The North Star

Publication of the Minnesota Space Grant Consortium

Winter 2001

Table of Contents

Minnesota Space Grant Consortium
Dept. of Aerospace Engineering and Mechanics
University of Minnesota
107 Akerman Hall
110 Union Street SE
Minneapolis, MN 55455
(612) 626-9295 (phone)
(612) 626-1558 (fax)
http://www.aem.umn.edu/msgc/

Advanced STEPS for Girls Launches Rocket Program

Advanced STEPS Faculty and Students with rocket, Summer 2000

They were given a protractor, a stopwatch, a bicycle, 12 feet of flexible measuring tape, a playing card, a roll of tape and a piece of string.

"How do you measure the height (maximum altitude) of the rocket with these simple tools?" asked Caroline Hayes, professor of mechanical engineering at the University of Minnesota, one of five faculty members for the week-long, tuition-free Science Technology and Engineering Preview Summer Camp for Girls (STEPS).

The 30 high school girls from across the region broke into the four groups they'd been in all week - Voyager, Discovery, Apollo and Gemini. Each team had a separate task - one to time the rocket's flight with the stopwatch, the second using the protractor to measure the angle of the rocket's highest point from the ground, the third to determine the distance from measurement site to launch site using the bicycle's wheel as a measuring stick, and the fourth to use trigonometry and physics to calculate the answer.

Wearing lime-green T-shirts with the words "Actually, I am a rocket scientist!" on the back, the girls scurried across the grounds of the airport in Stanton, Minn., on Thursday morning to fulfill their MacGyver-like mission.

Throughout the week, the girls had assembled two rockets and the circuitry for the altimeter, camera and temperature gauge placed in the rockets' nose cones. With the help of Ky Michaelson, a pyrotechnician who builds and launches rockets for feature films, the girls blasted the 6-foot-tall missile 2,160 feet high, according to their measurements. They will use the data gathered from the rocket's nose to analyze the flight trajectory and compare it to their predictions and calculations from the field.

Women Wanted

STEPS is a response to the dearth of women engineering the field of engineering. The program, in its first year in Minnesota, is a pilot for similar camps expected to be established in 11 other states in the next few years.

"I find this science much more interesting now," she said at the rocket launch. "I love this stuff because it is real life, not like math problems that they just make up. We get to apply here what we learned in school.

"Now I'm seeing that trigonometry last year was worth it," she added.

While there is an equitable ratio of men and women in the biological sciences, the field of engineering still has a large gender gap, said Susan Marino, one of the camp's directors. Nationwide, only about 20 percent of engineers are women - of that group, only about half are actually working in the industry.

"We really haven't gotten anywhere in getting women in engineering in the past 15 years," Marino said. "This program is a part of the first statewide outreach to get girls in engineering. The idea is to take a coordinated, systematic approach in which we will track the girls to see if the outreach really works."

Overcoming Obstacles

STEPS - a partnership that includes the "U," the Bush Foundation, the Society of Manufacturing Engineers, NASA and Medtronic Inc. - has a simple application process that emphasizes a participant's interest over academic standing.

"A lot of kids, and girls especially, think that engineers have to be math geniuses," Marino said. "You don't have to be an A student to be an engineer."

Another obstacle is the simple fact that many girls don't know what engineers do: "Boys are constantly taking things apart and seeing how things work - that's engineering," said Marino. "But if you don't start at that level - and girls often don't - you never really get what it is all about."

Most of the girls did not leave the camp confident they would become engineers: "I'm waiting to try everything before I put my foot down and decide what I want to do," Koenen said.

But that's OK, as far as Marino's concerned.

"It's not that I hope they all become engineers," she said, "but that they leave thinking it is a possibility."

~Article excerpted with permission from the *Star Tribune*

Experimental Study Group

Before the university's next generation of engineering alumni can start designing tomorrow's automobiles, aircraft, buildings, and bridges, they must get past a formidable hurdle: Aerospace Engineering and Mechanics 3031.

