Joint Space Weather Summer Camp 2014

July 16 - August 6

CSPAR
CENTER FOR SPACE PLASMA AND AERONOMIC RESEARCH

DLR Deutsches Zentrum für Luft- und Raumfahrt

LEIBNIZ-INSTITUT FÜR ATMOSPHÄREN PHYSIK IAP

UAH THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Universität Rostock
Traditio et Innovatio

Welcome to the Joint Space Weather Summer Camp 2014

The Joint Space Weather Summer Camp is a partnership between the University of Alabama in Huntsville, the DLR (German Aerospace Center), and the University of Rostock. Because of the considerable historical ties between Huntsville and the state of Mecklenburg-Vorpommern (Germany) in the development of rockets, missiles, and eventually manned spaceflight, the Joint Space Weather Summer Camp was created to forge ties and develop communication between these two regions that had such an impact on the 20th century.

The Joint Space Weather Summer Camp is an opportunity to learn about space physics in the context of meeting a very practical need - to understand the influence of the Sun on the space and upper atmosphere of the Earth and its related impact on the technological systems and needs of modern society. This is a new, exciting and emerging discipline called Space Weather.

About twenty students from The University of Alabama in Huntsville and from a variety of universities and research centers across Germany participate in a multiple week series of lectures, hands-on projects, and excursions as they learn both the theoretical underpinnings and practical applications of Space Weather.

The Joint Space Weather Summer Camp consists of two consecutive sessions.
During the first part in Northern Germany we will focus on the upper atmosphere and ionosphere. Besides the lectures there will also be practical project work, and we will visit the University of Rostock and the Leibniz-Institute of Atmospheric Physics e.V. at the University of Rostock (IAP) in Kühlungsborn.

Space Weather is more than just interactions with Earth's atmosphere. In order to understand and even predict Space Weather we also need to understand where those energetic particles come from and how and where they gain their energy.
In the second part of the Joint Space Weather Summer Camp students will learn about our Sun as the source of the solar wind, a stream of charged particles, that emanates outward forming the heliosphere; they will learn about coronal mass ejections and Gamma Ray Bursts, solar magnetic fields, sunspots, and ring currents.

As part of the Joint Space Weather Summer Camp we also want to give the students a first hand experience of what it means to be a researcher. During the second part of the Summer Camp they will work in smaller groups of 2-4 students on independent projects, which involve observations, data analysis and instrumentation.

The Joint Space Weather Summer Camp is much more than just lectures, projects and experiments. It also provides a wonderful opportunity for cultural exchange between the US and Germany in an academic setting. The visit of the 'Historical Technical Museum in Peenemünde' in the Northeast of Germany or the visit of the Space and Rocket Center in Huntsville, USA, are just two further examples of a program that goes beyond.

We hope that the Joint Space Weather Summer Camp will be an interesting introduction to the theoretical and practical aspects of Space Weather combined with a cultural exchange between the US and Germany!

