Oregon NASA
Space Grant Consortium

2010 Student Symposium Proceedings

November 5, 2010

9:00 am—6:30 pm

Memorial Union
Powell Learning Center Journey Room
Oregon State University

featuring presentations from
NASA student interns and researchers

2010 NASA Student Symposium

Hosted by
Oregon NASA Space Grant Consortium (OSGC)
November 5, 2010

Oregon Space Grant consortium
92 Kerr Administration Bldg
Corvallis, OR 97331-2103

Phone: 541-737-2414
Fax: 541-737-9946
spacegrant@oregonstate.edu

Agenda / Presentation Schedule

TIME	STUDENT NAME	SCHOOL	PROGRAM	NASA CENTER
9:00-11:30	Open Poster Session — Snacks and refreshments provided			
11:30-Noon	BREAK / NETWORKING			
Noon-1:00	LUNCH - Food and refreshments provided			
1:00	Jasper Cook	University of Oregon	Undergraduate Research Scholarship	N/A
1:15	Alexandria Russell	University of Oregon	NASA Center Internship	NASA Jet Propulsion Lab
1:30	Ellyne Kutschera	Portland State University	Oregon Space Grant Graduate Fellowship	N/A
1:45	Lauren Krueger	Portland State University	Undergraduate Research Scholarship	N/A
2:00	Matthew Fay	Oregon Institute of Technology	OIT High Altitude Balloon Team	N/A
2:15– 2:45	BREAK / NETWORKING			
2:45	Florian Kapsenberg	Oregon State University	OSU Mars Rover Team	N/A
3:00	William Natividad and Rafael Santiago	Oregon Institute of Technology	OIT High Altitude Air Sampler Project	N/A
3:15	Kristine Paul	Oregon State University	NASA Center Internship	NASA Ames
3:30	Brian Larson	Portland State University	Oregon Space Grant Graduate Fellowship	N/A
3:45	Cullen Andrews	University of Oregon	Oregon Space Grant Graduate Fellowship	N/A
4:00—4:45	RECEPTION—Snacks and refreshments provided			
4:45	Anthony Odenthal	Oregon State University	OSU Pico-Satellite Project	N/A
5:00	Austin Wardrip	Portland Community College	NASA Center Internship	NASA Jet Propulsion Lab
5:15	Thomas Bauska	Oregon State University	Oregon Space Grant Graduate Fellowship	N/A
5:30	Damani Proctor	Portland Community College	NASA Center Internship	NASA Goddard
5:45	Jenna Bell	Portland State University	Dryden Drop Tower Project	N/A
6:00—6:30	NETWORKING			

Abstracts

Cullen Andrews, University of Oregon
GALEX Observations of Nearby Disk Galaxies

GALEX observations of nearby disk galaxies have the potential to reveal new information about their low-surface-brightness (LSB) outer regions. We have acquired deep FUV and NUV images of large-scale-length disk galaxies NGC 5172 and UGC 9024, and I have inspected archived GALEX observations of nearby LSB disk galaxy NGC 247. IRAF and SExtractor have been used to characterize the UV flux in the regions beyond their nominal radii. As luck would have it the GALEX data pipeline failed to cleanly remove some reflection artifacts from our NGC 5172 images. A workaround for this error has been developed, in which SExtractor incorporates the erroneous flux into a coarse background model, and this helps to quantify the associated uncertainty in the measurements. In all cases, a UV signal is observed well beyond the nominal radius. Most notably, NGC 5172 emits out to a diameter of approximately 70 kpc. The existence of such large disk structures, and the occurrence of star formation (as evidenced by the UV signal) at such large radii, are challenging in developing disk formation models.