A considerable challenge, AEM 3031- Deformable Body Mechanics - is one of the first courses that aerospace, civil, and mechanical engineering students take as a part of their major sequence. Here, they grapple with the fundamentals of torsion and the bending of beams - the nuts and bolts of designing aircraft, buildings, or cars.

Open to any AEM 3031 student who wants extra help, ESG sessions are peer-run, voluntary study groups that meet eight times a week throughout the entire semester. Student instructors - graduates of the course who earned a grade higher than 3.0 - lead the group sessions devoted to homework problems. The student instructors maintain contact with the course's teaching assistants.

Because participation in the sessions is voluntary and anonymous, it doesn't influence how the professor and teaching assistants assign grades.

"We don't want it skewing how the professor grades," Quanbeck says. The student instructors are not involved in the grading process.

The study sessions definitely help students, says graduate student Wayne Falk, who was a teaching assistant for the course last year. Although he couldn't track the impact of ESG attendance on an individual student's performance, Falk says that the class as a whole achieved a higher success rate in its homework assignments. In previous years, 20 to 30 percent of students solved the homework problems correctly, he says, but last year 80 to 90 percent were getting the right answers or at least had the right idea.

"Some of the homework problems tended to be long, so if students made a small mistake somewhere in the answer, they wouldn't know it," says Falk. "That mistake would be carried through the whole solution, and it would be a complete mess. Having people to check their work against was the best way of finding errors and learning better ways to solve problems."

Nollenberger, who ended up doing well in the class despite her struggles, led ESG seasons twice a week during spring semester. "I think it's a great program to get into. The TAs were able to see a difference from [fall] semester," she says.

The sessions attract anywhere from five to 25 students, depending on when homework is due or when a test is scheduled, says Randy Anderson, former ESG student instructor and mechanical engineering graduate. In a typical session, he explains, students will choose a couple of homework problems, and then the student instructor would dissect the problems step-by-step on the blackboard.

"I wrote what they told me to do, and I tried to lead them the right way," he says.

For students, this blend of instruction and teamwork is what has made the ESG sessions so successful.

"It's great because one person may know one step but not know the next, and someone else who didn't know the first step may know the next," Nollenberger says.

The student instructors, who are paid for their work, are each responsible for two 50-minute sessions per week. Ideally they would also attend class, Quanbeck says, although she hasn't made their attendance mandatory.

Anderson, who received an "A" in the course in spring 1998, had no trouble finding other people to study with back then because he knew lots of engineering majors. However, as an ESG instructor, he saw firsthand how the group sessions benefit students who might be having a difficult time understanding a concept of solving a problem.

"Students who are having trouble get to see another method of [solving] a problem.

The program also eases the burden on the course's teaching assistants. Because there are more than 100 students in the class, Quanbeck says, it's impossible for two assistants to answer all of the student's questions. Students appreciate the opportunity for more personalized attention and "feel the department is doing something extra for them," she says.

For information on the University of Missouri-Kansas City program see website at: www.umkc.edu/cad. More information on the AEM program is available from the MnSGC Office at (612) 626-9295 or website: www.aem.umn.edu/msgc.

~ Article excerpted with permission from *Inventing Tomorrow,* magazine of U of MN Institute of Technology, Fall 2000.

Content & Communication Mathematics Institute for Paraprofessionals Held at Augsburg College

The first C & C Institute for paraprofessionals was held in June on the campus of Augsburg College. Dr. Randi Quanbeck and Dr. Jeanine Gregoire coordinated this new program through funding made possible by Eisenhower Professional Development grant funding. The Institute targeted adult professionals already assisting learners with mathematics curriculum in grades K-6. 20 educational assistants participated in this program offered free of charge for college credit.

The C & C Institute was designed as a two-part project: content and communication. The content section of the Institute consisted of a mathematics course taught by Dr. Larry Copes (Augsburg college) for three weeks in June using innovative techniques for problem solving as well as the SciMath curriculum for mathematics educators. The communication portion of the institute was coordinated by Dr. Quanbeck and featured guest speakers who had tackled a mathematics career as older adults. It also featured communication techniques for working with students, teachers, and administrators.

