Raytheon STX CASP

4400 Forbes Boulevard
Lanham, Maryland 20706
http://www.stx.com

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The following report covers CASP activities from 1 October 1997 through 30 September 1998.

1. INTRODUCTION

1.1 Company Background

STX was founded in 1973 as Systems and Applied Sciences Corporation. On October 1, 1991, STX was acquired by Hughes Aircraft Company and became Hughes STX Corporation headquartered in Lanham, Maryland. During the [ast year, STX was acquired by Raytheon as part of a merger between Hughes and Raytheon, and is currently known as Raytheon STX (RSTX). Once it becomes fully integrated into the Raytheon corporate structure, it will become Raytheon Information Technology and Scientific Services (ITSS).

RSTX is a for profit corporation of more than 1,400 employees who are skilled in a wide range of technical and administrative disciplines, including scientific research, software systems development, systems integration, and local-area network planning. Approximately 80% of our employees hold academic degrees, with 40% of this group at the Masters or Ph.D. level.

RSTX offers on site professional support at locations such as NASA/Goddard Space Flight Center (GSFC), the EROS Data Center, the Naval Research Laboratory, Edwards Air Force Base, the Pentagon, Marshall Space Flight Center, National Weather Service, and the National Environmental Satellite and Data Information Service. During the past year RSTX also won contracts with NASA/Ames and JPL.

This report focuses on RSTX science and computer support for a number of NASA's scientific programs at NASA/GSFC in Greenbelt, MD.

1.2 CASP

RSTX understands that in order to attract and retain scientists with outstanding credentials, it must support their need to perform *both* project oriented *and* independent research. Consequently, in addition to providing membership dues to professional societies, such as the AAS, for its professional staff it also established the Center for Astronomy and Space Physics (CASP). CASP's charge is to promote and facilitate professional achievement within RSTX, and is one of the RSTX centers of excellence,

`http://www.stx.com/about/centers.html`

CASP is made up of roughly 80 RSTX Astronomers and Space Scientists, primarily on site at GSFC. Its purpose is to provide RSTX scientists with a frame work in which to meet and discuss scientific and professional matters, to stimulate cross disciplinary ideas, and to provide an identity and voice for our employees, in science related matters. CASP is employee organized and supervised and its current chairperson is A. Danks.

CASP organizes monthly talks, produces a newsletter in which RSTX scientists discuss their science and project contributions, maintains a mailing list to inform its members of announcements of opportunity and encourages employees to apply for grants to pursue independent scientific research. CASP uses a small budget provided by RSTX to support company scientists while writing personal science proposals and to fund travel to scientific meetings and publication costs, when no other sources are available. It also supports the RSTX corporate membership in the AAS.

1.3 Personnel

As of October 1998, RSTX staff scientists with astronomy, solar physics or space physics related interests include: J. Allen, L. Allen, R. Arendt, E. Bell, D. Bilitza, J. Blackwell, S. Boardsen, K. Borne, L. Breedon, J. Brosius, L. Brown, S. Casey, R. Cebula, S. Chen, N. Collins, J. Cooper, R. Cornett, A. Danks, M. Deland S. Digel, M. Duesterhaus, E. Einfalt, B. Elza, M. Fanelli, D. Fixsen, H. Freudenreich, D. Friedlander, M. Greason, J. Hill, R.J. Hill, R.S. Hill, K. Hilldrup, K. Hills, J. Hollis, Z. Huang, P. Jackson, K. Jensen, V. Kargatis, S. Kashlinsky, P. Keegstra, E. Kemper, C. Klipsch, A. Kogut, P. Kuin, A. Kutyrev, M. Kuznetsova, W. Landsman, P. Lawton, E. Malumuth, D. Massa, L. Mayo, J. Mullins, T. Norton, N. Odegard, S. Odenwald, J. Offenberg, L. Ofman, N. Oliversen, B. O'Neel, R. Patterer, M. Peredo, B. Perry, E. Pier, T. Powers, B. Puc, G. Reichert, G. Rohrbach, N. Roman, T. Satoh, G. Schneider, R. Schwartz, J. Silvis, K. Smale, C. Standley, A. Szabo, L. Tan, W. Taylor, K. Tolbert, M. Tripicco, N. Tsyganenko P. Tyler, P. Uribe, F. Varosi, W. Waller, W. Warren, J. Weiland, D. Williams.