Thomas Bauska, Brook, E.J. and Mix, A.C., Oregon State University
Carbon Cycle Variability since the Last Ice Age

By analyzing the composition of air extracted from bubbles in ice cores, records of the CO_2 mixing ratio have been constructed for the last 6.5 glacial/interglacial cycles. Some of the most salient features of these CO_2 records are the large increases of about 80-100 ppm that correlate highly with temperature increases during the transitions from a glacial to interglacial state. Currently, there is no consensus as to the mechanisms behind these long-term, natural CO_2 variations. One promising tool for dissecting the natural variability of CO_2 is the stable isotopic ratio $^{13}C/^{12}C$, normally expressed as $\delta^{13}C$. Different sources of CO_2 to the atmosphere input different amounts of ^{13}C. A record of $\delta^{13}C$ of atmospheric CO_2 could thus delineate between the contributions each of these sources had to the atmosphere. When interpreted with a record of CO_2 concentration, one could deconvolve the magnitude of carbon fluxes to the atmosphere from specific sources. To obtain these high precision measurements, new techniques for extraction of gas from ice core are currently being developed. These measurements will be made using the newly cored WAIS Ice Core, which should provide an unsurpassed record of greenhouse gas variation for the last glacial/interglacial cycle. Additional measurements will be made on samples taken from a “horizontal” ice core on Taylor Glacier.

Jenna Bell, Donald Bell and Mark Weislogel, Portland State University
The Dryden Drop Tower : A New Facility for Low-Gravity Research

Drop towers are often used as a low cost option for achieving short duration access to a nearly weightless free-fall environment. A new 2.1 second drop tower – The Dryden Drop Tower (DDT), has been designed, constructed, and inaugurated at the Maseeh College of Engineering and Computer Science at Portland State University (PSU). The approach incorporates innovative features to increase throughput and micro-gravity quality in a highly public facility. Automated operation with full wireless CCTV coverage and passive magnetic deceleration provides quiet, safe operation from a single control station with low re-cycle time. A two-stage coaxial release mechanism decouples the payload from the drag shield to minimize disturbances to the experiment during release. This is especially important for fluids experiments that are highly sensitive to initial conditions. The two second tower is used for research and educational outreach. The research efforts focus on capillary flows and phenomena relevant to spacecraft fluid systems. The outreach efforts utilize partnerships with local primary, secondary and post-secondary institutions to promote the fields of science, technology, engineering and mathematics.

Jasper D. Cook, James Utterback, Lindsay Wills and Andrew Marcus, University of Oregon
Study of Nanoparticle Fluctuations in Polybutadiene by Fourier Imaging Correlation Spectroscopy

As a glass-forming polymer liquid cools, its molecules relax, slowly forming a non-crystalline solid. This process occurs such that the dynamics of the liquid are heterogeneous; that is, the dynamics vary throughout the glassy sample, and different regions of the cooling liquid have different levels of kinetic energy. These domains of heterogeneity could be responsible for the unique macroscopic properties of glasses, and a greater understanding of their role will aid in the synthesis of new glass-based substances. We utilize a novel spectroscopic technique known as Fourier imaging correlation spectroscopy, or FICS, to study heterogeneities in fluorescently doped polybutadiene near its glass transition temperature. FICS (which utilizes a sweeping interference pattern of excitation to detect a phase resolved fluorescence signal) is capable of precisely measuring the movement of a single probe molecule over arbitrarily long timescales, making it an ideal technique for the study of spatial heterogeneities. These observations will allow for the direct calculation of mean-squared-displacements, two- and four-point time correlation functions and 2-dimensional spectral densities, all of which aid in the characterization of dynamical heterogeneities and rigorous testing of current theories.

Michele Crowl, Oregon State University
Evergreen Aviation & Space Museum Evaluation Plan: Phase I

This report describes the creation and implementation of an evaluation plan at the Evergreen Aviation & Space Museum in McMinnville, Oregon. The methods and results constitute Phase 1 of a five-year plan for exhibit modification. The goal for this phase was to design and implement strategies that would help museum staff understand the effectiveness of educational programming and events and exhibits. For exhibits, methods such as scan sampling, comment cards, online surveys, exhibit observations and docent questions were put into practice. Online surveys and pre/post-tests were created and partially implemented to assess programming and events, which will be fully realized during the 2010-2011 school year. Results of each method are discussed and recommendations follow. Future plans for continuing to build the evaluation program are also described.

