Joint Space Weather Summer Camp 2017

June 24 – July 8

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE
CSPAR
CENTER FOR SPACE PLASMA & AERONOMIC RESEARCH

DLR
Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

sansa
SOUTH AFRICAN NATIONAL SPACE AGENCY

INAF ISTITUTO NAZIONALE DI ASTROFISICA
ISTITUTO DI ASTROFISICA E PLANETOLOGIA SPAZIALI DI ROMA

Welcome to the
Joint Space Weather Summer Camp 2017

The 2017 Joint Space Weather Summer Camp is a partnership between:

-The University of Alabama in Huntsville (UAH)
-The German Aerospace Center in Neustrelitz (DLR)
-The South African National Space Agency in Hermanus (SANSA)
-The Italian Institute for Space Astrophysics and Planetology in Rome (IAPS-INAF)

In 2011, the University of Alabama in Huntsville signed a Memorandum of Understanding with the University of Rostock and the German Space Agency (the *Deutsches Zentrum für Luft- und Raumfahrt e.V.*, abbreviated DLR, which is the national center for aerospace, energy and transportation research of the Federal Republic of Germany) agreeing to develop a joint collaborative educational and research program. One of the first joint programs to be developed was the Joint Space Weather Summer Camp (JSWSC). This program was initiated by the combined efforts of Gary P. Zank (director of CSPAR at UAH), John Horack (Vice President for Research), Wolfgang Mett and Holger Wandsleb (members of DLR), and Wolfgang Schareck (the Rector of the University of Rostock). This was originally envisaged as two 3-week sessions, the initial session being held in Neustrelitz, Germany and the second in Huntsville, USA.

The origin of the Memorandum of Understanding is due in large part to the close connection of Huntsville, Alabama with the state of Mecklenburg-Vorpommern in Northern Germany and the city of Peenemunde, being (“Peene [River] Mouth") a municipality on the Baltic Sea. Peenemunde is (in) famous for being the birthplace of modern rocket science, and was where the famed aerospace engineer Wernher von Braun developed the V1 and V2 rockets used by the Germans in World War 2.

After initially being moved to Fort Bliss, Texas, von Braun and his team of rocket engineers was transferred to Huntsville, Alabama. Being in Huntsville, van Braun was largely responsible for the development of the US missile program. In creating the missile program, van Braun initially developed the Redstone Missile based on his work with the V2 missile. His interest in the peaceful and scientific use of rockets never wavered and he was responsible for the use of the Jupiter-C rocket launch of the US's first satellite, Explorer 1, on January 31, 1958. This event signaled the birth of America's space program, which for von Braun culminated in the development of the Saturn V rocket. Von Braun’s dream to help mankind set foot on the Moon was realized on July 16, 1969, when Marshall Space Flight Center-developed Saturn V rocket launched the Apollo 11 astronauts on an extraordinary eight-day mission that culminated in the moon-landing by Neil Armstrong, “Buzz” Aldrin and Michael Collins. The Apollo program and the Saturn V rockets developed by von Braun and his MSFC team enabled six teams of astronauts to reach the surface of the Moon.

This close intellectual, engineering, and social connection between Huntsville, AL and the state of Mecklenburg-Vorpommern, the role of von Braun in creating the University of Alabama in Huntsville and the UAH Research Center makes the Memorandum of Understanding a natural bond. The JSWSC held by the UAH’s Center of Space Plasma and Aeronomic Research and the DLR can be viewed as an inevitable historic collaboration that spans and connects generations across the divide of history, economics, engineering, and humankind’s aspirations to reach to the stars. The JSWSC has been supported with enthusiasm by the joint efforts of several Vice-President’s of Research, most recently Prof. Ray Vaughn, and CSPAR, both of whom contribute jointly to the program.

The summer camp was a great success from its start, and over the years, the summer camp went through some re-organization and expansion. The program is four weeks long, and in its initial stage (years 2012, 2013, 2014, 2015), the program consisted of two weeks primarily located in Huntsville, AL (UAH), and of 2 weeks primarily located in Neustrelitz, Germany (DLR). Around 10 undergraduate and graduate students from UAH and 10 students from all over Germany participated in the summer program each year. The program is not restricted to these primary locations only, and both parties always made a great effort to make the program interesting and inspiring for students. The German part typically includes visits to participating research institutions, such as the Leibniz-Institute for Atmospheric Physics (IAP) at Kuhlungsborn, the University of Rostock, or the German Research Centre for Geosciences (GFZ) in Potsdam. The US part typically includes a visit to the Oak Ridge National Laboratory in Tennessee, which is one of the largest laboratories in the United States.