Additional funding for expanding C & C Institute next year is being sought from NSF by Dr. Gail Nordmoe, Director of the Richard Green Institute and the official evaluator for the program.

Camps & Program Announcements

C3 - Career Choices and Computing - A camp for young women entering grades 5 - 10 who want to explore high-tech careers and learn to use technology, located in state-of-the art computer facilities on the U of M campus, one and two week day and overnight sessions. For more information contact: Susan Marino, Ph.D., Director, Program for Women in IT, University of Minnesota, 107 Lind Hall, 207 Church Street SE, Minneapolis, MN 55455, phone: 612-624-1317, email: marino007@gold.tc.umn.edu.

Enhancement Grants - Please see MnSGC web site education section www.aem.umn.edu/msgc for more information.

ExplorSchool - A summer enrichment program for a current 5th or 6th grade student. ExplorSchool is held at Benjamin E. Mays elementary school in Rondo Education Center in St. Paul. Classes include: math, science, acting, art, writing, and languages. For more information contact the Minnesota Institute Office at 651-696-6590, web address: www.mity.org, email: mity@macalester.edu.

Eye to the Future Career Conference - A conference for young women (4-8th grade) and parents/adults to learn about mathematics, technology and science careers, the joys and challenges of such careers, early influences and experiences, as well as the skills and knowledge necessary to be successful in those careers. Eye to the Future Career Conference is held at Augsburg college. The NASA Science Coordinator for Augsburg is currently working on the Program Planning Committee on the 2001 Eye to the Future Conference which will take place May 12, 2001.

Grants - "Super Science Saturdays" Earns $50,000 Grant for Bethel College; Elementary Students in St. Paul to Benefit.

Toyota TAPESTRY Grants for Teachers. Deadline: **January 18, 2001**. Please see the following web site for more information http://www.nsta.org/programs/tapestry/.

MnSGC Scholarships - Please see web site: www.aem.umn.edu/mnsgc for more information. The deadline is: **March 1, 2001**.

MnSTA/WSST - Spring Conference 2001 is set for March 15, 16, and 17. Please see web site: www.mnsta.org for more information.

NASA Academy - Please see web site: www.nasa-academy.nasa.gov/summer00.html for more information.

National Congress 2001 - The Civil Air Patrol presents The National Congress 2001/Science, Math, and Technology for Today's Classrooms. The national congress will be held March 14 - March 17, 2001 at the Hyatt Regency Hotel in Minneapolis, MN. If you would like more information, visit the website: http://www.capnhq.gov/conference/ and click the red "National Congress" button.

Reach for the Sky - Program through 4-H Extension at U of MN to White Earth Indian Reservation. See http:// www.umn.cce.edu/reachforthesky/.

Share the Future - Share the Future program is designed to expose 7th and 8th grade girls to careers in science and mathematics. A guest speaker and university faculty conduct workshops in various disciplines and discuss potential career opportunities. This program is held at Bemidji State University in Minnesota.

SMM - Please see the web site: www.smm.org/museum/education/Programs/top.html for more information.

SSAC at SMM - 3rd Annual Space Science Across the Curriculum Conference is set for **March 10, 2001**. Please see www.aem.umn.edu/mnsgc/calendar.html for more information or call the Science Museum at (651) 221-4747.

SSEP - NASA Solar System Educator Program, please see the web page: www.ssep.org for more information.

STEPS - Science Technology & Engineering Preview Summer Camp for Girls - Camps were one week sessions during the summer. 7th grade STEPS held at Alexandria Technical College, Alexandria, MN or at University of St. Thomas, St. Paul, MN. 10th and 11th grade Advanced STEPS held at University of Minnesota, Minneapolis, MN. To learn more about STEPS and other SME Education Foundation programs check out these web sites: www.uwstout.edu/ctem/steps, www.alextech.org/steps, www.manufacturingiscool.com, and www.sme.org/foundation.