Matthew Fay, Oregon Institute of Technology
Dynamic Prediction of High Altitude Weather Balloon Flight Paths

Balloon Predict 1.1 was created to solve the problem of dynamically tracking and predicting weather balloon flight paths. The Mars Reach Program at Oregon Tech launches and tracks weather balloons for various high altitude experiments. The previous system for predicting balloon flight paths used outdated wind data in their estimations. Our project uses wind data gathered from the flight to continuously update the estimated landing location of the payload. The flight of the balloon was mathematically modeled and coded into our system. The ascent predictions are calculated using a linear equation. The decent prediction is based off a second order differential equation solved by a Runge Kutta algorithm. The burst altitude was estimated and based off of manufacturer specifications for burst diameter, the air density and the helium volume. We successfully predicted the landing location of our balloon on our Alpha Release and Release Candidate tests. It is important to note that the Release Candidate predicted the landing location even though the radio on the balloon malfunctioned and stopped transmitting points. Dynamic prediction is a large step forward in balloon retrieval technology. Other systems gave you an estimate of where the balloon might land before the launch happened. The data they base their estimations on could be half a day old and on the other side of the state. Our program can cut down retrieval time by using up to the minute data to predict the landing location.

Matthew Fiedler and Judy Jeevarajan, Oregon State University
Lithium-ion Battery Cooling systems

Lithium-ion cells are currently used in many aspects of space flight as well as other technologies due to their high energy density. The problem is that these batteries can heat up, and if they get hot enough, go into a thermal runaway. In a thermal runaway, the cells heat up uncontrollably and a catastrophic event such as a fire can take place. It is therefore necessary to cool these systems to prevent thermal runaways. Many systems were investigated to prevent thermal runaways such as active air-cooling, macro water-cooling, and micro-channel cooling. In order to analyze the effectiveness of these systems, numerical and computational analyses were performed. After completing the analyses on all of the systems, it was found that the most effective form of cooling was running water through a pipe on both the top and bottom of the cells in opposite directions. Through using this system, the maximum temperatures stay well below a thermal runaway condition and the amount of power needed to run the system is very small.

Marius Ghita, Portland State University
Serial Link Characterization

The goal for this research is to perform serial link tests to measure bit error rate (BER) and jitter for serial data transmission and reception using SERDES (serializer/deserializer) integrated circuits. Two different types of mediums are considered for transmission of serial data bits. The first medium is different coaxial cables with different characteristics and lengths, and the second medium is printed wiring board (PWB) traces. These tests will characterize the effect of the SERDES, link components, and link material (coaxial cable and PWB traces) on the data bits differential signals. Using signal generator, clocks are provided to the SERDES chips. The transmit circuit and SERDES number 1 generate pseudo random bit sequence (PRBS) digital patterns that feed the link and they are received by receiver circuit and SERDES number 2. A SERDES evaluation board was connected in a loopback mode. Using an oscilloscope, eye diagrams were captured and jitter measurements on multiple cables were performed. From these measurements “Bathtub plots” were generated. It was found that the mean total jitter of the serial link was about 222/228 ps at 1.6 Gbps, 173/158 ps at 2.0 Gbps, and 121/122 at 2.5 Gbps through 1.2m RG142/5m Gore cables. The eye diagrams captured show a large opening which is equivalent to a high quality serial link. The “Bathtub plot” estimations produced by the oscilloscope suggest eye openings after 10^{12} bits in the range of 0.6348-0.6935 Unit Intervals. These estimates were compatible with the result of monitoring the PRBSPASS signal on the SERDES with a logic analyzer. Using an FPGA based board connected to SERDES evaluation board, BER measurement logic is being developed to capture bit errors for more elaborate link operation between separate transmit and receive SERDES chips. A printed wiring board (PWB) schematic for testing PWB trace as a serial link medium is developed. A layout guideline procedure for PWB is currently being prepared.