Over the years, the South African SANSA Agency started to slowly participate in the program, first by sending 2-3 students to the German part of the camp, and steadily increasing the number of students. In 2016, SANSA organized the full leg of the summer camp in Hermanus, with participating students from South Africa, Germany & UAH, ultimately becoming a 3rd pillar and full-member-organization of the Joint Space Weather Summer Camp. The 2016 JSWSC was organized in Hermanus (South Africa) and Neustrelitz (Germany).

This year the camp is organized in Huntsville (USA) and Hermanus (South Africa), and each of the 3 major institutes are participating with 8 students. Importantly, this year we would like to welcome the Institute for Space Astrophysics and Planetology located in Rome, Italy. They are participating with 3 students, and only in the US part of the summer camp in their first year. This amounts to a total of 27 students, from 4 different countries that are located on 3 different continents, participating in Joint Space Weather Summer Camp this year!

The camp covers several topics related to space weather, with various introductory lectures in plasma physics, solar physics, heliospheric physics, cosmic ray transport, Earth's ionosphere, and radio emissions from the Sun, numerical simulations, remote sensing and others. In addition to lectures, students work in groups on one of the main projects, where they have direct hands-on experience in analyzing publicly available data from satellites.

The summer camp is much more than just scientific lectures and project work. The camp provides a wonderful opportunity for students to engage in multi-cultural experience with international students from the United States, Germany, South Africa and Italy. Welcome to the JSWSC 2017, and we hope that you will enjoy the program.

JSWSC 2017 Organizing Committee.

Rayford Vaughn, Ph.D.

Vice President for Research and Economic Development
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.

Gary P. Zank, Ph.D.

University of Alabama Trustee Professor
Eminent Scholar and Distinguished Professor
Director, Center for Space Plasma and Aeronomic Research (CSPAR)
Professor and Chair, Department of Space Science

Dr. Gary Zank received his Ph.D. in Applied Mathematics Applied Mathematics from the University of Natal in South Africa in 1987. Gary is an Eminent Scholar and Distinguished Professor, Director of Center for Space Plasma and Aeronomic Research (CSPAR), and Chair of the Department of Space Science (SPA) at The University of Alabama in Huntsville. Gary has been recognized in his field through the receipt of numerous honors and awards throughout his career. In 2017, he was named the University of Alabama Board of Trustees Trustee Processor, the first and only University of Alabama System faculty member to achieve this position. In part, this was in recognition of Dr. Zank being elected in 2016 as a Member of the US National Academy of Sciences, the only person in Alabama to be a member of this august body. He was recognized internationally in 2015 with the AOGS Axford Medal, the highest honor given by the Asia Oceania Geosciences Society (AOGS). Other awards include his being a Fellow of the American Geophysical Union, the American Physical Society, and the American Association for the Advancement of Science. In 2017, he was also elected an AGOS Honorary Member. One of his publications has been recognized as one of the twelve "classic papers' ever published in the Journal of Plasma Physics. Gary is dedicated to his research, which is clearly represented in his achievements over the years and categorizes him as a cutting-edge leader in the world of space physics.