The Joint Space Weather Summer Camp 2014 Committee

Schedule

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<tr><td>8.30 - 9.00</td><td rowspan="17">Arrival in Huntsville</td><td rowspan="10">Recuperation</td><td>Meet & Greet</td><td colspan="4"></td><td rowspan="17"></td><td rowspan="17">Transfer to Huntsville</td><td colspan="2"></td><td rowspan="17">Departure from Huntsville</td></tr>
<tr><td>9.00 - 9.30</td><td>Opening
Dr. Ray Vaughn</td><td rowspan="7">Project</td><td rowspan="7">Project</td><td rowspan="7">Project</td><td rowspan="12">Oak Ridge National Labs</td><td rowspan="7">Project</td><td rowspan="3">Project</td></tr>
<tr><td>9.30 - 10.00</td><td>Introduction
Alexander Dosch</td></tr>
<tr><td>10.00 - 10.30</td><td rowspan="2">Introduction to the Sun and Solar Phenomena
(L. Upton)</td></tr>
<tr><td>10.30 - 11.00</td><td rowspan="2">Ed Buckbee</td></tr>
<tr><td>11.00 - 11.30</td><td rowspan="2">Introduction to Active Regions and CME's (D. Falconer)</td></tr>
<tr><td>11.30 - 12.00</td><td rowspan="2">Owen Garriott</td></tr>
<tr><td>12.00 - 12.30</td><td rowspan="2">Lunch</td></tr>
<tr><td>12.30 - 1.00</td><td rowspan="2">Lunch</td><td rowspan="2">Lunch</td><td rowspan="2">Lunch</td><td rowspan="2">Lunch</td><td rowspan="4">Lunch at Wintzell's</td></tr>
<tr><td>1.00 - 1.30</td><td rowspan="2">Introduction to Gamma-Ray Bursts
(R. Preece)</td></tr>
<tr><td>1.30 - 2.00</td><td rowspan="4">1.30 pm
Cantina Laredo</td><td>Transfer to USSRC</td><td rowspan="7">Project</td><td rowspan="7">Transfer to Oak Ridge</td><td rowspan="3">Project</td></tr>
<tr><td>2.00 - 2.30</td><td rowspan="2">The Inner Magnetosphere and Plasmasphere
(D. Gallagher)</td><td rowspan="6">US Space and Rocket Center</td></tr>
<tr><td>2.30 - 3.00</td><td rowspan="5">Final Presentations and Concluding Remarks</td></tr>
<tr><td>3.00 -3.30</td><td rowspan="2">The Solar Wind and the Heliosphere
(V. Florinski)</td><td rowspan="3">Transfer to Nashville</td><td rowspan="4">Veronica BBQ</td></tr>
<tr><td>3.30 - 4.00</td><td rowspan="3">Recuperation</td></tr>
<tr><td>4.00 - 4.30</td><td rowspan="2">Project</td></tr>
<tr><td>4.30 - 5.00</td><td>7.00 pm
Wildhorse Saloon</td></tr>
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Presentations

	Speaker	Title	Time
	Monday, July 28		
1	Lisa Upton	Introduction to the Sun and Solar Phenomena	10.00 am - 11.00 am
2	David Falconer	Introduction to Active Regions and CME's	11.00 am - 12.00 pm
3	Rob Preece	Introduction to Gamma Ray Bursts (GRB's)	1.00 pm - 2.00 pm
4	Dennis Gallagher	The Inner Magnetosphere and Plasmasphere	2.00 pm - 3.00 pm
5	Vladimir Florinski	The Solar Wind and the Heliosphere	3.00 pm - 4.00 pm
	Tuesday, August 5		
	Ed Buckbee	The Real Space Cowboys	10.30 am - 11.30 am
	Owen Garriott	Space Weather	11.30 am - 12.30 pm

Rooms

Event	Room
Lunch	2076
Presentations	2096
Coffee Breaks	2008

Restaurants

Cantina Laredo	330 The Bridge St. Huntsville, AL 35806
WildHorse Saloon	120 2nd Ave.. N, Nashville, TN 37201

Rayford Vaughn, PhD

Vice President for Research
Distinguished Professor of Computer Science
University of Alabama in Huntsville

Dr. Vaughn received his Ph.D. in Computer Science from Kansas State University in 1988. Prior to entering academia, he completed a career in the US Army retiring as a Colonel followed by three years as Vice President of DISA Integration Services, EDS Government Systems. His research interests are cyber security and software engineering with a special focus on industrial control systems security. His past experience includes an assignment at the National Computer Security Center (NSA) where he conducted classified research and participated in the development of National Computer Security Guidance. Dr. Vaughn has over 100 publications to his credit, has obtained more than $40M in funded research projects. Dr. Vaughn joined Mississippi State University in 1997 where he was named an Eminent Scholar and in 2008 was named Mississippi State University's most outstanding faculty member. In 2009 he was designated the Department Head for Computer Science and Engineering and in 2010 became the Associate Vice President for Research at MSU. In May of 2013, he joined the University of Alabama in Huntsville as the Vice President for Research.

The University of Alabama in Huntsville

The University of Alabama in Huntsville was founded in 1950 and became an autonomous campus with The University of Alabama System in 1969. Since that time, it has grown into one of the nation's premiere research universities, offering a challenging hands-on curriculum that ensures our graduates are prepared to become tomorrow's leaders.

As a tier-one research university, UAH is home to more than a dozen research centers and labs – not to mention the recipient of hundreds of millions of dollars in grants and contracts.

