spin speed. Another subject was the definition of criteria for the scientific success of the GP-B mission i.e. the final accuracy in the measurement of the gyroscope precession for changing conditions during flight. Using different mission durations (amount of data collected in orbit), the relationship between measurement duration and final experiment accuracy was established with the error analysis model. R. Decher has visited Stanford University many times the period of performance to participate in the Science Advisory Committee meetings and monthly reviews of GP-B. In addition, several topics related to the experiment error analysis and data reduction were discussed with the Stanford team during these visits. This included alternate mathematical approaches developed by the UAH group. An interim report on the application of the least squares analysis (by P. Eby) was published in January 1999. Several brief presentations on various subjects were given to the GP-B Project Office.

The solar physics group (consisting only of UAH employees). The areas of emphasis are: (a) develop theoretical models of the transient release of magnetic energy in the solar atmosphere, e.g., in solar flares, eruptive prominences, coronal mass ejections, etc.; (b) investigate the role of the Sun's magnetic field in the structuring of solar corona by the development of three-dimensional numerical models that describe the field configuration at various heights in the solar atmosphere by extrapolating the field at the photospheric level; (c) develop numerical models to investigate the physical parameters obtained by the ULYSSES mission; (d) develop numerical and theoretical models to investigate solar activity effects on the solar wind characteristics for the establishment of the solar-interplanetary transmission line; (e) develop new instruments to measure solar magnetic fields and other features in the photosphere, chromosphere transition region and corona.During the period, we focused our investigation on the fundamental physical processes in solar atmosphere which directly effect our Planet Earth. The overall goal is to establish the physical process for the Sun-Earth connections.

Dr. David Falconer, Research Associate, has been primarily investigating coronal heating using a combination of Yohkoh/SXT, SOHO/EIT, MSFC vector magnetograms, Kitt Peak magnetograms, and SOHO/MDI. This has involved analysis of coronal heating in active regions, with investigation of the role of global nonpotentiality. He has also investigated quiet sun coronal heating. Also, and has done a pilot study on the two quantitative predictors of which active regions might produce flare-associated coronal mass ejections. The first having to do with quiet sun heating, and the second with non-Maxwellian effects on line-ratio temperature diagnostics.

Dr. Manfred Cuntz has been involved in a variety of projects relevant to solar and stellar astrophysics. His main projects were the following: (1) study of two-component chromospheric heating in stars of different magnetic activity taking K2V stars as examples. These computations made use of a magnetohydrodynamic computer code package, which had been developed by Drs. P. Ulmschneider, W. Rammacher, Z.E. Musielak, and M. Cuntz. The code package allows the treatment of the generation, propagation, and dissipation of magnetic and acoustic wave modes and the formation of specific spectral emission lines. The performed simulations allowed the explanation of the empirically deduced relationship between the Ca–II and Mg–II emission and
the stellar rotation rate by starting from first principles. (2) Involvement in assembling a paradigm to explain the interactions between extra-solar giant planets and the outer atmospheres of their host stars. Up to date, about 30 extra-solar planets have been identified including one extra-solar planetary system (ups And). Some of those planets have masses comparable to or larger than Jupiter and are in very close proximity to their host stars. The proposed paradigm will be able to explain the existence of both magnetic and tidal interaction and provides a roadmap for the explanation of stellar "superflares" initiated by the planets. and (3) A further research project involved the study of fine structure of the solar wind, particularly solar plumes. Plumes are bright rays in coronal holes, visible between one and several solar radii. The empirical properties of plumes have recently been analyzed using instruments onboard of SOHO [Solar and Heliospheric Observatory]. The aim is to provide reasonable theoretical models for these structures. In addition, Dr. Cuntz served as co-organizer and participant of the Topical Discussion Session "Understanding the Role of Binarity on Mass Loss and Atmospheric Structure in Detached Systems", Eleventh Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, Tenerife, Spain (October 1999). The research effort has resulted in Dr. Cuntz participating as an invited speaker at the Center for Excellence in Information Systems, Tennessee State, University, Nashville, Tennessee in July 1999; Eleventh Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, Tenerife, Spain in October 1999; Department of Physics, University of Texas at Arlington, Arlington, Texas in October 1999; Space Science Laboratory, Marshall Space Flight Center, Huntsville, Alabama in January 2000; and the UAH Department of Physics in February 2000.

Drs. A. H. Wang and S. T. Wu participate in collaborative research with Dr. Steve Suess at MSFC’s Space Science Laboratory. They have been developing a series of global coronal models directed at a better simulation of coronal hole and streamer properties.