Schedule

Time	Sunday June 25	Monday June 26	Tuesday June 27	Wednesday June 28	Thursday June 29	Friday June 30	Saturday July 1	Sunday July 2	Monday July 3	Tuesday July 4	Wednesday July 5	Thursday July 6	Friday July 7	Saturday July 8
7:00-8:30	CTC Café **Breakfast**	CTC Café **Breakfast**	CTC Café **Breakfast**	CTC Café **Breakfast**	CTC Café **Breakfast**	Hotel **Breakfast**	Hotel **Breakfast**	Hotel **Breakfast**	**See below**	Bevill Center **Breakfast**	CTC Café **Breakfast**	CTC Café **Breakfast**	CTC Café **Breakfast**	CTC Café **Breakfast**
09:00 - 10:00	**Unwind from Travel**	Summer Camp Introduction	**Ed Buckbee** The Real Space Cowboys	**Tae Kim** Probabilistic Forecasting of Extreme Space Weather Events	**Peter Hunana** Fluid Models with Kinetic Effects in Astrophysical Plasmas	**Tour of Oak Ridge National Laboratory** **Make sure you carry Passport / Visa with you to the lab**	**Nashville***	**Nashville***	**Meet in front of dorms at 9:00 Brunch at 9:30** Golden Corral	**Free Time***	**Dennis Gallagher** Inner Magnetospheric Physics	**Parisa Mostafavi** Shock Wave Structure in the Presence of Energetic Particles	**Preparation of Presentations**	**DEPARTURE**
10:00 - 11:00		**Linda Krause** The Grand Tour of Space Weather: An E-Ticket Ride	**Vladimir Florinski** The Guide to Space Magnetofluids	**Michael Briggs** Terrestrial Gamma-Ray Flashes	**Monica Laurenza** Impact of Solar Energetic Particles on Earth's Environment						**Laxman Adhikari** Turbulence Transport in the Solar Wind	**Anthony DeStefano** Charge-Exchange Collisions in Partially Ionized Plasmas	**Presentations**	
11:00 - 12:00		**Rob Preece** Introduction to Gamma-Ray Bursts	**David Falconer** Active Regions, Flares, CMEs: Drivers of Severe Space Weather	**Alphonse Sterling** Temperature Structure of the Sun	**Jakobus Le Roux** Basic Aspects of Solar Energetic Particle Transport and Acceleration at Traveling Shocks	**Lunch in Main Cafeteria from 11:30-12:15***			**Space And Rocket Center Tour**		**Lingling Zhao** Transport of Cosmic Rays in the Inner Heliosphere	**Ashraf Moradi** Propagation of Solar Energetic Particles in Interplanetary Magnetic Field		
12:00 - 13:30	SST 301 **Welcome Lunch**	CRH 1010 **Lunch**	CRH 1010 **Lunch**	CRH 1010 **Lunch**	CRH 1010 **Lunch**						CRH 1010 **Lunch**	CRH 1010 **Lunch**	Bridge Street **Lunch**	
13:30-14:00		**Alabama Credit Union (ACU)**	**Projects**	**Projects**	**Travel to Oak Ridge National Laboratory**	**Tour of Oak Ridge National Laboratory**			**Free Time***		**Projects**	**Projects**	**Preparation for Departure**	
14:00 - 15:00	**Unwind from Travel**	**Jacob Heerikhuisen** The Global Heliosphere and Neutral Atoms												
15:00 - 16:00		**Dr. Yeqing Bao** Associate Dean of Graduate School and **Dr. Sundar Christopher** Dean of College of Science				**Travel to Nashville**								
16:00 - 17:00		Free Time										**Preparation of Presentations**		
	Dinner located at *Newks* at 18:30	**Dinner***	**Dinner***	**Dinner***	**Dinner** located at *The Double Tree* in Salon C at 18:00	**Dinner** located at *BB Kings* at 19:00					**Dinner***	**Social at Space and Rocket Center Socal** (Leave campus at 17:00)	**Dinner***	

* Indicates meal is not provided
All Lectures will be located in CRH 2096
Projects by Dr. Hu and Dr. Florinski will be held in SWI 103 (Atmospheric Science Computer Lab)
Projects by Dr. Preece and Ms. Adams will be held in CRH 2015 (Department of Space Science Computer Lab)

Lodging:

The University of Alabama in Huntsville
301 Sparkman Drive
Huntsville, AL 35899
(256) 824-1000

Double Tree – Oak Ridge, Tennessee
215 S Illinois Ave.
Oak Ridge, TN 37830
(865) 481-2468

Hutton Hotel – Nashville, Tennessee
1808 West End Ave.
Nashville, TN 37203 ·
(615) 340-9333

Tours:

U.S. Space & Rocket Center
One Tranquility Base
Huntsville, AL 35805
(256) 837-3400

Oak Ridge National Lab
1 Bethel Valley Road
Oak Ridge, TN 37830
(865) 576-7658

Restaurants:

Newks
4925 University Dr.
Huntsville, AL 35816
(256) 430-9662

Cantina Laredo
300 The Bridge Street
Huntsville, AL 35806
(256) 327-8580

Golden Corral
4920 University Drive
Huntsville, AL 35816
(256) 430-9565

BB King
152 2nd Avenue North
Nashville, TN 37201
(615) 256-2724

Projects

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

Led by Dr. Qiang Hu

The students will work with a software package written in Matlab, i.e., a Graphic User Interface package, which enables quick and easy analysis of spacecraft observations of types 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 running through the GUI platform within the Matlab environment. Students will work individually at the beginning and as the project progresses, they will start to work collaboratively on more complex tasks that require certain in-depth analysis. Depending on the student’s capabilities and experiences, a certain level of programming, i.e., code writing, 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.

Cosmic Rays at Corotating Interaction Regions in the Solar Wind

Led by Dr. V. Florinski, assisted by K. Ghanbari

Corotating interaction regions (CIRs) are ubiquitous compressive structures that develop via an interaction between slow and fast solar wind streams. A typical CIR consists of a pair of compression, or shock waves, a stream interface, and may contain a sector boundary separating magnetic fields of opposing polarity. CIRs are known to modulate galactic cosmic rays, a principal component of the space radiation environment in the solar system. This project will involve identifying CIRs in plasma and magnetic field data from solar wind monitoring platforms by detecting stream interfaces and sector boundaries, and subsequently performing superposed epoch analysis of galactic cosmic ray intensities during CIR passages.