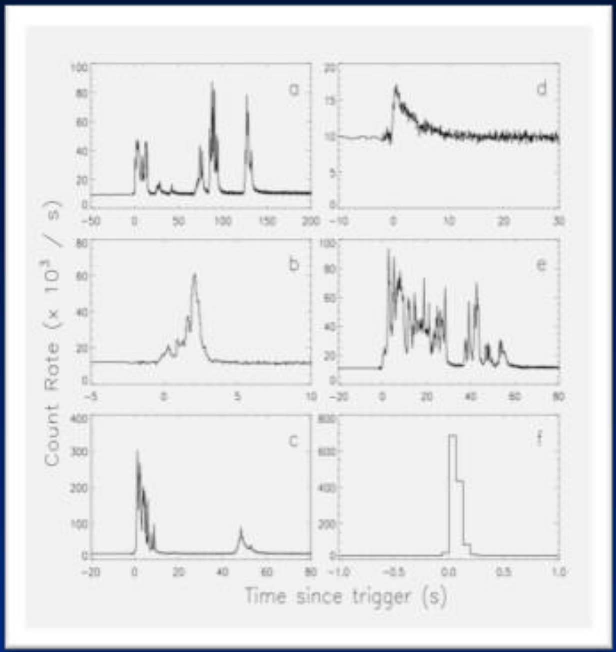
But research at UAH doesn't just take place on campus. Our Office of Research has ties to federal and industry partners across the country and around the world, including NASA, the U.S. Army, the HudsonAlpha Institute for Biotechnology, NIH, the Department of Energy, the National Science Foundation, and NOAA/National Weather Service. That means students have the chance to tackle the kinds of real-world challenges they'll one day face as a professional in the field, like filing patents, publishing papers, and presenting at conferences long before your peers at other universities. It's the kind of experience that can give students the advantage they need to rise to the top of their class – and their career field.

Projects

Build your own Gamma-Ray Burst

Dr. Rob Preece

Gamma-Ray Bursts (GRBs) are extreme cosmological explosions that happen roughly once per day in the Universe. Like snowflakes, no two are alike; if you look at the brightness of each over time they fluctuate unpredictably (see figure). Yet, it seems that they may be made up of a collection of overlapping pulses. We would like to test this hypothesis by trying to recreate bright GRBs by adding together a set of pulses with standard shapes. The student will select several GRBs from a published Catalog (up to ~10, if time is available) and try to match them by adding together pulses that have been stretched in height and offset in time. They will be using custom software that is fairly easy-to-use for this purpose. Each student will then use standard GRB analysis software (RMFIT) to generate a report for each burst they have done. These reports will be used for a data analysis project as part of a paper to be submitted to a peer reviewed journal, where the students will be given recognition for their efforts. Finally, there will be a contest to see who can create a burst with the most unusual characteristics ("Matterhorn", "Hand-of-god", ?)



Requirements:
Very little Math/Physics background is necessary.
Ideally, the student should have some experience running programs from a command line. Basic computer file management is required (making directories, storing related files in the same directory, maintaining a directory hierarchy). Finally, experience with a virtualization environment is a plus (VirtualBox, especially).

Number of Students: 3

Short Biography

UAH Associate Research Professor Robert Preece received his B.A. in Math and Physics from the University of California at Berkeley (Go Bears!) in 1982, a M.S. in Physics from The Ohio State University in Columbus, Ohio, and a Ph.D. in Astrophysics in 1990 from the Physics Department of the University of Maryland in College Park. He then moved to Huntsville, Alabama, and joined the BATSE gamma-ray astronomy team at Marshall Space Flight Center as an NRC post doc. He has been a researcher at UAH since 1993 and is a Co-I on NASA's GLAST Burst Monitor, which is being assembled at the NSSTC.

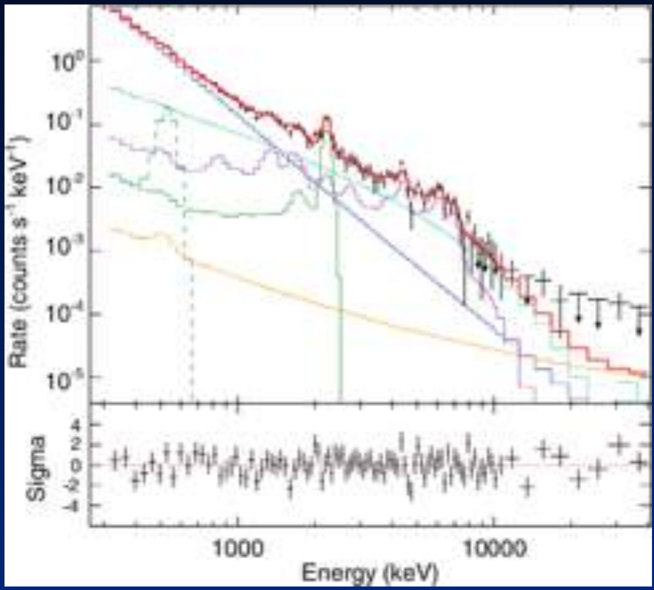
Gamma-ray emission in solar flares seen by GBM: search for nuclear lines