Walter Hudson, James Hoffman, Devon McClain and Jun Jiao, Portland State University
Resonant Micro-Raman Mapping of Single Walled Carbon Nanotubes

A pristine single walled carbon nanotube (SWCNT) is composed of a periodic array of sp2-bonded carbon atoms rolled into a cylindrical tube. This unique hexagonal array results in superior mechanical properties. Additionally, their electrical and optical properties make SWCNTs ideal for such diverse applications as field emitters, LEDs, and chemical sensors. However, both the mechanical and electrical properties of SWCNTs are contingent on the structural integrity of the tube. Raman Spectroscopy is an analytical tool readily used for characterizing SWCNTs. This projects aims to study SWCNTs through resonant micro-Raman spectroscopy on the single nanotube level. Raman active modes such as the Radial Breathing Mode (100-300cm-1) and the defect induced D-band (1200-1400cm-1) are mapped over a two-dimensional area. Investigation of Raman peaks relative to spatial orientation will give insight into the morphology of the tube. Areas of high D-band intensity, or shifts in RBM frequency, will indicate changes the in mechanical strength or electrical transport properties. The ability to fully characterize SWCNTs, including localization and identification of defects, is a necessary first step before real world CNT-based applications can be achieved.

Florian Kapsenberg, Oregon State University
2010 Oregon State University Mars Rover Team

Each year Oregon State University competes with other university teams from around the world in the Mars Society's international "University Rover Challenge" by designing, building, and operating a remotely controlled Mars Rover. Each team's rover is to complete a number of individual tasks, ranging from assisting an astronaut in distress, to repairing an instrument panel and taking soil samples. This was be our third year competing in the annual competition, held in June in the desert of Southern Utah. We placed first in 2008, as well as in the 2010 competition this past June. Our team placed first for a variety of reasons. Foremost, aside from operating the rover efficiently and completing many of the tasks, what made our Mars Rover stand out from the rest of the competition was the advanced level of engineering that went into the design and construction of this robotic vehicle. Because designing and building a Mars Rover is very complex undertaking, our team is highly multi-disciplinary in nature. Oregon State University was the only team to feature weather resistant electrical systems, high density bulkhead connectors, complete wiring harnesses, an ISA backplane with custom designed PCBs, solar reflecting Mylar on the electronics bay to keep the electrical systems cool, full independent direct drive and the most all-terrain, all-weather capable design ever brought to this competition stage.

Lauren Krueger, Portland State University
Fabrication and Characterization of Nanomaterials for Microbial Fuel Cells

This research concerns the fabrication and characterization of two types of nanomaterials for the device application of microbial fuel cells (MFCs). MFCs use microorganisms as the catalyst to oxidize matter and generate electricity. While MFCs hold the possibility of playing a major role in the areas of renewable energy and waste water treatment, they also retain a great challenge: to sufficiently increase their power generation. Nanomodification of anodes has proven to increase the current density and power output of the system. Thus far, the nanomodification of the anodes has included the fabrication of nanoparticles and aligned multi-walled carbon nanotubes (MWCNTs). Nanoparticles of different materials were synthesized through thermal annealing and MWCNTs were synthesized through plasma-enhanced chemical vapor deposition. Future research will include the fabrication of graphene and Fe_3O_4 nanoparticles to increase the power generation of the MFCs. Results show that the decorative material on the anode and its properties, such as density, size and morphology affect the current density and power output.

