating procedures.

Project (ID: 64-1192) - Remote Sensing Instrument Development and Testing

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Second Year

Disciplines:
- Computer Science
- Image Processing
- Software Engineering
- Earth Sciences
- Atmospheric Science
- Geosciences
- Engineering
- Design Engineering
- Electrical Engineering
- Mechanical Engineering
- Optical Engineering
- Applied Physics
- Optics

Location: Goddard Space Flight Center

Project Abstract: SSAI is involved with several optical instrument projects for the remote sensing of the earth and its environment. We support the development and test of small instruments (ground based and aerial) on the one hand and support the testing, test data analysis and calibration of larger spaceflight instruments. Thus there are opportunities for "hands-on" engineering and experimentation as well as opportunities for working on instrument related data systems (data quality assessment, data analysis, and instrument calibration and performance evaluation). The Intern will learn about the art, science and engineering of the remote sensing of the Earth and its environments.

Intern's Project Activities: Participate in instrument or instrument subsystems design fabrication assembly and test activities. Assist with instrument data systems for data acquisition, data quality assessment, and data analysis to characterize instrument performance. The Intern will earn about the art, the science and the engineering of remote sensing of the Earth and its environments. Interest in physical sciences or engineering (e.g. physics, mechanical engineering, electrical and electronics engineering, optics, laser or electro-optics) along with computer literacy are required.

Essay Question: Are you curious to discover the facts in front of you that you cannot discern with your God given sensors?

Project (ID: 66-1194) - Investigation of Sol-gel for Surface Preparation for Adhesive Bonding

Min. Level: Undergraduate - Sophomore
Max. Level: Graduate - First Year

Disciplines:
- Chemistry
- Engineering
- Aero/Astronautics
- Chemical Engineering
- Materials Engineering
- Mechanical Engineering
- Space Engineering

Location: Goddard Space Flight Center

Project Abstract: In an effort to improve on current procedures for preparing metal surfaces for adhesive bonding in clean rooms at Goddard Space Flight Center, the use of a new surface preparation method for metallic structural bonding of metals is being investigated. Research in this matter is necessary because the bonding processes for integrated flight structures are not as straightforward as bonding procedures for small components. Sol-gel technology offers the promise of an environmentally friendly surface preparation for adhesive bonding while maintaining excellent strength and durability of bonded joints.

Intern's Project Activities: The intern will prepare test samples, arrange testing, interpret results and document results.

Project (ID: 67-1195) - Oriented Nanocomposite Extrusion Development for Transfer to Industry

Min. Level: Undergraduate - Junior
Max. Level: College/University Faculty

Disciplines:
• Aero/Astronautics
• Chemical Engineering
• Mechanical Engineering
• Nanotechnology

Skills:
• Clear communication skills
• Self-motivated work ethic
• Either polymer-processing or a materials science background
• Familiarity with statistical methods and/or computational methods.

Location: Goddard Space Flight Center

Project Abstract: Recent progress on the fabrication and characterization of Oriented Nanocomposites via a scalable twin-screw extrusion process has made practical discussions of scale-up and spin-out of fabrication hardware design and process technologies with industry partners such as Spartech Corp., Clayton MO, to facilitate development of macro-scale (meter-wide) production of COTS composites to supports a variety of missions agency-wide. The performance and capability improvements of oriented CNT composites over current material capabilities are dramatic. CNTs have an axial modulus >1TPa allowing their composites to be potentially stronger than steel in tension yet flexible with near infinite life. CNTs axially conduct heat at >3,000W/mK and electricity six orders of magnitude better than copper, allowing their composites to de-localize any concentrated heat source and behave as ballistic electrical conductors. The major challenge to scale-up and spin-out of such oriented nanocomposite hardware design and process technology is demonstration of a new design paradigm to progress from the 3-inch wide samples we've produced using an etched silicon-die and the ~1 foot wide demonstration proof Spartech and others would require to iterate to meter-scale production. This proposal addresses the challenge of scale-up through the design for fabrication of parallel, interdigitated plates ~1-foot in width which may be defensibly iterated for meter-scale fabrication of composite laminate layers of continuous length. David G. Pocost, head of EVP Technology development at Spartech Corp. has agreed to work closely with our design and development team to insure that our ~1 foot wide microchannel die can be directly leveraged for integration into their new $50 Million twin-screw extrusion R&D facility in Richmond, IN.

Intern's Project Activities: Become familiar with the UMCP rheometry set-up, it's operation, and supplies. Dialogue with P.I, UMCP process lead (Arun Kota), and summer student lead to develop a rheometry investigation plan. Started preparing first rheometry

samples. Fully executed the rheometry investigation plan prepared earlier. Collected, analyzed, and reported rheometry findings and conclusions to the team. Made recommendations as to rheometry experiment best practices. Identified and substantiated best-fit melt formulations to serve NASA and industry partner needs.

Essay Question: What impact do you see Nanotechnology having on our society and our pursuit of manned interplanetary space exploration?