Dr. Veronique Pelassa

The Fermi Gamma-ray Burst Monitor (GBM) was developed as an all-sky observer of the hard X-ray and gamma-ray sky. Because of its energy coverage, 8 keV to 40 MeV, GBM is sensitive to non-thermal radiation from particles accelerated in a variety of sources, from Gamma-Ray Bursters at cosmological distances to more familiar objects in the solar system, the Earth and the Sun. GBM has detected over 700 solar flares since the launch of Fermi in June, 2008, very few of which show a significant non-thermal emission above 300 keV. This project involves the analysis of the energy spectra of a few strong GBM-detected solar flares. The aim of the analysis is to look for gamma-ray emission lines from nuclear deexcitation in the MeV range, seen in bright flares in the MeV range. Shown by a purple line on the figure, a count spectrum of the M2-class solar flare on June 12 2010 (Ackermann et al, ApJ 745:144, 2012). The students will get familiar with the GBM data, (understand and) perform background subtraction and spectral analysis on a handful of events (most likely M or X class flares which show evidence of non-thermal emission above 300 keV). This is a necessary systematic study, so the students' contribution will be a big help.

Requirements:
No specific math or physics knowledge beyond undergraduate students' general physics background is required for this project.
Students will be taught the use of the specific analysis tools developed by our team. Besides this, they will be expected to know how to use the terminal and command line (in linux/unix), name and organize files in directories, find and edit files. A little skill in data visualization (translate a table of numbers into an eye-friendly figure) is a plus, but not mandatory.

Number of Students: no preference



Short Biography

I grew up in France, did my undergraduate studies at Ecole Normale Superieure and Université Pierre et Marie Curie in Paris. My Ph.D. work was done at the University of Montpellier under the supervision of Fred Piron and involved both pre-launch and post-launch calibration work for the Large Area Telescope (LAT) on-board the Fermi Gamma-ray Space Telescope, and studies of Gamma-Ray Bursts (GRBs) using the LAT. This work brought me into contact with the team from the other Fermi instrument, the GBM, and I joined the Fermi GBM team as a post-doctoral research assistant in February 2011. My supervisors at the University of Alabama in Huntsville are Valerie Connaughton and Michael Briggs.
I widened my research interests since I joined the team: now I study also the gamma-ray emission from Solar Flares observed by Fermi GBM.
In addition to my research, I help with operations activities such as Burst Advocate duty and calibration work. I have been a coordinator of a working group of scientists from both the GBM and LAT teams focusing on GRB studies.

Non-potentiality of active regions and speed of associated CMEs

Dr. Sanjiv Tiwari

Space weather prediction is one of the most challenging concerns before the space physicists. Solar coronal mass ejections (CMEs) are the major contributors to the geomagnetic disturbances. CMEs originate from active regions (ARs) and quiescent filament regions. The most energetic CMEs responsible for geomagnetic storms are found to originate from sunspot regions. The intensity of geomagnetic storms is related with the “initial” speeds of associated CMEs. In this project, we attempt to find any relationship between magnetic non-potentiality (by measuring global twist of sunspots; free energy stored in ARs; total unsigned magnetic flux on surface) of solar ARs and speed of the associated CMEs.

Using a list of all flares and CMEs in last 4 years, that we have, students shall first need to identify the ARs which are associated with the (halo) CMEs. Once there are good number of such CMEs identified, they will co-relate CME speed, width and KE with magnetic measures of ARs. They will understand the origin of these magnetic parameters, mainly the non-potentiality parameters e.g. twist (using signed shear angle, and force-free parameter α), and free energy, or its proxies (using virial theorem, gradient weighted length of strong field neutral line). This work will be done together with Dr. David Falconer.

Requirements:
Experience with IDL would help; Knowledge of basic concepts of what solar flares and CMEs are would be required.

