JPL SIRI INTERNSHIP ANNOUNCEMENTS OF OPPORTUNITY (AO) – SPRING 2024
(Subject to change without notice)

AO#: 15149
Project: Cubesat & Friends Guide to the DSN
Internship Type: On-site at JPL
Preferred Major(s): Systems Engineering, Remote Sensing, Technical Writing
Desired Background: This opportunity is open to students with strong skills in technical writing. Students must be self-motivated, possess excellent interpersonal skills, be able to collect and organize data from multiple sources, and write in an approachable, engaging manner.

Project Description: The Artemis I mission launch included 9 cubesats as secondary payloads. The teams that provided those cubesats had widely-varying levels of experience, from industry professionals to mentored college teams to commercial groups, many with little or no knowledge of what it means to operate in space and communicate via the Deep Space Network (DSN). One of the lessons learned from supporting the concurrent launch of 10 spacecraft is that cubesat developers do not necessarily have access to or awareness of the information and training they will need.

This project will focus on researching, interviewing, and collecting information to create a "Cubesats for Dummies" style guide that will be provided to cubesat development teams. The focus will be on building and testing to interface with the DSN but will also include lessons from JPL experts, many of whom have decades of experience in space operations, from both ground and spacecraft viewpoints.

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AO#: 15148
Project: Water content and retention of geologic samples
Internship Type: On-site at JPL
Preferred Major(s): Earth Science, Lab experience
Desired Background: Background in Earth, Planetary or Environmental science is required. Lab experience is preferred. Experience with geologic field work or sample handling is a plus.

Project Description: Radar is a powerful remote sensing technique used to map the surface of Earth and other planets. One of the key parameters controlling the amount of radar energy reflected of the surface is moisture content. Different soils and rocks accumulate moisture to different extents. We are currently measuring a suite of rocks and soils from California and Iceland to characterize their ability to absorb and retain moisture, and feed those data into radar models.

Our sample suite consists of samples that have been either exposed to the laboratory environment or have been packaged at the field site. In the former, we proceed to wet the sample, measure its wetted mass and proceed with drying. The sealed samples, in contrast, are unpackaged, weighted, and then put to dry. We use the gravimetric method to determine the water content between wetted and dry samples.

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AO#: 15147
Project: Analysis of subsurface sounding data of Planetary Analogs
Internship Type: On-site at JPL
Preferred Major(s): Earth Science, Physics, Geophysics
Desired Background: Students need to have Earth/Planetary science background. Experience with geophysics or GPR preferred. Experience with Geographic Information Systems software (e.g., QGIS or ArcMap) is a plus.

Project Description: A plethora of remote sensing and in situ data obtained via planetary missions gives us a window to peer backwards through time and reconstruct the history of geologic events that have shaped the rocky planets. Information about the subsurface is key in this kind of reconstruction as younger sedimentary and volcanic processes tend to bury the signature of older events, which can then be modified by tectonic, hydrologic, and other processes. Amongst the geophysical methods that permit us to interrogate the subsurface, electromagnetic methods as ground-penetrating (GPR). Current and past missions to Mars and the Moon have carried out successful GPR investigations, and newer missions are being planned to carry GPR.

The student will analyze GPR data using a combination of GPR analysis software (RADAN, GPR-SLICE) and homebred Matlab scripts to derive subsurface stratigraphy and dielectric properties.

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AO#: 15146
Project: Microbial Identification by genetic sequencing and MALDI-TOF mass spectrometry.
Internship Type: On-site at JPL
Preferred Major(s): Microbiology, Biology/Bioengineering
Desired Background: Bioinformatics, genetics, genomics, and microbiology are highly recommended. Experience with databases and data handling would be helpful.

Project Description: The Mars Sample Return Campaign intends to bring surface and rock core samples from Mars. As a precautionary measure, to avoid future controversy, a catalog and archive of microorganisms from our outbound spacecraft has been established. It is important to identify, document microorganisms collected from the Mars 2020 mission and other past missions. The Planetary Protection Microbial Archive identifies and preserves microbes that have been isolated from JPL's Robotic Spacecraft as they are assembled. It is desirable to identify these microbes to aid in tracking contamination on spacecraft and in our cleanrooms. The primary identification methods are MALDI-TOF mass spectrometry and 16SrRNA gene sequencing. Algorithms from the mass spec instrument manufacturer uses the manufacturers database and our own in-house database. Nearly all of the closest matches of unknown organisms are obtained from our in-house database rather than the commercial hospital-oriented dataset. We wish to improve this in-house database to improve our daily identifications.