STREAMS - The "Summer Teen Research Encouraging Attitudes in Mathematics and Science" promotes a college setting and learning experience for 7th and 8th grade girls. They spend a weekend at Bemidji State University living in college dormitories and attending lab-oriented sessions pertaining to math and science.

Summer Science Program - An introduction to mathematical and scientific reasoning for students completing grades 8 - 10. Camp held at Carelton College in Northfield, MN. For more information contact: Office of Summer Academic Programs, One North College Street, Carleton College, Northfield MN, 55057-4016, phone: 507-646-4038, email: summer@Carleton.edu.

Visualization of Fluid Motion - A one -day workshop offered for High School teachers to increase knowledge about fluid dynamics. Offered for free by faculty of Department of Aerospace Engineering & Mechanics at U of MN. Contact msgc@aem.umn.edu or call (612) 626-9295. Date to be announced.

Undergraduate Student Research Program - Offered by NASA. Deadline January 6, 2001. See http://education.nasa.gov/usrp.

To post an announcement on this page please contact the MnSGC Office at (612) 626-9295 or at msgc@aem.umn.edu

National Space Grant Opportunities

CubeSat - This is an Earth-orbiting satellite, a cute 10 cm on a side that can be built for a cost of about $5,000 if commercial parts are used. The present cost for providing vibration, thermal vacuum, launch integration is $30,000 well within a consortium's budget. There is a potential Russian flight that could launch 15 - 45 of these as early as November 2001. We also expect to have groups of these small satellites that could be launched together as a secondary payload on, e.g. a Delta or Ariane rocket. We could potentially have a number of Western Region states commit to each building their own CubeSat, to be launched (and subsequently monitored) en masse. For more information on CubeSat see: ssdl.stanford.edu/cubesat.

CanSat - This is an easier step for a Consortium that has little or no experience with building space hardware, this is a small payload (size and shape of a soft-drink can) designed to be launched on a high-power amateur rocket (not a model rocket-these vehicles can potentially reach 50,000 feet or more). The Consortium build the payload, then we work to find an amateur who contributes launch. If we have a number of states interested in jumping in at this level, we could organize a mass launch at the annual amateur rocketry festival in Black Rock, NV. The CanSat program is very useful in getting new programs started and a great experience at a low cost for working towards the CubSat type program. For information on CanSat see: ssdl.stanford.edu/arliss.

Ground stations - CubeSats, like Citizen Explorer, will use AMSAT frequencies. As Elaine Hansen has taught us, schools can build a downlink station for ~ $1,000; a true ground station, with both up - and down-link capabilities, would run about $20,000 - again, well within the potential budget of a Consortium.

LiftOff Summer Institute 2001, A Texas Space Grant Consortium Summer Institute for Middle and High School Teachers - This innovative educational program, sponsored by the Texas Space Grant Consortium and is held at Space Center Houston. The program features: presentations by space scientists and engineers, tours of NASA Johnson Space Center and Space Center Houston, hands-on/inquiry-based classroom activities, free curricula and space science materials, opportunities to interact with researchers dedicated to future space missions, and idea sharing with other educators. For more information see: http://www.tsgc.utexas.edu/liftoff.

Wanted: Students to Build Robots - NASA is seeking future engineers with creative imaginations, drive, energy, or just plain curiosity to build their own robot. NASA's Jet Propulsion Laboratory, Pasadena, Calif., is putting out the call to Southern California area high schools to involve them in the FIRST (For Inspiration and Recognition of Science and Technology) program. The FIRST program is a robotics competition aimed at inspiring students, providing hands-on activities, fostering teamwork, and giving students access to work with engineers to help students build their own robot. Each year, students get a "problem" or task that their robot must perform and a kit with "nuts and bolts" to get them started. The FIRST regional competition event, sponsored by JPL and hosted by the University of Southern California, will be held March 15 - 17, 2001, at the Los Angeles Memorial coliseum. NASA will award 100 scholarships and locally, JPL will award 20 teams with sponsorships to help them compete in the Southern California Regional. Each Sponsorship will pay the $5,000 entry fee and travel one person to attend the January 2001 kickoff meeting in Manchester, New Hampshire. Schools interested in participating should call Kimberly Lievense in JPL's Public Service Office at (818) 354 - 0122. Information on team building, sponsorship requirements and application is available at http://technology.jpl.nasa.gov/education/education_index.html#FIRST.