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.

Projects

Build your own Gamma-Ray Burst

Led by 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 bright- ness 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 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 review 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.

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).

Finding Coronal Holes

Led by Mitzi Adams, M.S.

The students will examine 193 Angstrom SDO data beginning April 30, 2010 to find coronal holes that are as close to the center of the solar disk as possible and will compile a list of these in a text file. For this work, the students will use this website:

http://www.solarmonitor.org

From the list of equatorial coronal holes, each student will then select one coronal hole to examine for jets over twelve hours, six hours before the coronal hole reaches the disk center and six hours after. Understanding jets in coronal holes is important for understanding coronal heating.

Requirements: The student should be able to use a web browser. Knowledge of Linux and IDL is a plus.

Abstracts

Monday, June 26

Dr. Linda Krause

The Grand Tour of Space Weather: An E-Ticket Ride

What is the difference between Space Science and Space Weather? Well, it is a lot like the difference between atmospheric dynamics and what you would see on the Weather Channel. In order to understand and predict tropospheric (i.e. “normal”) weather, it is important to understand atmospheric dynamics behind it, but that isn’t enough to predict it. This is why we have the discipline of meteorology: a field of expertise that studies atmospheric processes relevant to weather and uses that knowledge to develop tools for prediction. Also, whereas atmospheric dynamics is interesting for its own sake, meteorology is focused on understanding specific processes that affect various aspects of societal life. Finally, as increased understanding is obtained, a network of sensors and computer models are used to produce and disseminate weather predictions. And, voilà! We have the Weather Channel! Space weather is similar to tropospheric weather in these ways. In this talk, we will take a rip-roaring tour of the space environment from the Sun to the Heliopause (the edge of our solar system!) Next, we will cover an overview of different types of Space Weather storms. We’ll see how these storms affect societal life. Finally, we’ll take a look at diagnostic methods, missions, and models all working together to improve our understanding of the space environments and relevant physics-based processes - all working toward the ability to predict Space Weather. Who knows… maybe one day, we will have our very own Space Weather Channel!

Dr. Rob Preece

Introduction to Gamma-Ray Bursts

Gamma-ray bursts are, by far, the most energetic astrophysical phenomenon after the Big Bang. Little is known for certain about them, except that they occur roughly once per day in the Universe, lasting from less than a second to hours, with an initial outburst in the gamma-ray energy band. The Huntsville Gamma-Ray Astronomy Team has been closely associated with the observation and analysis of these enigmatic events. The Gamma-Ray Burst Monitor on NASA’s Fermi Gamma-Ray Space Telescope was developed in-house by our Team and is currently in its ninth year of operations in orbit. Bursts are the ultimate efficient energy source and you should be very afraid if one goes off in our stellar neighborhood.

Dr. Jacob Heerikhuisen

The Global Heliosphere and Neutral Atoms

The heliosphere forms from the continuous injection of solar wind into the galactic environment. The motion of the sun through the interstellar medium creates a heliosphere with a well-defined nose and tail. While the solar and interstellar ions are separated by the heliopause, neutral articles can cross this boundary and collide with ions on either side. In this talk I will introduce the concept of the global heliosphere, show how it is influenced by neutral atoms, and indicate how energetic neutral atoms can be used to probe distant plasma regions.

Abstracts

Tuesday, June 27

Dr. Vladimir Florinski

The Guide to Space Magnetofluids

Much of interplanetary and interstellar matter exists in the plasma state, where charged particles are not interacting with each other via collisions, but move collectively in what resembles the motion of a highly conductive fluid. Cosmic magnetic fields provide the “glue” that makes plasma behave like a medium, rather than a collection of non-interacting particles. This presentation will review the fundamental physical principles governing the evolution of a magnetofluid and provide examples of dynamical phenomena in the solar wind. Small amplitude waves, simple equilibrium structures, and different classes of discontinuities will be discussed.