Ellynne Kutschera, Aslam Khalil and Martha Shearer, Portland State University
Transport of the Greenhouse Gas Methane in Trees

Natural and cultivated vegetation is an important source of atmospheric methane (CH_4). Although the emission of CH_4 from these systems has been widely investigated, the plant-mediated transport of CH_4 from the soil to the atmosphere is yet undefined for natural wetland and upland systems. Methane transport processes are being investigated in hydroponically-grown black cottonwood (*Populus trichocarpa*), a wetland tree native to the Pacific Northwest. Isolation from soil media provides direct correlation between CH_4 applied to the root zone and plant transport mechanisms. Experiments in progress differentiate between diffusive and bulk flow transport pathways. Emissions from the canopy, stems, and leaves are measured by enclosing the respective structures in static cuvettes while roots are submerged in a sealed chamber filled with CH_4 saturated water. Detection of leaf flux will indicate CH_4 movement via transpiration (bulk flow), while stem emission will indicate diffusion through air-filled plant tissues. Soil and vegetative properties can be parameterized to specific plant transport mechanisms, allowing the processes to be included in an existing agricultural emission model and extrapolated at the global scale using vegetation indices such as leaf area index derived from satellite data products.

Brian Larson and Niles Lehman, Portland State University
Interpretation by the DSNL-0 Ribozyme and its Implications to Origins of Life

RNA enzymes (ribozymes) have qualities suited for *in vitro* evolution experiments, making it possible to isolate nucleic acids with novel structure and function. A population of RNAs can be exposed to repeated rounds of selection, amplification, and mutation, resulting in RNAs that express some desired catalytic activity. We have exploited these qualities to select a molecule representing a minimal semiotic entity for Robinson and Southgate's definition of interpretation as it relates to origins of life research. The selection criteria rely on RNA performing both roles of an information carrier and a catalyst and that abiotic chemical organization does not become lost upon the emergence of life. Catalytically favorable variants preferring a non-normal metal ion, Co^{2+}, are simultaneously selected at pH 8.3 for multiple generations and followed by negative selection for variants of the Co^{2+} dependent enzyme that are inactivated by base hydrolysis in the presence of the metal ion. This *in vitro* evolution study will uncover the potential role of interpretation as a selection pressure in early evolutionary steps in the emergence of life and foundation of such properties in an RNA world. In line with NASA's Astrobiology goals the research provides insight to the study of the origin, evolution, distribution, and future of life in the universe through, to the best of our knowledge, the first double selection of a ribozyme.

Logan Mitchell and Ed Brook, Oregon State University
New High-precision, High-resolution Records of Atmospheric Methane from Greenland and Antarctic Ice Cores: 0-1800 C.E.

Atmospheric methane is a potent greenhouse gas that is responsible for ~20% of the total increase in radiative forcing since the industrial revolution. Despite its importance there is a lack of scientific understanding regarding the controls on sources and sinks. Here we present high-precision, high-resolution records of atmospheric methane from the West Antarctic Ice Sheet (WAIS) Divide 05A ice core (WDC05A, 1000-1800 C.E., [*Mitchell et al.*, submitted.]) and preliminary measurements from the WAIS Divide deep ice core (WDC06A, 0-1800 C.E.) and the Greenland ice core (GISP2D, 0-1800 C.E.). These records have decadal scale resolution, analytical precision of <3 ppb, and are highly correlated with the only previous high resolution ice core methane record which comes from Law Dome, Antarctica. The high degree of correlation between multiple ice cores demonstrates that the multidecadal variability is real and presents an opportunity to investigate the causes of this variability. We compared our methane records to paleoclimate proxies for temperature and precipitation as well as anthropogenic activities which could have affected methane emissions over the past millennium. On multidecadal time scales there are low correlations with temperature and precipitation reconstructions with regional to global spatial scales. Times of war and plague when large population losses reduced anthropogenic emissions appear coincident with decreasing global methane concentrations however anthropogenic activity cannot explain all of the observed variability. We conclude that multidecadal variability of methane over the past millennium was not controlled by temperature, precipitation, or anthropogenic activity alone and instead by some combination of these parameters.