The goal of this internship is to use microbial identifications found through genetic sequencing as well as high quality spectra to create new database entries. Expanding our in-house curated database of cleanroom microbes allows for future rapid identification of samples taken from spacecraft surfaces. Specifically, students will revive and culture a set of 200 microbes from our collection. These organisms will be sent out for 16SrRNA gene sequencing. The results will be used to obtain the most likely match. The organisms will also be analyzed by MALDI-TOF mass spectrometry and the combination of data used to update the mass spectra database. These organisms which have high confidence identifications will be used to add new high-confidence spectral nodes to the in-house spectral library. In addition, students will also correct some nomenclature where certain species have been reassigned to a different genus.

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AO#: 15142
Project: Open Source Rover Innovative Development
Internship Type: On-site at JPL
Preferred Major(s): Electrical Engineering and Computer Science, Mechanical Engineering,
Desired Background: STEM background

Project Description: The 174 Division is responsible for AI, Analytics, and Innovative Development within JPL's IT Directorate. A few years ago, we developed and mobilized an Open-Source Rover (OSR) community.

We are looking for 2 dynamic and entrepreneurial students to join our team and push the boundaries of the OSR further. Specific scope for the project will be tailored to each intern's skillsets, experiences, and interests. However, the main thrust of their internship will be focused on developing a familiarity with the OSR platform (mechanical, electrical, and software) and finding a unique and innovative capability to develop and ultimately publish to the OSR community. Example activities have been but are not limited to - Design and 3D print your own components, swap out compute or other hardware to support a more complex function, infuse 174 developed or other Open Source AI/software into the rover to improve autonomy or performance, etc. Students will have access to and become familiar with our team, our tools, and so much more as they ideate and deliver the next iteration of new capabilities to the OSR.

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AO#: 15112
Project: Mapping the Lunar Regolith Thickness using Young Craters
Internship Type: On-site at JPL
Preferred Major(s): Planetary Science, Earth Science
Desired Background: All skills can be learned during the internship.

Project Description: Most geologic activity on the Moon ceased a billion years ago, but it is continually bombarded by everything from small grains of dust to large boulders. Over the years, this bombardment has broken down the lunar surface into a layer of fine-grained rock fragments known as regolith. However, large impacts can punch through this regolith layer and excavate buried rocks. The regolith layer is expected to vary in thickness, and larger impacts are required to excavate rocks in areas where the regolith is thicker. Knowing the variability in thickness of the lunar regolith helps us to understand the geologic history of the Moon.

The project is seeking 3 interns. Students will use images from the Lunar Reconnaissance Orbiter Camera (LROC) to count boulders at young impact craters. Additionally, students will analyze differences in the number of rocks (or lack of rocks) around craters of different sizes and in different locations to constrain variations in the thickness of the regolith layer.

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AO#: 15110
Project: Analysis and Archiving of Near- and Mid-Infrared Observations of Outer Planet Atmospheres
Internship Type: On-site at JPL
Preferred Major(s): Planetary Science, Astronomy, Computer Science
Desired Background: The data reduction programs are written in the Interactive Data Language (IDL, which is close to Matlab in format, and ultimately not very different from Python). The analysis code is written in FORTRAN. At least rudimentary knowledge of these (or willingness to learn before the beginning of the research) is highly recommended. Some programming experience is required. With a significant level of contribution, students are welcomed as co-authors on papers emerging from this research.

Project Description: Images and spectra of the outer planets (Jupiter, Saturn, Uranus, and Neptune) from visible, near- and mid-infrared instruments are sensitive to temperatures, abundances of a major condensate (ammonia) opacity of clouds and the variability of the molecular para vs. ortho-H2 ratio. These define the fundamental state of the atmosphere and constrain its dynamics. This research will focus on observations obtained from a variety of instruments used at large professional telescopes: NASA's Infrared Telescope Facility, Gemini North and South Telescopes, ESO's Very Large Telescope, and the Subaru Telescope, and the Juno mission images of Jupiter in reflected sunlight from the JunoCam instrument. The general objective of the specific tasks below will be to create fully reduced data from unreduced or partially reduced sets. In some cases, our objective is to format the data for input into an atmospheric retrieval code from which atmospheric properties will be derived.