2. SPACE INSTRUMENTATION AND MISSION SUPPORT

GLAST: The Gamma-ray Large Area Space Telescope (*GLAST*) is a proposed astrophysics mission to study the high-energy gamma-ray sky at energies between 10 MeV and 300 GeV. The primary instrument is a pair-conversion telescope based on solid-state particle-tracking technology. *GLAST* will be 30 times more sensitive than the Energetic Gamma Ray Experiment Telescope (EGRET) on board the Compton Gamma Ray Observatory (CGRO). *GLAST* is a two-year mission (with planning for five years) with an anticipated launch in 2005. Observing targets include 1) active galactic nuclei, 2) gamma-ray burst sources, 3) pulsars, 4) supernova remnants, 5) diffuse emission sources (including interstellar gas in our Galaxy, and the isotropic component which is probably extragalactic), 6) unidentified EGRET sources, and 7) solar flares.

GLAST is a collaboration of several institutions. GSFC scientists are deeply involved in the planning of the project and RSTX scientists are assisting all levels of the effort including simulations of its astronomical performance.

More information about *GLAST*'s science objectives can be found at

`http://glast.gsfc.nasa.gov/LHEA/`

HEASARC: The High Energy Astrophysics Science Archive and Research Center (HEASARC) supports a multimission archive facility in high energy astrophysics for scientists all over the world. Data from space-borne instruments on spacecraft, such as *ROSAT*, *ASCA*, *CGRO*, *BBXRT*, *HEAO-1*, *HEAO-2*, *EXOSAT*, and *XTE* are provided, along with a knowledgeable science-user support staff and tools to analyze multiple datasets. For further information, see

`http://heasarc.gsfc.nasa.gov/`

IMAGE: is a MIDEX mission, scheduled for launch in 2000, to study the global response of the Earth's magnetosphere to changes in the solar wind. IMAGE will use neutral atom, ultraviolet, and radio imaging techniques to:

1. Identify the dominant mechanisms for injecting plasma into the magnetosphere on substorm and magnetic storm time scales;

2. Determine the directly driven response of the magnetosphere to solar wind changes; and,

3. Discover how and where magnetospheric plasmas are energized, transported, and subsequently lost during substorms and magnetic storms.

`http://image.gsfc.nasa.gov/`

RSTX scientists are involved with developing tools to reduce and interpret *IMAGE* data. This includes software to simulate the expected observations, models which will be used to interpret the physical processes *IMAGE* will observe and complex algorithms to reduce the raw data into a usable form.

The *IMAGE* Mission Team is also committed to a strong program of Public Outreach, and Education, and RSTX scientists are also contributing to this aspect of the mission as well.

MAP: The Microwave Anisotropy Probe (*MAP*) is a MIDEX class mission, selected by NASA in 1996, to probe conditions in the early universe. *MAP* is scheduled for launch in 2000 and will measure temperature differences (''anisotropy'') in the cosmic microwave background radiation over the entire sky. For further information, see

`http://map.gsfc.nasa.gov/`

SOHO: The Solar and Heliospheric Observatory (*SOHO*) is one of ESA and NASA's most ambitious projects for the 1990's. Its mission is to understand the interactions between the Sun and the Earth's environment and to address some of the most perplexing riddles about the Sun, including the heating of its corona, the acceleration of its wind, and the physical conditions of the solar interior. It is giving solar physicists their first long term view of the Sun by operating from a permanent vantage point 1.5 million km ahead of the Earth in a halo orbit around the *L1* Lagrangian point. *SOHO* was recently lost and then recovered and is once again returning spectacular images and information about processes in the Solar atmosphere, Corona and wind. Further information may be obtained at

`http://sohowww.nascom.nasa.gov/`

SSDOO: The Space Sciences Data Operations Office (SSDOO) is responsible for the project management of selected missions and the development and operations of data and information systems which support processing, management, archiving, and distribution of space physics, astrophysics, and planetary data. The SSDOO includes the Astrophysics Data Facility (ADF) and Space Physics Data Facility (SPDF)