Within the Solar Physics Group is a sub-group (Astrobiology Group) lead by Dr. Richard Hoover at the NASA/MSFC. During the period of performance research was preformed on the ancient microfossils and micro-organisms such as cyanobacteria associated with ancient phospherous and meteorites for studies of living ancient micro-organisms using the environmental scanning electron microscope at NASA/MSFC. The research effort was in collaboration with the Russian Academy of Sciences. Dr. Sabit Abyzov of the Institute of Microbiology, visited the NASA/MSFC (Dr. Richard Hoover) to discuss joint collaborative research on ancient microorganisms from the deep ice cores recovered from Vostok Station, Antarctica and to participate in the Studies of Deep Ice Microorganism Conference in Denver, Colorado during the time period July 10 – 28, 1999. Dr. Alexei Yu Rozanov, Institute Director, Paleontological Institute, Russian Academy of Sciences was invited to visit the NASA/MSFC (Dr. Richard Hoover) in Huntsville, AL and participate in the Studies of Deep Ice Microorganism Conference in Denver, Colorado during the time period July 18 – 28, 1999. Dr. Rozanov discussed joint collaborative research on the microfossils and micro-organisms with the cyanobacteria using the environmental scanning microscope. Elena A. Vorobieva, Soil Science Faculty, Moscow State University, Russia, visited the NASA/MSFC (Dr. Richard Hoover) in Huntsville, AL and participate in the Studies of Deep Ice Microorganism Conference in Denver, Colorado during the time period July 10 – 28, 1999. She discussed the joint collaborative research on viable microorganisms in permafrost and ice. Dr. Elena Pikouta of the Institute of Microbiology of
Russian Academy of Science visited UAH and the NASA/MSFC during the period October 1999 – November 1999. The purpose of her initial visit is to conduct research on terrestrial extremophiles for the ongoing NASA Astrobiology program. This research effort was primarily directed toward the isolation and culture of enigmatic microbial psychrophiles from glaciers, ice wedges, and permafrost and hyperthermophiles from samples returned by Astronaut Owen Garriott from the Rainbow Deep Sea Hydrothermal Vent site. She participated in the study of the morphology of these microorganisms using the Environmental and Field Emission Scanning Electron Microscopes, the Scanning Transmission Electron Microscope, and advanced Epifluorescence and Video Optical Microscopy systems available at MSFC. Dr. Pikouta was subsequently hired by UAH to continue this research effort in the US. Professor Dr. Vladimir Ostrooumov of the Institute of Basic Problems of Biology, visited UAH and NASA/MSFC during the time period November 5 – 13, 1999 to discuss the study of water regimes in permafrost and microorganisms in permafrost with Dr. Richard Hoover and the personnel at the Space Science Laboratory. A contract for Professional Services was initiated with the Planetary Studies Foundation in support of the research on extremophile life forms in Antarctica from January 2 to January 20, 2000. Dr. Richard A. Hoover of the Marshall Space Flight Center in Huntsville, Alabama conducted his field work included the collection of numerous ice specimens from both the Patriot Hills area and the South Pole. In addition, he will be collecting specific sedimentary rocks from Patriot Hills to support this research. This will require snowmobile support to and from the Patriot Hills base camp on a daily basis, as well as a research associate/field guide who will assist in the collection of ice and rock specimens. David G. Butts, a member of the Planetary Studies Foundation, served in this capacity. In September 1999, the UAH and the NASA/MSFC hosted the Solar B Working Group Meeting held at NASA/MSFC. In addition, during the period of performance several visiting scientists made presentations and consulted with the personnel at the NASA/MSFC and UAH concerning the Solar Space Physics. These scientists usually gave seminars at the UAH or SSL regularly scheduled seminar time.

Publications & Presentations


Falconer, D.A., "A Correlation between Length of Strong-Shear Neutral Lines and Total X-ray Brightness in Active Regions", Solar Physics, 176, 123, 1997,


Falconer, D.A. "A Prospective Method for Predicting Coronal Mass Ejections from Vector Magnetograms," accepted JGR Space Physics 2001,


HIGH ENERGY PLASMA SPACE PROPULSION

In order to meet NASA's challenge on Advanced concept activity in the propulsion area, we initiated a new program entitled "High Energy Plasma Space Propulsion Studies" within the current cooperative agreement in 1998. The goals of this work are to gain further understanding of the engine of the AIMStar spacecraft, a concept which was developed at Penn State University (1), and to develop a prototype concept for the engine.

The AIMStar engine concept was developed at Penn State University several years ago as a hybrid between antimatter and fusion technologies. Because of limited amounts of antimatter available, and concurrently the demonstrated ability for antiprotons to efficiently ignite nuclear fusion reactions, it was felt that this was a very good match.

Investigations have been made concerning the performance of the reaction trap. This is a small Penning-like electromagnetic trap, which is used to simultaneously confine antiprotons and fusion fuels. Small DHe3 or DT droplets, containing a few percent molar of a fissile material, are injected into the trap, filled with antiprotons. We have found that it is important to separate the antiprotons into two adjacent wells, to inject the droplet between them and to simultaneously bring the antiprotons to the center of the trap, surrounding the droplet. Our previous concept had the droplet falling onto one cloud of antiprotons. This proved to be inefficient, as the droplet tended to evaporate away from the cloud as it interacted on its surface.

We have found that the most efficient method of constructing the droplet is to build a very thin shell of fissile material, with thickness of perhaps 10 microns, and to fill the shell with a cryogenically prepared mixture of DHe3 or DT. The outside diameter of the droplet is about 50 microns. The antiprotons interact with the fissile shell, and one of the two fission fragments injects itself into the fusion fuel. We find that 10E10 antiprotons interacting uniformly over the surface of the droplet can raise the temperature of the droplet to about 10 eV. This temperature is