Dr. David Falconer

Active Regions, Flares, CMEs: Drivers of Severe Space Weather

As we become ever more reliant on technologies such as GPS and power grids, we also increase our susceptibility to space weather. The most severe space weather is driven by solar flares - especially eruptive flares that produce fast Coronal Mass Ejection (CMEs). Flares and CMEs are powered by explosive releases of energy stored in the coronal magnetic fields, with the biggest events coming from active regions (AR). MAG4 (Magnetogram Forecast) is a fully automated Research-to-Operation (R2O) tool that measures a free-energy proxy from line-of-sight or vector magnetograms. The free-energy proxy is then converted to a predicted event rate using empirically derived forecast curves. The forecast is then made available to The National Oceanic and Atmospheric Administration (NOAA) as well as Johnson Space Center. Besides being a R2O tool, MAG4 can also be used as Operation-to-Research (O2R). It produces a large data set that can be used in studying how to better forecast flares and CMEs, as well as coronal heating. MAG4 was developed to support the astronauts in collaboration with the Space Radiation Analysis Group (SRAG) at the Johnson Space Center, who monitor and reduce the radiation exposure received by astronauts.

Abstracts

Wednesday, June 28

Dr. Tae Kim

Probabilistic Forecasting of Extreme Space Weather Events

The occurrence rates of extreme space weather events, such as the Carrington Event of 1859, are very difficult to estimate due to their rarity. However, statistical methods may be used in conjunction with available space physics data to derive reasonable estimates of the probability of occurrence of extreme space weather events. In one approach, an inverse power law relationship between the frequency of data and the severity of events is extrapolated to higher magnitudes to estimate the probability of a Carrington-type event occurring within the next decade to be ~12%. Such statistical technique contains limitations due to many simplifying assumptions and cannot be used for prediction of specific events. However, it may be useful for policy making and risk analysis.

Dr. Michael Briggs

Terrestrial Gamma-Ray Flashes

Terrestrial gamma-ray flashes are bright, sub-ms flashes of gamma-rays observed from orbit. The gamma-rays are produced from bremsstrahlung from electrons that are accelerated in thunderstorms. An uncommon type is detected via electrons and positrons instead of gamma-rays. TGFs are associated with intra-cloud lighting. Ground-based radio observations of radio emission from lighting and TGFs provide more information, including more accurate locations. With these locations, specific storms that produce TGFs are identified. A wide range of thunderstorms, including very ordinary ones, are found to produce TGFs. Relativistic particle acceleration is a common atmospheric phenomena.

Dr. Alphonse Sterling

Temperature Structure of the Sun

We present an overview of the Sun's interior and atmosphere, from the standpoint of it's temperature structure: The core region, where energy is generated via nuclear fusion reactions, is an extremely hot 15 MK; at its visible surface the temperature falls to a comparatively balmy 6000 K; and then, for reasons that are still mysterious, the temperature begins to rise moving radially away from the surface, exceeding several MK in the outer atmosphere, the corona. Our discussion will include scientific aspects and consequences of this temperature structure, and also some historical perspectives on the discovery of that structure.

Abstracts

Thursday, June 29

Dr. Peter Hunana

Fluid Models with Kinetic Effects in Astrophysical Plasmas

Astrophysical collisionless plasmas are often found in a state with anisotropic temperatures, a state that cannot be addressed with the classical magnetohydrodynamic (MHD) description that employs a scalar pressure. We will present a brief introduction to the simplest fluid models that can account for anisotropic temperatures and that are generalizations of a fluid model developed by Chew, Goldberger and Low, known as the CGL description or the collisionless MHD. We will concentrate on the parallel and oblique firehose instability, which are two out of four basic instabilities that are believed to be crucial for understanding and correct modeling of solar wind dynamics, the other two being the mirror instability and the ion-cyclotron anisotropy instability.

Dr. Monica Laurenza

Impact of Solar Energetic Particles on Earth's Environment

Energetic particles constitute an important component of the heliospheric plasma environment. In particular, solar energetic particles (SEPs) generated at the Sun, affect the whole Heliosphere and are responsible for a variety of Space Weather effects. The major characteristics of SEP events are described including their association with flares and coronal mass ejections (CMEs), their ion composition and energy spectra as well as the physical processes responsible for their acceleration and transport. Finally, SEP events are discussed in a Space Weather perspective.

Dr. Jakobus Le Roux

Basic Aspects of Solar Energetic Particle Transport and Acceleration at Traveling Shocks

It is generally understood that the highest energy solar energetic particles (SEPs) which pose a threat to astronauts are produced at extremely fast coronal mass ejection driven shocks propagating between the Sun and Earth. A certain class of sophisticated numerical models of SEP transport and acceleration at traveling shocks in the solar wind plasma is fundamentally based on the single particle guiding center theory of charged particle motion in slowly varying electromagnetic fields. Therefore, in this presentation the following material will be presented: (i) The different basic motions of single charged particles in uniform and non-uniform electric and magnetic fields, and their unification in single particle guiding center theory, (ii) the close connection between this guiding center theory, and the guiding center kinetic and focused transport equations for a distribution of charged particles, (iii) the many different ways that SEPs can gain energy at a traveling shock on the basis of focused transport theory, and (iv) examples of idealized solutions of the time-dependent focused transport model for SEP acceleration at a fast planar shock propagating between the Sun and Earth.