Number of Students: 2

Short Biography

I completed my PhD in Solar Physics from Udaipur Solar Observatory/Physical Research Laboratory, Udaipur India, in 2010. I received best PhD thesis award of the year 2010 by Astronomical Society of India. My thesis topic was 'Helicity of the Solar magnetic Field'. Motivation of the work was to help space weather prediction by investigating the role of helicity of sunspot magnetic fields in solar eruptions.

From January 2011 to December 2013, I worked at Max-Planck Institute for Solar System Research in Germany, where I investigated small-scale structure of sunspots. In particular I investigated internal structure of sunspot penumbral filaments.

In December 2013, I joined NASA Marshall Space Flight Center as a NASA Postdoctoral Program (NPP) Fellow, where I am working on magnetic structure of sites of enhanced coronal heating in Hi-C active region.

Empirical Modeling of the Plasmasphere

Dr. Dennis Gallagher

This project involves the development of an empirical model for a plasmaspheric ion density and temperature as a function of geomagnetic conditions and location. Derived values of these quantities are available for five plasmaspheric ions, H+, He+, He++, O+, and O++. One approach would be to assign each student one of these three ions to study, including that ion's density and temperature. The students assigned to this project could collaborate on the techniques, the use of statistics, and the programming, but would separately need to apply them to their ion's properties. Existing models and some general information about the plasmasphere can be found at http://plasmasphere.nasa.gov

1. Students will attempt to develop empirical models for density and temperate of one plasmaspheric ion. The objective is to minimize the scatter or error associated with the model's description of these quantities. That means they will need to identify the most statistically meaningful independent variables for inclusion in their models.
2. Empirical models of a physical system are used to test physical models, ideally serving as an unbiased representation of the systems behavior that must be reproduced by a physical model before that model can be accepted as valid. Empirical models are also used to reproduce system properties for the purpose of providing that information into other modeling efforts that depend on that information. Empirical models are almost always faster to execute on a computer, so can be a convenient tool for reducing the computational demands on more complex modeling of the dynamics of a large system. For plasmaspheric properties, there currently exists no empirical model that includes all these ion densities and temperature. Many physical phenomena depend on these properties, such as wave propagation and wave-particle interaction.
3. The students will need to receive background information about the plasmasphere, the inner magnetosphere, and geomagnetic indices. They will need to write computer code, possibly using the IDL language, to read in the data they will analyze. They will need to write code to display that data. They will need to learn what free parameters, provided to them or that they obtain, are most relevant for describing the behavior of the ion assigned to them. They can work collaboratively on the techniques for analysis and the code that implements the analysis. Their personal objective would be to develop an empirical model that can reproduce the properties of that ion's density and temperature with a minimum residual uncertainty or error.

Requirements:

Students will be expected to perform computer-based statistical data analysis with the objective to produce an empirical model of some aspect of thermal ions in the plasmasphere. If IDL is available, that would be ideal as this is what I am using with the dataset they will work with. A background in plasma physics or of the workings of the inner terrestrial magnetosphere would be helpful, but perhaps not necessary. I expect to provide background information about the plasmasphere and general behavior relative to the ambient magnetic field. I also expect to have to describe the various solar wind properties and geomagnetic indices that are available as independent variables. Knowledge of statistics and curve fitting would of course be very helpful. Knowledge of basic visualization using a computer would be helpful.

Number of Students: 1 - 5

Short Biography

Dr. Dennis L. Gallagher received his Doctorate and Masters Degrees in Physics from the University of Iowa in 1982 and 1978, respectively, and Bachelors Degree in Physics from Iowa State University in 1974. He worked for two years at the University of Alabama in Huntsville in the Physics Department and subsequently has worked for NASA Marshall Space Flight Center since 1984, doing research in space plasma physics.
He was the study scientist for the Inner Magnetosphere Imager Mission concept that was realized in the first selected MIDEX Explorer mission, IMAGE, for which he was a Co-Investigator. He supported IMAGE mission planning and instrument requirements definition for the Extreme Ultraviolet imager and the Radio Plasma Imager instruments and has participated and led numerous studies of the measurements obtained by this first-ever magnetospheric imaging mission. From 2006 to 2011 Dr. Gallagher served as Deputy and Acting Manager for the Space Science Office at NASA Marshall Space Flight Center.