Project (ID: 68-1195) - Oriented Nanocomposite Extrusion Development for Transfer to Industry

Min. Level: Undergraduate - Sophomore
Max. Level: College/University Faculty

Disciplines:
• Engineering
• Business

Skills:
• Excellent Written and Oral Communication Skills
• Superior Interpersonal Skills
• The Ability to Understand, Communicate, and Associate Complex Systems, their virtues, their challenges, and lateral solutions to each.

Location: Goddard Space Flight Center

Project Abstract: Recent progress on the fabrication and characterization of Oriented Nanocomposites via a scalable twin-screw extrusion process has made practical discussions of scale-up and spin-out of fabrication hardware design and process technologies with industry partners such as Spartech Corp., Clayton MO, to facilitate development of macro-scale (meter-wide) production of COTS composites to supports a variety of missions agency-wide. The performance and capability improvements of oriented CNT composites over current material capabilities are dramatic. CNTs have an axial modulus >1TPa allowing their composites to be potentially stronger than steel in tension yet flexible with near infinite life. CNTs axially conduct heat at >3,000W/mK and electricity six orders of magnitude better than copper, allowing their composites to de-localize any concentrated heat source and behave as ballistic electrical conductors. The major challenge to scale-up and spin-out of such oriented nanocomposite hardware design and process technology is demonstration of a new design paradigm to progress from the 3-inch wide samples we've produced using an etched silicon-die and the ~1 foot wide demonstration proof Spartech and others would require to iterate to meter-scale production. This proposal addresses the challenge of scale-up through the design for fabrication of parallel, interdigitated plates ~1-foot in width which may be defensibly iterated for meter-scale fabrication of composite laminate layers of continuous length. David G. Pocost, head of EVP Technology development at Spartech Corp. has agreed to work closely with our design and development team to insure that our ~1 foot wide microchannel die can be directly leveraged for integration into their new $50 Million twin-screw extrusion R&D facility in Richmond, IN.

Intern's Project Activities: Have established lines of communication with at least one industry partner interested in spinning-in O.N.E./C.L.O.N.E. technologies for evaluation of scale-up investment and gained an in-depth technical understanding of O.N.E./C.L.O.N.E. technologies and processes. Have evaluated a number of potential industry partners, both technically, functionally, And from a risk-mitigation standpoint,

presented partnership recommendations to the team, and coordinated initial cooperative agreement negotiations between team leadership, Goddard tech-transfer office (Code 504), and select industry partners.

Essay Question: What defines an effective business relationship?

Project (ID: 7-10) - Improvements in Energetic Neutral Particle Detection

Min. Level: Undergraduate - Junior
Max. Level: Undergraduate - Senior

Disciplines:
• Robotics Engineering
• Physics

Skills:
• Like to work with hands
• Experimentalists

Locations:
• Goddard Space Flight Center
• University of Maryland

Project Abstract: In the recent past work has been carried out to clarify and improve instruments to detect and measure the characteristics of energetic neutral particles. Such particles are observed in the heliosphere resulting from atomic interactions near planets, comets, etc.

Intern's Project Activities: In 2006 we had an intern, an engineering junior and this turned out very well. He made useful progress in the measurement of work functions of surfaces using a Kelvin probe. I would like to repeat this experience in 2007. I prefer someone who, as well as being a good student, likes to work with his or her hands.

Project (ID: 70-1197) - Solar Flare X-ray Imager for Solar Sentinels

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Astrophysics
• Computer Science
• Image Processing
• Software Engineering
• Engineering
• Optical Engineering
• Space Engineering
• Physics
• Applied Physics
• Nuclear Physics
• Optics
• Particle Physics
• Thermal Physics

Locations:
• Goddard Space Flight Center

Project Abstract: Design of the X-Ray Imager (XRI) that is planned for each of the four Inner Heliospheric Solar Sentinels that are part of the NASA Living With a Star (LWS) program. The Sentinels will each be placed in orbit about the Sun, reaching as close as 0.25 Astronomical Units with at least one able to view the backside of the Sun. The XRI is critical for achieving the major LWS science goal of understanding the acceleration of electrons in solar flares. XRI uses a Fourier-transform imaging technique incorporating tungsten X-ray modulation grids, similar to the technique used so successfully on the Ramaty High Energy Solar Spectroscopic Imager (RHESSI), a NASA spacecraft that has been operational in Earth orbit since 2002.

Intern's Project Activities: The intern will participate with Goddard scientists and engineers in addressing one or the other of the two major challenges of the XRI design: the miniaturization required by the smaller XRI size and the thermal concerns associated with the planned close approach to the Sun. The miniaturization will require mechanical engineering skills and knowledge of the physics of X-ray interactions. It will require the investigation of techniques used in the fabrication, characterization, mounting, and alignment of the fine tungsten grids with the required micron precision. Addressing the thermal concerns of accommodating up to 20 times the normal solar flux seen in Earth orbit will require thermal engineering skills.