Abstracts

Wednesday, July 5

Dr. Dennis Gallagher

Inner Magnetospheric Physics

Earth's magnetosphere is the region of space where the terrestrial magnetic field dominates over the Sun's magnetic field. Inside of geosynchronous orbit is roughly considered the inner magnetosphere, where there is strong interaction between the space plasma environment and Earth's upper atmosphere and ionosphere. Outflowing ionospheric plasma is the dominant source of plasma in the inner magnetosphere, which becomes energized by the release of energy stored in the terrestrial magnetic field and by wave-particle interactions. It is in this highly coupled, dynamic environment, and often dangerous environment that most of humanities space technology and astronauts operate. An overview of the environment, processes, and models will be discussed.

Dr. Laxman Adhikari

Turbulence Transport in the Solar Wind

Turbulence is an universal phenomenon and exists everywhere in the solar wind. Turbulence is thought to be responsible for several important phenomena in the solar wind such as coronal and solar wind heating, acceleration of the solar wind, scattering of the solar energetic particles and so forth. In understanding these phenomena, it is required to understand the transport of low-frequency turbulence in the solar wind. Three types of source of turbulence are considered which drive turbulence in the heliosphere. It is also thought that shocks, which are common in the solar wind, are responsible for the generation of turbulence. We study turbulence in the solar wind and in the upstream and downstream shock by solving 1D turbulence transport model equations obtained from the Zank et al 2012. We compute several turbulent parameters such as the energy in forward and backward propagating modes, the normalized residual energy and cross-helicity, the fluctuating magnetic and kinetic energy, the correlation lengths corresponding to forward and backward propagating modes and the residual energy, the solar wind temperature and so on. We compare our theoretical results with Voyager 2, Ulysses, IMP, ACE, and WIND spacecraft data sets, and find that our theoretical results are in reasonable agreement with observations.

Dr. Lingling Zhao

Transport of Cosmic Rays in the Inner Heliosphere

During the recent solar minimum, the intensity of galactic cosmic rays (GCR) measured at the Earth was the highest ever recorded since space age. In order to resolve the most plausible mechanism for this unusually high intensity, we calculated GCR proton energy spectra at the Earth for the last three solar minima based on a simulation of Markov stochastic process. Besides weak IMF magnitude and slow solar wind speed, we find that a possible low magnetic turbulence, which increases the parallel diffusion and reduces the perpendicular diffusion in the polar direction, might be an additional possible mechanism for the high GCR intensity in this unusual solar minimum.

Abstracts

Thursday, July 6

Parisa Mostafavi

Shock Wave Structure in the Presence of Energetic Particles

Energetic particles such as Pick Up Ions (PUIs), Anomalous cosmic rays (ACRs), and solar energetic particles can affect all facets of plasma physics. Energetic particles play an especially significant role in the dissipative process at shock waves and in determining their structure. The very interesting recent observations of shocks in the inner heliosphere found that many shocks appear to be significantly mediated by solar energetic particles which have a pressure that exceeds considerably both the thermal gas pressure and the magnetic field pressure. Voyager 2 observations revealed that the heliospheric termination shock (HTS) is very broad and mediated by energetic particles.

Energetic particles contribute an isotropic scalar pressure to the plasma system at the leading order, as well as introducing dissipation via a collisionless heat flux (diffusion) at the next order and a stress tensor (viscosity) at the second order. Here, we talk about the shock waves and their mediation by energetic particles. We show that the incorporation of both dissipation effects can completely determine the structure of collisionless shocks mediated by energetic particles. By considering parameters upstream of the HTS, we show that the thermal gas remains relatively cold and the shock is mediated by PUIs. We also determine the structure of the weak interstellar shock observed by Voyager 1.