Hardware Development and Calibration for Charged Particle Instrumentation

Dr. Victoria Coffey

1. What will the students do?
a. Repairing and replacing an electroform mesh grid and re-assembling a small Retarding Potential Analyzer (RPA). (About 4 hours)
b. Assembling the optics portion of a Top Hat or Capped Hemisphere. (2-3 days)
c. Supporting the team in testing and calibrating the Dual Ion Spectrometer (DIS) for the Magnetospheric Multiscale Mission (MMS).
d. Expect a high level of competence, integrity, and continued discussion throughout each task.

2. Why is the project relevant/important?
   a. The RPA grid needs to be repaired so that it can be mounted again with another.
   b. The Capped Hemisphere has been fabricated for any possible flight opportunity that may arise. It needs to be assembled.
   c. The testing and calibration of the flight DIS units is a very important need for the MMS mission before this 4 spacecraft launch in March.

All work will take place in the LEEIF lab, Cramer Hall Annex, Rm. 1228.

Additional Information
   a. Retarding Potential Analyzer,
      Link: http://www-ssc.igpp.ucla.edu/personnel/russell/ESS265/ISSI_Calibration_Particle_Instr.pdf
   b. Capped Hemisphere (sometimes called a Top Hat)
      Link: http://www-ssc.igpp.ucla.edu/personnel/russell/ESS265/ISSI_Calibration_Particle_Instr.pdf
   c. Magnetospheric Multiscale Mission (MMS)
      Link: http://mms.gsfc.nasa.gov

Requirements:

An interest in hardware development, testing, and/or calibration.
For projects a and b, the student needs to be very interested in working with hardware development, has handled small tools, and possibly has previous experience in the lab.
For project c, the person will require a high level of competence and some amount of paranoia while monitoring a flight instrument valued at $1M and its ground support equipment.

Number of Students: 2, 3, or 4. Depending upon the particular hardware project listed.

Short Biography

Dr. Coffey obtained a B.S. in Business Administration from Auburn University in 1981, a B.S. in Physics from the University of Alabama in Huntsville (UAH) in 1988 and her M.S in Physics from UAH in 1997. At Marshall Space Flight Center full time since 1989, Mrs. Coffey has supported the development of flight instruments in the branch. She has optimized particle throughput for flight instrument designs via numerical raytracing and has tested and calibrated several charged particle detectors for flight.
She is now continuing the development of a pinhole camera technique for charged particle imaging. For her thesis, she analyzed the characteristics of the thermal bulk ion parameters in the nightside aurora as observed by the STICS instrument on the TOPAZ 3 sounding rocket flight. She is continuing this characterization for the SCIFER / STICS flight which flew in the energization region of the cleft ion fountain. Presently she is the Experiment Scientist for the TICHS instrument that will be on the CAPER sounding rocket to again study this energization region.

Computing the Earth's Ring Current through Test Particle Simulations

Dr. Jacob Heerikhuisen

The Earth's ring current is formed by energetic ions (mostly protons) that gyrate about the Earth's magnetic field at distances between about 3 and 5 earth radii. The gyromotion has a component along the magnetic field that tends to move particles towards the poles. Near the poles, however, the magnetic field intensity increases and charged particle are reflected by the “magnetic bottle” effect, and particles with certain pitch angles “bounce” between the poles. In addition, the is a curvature drift effect that causes charged particles to slowly drift either clockwise or anti-clockwise about the earth, depending on their charge. In this project students will write a numerical code to solve the equation of motion of a proton in a dipole magnetic field using a Runge-Kutta method, and thereby obtain estimates for the drift dynamics of particles that make up the ring current.

Requirements:
Two years of Math & Physics, some experience writing simple codes in C++ or similar.

Number of students: 2 or 3

Short Biography

I study the interaction of the solar wind with the interstellar medium using a variety of computational tools developed by our team of heliospheric modelers in the UAH Space Science department and CSPAR. In particular, I have developed a Monte-Carlo code that tracks hydrogen atoms as they pass from interstellar space through the heliosphere. When these charge-exchange with the plasma, momentum and energy source terms are generated that are fed back into the MHD equations that we solve for the plasma. At the same time, some charge-exchange collisions produce energetic neutral atoms (ENAs) that travel large distances through the heliosphere. I work closely with the team from NASA's IBEX satellite which detects ENAs and generates all-sky maps. To relate these 2D maps to the global structure of the heliosphere requires accurate models which we develop.