`http://ssdoo.gsfc.nasa.gov/c630/`

The ADF is responsible for the processing and distribution of proprietary data from missions such as *ROSAT*, *ASCA*, and *XTE*. The staff is now in the process of developing similar capabilities for the new *ASTRO-E* X-ray mission. In addition, the ADF supports the astrophysics community's access to multi-mission and multi-spectral data archives through the creation of tools and online archives. Recent developments at the ADF now give researchers expanded location, browse, and retrieval capabilities for this rich and diverse collection of data. The group includes the Astronomical Data Center (ADC) which acquires, verifies, formats, and distributes astronomical catalog data in computer-readable form. The ADC's archives contain more than 2500 catalogs and journal tables of astrometric, photometric, morphological, spectroscopic, polarization, kinematic, and multiwavelength data for stellar and non-stellar objects. The ADC group also develops and maintains software tools to access these data. The ADC is part of an international federation of astronomical data centers. The capabilities of the ADF and ADC allow researchers to identify scientifically interesting objects and correlations, to carry out archival data-mining searches, to locate existing archival data on user-selected objects, and to prepare observing lists for further observational studies. The ADF and ADC can be accessed *via*

`http://adf.gsfc.nasa.gov/adf/`
`http://adc.gsfc.nasa.gov/`

Recently created UV mission data browsers can be accessed *via*

`http://adf.gsfc.nasa.gov/uv/`

Access to legacy data and software tools from the *COBE* mission are now available at

`http://www.gsfc.nasa.gov/astro/cobe/cobe_home.html`

The ADC has recently developed several new data visualization tools which can be accessed *via*

`http://adf.gsfc.nasa.gov/adf/visualization/`

These include AMASE, which is an object-oriented multi-spectral astrophysics database search engine that is being prototyped at the ADF. AMASE can be accessed *via*

`http://amase.gsfc.nasa.gov/`

The group also produces educational products, including the Multiwavelength Milky Way poster which can be accessed online at

`http://adc.gsfc.nasa.gov/mw/milkyway.html`

The ADF has on-going cooperative efforts with other data centers in the Astrobrowse effort

http://sol.stsci.edu/~hanisch/astrobrowse_links.html

The SPDF is responsible for the development of a variety of space physics mission planning tools and facilitating correlative data analysis for the International Solar Terrestrial Physics (ISTP) program. For additional information, see

http://nssdc.gsfc.nasa.gov/spdf/spdf.html

STIS: The Space Telescope Imaging Spectrograph (STIS), is one of the second-generation instruments for the Hubble Space Telescope (*HST*). It was successfully installed on *HST* during the second servicing mission in 1997 February. In addition to general science support, A. Danks (RSTX) is a Co-Investigator on the STIS science team and responsible for the UV detectors, Multi Anode Microchannel plate Arrays (MAMA's).

With the STIS now fully functional, RSTX support for STIS is now peaking. RSTX astronomers: R.S. Hill, N.R. Collins, R.H. Cornett, R.J. Hill, W.B. Landsman, E.M. Malumuth, and C. Standley are contributing to the scientific calibration and to the analysis and interpretation of the observations. This included the STIS early release observations featured in Volume 492 No. 2 of ApJ *Letters* (Bowers, G.A., *et al.*, 1998, Gardner, J.P., et al. 1998, Hutchings, J.R., *et al.* 1998, Jenkins, E.B., *et al.* 1998, Kashlinsky, A. 1998, Kimble, R., *et al.* 1998, Sahu, K.C., *et al.* 1998, Schultz, A.B., *et al.* 1998, Sonneborn, G., *et al.* 1998, and Walborn, N.R., *et al.* 1998). Additional contributions by several RSTX STIS team members will be found throughout this report. Further information about STIS can be found at:

http://hires.gsfc.nasa.gov/

XTE: The Rossi X-ray Timing Explorer (*XTE*) is a GSFC mission which was launched on 30 December 1995. It is designed to study time variability in X-ray sources with moderate spectral resolution. Time scales from μsec to months are covered in a spectral range from 2 to 250 keV. It is designed for a required lifetime of two years, with a goal of five years

http://heasarc.gsfc.nasa.gov/docs/xte/xte.html

3. RESEARCH

3.1 Space Physics

D. Bilitza (RSTX) continued his effort to improve the specification of the topside electron density in the International Reference Ionosphere (IRI) in the framework of an NSF-supported Space Weather project (Bilitza *et al.*, 1998a). This improvements will be very important for the application of the IRI ionospheric model for the correction of satellite altimeter data (Bilitza *et al.*, 1997).