Anthony DeStefano

Charge-Exchange Collisions in Partially Ionized Plasmas

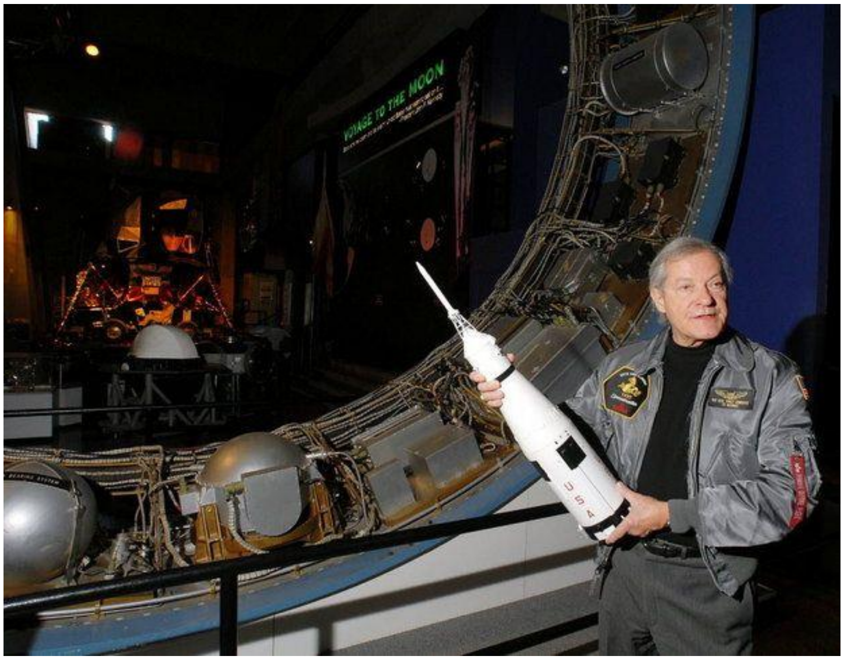
Current models of the heliosphere rely on the coupling between the plasma and neutral atoms via charge-exchange interactions of protons and hydrogen atoms. Ion-neutral simulations couple the MHD equations for the ions to either a Monte-Carlo particle description or multiple neutral fluid descriptions for neutral hydrogen. In simulations with fluid-fluid interactions, the charge-exchange sources are imparted on the MHD fluid from the neutral atom moments, therefore coupling the two systems. The charge-exchange number, momentum, and energy sources modify the global structure of the heliosphere, including the location of the termination shock and heliopause. We explore several approaches to approximating charge-exchange sources in MHD simulations. We show how assumptions about the local plasma e.g., the presence of suprathermal ions, and the energy-dependent treatment of the charge-exchange cross section affect the properties of the energy and momentum transfer between the ion and neutral species.

Ashraf Moradi

Propagation of Solar Energetic Particles in Interplanetary Magnetic Field

Solar Energetic Particles (SEPs) travel along the field lines. Ulyssess observations during impulsive events did not show any significant change in the density of SEPs from lower to higher latitudes. Possible explanations can be that the field lines are not Parker anymore. There have been many attempts to introduce new models for interplanetary magnetic field that extend from lower to high latitudes. Since the magnetic field lines are shaped by the footpoint motion in the photosphere which is not static and there are many different surface flows that lead to meandering of the field lines that make the fields access different latitudes. In this study, we consider fluctuating field lines that are caused by the motions of the footpoints and follow the trajectories of test particles and drifts from the initial Parker lines for different latitudes and different surface flow parameters. Our goal is to examine to what extend can the field line meandering be responsible for the latitudinal spreading of SEPs in.