The Grad-Shafranov Reconstruction of Magnetic Flux Ropes in Space Plasmas

Dr. Qiang Hu

The students will work with a software package written in Matlab, i.e., a Graphic User Interface package, that enables quick and easy analysis of spacecraft observations of a type of transient structures in space. These structures as originated from the Sun carry along the solar magnetic field which interacts with the Earth’s magnetic field and sometimes causes significant disturbances. Thus to study quantitatively the internal magnetic field configuration of these structures has always been a focus area of current space weather research. The students are expected to be able to successfully run the software package and analyze a few selected events mostly by clicking through the GUI platform within the Matlab environment. Students will work individually at the beginning and when the project progresses they will start to work collaboratively on more complex tasks that require certain in-depth analysis. Depending on the students’ capability and experience, certain level of programming, i.e., writing some codes, might be required.

Requirements:
College level physics and math are necessary. No specific programming skills are required. But experience with any programming languages (other than MS Office) would help.

Number of students: 4

Short Biography

Dr. Hu received his B.S. 1994 from the University of Science and Technology of China, and his M.S. 1997 from the Chinese Academy of Sciences.
2001 he received his Ph.D. from the Thayer School of Engineering, Dartmouth College.
His primary research interests are Spacecraft data analysis of transient structures in space plasma environment, solar coronal magnetic field modeling, turbulence properties of the solar wind and in-situ magnetic field data analysis, interconnection between large-scale magnetic structures at Earth orbit and their solar sources.

Finding Coronal Holes

Mitzi Adams, M.S.

The students will examine 193 Angstrom SDO data beginning April 30, 2010 to find equatorial coronal holes and will compile a list of these. The coronal hole should be as close to disk center as possible. It may be possible to enter the same coronal hole for two consecutive days.

From the list of coronal holes, I will download data and examine each coronal hole for small jets. These jets could be important for understanding coronal heating.

The two students will divide up the time since April 30, 2010, each will look through two years of data, using this website:

http://sdowww.lmsal.com/suntoday_v2/index.html?suntoday_date=2010-04-30

When an equatorial coronal hole is found, using a text file, the student will make note of the date. If there is time, the students can begin looking for jets in the data.

Requirements:

The student should be able to use a web browser. Familiarity with IDL is preferred.

Number of students: 2

Short Biography

In her career at the Marshall Space Flight Center, Mitzi Adams has conducted research for a variety of solar missions, including work with Marshall's vector magnetograph, a pioneering instrument that studied magnetic fields in sunspots; SOHO, a mission to study the sun from its deep core to the outer corona; and Hinode, a project to improve our understanding of the sun's magnetic field and the mechanisms that drive solar eruptions.

As a guest lecturer for science courses at the University of Alabama in Huntsville, Adams works to sustain enthusiasm and engagement at the college level. She has led several sessions of "Theories of the Universe," a class that explores how various cultures perceive the cosmos, discussing the astronomy-savvy Maya and Inca civilizations of Central and South America, respectively. She's well-versed in the subject matter - and not just the astronomy.

Abstracts

Introduction to the Sun and Solar phenomena

Dr. Lisa Upton

The Sun is an exciting and challenging area of study. The Sun provides Earth with warmth, light, and energy. As the largest body in the solar system, the Sun is the focal point. It guides the planets in their orbits and is the source of all space weather. Worshiped by cultures throughout history, the Sun was once thought to be constant and unchanging. It is only in modern times that is has become evident that the Sun is in fact extremely dynamic. Since the invention of the telescope, knowledge of the Sun has grown at an extraordinary rate.

In this lecture, I will provide a general introduction to the Sun. I will discuss the structure of the Sun: from the core, where nuclear fusion takes place to the surface and beyond. I will describe many phenomena observed on the Sun, including supergranules, sunspots, coronal loops, and coronal mass ejections (CMEs). I will discuss how the frequency of solar phenomena varies with the 11 year solar activity cycle, and how this is produced by the solar dynamo. Finally, I will discuss how these phenomena drive space weather, interacting with the Earth and the rest of the heliosphere.

Introduction to Gamma-ray bursts

Dr. Rob Preece

Gamma-ray bursts are the most energetic explosions in the universe, releasing mind-boggling amounts of energy. At least some of them are associated with a special type of supernovae, marking the deaths of especially massive stars. Lasting anywhere from a few milliseconds to several minutes, gamma-ray bursts shine hundreds of times brighter than a typical supernova and about a million trillion times as bright as the Sun, making them briefly the brightest source of cosmic gamma-ray photons in the observable Universe and are detected roughly once per day from wholly random directions of the sky. Huntsville, Alabama is a world-class center in gamma-ray astronomy. Several high-energy astronomy instruments have been developed here, including BATSE and the Burst Monitor for NASA's current Fermi Gamma-Ray Space Telescope mission.