As Chair of the IRI Working Group (URSI, COSPAR) D. Bilitza continues coordination of IRI activities (Bilitza, 1997). He organized a 3-day session during the 1998 COSPAR meeting: Lower Ionosphere: Measurements and Models. He was a co-editor of a special issue of Advances in Space Research with selected papers from the 1996 IRI Workshop (Rawer and Bilitza, 1997). Together with Prof. S. Radicella, he organized and chaired a special IRI task force activity at the International Center for Theoretical Physics (Trieste, Italy) on the bottomside ionosphere.

D. Bilitza (RSTX) worked with A. Komjathy (U. of New Brunswick; now U. of Colorado Boulder) and with M. Hernandez and M. Juan (Polytechnical U. of Barcelona) on the (real-time) updating of ionospheric models with ionospheric data deduced from GPS measurements (Komjathy *et al.*, 1998, Bilitza *et al.*, 1998b).

S.A. Boardsen (RSTX) developed an empirical model of the high latitude magnetopause and nose which is parameterized by dipole tilt angle, solar wind dynamic pressure and IMF Bz. This study clearly shows that it is important to remove the positional effects caused the dipole tilt angle on magnetopause location in order to clearly interpret the effects of IMF on the magnetopause position.

Nikolai Tsyganenko (RSTX) developed a quantitative model of the effects of the seasonal/diurnal wobbling the Earth's magnetic moment and of the interplanetary magnetic field upon the shape of the current sheet in the tail of the geomagnetosphere, based on data of 5 years of measurements by *GEOTAIL* spacecraft and 10 years worth of ISEE-1/2 data.

Using these results and a multi-spacecraft data set of direct magnetopause crossings, for the first time the effect of the Earth's dipole tilt was found upon the shape of the magnetotail boundary.

A new method was developed for the mathematical modeling of these effects, making it possible to quantitatively represent a wide variety of realistic global magnetospheric configurations.

Using ten months worth of *POLAR* spacecraft magnetometer data, combined with the simultaneous measurements of *WIND* and *IMP-8* spacecraft in the interplanetary medium, a statistical study was made of the inner equatorial magnetospheric magnetic field structure and its dependence on the parameters of the solar wind. A significant asymmetry was found, sensitive to the Dst index and the solar wind pressure.

A simulation study was made of the real-time reconstruction of the global magnetospheric magnetic configuration, based on data from a ‘‘swarm’’ of the space multi-probe satellites. It was found that the monitoring of the global magnetosphere by 50-100 space magnetometers is quite a feasible task, provided a thoughtful planning of the spacecraft orbits is made.

J.F. Cooper (RSTX), E.C. Sittler (GSFC), B.H. Mauk (APL/JHU) and two other co-authors (Cooper *et al.*, 1998b) calculated the effects of magnetospheric electric fields at Saturn on drift shells of energetic electrons, for which the drift orbits vary from circular for no field effect to banana shapes (no closure around Saturn) for drift resonance energies at which opposing corotation and gradient-curvature drifts from the planetary magnetic field cancel each other. Updates on this work, including effects on electron radial diffusion, were presented at the *Galileo*/*Cassini* conference in Nantes, France in May 1998. L.C. Tan and J.F. Cooper of RSTX collaborated with S. F. Fung (GSFC) and others on data analysis and drift shell modeling of energetic electron data in the earth's low-altitude magnetosphere from the Japanese *OHZORA* satellite (Fung *et al.*, 1998).

3.2 Solar Physics

J. Brosius (RSTX), J. Davila (NASA/GSFC), R. Thomas (NASA/GSFC), and S. White (UMD) (Brosius *et al.* 1997) advanced the technique for solar coronal magnetography using SERTS (Solar Extreme-ultraviolet Rocket Telescope and Spectrograph) EUV spectra – spectroheliograms and coordinated VLA 20 cm and 6 cm radio observations. This important technique yields a direct measurement (rather than an extrapolation) of the solar coronal magnetic field, a quantity widely believed to play a central role in phenomena such as coronal heating, the solar wind, and flare energy storage and release mechanisms.