Essay Question: Are you interested in Solar Physics, the technology of X-ray imaging spectroscopy, and/or the scientific analysis of space observational data?

Project (ID: 71-1198) - Mars data analysis

Min. Level: Undergraduate - Senior
Max. Level: College/University Faculty

Disciplines:
• Planetology
• Atmospheric Science
• Space Engineering
• Applied Physics

Location: Glenn Research Center

Project Abstract: The Martian environment is dominated by fine dust suspended in the atmosphere. This dust affects the climate and meteorology of Mars, as well as having effects on both robotic and human missions. This project will analyze data from the Mars Exploration Rover mission in order to determine atmospheric dust parameters and the effect of dust on the Martian environment.

Intern's Project Activities: Analyze data from the Mars Exploration Rover mission in order to determine atmospheric dust parameters and the effect of dust on the Martian environment.

Project (ID: 72-1199) - Optical metrology and astronomical instrumentation for the James Webb Space Telescope's Integrated Science Instrument Module

Min. Level: Undergraduate - Sophomore
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Engineering
• Aero/Astronautics
• Electrical Engineering
• Mechanical Engineering
• Optical Engineering
• Space Engineering
• Physics
• Applied Physics

Skills:
• Familiarity with basic physics/optics
• Familiarity with basic PC-MSWindows operation

Location: Goddard Space Flight Center

Project Abstract: The James Webb Space Telescope (JWST) is a 6.6m diameter, segmented, deployable telescope for cryogenic IR space astronomy (~40K). The JWST Observatory architecture includes the Optical Telescope Element (OTE) and the Integrated Science Instrument Module (ISIM) element that contains four science instruments (SI) including a Guider. The SIs and Guider are mounted to a composite metering structure with outer dimensions of 2.1x2.2x1.9m. The SI and Guider units are integrated to the ISIM structure and optically tested at NASA/Goddard Space Flight Center as an instrument suite. The SIs are aligned to the structure's coordinate system under ambient, clean room conditions using laser tracker and theodolite metrology. However, the SIs are first aligned to precision fixtures which replicate the flight ISIM structure interface --- the JWST project is currently building these Ambient SI Mechanical Interface Fixtures (ASMIF).

Intern's Project Activities: The student would work with a NASA/GSFC engineering team to perform optical metrology on the ASMIFs, which are critical ground support equipment. The student would learn optical metrology and data reduction techniques. The student would learn about applied optics for astronomy instrumentation. The student must work in a clean room environment. The student must be familiar with basic physics and willing to learn in a fast-paced environment. No prior experience with optics is required beyond standard undergraduate physics courses. The student must work well with others and be patient and motivated about working for NASA. US citizenship is required.

Project (ID: 74-1201) - Analysis of Millimeter-wave Astronomical Images from a Novel Instrument

Min. Level: Undergraduate - Sophomore
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Astrophysics
• Cosmology
• Computer Science
• Image Processing

Skills:
• IDL

Location: Goddard Space Flight Center

Project Abstract: We are building a bolometer camera (the Goddard-IRAM Superconducting 2-Millimeter Observer, GISMO) for operation in the 2 mm atmospheric window to be used at the IRAM 30 m telescope. The instrument uses a large format detector array, which makes it unique in that it will be capable of providing significantly greater imaging sensitivity and mapping speed at this wavelength than has previously been possible. The major scientific driver for GISMO is to provide the capability to rapidly observe galactic and extragalactic dust emission, in particular from high redshift ULIRGs and quasars. The 2 mm spectral range provides a unique window to observe the earliest active dusty galaxies in the Universe. Our models predict that at this wavelength we will discover one new galaxy every four hours. Even more exciting, one out of four of these galaxies will be at a redshift of $z > 6.5$, setting the record for the most distant galaxy.

Intern's Project Activities: We anticipate having begun data acquisition in May 2006. The data are recorded in a high time resolution stream of images, containing a combination of the celestial sources, emission from our atmosphere, and instrumental artifacts. We will be engaged in an effort to optimize algorithms for processing the stream of images to produce accurate maps of the celestial sources. An intern capable with IDL and/or Java would work on the software for this analysis, and would use it to process data from the instrument. The ideal candidate would also analyze the final images to extract the positions and brightness of galaxies or other objects in the field.

Essay Question: In a concrete, specific example, what skill or experience do you most hope to gain from a summer internship?