Mohsen Nasroullahi and Mohammad Mojarradi, Oregon State University
Design of Cold-Capable Digital ASIC For Brushless DC Motor Controller to Operate at Extreme Environment of NASA Missions for next generation of spacecraft.

As NASA expands space exploration into more extreme environments such as the Moon, Mars, Titan, and Europa, there is an increasing demand for flight electronics that are capable of operating in extreme environments with wide temperature swings (e.g. -180°C to +120°C) and constant exposure to ionizing radiation to a TID of 100-300 krad. These specifications allow for the reduction or elimination of the 'warm electronics box', providing a significant reduction in spacecraft weight, power requirements, and ultimately cost. It has been proposed to use cold-capable application specific integrated circuits (ASICs) to meet these specifications. This project explores the limits of existing semiconductor technologies and leverages these technologies for design and development of cold-capable digital ASIC components. These ASIC components will be utilized for distributed brushless DC motor controllers to operate in the harsh space environments for the next generation of spacecraft.

William Natividad and Rafael Santiago, Oregon Institute of Technology
The Oregon Institute of Technology High Altitude Air Sampler Project

The High Altitude Air Sampler Project was a multi-disciplinary project that involved the departments of Electrical Engineering and Renewable Energy, Manufacturing & Mechanical Engineering & Technology, and Natural Science as well as members of the MarsReach Club at Oregon Institute of Technology. Dr. Lawrence Powers, Dean of the School of Health, Arts and Sciences (HAS), proposed in the fall of 2009 that the seniors in the electrical engineering program design and construct a device that could take samples of air at altitudes ranging between 10k and 55k feet (above sea level) via a 1200 gram, latex weather balloon. These samples were expected to contain microbes indigenous to Klamath Falls and neighboring cities, as well as microb es that may have traveled from other parts of the world through the jet stream. The sampler was composed of (3) 1 micrometer pore filters with auxiliary equipment cushioned and supported within a 12”x8”x6” plastic case and fed by a 28 L/minute vacuum pump. This air sampler was successfully launched and recovered on June 5, 2010. Filters contained within the sampling chambers were physically sectioned and then cultured in various media at various temperatures. Culturing resulted in growth of (2) different microbial colonies, both from the 10k-25k foot altitude band. Overall experimental results indicate sampler design is sufficient to recover atmospheric microbes, but that increased sampling volume is required for altitudes in excess of 25k feet.

Anthony Odenthal, Oregon State University
High Altitude Balloon, Satellite Groundstation Construction, and Outreach

The OSU Pico-Satellite Program with funding from the OSGC has launched two High Altitude Balloons (HABs) and started construction of a radio ground station for communicating with satellites in low-earth orbit in the last year. The first HAB launch was a successful flight though the datalogger failed. The second flight suffered a double failure of the tracking system and has yet to be recovered. All the parts for the ground station are ready to go, several amateur radio satellites have been heard using the equipment. A tower with better antennas is waiting for a mounting plate to be ready; these antennas will allow communication to the satellites as well as from. Members of the group have also participated in outreach events, one presentation to the Civil Air Patrol that generated interest in a partnership between the HAB project and the CAP; the other event was the annual Jamboree on the Air where the groups radio equipment was used to listen to Satellites and to communicate with radio amateurs with Scouts to help generate interest in Amateur Radio.

Kris Paul, Oregon State University
Using Photometric Data for Estimating Redshift of Galaxies Observed in the Sloan Digital Sky Survey

An important piece in mapping the visible universe involves determining the redshift of celestial objects. Currently spectroscopy is the most accurate method of measuring redshift and the Sloan Digital Sky Survey (SDSS) has proved to be a prolific source of spectral data. During 8 years of operations it has collected data from ¼ of the sky on more than 200 million objects including spectral data on more than 930,000 galaxies. Spectral data can only be collected on a small portion of selected objects while a photometric telescope obtains images of all detectable objects in the viewing area using filters that provide broadband data in 5 color bands. Several computational methods have been developed to determine the object's redshift using this data, but with considerably less accuracy than what is possible with the spectroscopic data. Considering natural variations in broadband data collected and other sources of error, my research addresses the question as to whether it may be possible to improve accuracy in estimates of redshift using photometric observations. The results of this work will help astronomers evaluate current courses of action and perhaps provide new direction in mapping the known universe.