Brosius continued his collaboration with Davila and Thomas in the analysis of EUV spectra and spectroheliograms obtained during the 1995 SERTS flight. Density and temperature insensitive line intensity ratios were used to derive the instrument's relative radiometric calibration from solar spectral data (Brosius, Davila, & Thomas 1998a, 1998b), and a well calibrated, high spectral resolution emission line catalog for NOAA region 7870 was obtained (1998b). The calibration technique is general, and can be applied to other instruments such as *SOHO*/CDS. Density sensitive line intensity ratios yield typical coronal plasma densities of $\log n_e = 9.4 \pm 0.2$.

In an ongoing effort to understand the intensity of the solar He II λ304 emission, Brosius collaborated with S. Jordan (NASA/GSFC) to examine observational evidence for ''velocity redistribution'' of He II ions in the quiet Sun (Garcia *et al.* 1998). Correlations were sought between He II λ304 intensity enhancements and small-scale chromospheric velocities.

D. Falconer (NASA/MSFC), Jordan, and Brosius *et al.* (1998) used coordinated SERTS and *Yohkoh* observations to correlate the intensities of strong EUV coronal emission lines with broad band soft X-ray fluxes. Power law fits indicate that the intensities of highly ionized iron lines (Fe XV, Fe XVI) provide reasonably good proxies for the soft X-ray emission over a broad range of coronal intensities.

R. Cebula and M. DeLand (RSTX), in collaboration with E. Hilsenrath (GSFC), continued their studies of solar UV irradiance variability. The long-term solar UV irradiance data set from the *NOAA-11* SBUV/2 instrument, covering the maximum and declining phase of solar cycle 22, was archived for general use. These data indicate long-term decreases from February 1989 to October 1994 of approximately 7% at 205 nm and 3-4% at 250 nm, where solar variations drive stratospheric photochemistry. The data also document the spectral and temporal evolution of solar rotational variability during this period. Comparisons with the UARS SUSIM and SOLSTICE measurements between 1991-1994 verify the accuracy of the *NOAA-11* results (DeLand & Cebula, 1998b). Additional information is available at

`http://ssbuv.gsfc.nasa.gov/solar.html`

Cebula and DeLand have received additional funding to produce long-term solar UV irradiance data sets for *Nimbus-7* SBUV (1978-1986) and *NOAA-9* SBUV/2 (1985-1997). This will provide an 18+ year continuous record of solar UV irradiance data for long-term solar activity studies.

L. Ofman (RSTX) continued his collaboration with J.M. Davila (NASA/GSFC) on nonlinear multidimensional magnetohydrodynamic (MHD) models of the solar wind. Their recent parametric studies (Ofman & Davila 1998a) indicate that nonlinear large amplitude solitary-like waves may contribute significantly to the solar wind acceleration. They have recently extended their model into two-fluid electron proton plasma (Ofman & Davila 1998b).

Ofman, a guest investigator on the Ultraviolet Coronagraph Spectrometer (UVCS) instrument on board *SOHO*, continued the White Light Channel (WLC) observations of the density fluctuations in the solar wind. His new observations of density fluctuations in solar coronal holes in collaboration with M. Romoli (U. Florence), G. Poletto (Arcetri Observatory), G. Noci (U. Florence), and J. Kohl (CfA) established his earlier findings of the presence of compressional waves in the solar wind (Ofman *et al.* 1997; Ofman *et al.* 1998a).

Ofman continued the collaboration with J. Klimchuk (NRL), and J.M. Davila (NASA/GSFC) and developed a new model of coronal loop heating that includes the effects of coupling of the loop density with the chromosphere. This important effect was neglected in earlier models of coronal loops. The understanding of coronal loop formation and heating is one of the keys to understanding the coronal heating mechanism - still an unsolved mystery (Ofman, Klimchuk, & Davila 1998)

Ofman continued the collaboration with Z. Mouradian (Meudon Observatory), T. Kucera (SAC), and A. Poland (NASA/GSFC) on the analysis of observations of prominences obtained with the Solar Ultraviolet Measurement of Emitted Radiation (SUMER) instrument on board *SOHO*. They studied in detail the temperature evolution of a prominence and the possible implications for the prominence heating mechanism (Ofman *et al.* 1998b; Ofman *et al.* 1998c).

Ofman collaborated with V. Nakariakov (St. Andrews) and C.E. DeForest (Stanford/NASA) on theoretical and observational studies of slow magnetosonic waves in coronal plumes (Ofman, Nakariakov & DeForest 1998). These waves were recently detected by the Extreme Ultraviolet telescope (EIT) on board the *SOHO* spacecraft. Their presence is an important clue on the solar wind acceleration and heating mechanism.