This project is seeking 3 interns to assist with the following tasks:

1. Analyze images made by the JunoCam imaging instrument on the Juno mission. To some extent, each of these tasks may require work with a transformation of the images to a latitude-longitude map using "ISIS3" software supplied by the US Geological Survey. A task associated with any of the following science goals could be automating this process. 1a. Understanding the dynamics of Jupiter's high northern latitudes. Search for sequential JunoCam observations near the north polar region with time dependence to determine the wind field of this region and the degree to which Jupiter's winds flow east-west to something different, possibly chaotic, but with a component of east-west prevalent winds. 1b. Search for and measure hazes in Jupiter's atmosphere, i.e., particles lying above Jupiter's main cloud deck. This will include the following, each of which could be a separate research task: (i) Identify clouds near Jupiter's dusk region that appear to have different shapes or positions that are wavelength dependent, creating a "rainbow" appearance. (ii) Identify persistent hazes, their level of transparency and changes in their morphology between successive Juno orbits to determine a velocity. Where possible, verify

their appearance in a special filter that is sensitive to high-altitude particles. (iii). Survey JunoCam images of Jupiter's horizons to detect and measure "detached" haze layers. 1c. Continue previous work in the first 20 orbits of the Juno mission to detect and measure small-scale waves in Jupiter's atmosphere to increase statistical evidence for their latitudinal distribution and association with larger features.

2. Archive images of Jupiter made in support of the Juno mission. To fulfill contractual obligations to NASA, we need to archive our infrared imaging of Jupiter from various instruments from the last four years of mid-infrared images and two decades of near-infrared images with NASA's Planetary Data System (PDS). These data must be accompanied by required ancillary files in a specific PDS format. The goal of this work is to collect copies of the images and related files into a single location with a specific nomenclature and submit these to review by the PDS. Aspects of this work could be done concurrently with other student work on the long-term variability of Jupiter.

3. Reduce near-infrared images of Jupiter. We will be acquiring a large volume of observations of Jupiter that are designed to support observations from instruments on the Juno spacecraft. We want to reduce the data and, to the extent possible, analyze the results. There are several objectives in this broad category. 3a. Develop quasi-automated software for reducing near-infrared imaging observations. The basis of this software exists in the Interactive Data Language (IDL), but the order of operations must be reversed at one stage and a subtracted pair of images must be reversed at another stage. 3b. Develop software for combining Mercator maps derived from images taken at different times as the planet rotates; use these to create full maps of Jupiter over all longitudes, as well as to polar project those maps – for example - to investigate correlations between different phenomena in the neutral atmosphere and the aurora. 3c. Create an absolute calibration of the reflectivity of these images by referencing the flux from measured standards stars. Compare this with a calibration scaled to spacecraft observations of the near-infrared spectrum. 3d. Measure the distribution of cloud properties in the atmosphere with near-infrared reflectivity, including high-resolution adaptive-optics stabilized images. Use these data to characterize the chemistry and dynamics of the atmosphere, associated with specific atmospheric features e.g., polar hazes, the Great Red Spot and its environment, their evolution and their relationship with temperatures and winds. 3e. Reduce scanned spectral observations of Jupiter that create a hypercube of data (two dimensions of imaging and one of wavelength), deriving spectra at each pixel of the slit. Analyze these for properties of clouds and hazes, comparing them with models.

4. Examine the long-term variability of longitudinally averaged temperatures and other properties in Jupiter to create accurate and self-consistent calibrations of all data from a variety of telescopes. Extend a current program to input longitudinally averaged data over Jupiter's full disk to include observations at facilities where only a northern or a southern hemisphere of Jupiter could be captured. Format these data to be an input to an atmospheric retrieval program. Organize the output of this program to enable rapid plotting and correlation with previous studies and between different retrieved atmospheric properties. 5. There also may be opportunities to work on imaging or spectra of Uranus or Neptune from James Webb Space Telescope (JWST) and supporting observations from NASA's Infrared Telescope Facility and Palomar Observatory.