Project (ID: 76-1202) - Electronics Support for Space Plasma Analyzers

Min. Level: Undergraduate - Freshman
Max. Level: College/University Faculty

Disciplines:
• Astronomy
• Computer Science
• Earth Sciences
• Engineering
• Physics

Skills:
• Knowledge of classical
• Knowledge of atomic physics
• Basic facility with data analysis using MS Excel or equal

Location: Goddard Space Flight Center

Project Abstract: We will propose plasma analyzers for multiple future opportunities presented by the NASA Heliophysics Division, including missions under the STP, LWS, and Explorer lines, and also for missions of the Planetary Exploration and Exploration Systems Divisions, where requirements exist for space plasma analyzers. The proposed IRAD support will update and develop new GSFC core capabilities in the areas of supporting electronics for space plasma analyzers, including fast and flexible stepping high voltage supplies, multi-pixel imaging systems, signal generation and amplification, and onboard data processing. We will develop the key electronic technologies needed for missions requiring plasma velocity analyzer systems, such as GEC, MC, ITSP, and a MIDEX called MCE (Magnetospheric Convection Explorer) including those that will function in demanding radiation and thermal environments, and with challenging requirements on time resolution and dynamic range of spectral measurements. Plasma analyzer systems are required for space weather observations throughout the solar system, in support of Heliophysics and Solar System Exploration objectives, and to meet the challenge presented by the new NASA Exploration Initiative. A small Goddard investment in these technologies has already paid off in the form of winning the job of building what is arguably the fastest and most powerful plasma analyzer ever designed, for the MMS mission. Similar investments will bring similar returns in the future.

Intern's Project Activities: Participate in laboratory testing of prototype plasma analyzers using prototype electronics systems in the Space Plasma Instrument Facility, b.21-r.241. This will include preparation of test articles and fixtures, operation monitoring of vacuum chamber and associated equipment, collection and analysis of test data. Depending on the skills of the intern, some computer modeling and simulation may be involved.

Essay Question: Would you like to learn how space weather is measured?

Project (ID: 77-1203) - Human Power Generation in Space

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Second Year

Disciplines:
• Engineering
• Bioengineering
• Electrical Engineering
• Mechanical Engineering

Location: Glenn Research Center

Project Abstract: Electrical power is a critical issue as the lunar settlement is designed and developed. A plentiful power source is necessary in order to carry out the mission, but at the same time, uploading consumable power sources must be minimized due to the significant cost. The human body dissipates energy as it interacts with the environment. For example, heat is radiated from the skin. Mechanical energy is dissipated into the ground during walking and into structures and equipment that is touched. Arm and leg joints in motion house kinetic energy. During each breath the weight of the chest wall is displaced over a distance and air is expired at a higher temperature and pressure than the surrounding atmospheric air. It is possible to harness this dissipated energy and convert it into electricity through low mass energy conversion methods, such as thermoelectric, electromagnetic, piezoelectric and electrostatic methods. Humans are also capable of doing work on objects to generate electricity through hand cranking and shaking motions, during bicycling and by manipulating objects in other ways. An activity performed in space by the astronauts that is well suited for energy harvesting is exercising. Astronauts exercise in space to counteract the deleterious effects of the reduced gravity environment. Energy harvesting methods such as heel strike generators, respiratory generators and generators embedded into the exercise equipment could be used to generate significant amounts of power. These human power generation technologies have the potential to be an attractive low mass, replenishable, alternative energy source which could extend the lifetime or reliability of consumable power sources brought from Earth, especially during the critical initial stages of settlement development.

Intern's Project Activities: The activities associated with this project include design work and feasibility studies on a respiratory generator or a generator that can be embedded into exercise equipment.

Project (ID: 78-1204) - Web Sensor Strand (WSS)

Min. Level: Undergraduate - Junior
Max. Level: College/University Faculty

Disciplines:
• Computer Hardware
• Image Processing
• Software Engineering
• Soil Science
• Control Systems
• Electrical Engineering
• Synthetic Aperture Remote Sensing

Skills:
• Wireless Phase Lock Loop
• Digital Beam forming
• Synthetic Aperture Radar
• Synthetic Aperture Radiometer
• FPGA Programming
• Radio Frequency Design
• Communication wireless
• Global positioning system(GPS)

Location: Goddard Space Flight Center

Project Abstract: Interns will work with Engineers to demonstrate Web Sensor Strand with wireless phase lock loop. The strand will be formed between two nodes - the Expandable Reconfigureable Instrument Node (ERIN) which use Field Programmable Gate Array (FPGA) and phased lock loop (PLL) technologies. The WSS has application in interferometric radars and radiometers, and other remote sensing instruments where line of sight communication and precise position knowledge can be maintained.

Intern's Project Activities:
1. The intern will be asked to capture design information using Xilinx simulation software for FPGA programming.
2.The system requirements capture may lead to components research on the web and system integration
3. Laboratory demonstration of interfaces to existing radars and radiometers
4. Possible field tests with tower and boom truck
5. Beyond Summer 2007 (UAV Tests)

Essay Question: Are you aware of a commercial off-the shelf wireless phase lock loop? We seek to synthesize large apertures using small robotic platforms.

Project (ID: 79-1205) - EOS Data Operations System

Min. Level: Undergraduate - Junior
Max. Level: Undergraduate - Senior

Disciplines:
• Databases
• Graphics
• Info. Tech.
• Networking
• Software Engineering
• Web Development
• Computer Engineering
• Analysis
• Statistics

Location: Goddard Space Flight Center

Project Abstract: The Earth Observing System (EOS) Data and Operations System (EDOS) provides data capture, Level Zero and rate buffered data processing, short term raw data storage, life of mission storage for the level Zero products, and distribution functions for the EOS program Terra, Aqua, Aura and ICESat missions.