NASA Means Business Student Competition 2001 - It is our pleasure to announce NASA Means Business Student Competition 2001 - a national program that directly involves a wide range of university students in real NASA programs and missions. NASA Means Business Student Competition 2001 will choose six (6) student teams to develop an "architecture" and "user requirements" for integrating NASA "Customer Engagement" processes into NASA's Mars mission planning. Selected teams will also receive cash awards of $1,000, travel grants to Johnson Space Center to present their work, and international recognition for their contribution to NASA's Mars exploration planning effort. NASA Means Business Student Competition 2001 is designed around the Spring 2001 academic semester calendar. The DEADLINE for submission of proposals is JANUARY 19, 2001. Details regarding NASA Means Business Student Competition 2001 are located at http://www.tsgc.utexas.edu/nmb/.

Director's Note

We are ending the second year of our upgraded status as a Designated State Consortium. This has resulted in almost doubling our funds and has allowed us to expand our activities in significant ways. We have increased our support of graduate research by providing scholarships for Ph.D. students in Space Physics, Astronomy, Geo-Physics, and Aerospace Engineering at the University of Minnesota. We are also supporting two masters students at Bemidji State University and have doubled our Consortium Wide Fellowship Program for undergraduates as well as increasing the scholarship programs at our Affiliates. We were able to add a new Affiliate, Southwest State University, in Marshall, Minnesota. This gives MnSGC a presence in the southwestern part of the state. Two undergraduate students are working on experiments to be flown as a part of NASA Reduced Gravity Program. The students are studying material damping and droplet formation under reduced gravity. We had a most successful Undergraduate Student Research Symposium and have expanded undergraduate research opportunities at many affiliates. In addition we have added several new K-12 and outreach activities. The expanded Enhancement Grant Program will allow us to provide seed money for a variety of projects and already we are supporting two new initiatives in Geo-Spatial Information Systems at the University of Minnesota and Southwest State, a program in astro-biology at Bemidji State, and an Experimental Study Group Program at the University of Minnesota. All in all we had a very successful two years and look forward to further expansion of our programs.

Eric Euteneuer: Report from Abroad

In the Spring of 2000, I crossed the Atlantic to work at one of the largest and most prestigious divisions of the automotive industry, Mercedes-Bens, part of the DaimlerChrysler Corporation. My experience at DaimlerChrysler in Stuttgart, Germany was not only one of the most valuable experiences I have had in my collegiate career, but also a life experience I will never forget. There I worked in a group that was working on prototype traction motors being built for electric and hybrid automobile applications. These traction motors had to be connected to the electronics of the motor through something called a connector ring. These two pieces are then welded together to form the complete motor. The way to connect these two pieces was by an ultrasonic welding process in which the two pieces are rubbed together under great pressure at an ultrasonic frequency such that the two pieces become one. My job was to develop a test section of this connecting ring in order to test this welding process and help determine if this was a feasible process for mass production. This, along with other small tasks, allowed me to get valuable hands on experience in a highly developing field as well as priceless international experiences that is becoming so important in a worldwide marketplace.

In addition to working, this internship allowed me the chance to travel within Germany and learn a new culture. This experience allowed me to see such cities as Berlin, Munchen, and Hamburg, visit such diverse landscapes like those found in the Alps, the Schwarzwald (Black Forest), and the Bodensee, and allowed me to become friends with people from all over the world. This is a collegiate and life experience I would highly recommend to anyone! (*This internship was made possible through the Minnesota Space Grant Office and the Department of Aerospace Engineering and Mechanics).*