Damani Proctor, Portland Community College
NASA Goddard Space Flight Center Management

During my internship experience at Goodard, I supported the NASA GFSC Educational Office; processed international students for security clearance; provided office design in accordance with GSFC safety ordinance, and facilitated internship program activities coordination. I also provided educational program support for NASA Academy, Student Intern Program, APL and STEM programs. Additionally, I acted as a Resident Manager for NASA Academy participants. I was responsible for check ins check outs, coordinating fire drills, aiding in planning trips and enforcing house protocol, aiding in planning meals and offering 24 hour support. I also aided in research and reported for a news article on the DAWN team's ability to correct satellite's optics issues. I participated in astronomy and geological research, aided in setting up intern NASA GSFC, website worked on the Race to the Top Research project to study statistical data on program policy. Some of my primary accomplishments included the following: coordinated with department staff to organize events, process international students. Manage intern house operations participated in NASA job site promotional video, worked with public affairs office to file media related files and participated in independent research projects, worked with NASA HQ to locate NASA Ambassadors for involvement in state oriented educational and recruitment efforts. My experiences at Goddard provided me with an excellent overview of NASA administration policies and procedures.

Alexandria Russell, University of Oregon
Detecting Precipitation Using Satellite-Based Passive Microwave Radiometers

Understanding tropical rainfall is important for several reasons: tropical storms can have a large impact on the lives of humans; tropical rainfall contributes about three fourths of the energy that drives atmospheric wind circulation due to the latent heat that is released by tropical precipitation; and by understanding tropical rainfall, we can facilitate our understanding of climate change. In order to understand tropical rainfall, we must be able to detect it. Detecting precipitation using satellite-based passive microwave radiometers can be difficult due to poor ability to distinguish between rain signal and background surface contributions. However, by analyzing data from two instruments aboard the Tropical Rainfall Measuring Mission (TRMM) satellite, the TRMM microwave imager and the precipitation radar, it may be possible to improve the accuracy of the precipitation detection methodology. The goal is to determine a predictable relationship between these combined radar-radiometric observations that can be used by the microwave imager alone, in lieu of any precipitation radar information. The principal components of the data are calculated and investigated in order to improve the precipitation detection scheme as well as contribute to a better understanding of the vertical structure of precipitation in tropical storms.

Austin Wardrip, Portland Community College
In-Situ Study of Comets

The detailed in-situ study of comets has been challenging. Their small size and great distance make earth-based observations difficult, and their rapid appearances/disappearances make planning and launching space-based missions infeasible. However, the orbits of short period comets, ones with periods less than 200 years, are understood well enough to send unmanned exploration spacecraft. In 2004, after a series of successful comet missions, the European Space Agency (ESA) launched the Rosetta spacecraft. Its mission is to reach comet 67/Churyumov-Gersimenko and follow it as they both orbit around the sun. One of the instruments aboard Rosetta is MIRO, a microwave spectrometer built at the Jet Propulsion Laboratory. This instrument allows examination of the gas dynamics and the chemical/physical properties of the comet coma. Various models have been developed to simulate the physical characteristics of a comet coma. These models depend on key comet parameters, such as distance from the sun, surface temperature, outgassing rate (how much gas is sublimating off the nucleus), etc. A model for the microwave spectrum from a coma has also been developed. In preparation for the data from MIRO, the observable microwave spectrum, due to water, was simulated for various sets of key parameters (coma profiles). This allowed the evaluation of how physical features, such as outgassing rate, affect the observable spectrum. From this, it was possible to estimate how sensitively these key parameters could be determined from the spectrum.