Intern's Project Activities: We are looking for an intern who could help with the new EDOS external web server and GUI development, giving them some hands-on Java development experience.

Essay Question: Tell me about your experience with HTML and web page development.

Project (ID: 81-1279) - James Web Space Telescope Science Instrument Interface

Min. Level: Undergraduate - Junior
Max. Level: Graduate - First Year

Disciplines:
• Engineering
• Aero/Astronautics
• Electrical Engineering
• Mechanical Engineering
• Optical Engineering
• Space Engineering
• Physics
• Thermal

Skills:
• Word
• Excel
• CAD/Pro E (OJT)
• Presentations/Power Point
• Work Independently
• Multiple Tasking
• Communication Skills

Location: Goddard Space Flight Center

Project Abstract: JWST/NASA works with international partners in the collective development of the next generation space telescope -- James Web Space Telescope. The ISIM systems group is tasked to look at multiple systems disciplines and perform trade studies, systems analysis, and verification. JWST is using cryogenic technology to see "First Light" after the Big Bang.

Intern's Project Activities: Interns will assist in the development and verification of interface requirements and interface definitions of Science instrument to the ISIM enclosure. Perform systems analysis and trade studies. Use of Word and excel are a must. Applicant will give presentations on the trade studies/analysis done to senior level engineers.

Essay Question: What experience do you envision you will gain from working on a cryogenic space telescope? What experience would you like to gain from your internship?

Project (ID: 82-1280) - ADVANCING STEREO RADIO OBSERVATIONS OF THE SUN

Min. Level: High School - Senior
Max. Level: Undergraduate - Senior

Disciplines:
• Astronomy
• Web Development
• Electrical Engineering

Skills:
• Works with electronics

Location: Goddard Space Flight Center

Project Abstract: The Solar Terrestrial Environmental Observatory (STEREO) is the first NASA mission to launch two identical spacecraft to make 3-D observations of the Sun. The spacecraft are similar to the famous Solar Heliospheric Observatory (SOHO); each STEREO spacecraft has coronagraphs and other imaging instruments. A big difference with STEREO is that each spacecraft can observe solar radio bursts, including those whose sources propagate from the Sun to 1 AU and beyond. Throughout the plasma universe, radio emissions are the signal of particle acceleration. By studying the solar radio bursts, we see where flares and shocks accelerate particles and can track their movement through the interplanetary medium.

Intern's Project Activities: The primary goal of this project is to build electro-mechanical models of the STEREO spacecraft to permit demonstration of the radio burst measurements and how they are used to determine the radio source locations using triangulation. We will assemble two working models with antennas and electronics that perform similar functions to the spacecraft receivers. These will be used in public and educational presentations. The intern will also have the opportunity to make scientific observations with the STEREO spacecraft and, assuming the early completion of the development and assembly of the STEREO radio models, to carry out a scientific project using STEREO data. Skills working with electronics projects would be most useful. Scientific programming and web development skills may also be applicable.

Essay Question: Have you used a soldering gun before? If not, would you like to learn?

Project (ID: 84-1278) - Finding young stellar jets

Min. Level: Undergraduate - Junior
Max. Level: Post Graduate

Disciplines:
• Astronomy
• Astrophysics
• Physics

Skills:
• Data analysis
• IDL or IRAF

Location: Goddard Space Flight Center

Project Abstract: We are investigating the era of planetary system formation around newly formed stars. Phenomena include circumstellar disks, polar jets, and eventually planets themselves. Observational tools are NASA satellites (Hubble coronagraphs and spectrographs, Spitzer, Chandra and FUSE) and ground based instruments, particularly the Goddard Fabry-Perot imager at the Apache Point 3.5 meter telescope.

Intern's Project Activities: Analyze image and spectral data from the above satellites and ground based instruments. If observing time is obtained in the summer, participate in an Apache Point observing run.

Essay Question: Are you familiar with IDL and/or IRAF data analysis programs? Are you pursuing a Physics or Astronomy degree?

Project (ID: 85-1856) - Laser Altimeter and Lidar Receiver Modeling and Data Analysis

Min. Level: Undergraduate - Freshman
Max. Level: Graduate - Second Year

Disciplines:
- Software Engineering
- Computer Engineering
- Control Systems
- Design Engineering
- Electrical Engineering
- Mathematics
- Analysis
- Statistics

Skills:
- Microsoft Excel
- Matlab
- Statistics

Location: Goddard Space Flight Center

Project Abstract: Modeling and analyzing the laser altimeter and lidar receiver performance of the orbiting satellite, such as ICESat, and instruments currently under development at NASA GSFC, such as the CO2 sounder and pushbroom laser altimeter.

Intern's Project Activities: Learn the basic principle of laser rangers, altimeters, and atmosphere lidars. Learn the basic software tools for data analysis, such as Labview and Matlab. Assist in the experiments and data acquisition, and analyze the test data.