Junior Ryan Cobian wins Goldwater Scholarship

MnSCG scholarship winner and a junior physics and mathematics major, Ryan Cobian was one of 309 undergraduate students nationwide in the field of mathematics, science and engineering to win a prestigious Goldwater scholarship for the 2000 - 2001 academic year. The $7,500 scholarship will cover the cost of tuition, fees, books, and room and board. A student at Augsburg College, Cobian has participated in two international space physics conferences, making an oral presentation at one and a poster presentation at another. In addiction, he is the second author of an academic paper published this summer in the Journal of Geophysical Research. Cobian is the fourth Augsburg Goldwater scholar in the last five years and is on of 13 recipients from Minnesota colleges and universities. The scholarship winners are selected by the Barry M. Goldwater Scholarship and Excellence in Education Foundations from among 1,100 nominees by college and university faculties. Goldwater scholarships are the premier undergraduate awards of their kinds in these fields.

Carleton Student Receives Rhodes

Carl Tape, a senior in physics and geology at Carleton College, Norhtfield, MN, received a 2001 Rhodes Scholarship Award announced in December, 2000. Carl was the recipient of an MnSGC scholarship award last year. The Rhodes selection was based on academic achievement, personal integrity, leadership potential, and physical vigor, among other criteria. Carl plans to go to graduate school and has already published one paper listed in this issue.

Undergraduate Student Research Symposium

Variability of Snow Depth on Sea Ice in the Southern Ocean

Student Researcher: Sarah Boswell
Mentors: Thorsten Markus and Don Cavalieri Code 971.0
1999 Summer Institute for Atmospheric and Hydrospheric Sciences Goddard Space Flight Center

In 1998, Markus and Cavalieri published the first algorithm for deriving the depth of snow on sea ice from satellite passive microwave data. At Goddard Space Flight Center, the snow depth algorithm is the key for using satellite data records spanning nearly two decades to study variabilities in snow depth distribution. For this project we considered the snow depth distribution in the Southern Ocean poleward of about 60 degrees South. This involved writing data manipulation programs to create plots, tables, and movies for analyzing patterns in snow depth distribution, and finding correlation coefficients between snow depth and sea ice concentration, near-surface air temperature, and wind speed. The project was the beginning of an investigation exploring the relationship between snow depth and other climatological factors.

A Conjugate Study of Ultra-Low-Frequency Electromagnetic Pulsations in the Earth-Space Environment

Student Researcher: Ryan Cobian
Faculty Sponsor: Professor. Mark Engebretson
Augsburg College
Physics Department

Electromagnetic pulsations in the Pc 3 range (15-50mHz) are often observed during daytime hours in the Earth's magnetosphere and on the ground. The interplanetary magnetic field (IMF) is now understood to control the occurrence of these pulsations. A recent hypothesis states that the latitudinal component of the IMF should produce pulsations that might preferentially reach either northern or southern high latitude regions. To test this, we have compared a full year's (1997) data from two cusp-latitude stations in Greenland and Antarctica. Our data indicates that the occurrence and relative amplitude are essentially identical near both cusps. Therefore, our analysis shows that the IMF has no control over the hemisphere to which the pulsations propagate. These observations indicate that only the pulsations formed at the nose of the bow shock (the shock wave formed by the solar wind interacting with Earth) can propagate to the magnetosphere and be observed on Earth.

Coherence and Phase Delays of QP and PE Emissions and PC 3 Pulsations from Middle to High Latitudes in Antarctica

Student Researcher: Mauris de Silva
Faculty Sponsor: Professor. Mark Engebretson
Augsburg College
Physics Department

Electron cyclotron wave emissions in the ELF and VLF frequency bands are often observed to be modulated at ULF frequencies. Quasi-periodic emissions (QP), which are modulated at Pc 3-4 frequencies, and periodic emissions (PE, or echoing whistlers), which are modulated at Pc 1-2 frequencies, can occur separately, but often occur together. They also at times occur simultaneously with magnetic Pc 3-4 pulsations. A recent multistation study using magnetometer and ELF-VLF receiver data from several Antarctic stations (South Pole, Halley, and several U.S. and British Automatic Geophysical Observatories) by [Smith et al., JGR 103, 23611, 1998] found that those QP emissions not associated with Pc 3-4 magnetic pulsations were in every case associated with PE emissions. In this study we use data from these stations in 1996 and 1997 to further study these QP and PE emissions. In particular, we have found that QP and PE modulations were coherent at all stations. Time delays varied from 0 to 3 seconds from event to event and station to station, but were generally consistent with a signal source at subauroral or mid-latitudes, while the roughly simultaneous magnetic pulsations showed no detailed temporal coherence between any of these stations (separated by a minimum of 370 km). On the basis of amplitudes and phase lags determined from this data set we will attempt to learn more about the origin of these emissions.