Inner Magnetosphere Processes and Coupling

Dr. Dennis L. Gallagher

The inner magnetosphere is loosely defined to be the region of space threaded by terrestrial magnetic field lines from geosynchronous orbit inward. The dominant sources of energy in this region are the radiation belts and the ring current. The dominant mass in the region is the plasmasphere, which is an extension of the ionosphere. The region is characterized by the transport of plasma and energy both inward driven by the solar wind magnetosphere interaction and outward driven by ionization of the upper atmosphere and by plasma heating. The physical processes involved depend on particle-particle and wave-particle processes and on electric currents driven by energetic plasma through the resistive ionosphere. Plasma dynamics throughout the inner magnetosphere are highly coupled with that in the ionosphere and thermosphere as a consequence of these processes. An overview of these interactions and their consequences
will be discussed.

The Solar Wind and the Heliosphere

Dr. Vladimir Florinski

The solar wind is a radially expanding stream of hot ionized gas from the Sun's corona. The wind supports a broad range of physical phenomena, including transient structures, solar-cycle variability, and energetic charged particles. Beyond the orbits of the planets, the solar wind terminates (passes through a shock wave) and is compressed into a thick shell, known as the heliosheath, that separates the solar system from the surrounding interstellar cloud. The Voyager 1 space probe crossed the boundary of the heliosphere, known as the heliopause, in 2012 to become the first man made object to escape the confines of the solar system.

In this talk I will give a brief introduction to the fundamental physics of solar wind dynamics, its interaction with the interstellar medium, and its effects on cosmic rays and other energetic particles. Examples of computer simulations of solar wind related phenomena and Voyager observations in the outer heliosphere will be given.

Special Guests

Ed Buckbee

Remembering the Real Space Cowboys

The Soul Of An Explorer Lives In Us All!

"As far as returning to normal life, I don't think any of us ever returned to normal life. I don't think any us were normal people to began with."
Mercury Astronaut Alan B. Shepard, Jr.

Fifty-two years ago, Alan Shepard climbed aboard a Huntsville-developed Mercury Redstone rocket and blasted off from Cape Canaveral to became the first American to ride a rocket. That was the beginning for U.S. manned space flight. He had been selected to train with America's first astronauts—John Glenn, Wally Schirra, Gordon Cooper, Gus Grissom, Scott Carpenter and Deke Slayton -- who accepted their country's call to service and would become known as the Mercury 7.
These men who had jockeyed for the best flying jobs in the military, began competing for rides on rockets. Most would eventually vie for the ultimate ride to the moon. This was the dream—a chance to ascend to the top of the pyramid—a lion-hearted pilot's deepest desire. Ed Buckbee, who has enjoyed a 50+ year association with the U.S. space program, follows these brave pioneers. From Alan Shepard's sub-orbital flight to the last man to walk on the moon, Gene Cernan, Buckbee covers all the manned missions of that era. Through time and personal friendships, he captures their dreams of flying higher, faster and farther than anyone in the known universe. You are taken behind the scenes to witness the competition between chimpanzees and astronauts and the conflict between NASA engineers designing capsules and those who would pilot them. They were our first astronauts. The path they blazed now shines for others; on a voyage that is a measure of the best in us all. The Mercury 7 astronauts were the first, the bold, the brave. They had the right stuff. They were The REAL Space Cowboys.

Dr. Owen Garriott

Space Weather

Forecast:
Lot's of sun (except at "night"). Cloud free (above the horizon).
No precipitation (except in case of propellant leak!)
Be sure to prepare for extensive UV, EUV and even Xray exposure if you expect to take a stroll outside. (As an extraordinary requirement when strolling, bring along your own breathing atmosphere as well!) For the rest of the week (and even longer) expect no major changes for a long time.

Our observation post? Skylab, the US first space station, orbited precisely 40 years ago in 1973.
Skylab was flown in 3 missions of about 1, 2 and 3 months duration, all world records at the time.
Although there were many experiments in multiple fields conducted, we will talk mostly about research done on the Sun at wavelengths which cannot penetrate the earth's atmosphere. Secondly we discuss the many life science experiments conducted to better understand how the human body adapts to weightlessness and then readapts when one comes back to a normal gravitational environment.