Project (ID: 86-1857) - Studies in cosmology

Min. Level: High School - Junior
Max. Level: Undergraduate - Junior

Disciplines:
• Astronomy
• Astrophysics
• Cosmology

Skills:
• Programming in C++
• AP physics, calculus
• Intro to electrical engineering

Location: Goddard Space Flight Center

Project Abstract: Studies on the cosmic microwave background and its polarization are the newest frontier in cosmology. the project will entail simple modeling of the polarization combined with laboratory work.

Intern's Project Activities: The intern will conduct some laboratory work, assist in the development and testing of instruments and detectors, and conduct some simple theoretical models.

Project (ID: 87-12) - Multiwavelength Studies of Galaxies in Groups and Clusters

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Astrophysics
• Computer Science
• Graphics
• Image Processing
• Software Engineering

Skills:
• Computer programming
• Writing skills

Location: Goddard Space Flight Center

Project Abstract: This project involves multiwavelength data from a number of NASA and ESA observatories (GALEX, XMM-Newton, Hubble Space Telescope, Spitzer) as well as ground-based imaging and spectroscopy. Dr. Ann Hornschemeier Cardiff's team is working in two basic areas, one is on in-depth studies of galaxies in the nearest rich cluster of galaxies (Coma) and the other is on a coordinated multiwavelength campaign to study 12 nearby Hickson Compact Galaxy groups. The project is an observational astronomy project, involving data analysis. Experience with writing computer code (FORTRAN, C, IDL, etc.) is a major advantage. The student must be willing to work with a team of graduate students and postdocdtoral associates.

Intern's Project Activities: The exact details of this position depend somewhat on the interests/experience of the successful intern. We have a large number of astronomical images for which we must produce catalogs (using standard astronomical data analysis tools), there is work to be done on fitting spectral energy distributions of galaxies as well as calculating luminosity functions. The student will work closely with graduate students and/or postdocs on these projects and must be willing to work in a team. The student must be comfortable writing computer code in a serious programming language such as C, FORTRAN or IDL. Writing a paper is a major goal of this project, so the student should be comfortable with writing.

Essay Question: We have a large quantity of data in hand and are in need of help, will you be willing to read papers to prepare yourself ahead of time?
What are the prospects for you continuing to work with our group during the school year (e.g., as part of a senior thesis project, etc. or possibly if, in the area, to return to NASA Goddard)?

Project (ID: 88-1858) - Visitor Center Intern

Min. Level: High School - Senior
Max. Level: Graduate - First Year

Disciplines:
• Astronomy
• Earth Sciences
• Education
• Humanities and Arts
• Professional Sciences
• Administration
• Business
• Library/Info. Science
• Management
• Marketing
• Communications
• Public Affairs

Skills:
• Communication
• People Skills

Location: Goddard Space Flight Center

Project Abstract: The Visitor Center Intern is an exciting and rewarding opportunity. The intern will support the GSFC Visitor Center and education resource center, interacting daily with visiting children, educators and the general public. They will support the tours of Goddard, and our educational programs and exhibits including Science on a Sphere, Hubble, and our Ozone Garden and our new Atmosphere exhibit. They will have opportunities to provide input and suggestions on improvements and new programs.

Intern's Project Activities: The intern will support the GSFC Visitor Center and education resource center, interacting daily with visiting children, educators and the general public. They will support the tours of Goddard, and our educational programs and exhibits including Science on a Sphere, Hubble, and our Ozone Garden and our new Atmosphere exhibit. They will have opportunities to provide input and suggestions on improvements and new programs.

Project (ID: 89-1855) - Absorber Optimization for Terahertz and Xray radiation

Min. Level: Undergraduate - Sophomore
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Electrical Engineering
• Applied Physics
• Quantum Physics

Location: Goddard Space Flight Center

Project Abstract: Student will study absorber structures that can transduce incident photons to measurable electrical or thermal signal. The relationship between measured electrical properties will be correlated with detector performance. The goal is to optimize sensor performance and quantum efficiency of several types of sensors.

Intern's Project Activities: Duties will include cryogenic testing of electronic properties, design of custom hardware for device testing, and data analysis. The student will interface with a detector fabrication team who will produce samples for testing relevant to the targets for the detector. Student may assist in this sample preparation and will maintain records of samples. Safety training for basic laboratory operations will be provided.