Studies of Long-Period ULF Pulsations at High and Middle Latitudes During GEM Storm Intervals in 1997 and 1998

Student Researcher: Jake T. Kern
Faculty Sponsor: Professor. Mark Engebretson
Augsburg College
Physics Department

Particle energization by means of long-period (Pc 5) magnetic pulsations has been suggested as a likely cause for the great particle fluxes in the inner magnetosphere during magnetic storms. Several externally driven mechanisms have been suggested for the increased Pc 5 wave activity associated with such storms: a) increased Vsw (initiation Kelvin-Helmholtz or similar velocity shear instabilities), b) increased variations in Vsw or Psw, and c) increased penetration of wave activity in the IMF. The first is expected to generate relatively broad ULF activity, at least at high latitudes, while the others may generate pulsations at externally determined frequencies. In this study we analyze ground-based magnetometer data from several networks during the three GEM magnetic storm intervals (May 15-18, 1997; September 24-October 1, 1998; and October 18-31, 1998) and compare the observed wave activity to variations in solar wind and interplanetary magnetic field parameters as measured by the Wind satellite. Cusp and polar cap latitude data from MACCS in Arctic Canada and from several U.S. stations in Antarctica show increased wave activity as Vsw increases, but there is little evidence that temporal variations in solar wind/IMF parameters directly drive pulsations of like periods. We will also present a preliminary analysis of data from auroral and subauroral latitude Antarctic data from sites operated by the British Antarctic Survey and sites in the Canopus chain, from five mid- and low latitude stations in the U.S., and from a low latitude station in South Korea.

Undergraduate Student Research Symposium

Applications and Improvements of a Stabilized Heterodyne Interferometer

Student Researcher: Matthew S. Lang
Bethel College
Physics Department

The intent of this research was to investigate the applications and improve the operation of a stabilized heterodyne interferometer designed to optically measure differential air pressure. Optically measuring air pressure via index of refraction changes allows for remote, very fast, and high-resolution observations on the order of 10-20 N/m^2 (maximum sensitivity), not possible with conventional barometers or manometers. Applications have included studying pressure differences above and below an airfoil in a wind tunnel, pressure nodes and antinodes in a closed acoustic resonance cell, and currently, intense sound pulses emanating from sparks. This research's attempts at improving the system focused on creating a feedback loop to counteract the inherent non-linear regions of the interferometer output. Frequency dependence of piezoelectric mirror motion and exotic mechanical resonances were also investigated.

Modeling Diffusion and Drift in Dielectrics under High-Energy Bombardment and the Resulting Secondary Electron Emission

Student Researcher: Aaron Rendahl
Bethel College
Physics Department

The bombardment of dielectrics within spacecraft by high-energy electrons leads to destructive electrostatic discharges. These events occur because the incident high-energy electrons generate electron-hole pairs deep within the dielectric. It is commonly held that the electrons move through the dielectric material, accumulate on the surface, and then discharge in a pulse. A model of the flow due to drift has been previously accomplished. This research adds understanding of the flow due to diffusion, with the goal of eventually creating a computer simulation of the transport of the charges through the dielectric by means of diffusion and drift. The model includes the vacuum/dielectric surface and provides for the analysis of secondary electron emission from the surface before electrostatic discharge events occur. An improved understanding of how this secondary electron emission occurs may enable appropriate measures to be taken to minimize discharge events.