Special Guest



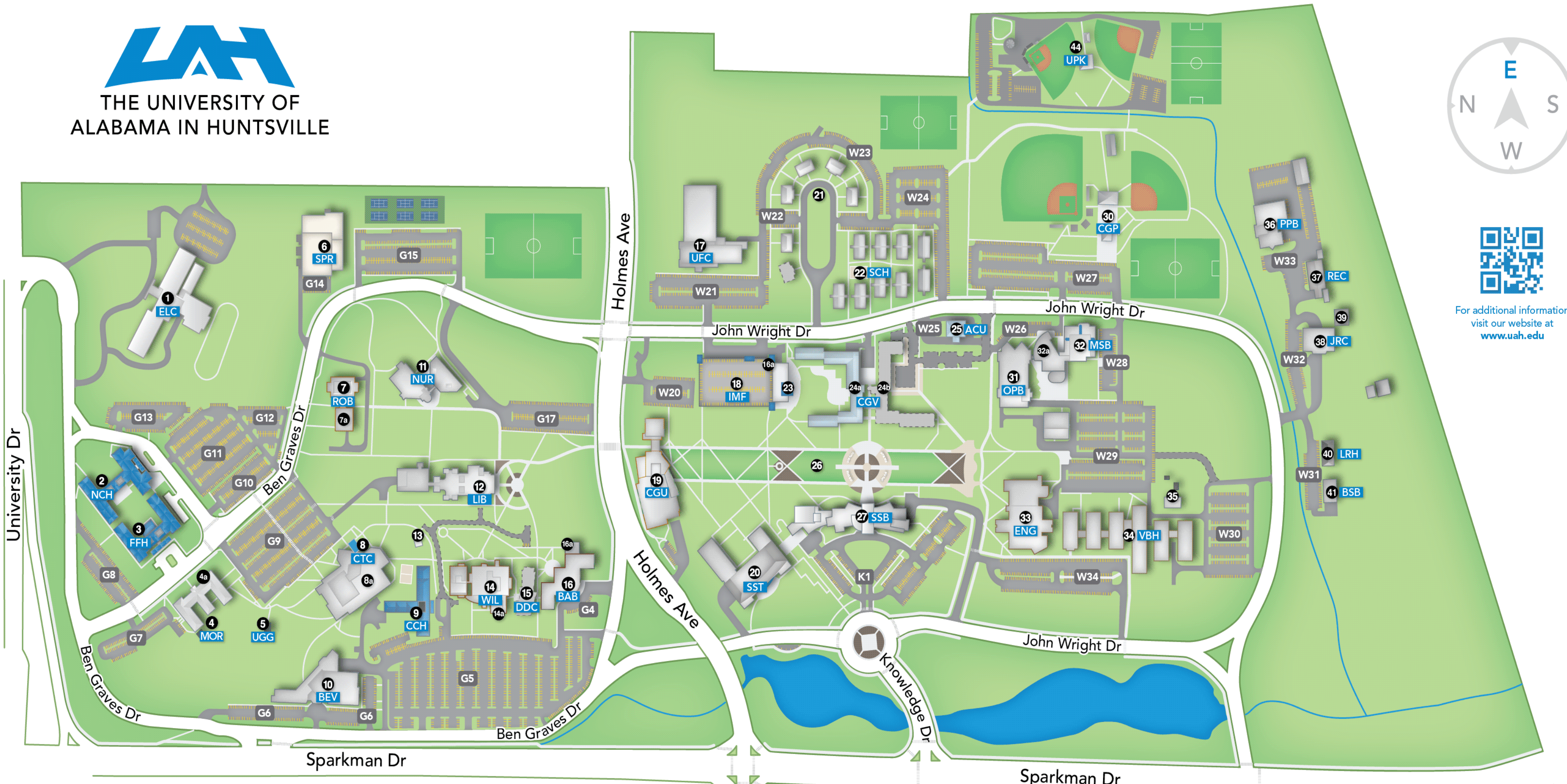
Ed Buckbee

Remembering the Real Space Cowboys

The Soul of an Explorer Lives In Us All!

Over fifty years ago, Alan Shepard climbed aboard a Huntsville-developed Mercury Redstone rocket and blasted off from Cape Canaveral to become the first American to ride in 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, and the brave. They had the right stuff. They were The REAL Space Cowboys.

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE



1. ELC Early Learning Center
2. NCH North Campus Residence Hall
3. FFH Frank Franz Hall
4. MOR Morton Hall
4a. Studio 106/Black Box Theatre
5. UGG Union Grove Gallery and Meeting Hall
6. SPR Spragins Hall
7. ROB Roberts Hall
7a. Roberts Recital Hall
8. CTC Conference Training Center
8a. Exhibit Hall
9. CCH Central Campus Residence Hall
10. BEV Bevill Conference Center & Hotel
11. NUR Nursing Building
12. LIB M. Louis Salmon Library
13. Amphitheater
14. WIL Wilson Hall/Disability Support
14a. Wilson Theatre
15. DDC D.S. Davidson Invention to Innovation Center (I²C)
16. BAB Business Administration Bldg
16a. Chan Auditorium
17. UFC University Fitness Center
18. IMF Intermodal Parking Facility
18a. Public Safety
19. CGU Charger Union/Campus Visits
20. SST Shelby Center for Science and Technology
21. Fraternity/Sorority Row
22. SCH Southeast Campus Housing
23. Charger Village Food Court
24a. CGV Charger Village I
24b. CGV Charger Village II
25. ACU Alabama Credit Union
26. University Greenway
27. SSB Student Services Building/Admissions
28. CRH Robert "Bud" Cramer Research Hall (National Space Science and Technology Center and NOAA Weather Forecasting Office)
29. SWI SWIRLL (Severe Weather Institute Radar and Lightning Laboratories)
30. CGP Charger Park
31. OPB Optics Building
32. MSB Materials Science Building
32a. McDonnell Douglas Auditorium
33. ENG Engineering Building
34. VBH Wernher von Braun Research Hall
35. VBH Annex
36. PPB Physical Plant Building
37. REC Central Receiving and Shipping
38. JRC Johnson Research Center
39. Propulsion Research Lab
40. LRH WLRH Radio Station
41. BSB Business Services Bldg./Copy Center
42. SKH Shelbie King Hall
43. OKT Olin B. King Technology Hall
43a. Oak Ridge-Huntsville Partnership
44. UPK University Park