Essay Question: Describe a procedure you developed to solve a scientific or engineering problem (this could be something for class or that time you figured out why your clock radio had stopped working)

Project (ID: 75-1201) - Target Field for a Dark Energy Survey

Min. Level: Undergraduate - Sophomore
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Astrophysics
• Cosmology
• Computer Science
• Image Processing

Skills:
• IDL

Location: Goddard Space Flight Center

Project Abstract: We are developing a mission concept called Destiny as a simple, direct, low cost mission to determine the properties of dark energy by obtaining a cosmologically deep supernova (SN) type Ia Hubble diagram. Its science instrument is a 1.65m space telescope, featuring a grism-fed near-infrared (NIR) survey camera/spectrometer with a large field of view. During its two-year primary mission, Destiny will detect, observe, and characterize ~3000 SN Ia events over the redshift interval $0.4 < z < 1.7$ within a 3 square degree survey area. In order to adequately predict the performance of the mission, the survey area must be selected. This requires an analysis of candidate regions, taking into account the density of desirable bright stars for guiding and the undesirable foregrounds such as zodiacal light and galactic cirrus emission. Destiny will be used in its third year as a high resolution, wide-field imager to conduct a multicolor NIR weak lensing (WL) survey covering 1000 square degrees. This survey area need not be contiguous, but must be selected with certain criteria in mind as well. Used together, the two surveys as will -- compared to ongoing ground-based projects -- have more than an order of magnitude greater precision in measuring dark energy and its evolution with time.

Intern's Project Activities: The intern is requested to study sky images at visible, near-infrared, and radio wavelengths to select beneficial fields for the Destiny survey. This will involve selecting out candidate regions and analyzing them for a minimum criteria and a figure-of-merit defining the quality of each field. The ideal candidate will be familiar with IDL or a similar astronomical image-processing software package. The final output of this study should be a list of the target fields, backup fields, and a report on the methodology used to select them. This report should be prepared for eventual publication in a scientific journal.

Essay Question: In a concrete, specific example, what skill or experience do you most hope to gain from a summer internship?

Project (ID: 9-12) - Multiwavelength Studies of Galaxies

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Beyond Second Year

Disciplines:
• Astronomy
• Astrophysics
• Computer Science
• Databases
• Graphics
• Image Processing
• Software Engineering
• Web Development
• Robotics Engineering

Skills:
• Computer programming
• Familiarity with UNIX

Location: Goddard Space Flight Center

Project Abstract: This project will involve observational data taken with a variety of telescopes on galaxies in the field, in groups of galaxies and in clusters of galaxies. Galaxies most commonly reside in groups, but it is important that we characterize them in broad range of environments to understand the effect that higher galaxy density has on galaxy evolution. Right now, we have extensive Chandra X-ray data, Spitzer infrared data, and GALEX data on the nearest rich cluster of galaxies (the Coma cluster) plus 12 nearby galaxy groups. The hope is that by the time the intern starts we will have ground-based imaging from telescopes in Chile as well. The successful applicant might go observing if they are available when the run occurs.

Intern's Project Activities: The students will reduce data, produce catalogs, write material for a science paper and likely do some small amount of webpage development. There may be an observing run to Arizona (but this might happen outside the summer student's term). The work will involve extensive UNIX and Mac OS X work as well as programming in IDL.

Essay Question: What experience with writing computer code do you have? Please cover real programming languages such as C, FORTRAN, IDL, etc.

How do you work in teams and how willing are you to ask questions when you do not understand something?

Project (ID: 90-2009) - Liquid Propellant Gauging in Low Gravity

Min. Level: Undergraduate - Junior
Max. Level: Graduate - Second Year

Disciplines:
• Analytical Chemistry
• Chemical Engineering
• Mechanical Engineering

Skills:
• Thermodynamics
• Numerical Modeling
• Data Analysis
• Chemistry of Binary Mixtures
• Programming Experience
• Error Analysis
• Experimental Methods

Location: Glenn Research Center

Project Abstract: NASA missions to the Moon and Mars will use cryogenic propellants such as liquid hydrogen, oxygen and methane. It is vital to mission safety and success to be able to measure the amount of liquid in a spacecraft's propellant tanks. One way to do this is to perform a thermodynamic analysis on the propellant tank using measured temperatures and pressures. In this project, analytical fundamentals will be established and utilized to develop a computational tool and/or to investigate experimental results. The end result will be to determine the accuracy of this gauging method.

Intern's Project Activities: The student will work with the mentor to establish a fundamental understanding of the gauging concept using their knowledge of thermodynamics and chemistry. Next, the student will either develop a numerical simulation tool (computer program or perhaps a spreadsheet) that models the gauging process over a range of expected operating parameters or analyze experimental data obtained from NASA's test facilities. A combined computational and experimental analysis is preferred and will be done if possible. At the end of the summer, the student will be expected to write a formal report documenting the results and to present these results to NASA engineers working on the propellant gauging challenge.

Essay Question: What prior experience do you have that qualifies you for this project and increases your potential to complete the project successfully?

Project (ID: 91-2010) - Sonification of space physics data

Min. Level: Graduate - First Year
Max. Level: Post Graduate

Disciplines:
• Physics

Location: Goddard Space Flight Center

Project Abstract: Continue development and evaluation of a JavaSound client for sonification of space physics data, emphasizing support for visually-impaired scientists. spdf.gsfc.nasa.gov/research/sonification/

Intern's Project Activities: Development and evaluation of a JavaSound client for sonification of space physics data.

Essay Question: How would you contribute to this project?