Hubble Telescope: Project Development

Student Researcher: Philip Chrylser
Faculty Sponsor: John O. Annexstad

Abstract: This project will focus on the history of the Hubble Space Telescope, beginning with the ideas for large space telescopes, and tracing the growth of the Hubble program up to its launch date. The NASA process of choosing which missions to support along with budget predictions and funding requests will be shown. The hurdles and obstacles encountered by the program managers in their quest for congressional approval and subsequent funding will be addressed. This thesis brings into focus the buercratic and poligical aspects of the space program and/or large space based projects.

Making the Moon: A Science Curriculum Enhancement

Student Researcher: Jill Thompson
Faculty Sponsor: John O. Annexstad

Abstract: Explorations of the Moon's surface indicate that volcanism was a major contributor to the geological characteristics seen on the Moon today. Two lesson guides produced by the Hawaii Space Grant Consortium very effectively illustrate the underground and surface activities of volcanism. These laboratory explorations suggest inventive strategies for teachers to simulate volcanic processes and ultimately, Moon surface formations. This poster will illustrate and demonstrate these explorations and will expand on the strategies and their uses for middle school students.

Mythology, Fiction, and Fact: Human Evolutionary Perception of the Moon

Student Researcher: Katrina Neckuty
Faculty Sponsor: John O. Annexstad

Abstract: Throughout the ages, the Moon has been the subject of curiosity, intrigue and scientific observation. Long before the construction of Stonehenge (dated back to 1800 BC) to the present, the Moon has proven that it is a constant source of exploration within the arts, literature and science. Artwork, literature, and scientific drawings have given us ideas of how the Moon was portrayed by humans before the time of telescopes, satellites and space shuttles. Human kind has gone from imagining what life is like on the Moon, to actually walking upon its surface. Scientific exploration of the Moon's features have put at rest the notions of a mythological past (embracing the idea of the lush life of the gods on the Moon) but has added to our culture and evolutionary perceptions of our planet as a whole. This poster session will be a compilation of examples from all three genres exploring the way the Moon has been a source of inspiration to man throughout time.

Spin-Offs From NASA Research

Student Researcher: Jaime Leeper
Faculty Sponsor: John O. Annexstad

Abstract: NASA has provided the information and technology behind many of the products that shape our lives today and is still providing more ideas for the future. This poster is a look at the many products and processes that have been developed and influenced by NASA's research. This will be done through the study of various magazine articles and NASA publications. A diverse list of spin-offs from NASA's technology that affects almost every aspect of our lives will be shown in illustration form.

CONSORTIUM AFFILIATES

Ken Erickson, Physics
Jeanine Gregoire, Science Education
Augsburg College

John O. Annexstad, Geology
Deb Davis, Administration
Bemidji State University

Tom Greenlee, Physics
Richard Peterson, Physics
Bethel College

Cindy Blaha, Physics
Carleton College

Terry Flower, Physics
College of St. Catherine

Glenn Langhorst, Physics
Fond du Lac Tribal & Community College

Michael Price, Science Education
Leech Lake Tribal College

Karl Wirth, Geology
Macalester College

Mark Hollabaugh, Physics
Julie Johnson, Physics
Normandale Community College

Ken Murphy, Astronomy
Southwest State University

William L. Garrard, Aerospace Engineering & Mechanics
University of Minnesota - Twin Cities

Bruce Munson, Sea Grant
University of Minnesota - Duluth

Paul Lane, Physics
Martin Johnston, Physics
University of St. Thomas

State-Governmental Affiliate
Minnesota Dept. of Transportation

Director
William L. Garrard, UM-TC

Co-Directors
John O. Annexstad, BSU
Ken Erickson, Augsburg College

Program Coordinator
Randi Quanbeck, UM-TC

Http://www.aem.umn.edu/msgc

Minnesota Space Grant Consortium
Department of Aerospace Engineering
and Mechanics
University of Minnesota
107 Akerman Hall
110 Union Street SE
Minneapolis, MN 55455

Nonprofit Org.
U.S. Postage
PAID
Minneapolis, MN
Permit No. 155

Address Service Requested