Project (ID: 92-2011) - Planetary Astronomy - Observing Io & the Plasma Torus

Min. Level: Undergraduate - Sophomore
Max. Level: Undergraduate - Senior

Disciplines:
• Astronomy
• Planetology
• Computer Science
• Image Processing
• Physics
• Optics

Skills:
• Highly organized
• Works well with others
• Takes initiative
• Listens well
• Ask questions
• Computer skills a plus
• Lab experience a plus
• Observing experience a plus

Locations:
• Goddard Space Flight Center

Project Abstract: This project provides hands-on observational astronomy experience from mountaintop observing to data reduction and analysis. This project requires a starting date of no later than May 21 and immediately going to Kitt Peak, AZ to assist with optical observations of Jupiter's moon, Io and its plasma torus. These observations are in support of a month-long HST campaign of the Jovian aurorae. This project is part of a larger effort to understand the Jovian magnetosphere and the relationship between Io, the dominant internal source of ions in the magnetosphere, the plasma torus, the aurorae, and the solar wind, the dominant source of external ions..

Intern's Project Activities: 1) Starting date no later than May 21, 2007; 2) Immediately go to Kitt Peak, AZ (attitude 7000 ft) for 2-3 weeks of nighttime observing; 3) Assist with instrument setup (spectrographs & imaging CCD cameras), calibrations, & operations; 4) Assist with telescope operations & alignment; 5) Catalog & create database of observations and related observing & object parameters; 6) Back at GSFC reduce & analysis a subset of Io or plasma torus data using IDL; 7) Strong emphasis on understanding random & systematic noise and applying good calibrations. No previous observing or experience with IDL is required. The project is well-suited to strongly motivated, hands-on, problem solving students in the fields of astronomy, physics, computer science, or engineering with an appreciation of amateur astronomy

Essay Question: Assume the Earth is a sphere of radius 6300km and you have a clear view of the horizon. On the horizon you see the lightening from the top of a 15km storm cloud. How far away is the lightening?

Project (ID: 93-2176) - Toolbox for Automated Registration and Analysis (TARA)

Min. Level: Undergraduate - Sophomore
Max. Level: Undergraduate - Senior

Disciplines:
• Image Processing
• Info. Tech.
• Software Engineering
• Web Development

Location: Goddard Space Flight Center

Project Abstract: The Toolbox for Automated Registration and Analysis (TARA) is a web-based image registration tool, which provides Earth scientists with a cross-platform interface for performing automatic registration with remote sensing images. Users can upload a pair of images from two different instruments, and select precise methods and parameter filters that describe the result they wish to generate. This project uses the following technologies: Java, HTML, JSP, JavaScript, and XML.

Intern's Project Activities: The intern should know the basics of Java and the knowledge of HTML, JSP, JavaScript, and XML technologies is a plus. Interns will extend the toolbox with new features using the aforementioned technologies. For example, intern will create a web page which will register a set of images using multiple algorithms and a set of images using the same algorithm, create user sessions and store user specific data on the server, add client and server side validation, etc.

Project (ID: 80-1206) - Digital Beamforming Synthetic Aperture Radar Imager

Min. Level: Undergraduate - Senior
Max. Level: Graduate - Beyond Second Year

Disciplines:
- Computer Science
- Software Engr.
- Earth Sciences
- Geosciences
- Oceanography
- Soil Science
- Engineering
- Computer Engr.
- Electrical Engr.
- Physics
- Applied Physics

Location: Goddard Space Flight Center

Project Abstract: We propose to implement and flight test the Digital Beamforming Synthetic Aperture Radar signal processor on the L-Band Imaging Scatterometer (RadSTAR-A). The proposed work leverages two ongoing efforts at GSFC: the real-time Digital Beamforming Synthetic Aperture Radar (DBSAR) processor funded under the FY06 IRAD program, and the L-Band Imaging Scatterometer RadSTAR-A, recently developed at Goddard with internal resources. The proposal objective consists of gathering and generating real-time high resolution images over wide areas using RadSTAR and the DBSAR processor. RadSTAR-A was successfully flight tested in FY2006 and is now ready for the needed subsequent tests with the upgraded processor. This goal will be accomplished by flying both systems on board of the NASA P3 aircraft to collect and process airborne data of targeted areas. The resultant, high resolution microwave backscatter observations of the Earth's surface support key soil moisture and sea surface salinity research goals. The proposed effort will benefit these and other earth science remote sensing applications of land and surface water as well as planetary exploration missions such as RLEP and Mars Scout.

Intern's Project Activities: The student will help with the testing, debugging, and optimization of the Digital Beamforming Synthetic Aperture Radar processor. There area several areas of work including data analysis, FPGA code development, C++ programming, microwave hardware testing, and aircraft flight support. The student may be involved in one or several of areas depending on her/his background. The student will also learn fundamental radar theory and techniques.

Essay Question: Do you know Matlab or IDL? Do you have any experience in FPGA programming, C++ programming?