Ofman collaborated with M. Goldstein (NASA/GSFC), A. Roberts (NASA/GSFC), M. Ruderman (St. Andrews) and A. Dean (UMD) on the study of Alfvén wave phase mixing driven by velocity shear in two-dimensional open magnetic configurations. This mechanism may provide a possible source of heat in solar wind streams (Ruderman *et al.* 1998).

3.3 Planetary Physics

J.F. Cooper (RSTX) and N. Gehrels (GSFC) are collaborating with C.M.S. Cohen and E.C. Stone (Caltech) on analysis and modeling of energetic particle data from the Heavy Ion Counter (HIC) experiment on the *Galileo* Orbiter satellite at Jupiter. Collaborative work is also being done with

B.H. Mauk (APL/JHU) on related data from the *Galileo* Energetic Particle Detector (EPD) experiment. Work is in progress on flux spectra and anisotropies of 2 - 50 MeV/nucleon ions, mostly sulfur and oxygen, near the orbit, and during the initial *Galileo* flyby, of the satellite Io.

J.F. Cooper (RSTX) collaborated with E.R. Christian (USRA/GSFC) and R.E. Johnson (U. of Virginia) on calculations of heliospheric and galactic cosmic ray flux spectra for irradiation of Kuiper Belt Object (KBO) and Oort Cloud comets (Cooper *et al.*, 1998a). Heliospheric protons and heavier ions accelerated at the solar wind termination shock were found to be the dominant irradiation component within the visible optical layer of the KBO comets. Future work will include comprehensive cosmic ray spectra from Jupiter outward to the local interstellar medium, rate calculations for surface erosion by ion sputtering, and modeling of volume dosage effects.

Cooper, Johnson, Mauk, and Gehrels have just submitted a paper (Cooper et al., 1998c) to Science on usage of new EPD data to model the irradiation of these satellites; this paper includes a discussion of ‘‘radiation climatology’’ on the surface of Europa, for which radiation-induced changes can occur on time scales comparable to those of terrestrial climatology since our own last ice age. Since fresh water from a subsurface ocean on Europa is needed to maintain the currently bright ice surface against the darkening effects of radiation, this work argues strongly in confirmation of a ‘‘young’’ Europa.

J.F. Cooper (RSTX) has received funding from the NASA Jupiter System Data Analysis Program (JSDAP) to use *Galileo* HIC and EPD experiment data to model energetic ion interactions with the Galilean satellites, including effects of the ion charge states and the internal or induced magnetic fields of the satellites. This wor will be done in collaboration with E.V. Bell II and D. Williams of RSTX, C.M.S. Cohen (CIT), N. Gehrels (GSFC), B.H. Mauk (APL/JHU), and R.E. Johnson (U. of Virginia).

3.4 Stars and Stellar Clusters

W. Landsman (RSTX) continued his investigation of unusual stars detected during the two UIT missions. A complete census of hot stars in the old, open clusters M67, NGC 188 and NGC 6791 was derived from the UIT images, and used as templates for the understanding of the ultraviolet emission of old galaxies (Landsman *et al.* 1998). Seven white dwarf candidates and eleven blue stragglers were detected on the UIT image of M67, and eight sdB/O stars were detected on the UIT images of NGC188 and NGC 6791. With S. Moehler and R. Napiwotzki (Bamberg), Landsman reported on optical spectra of seven UV-bright stars discovered on UIT images of the globular clusters M4, NGC 6752, and NGC 6723 (Moehler *et al.* 1998). These observations showed the dichotomy between post-AGB stars, with approximately solar helium abundances, and post-early-AGB stars with strong helium depletions.

Landsman assisted the STIS team in a ultraviolet spectroscopic study of nearby F stars, in order to provide templates for the age-dating of old galaxies from spectral synthesis of their integrated spectra (Heap *et al.* 1998).

In a continuing collaboration with B. Woodgate (NASA/GSFC), Brosius (RSTX) further advanced model calculations for the time dependent, redshifted Ly-α emission from nonthermal proton beams injected into stellar chromospheres. Brosius & Woodgate (1999) conclude that observations of the time history of such emission could be used to deduce properties of the proton beams.

Ofman continued a collaboration with V. Airapetian (CSC), R. Robinson (Catholic U.), K. Carpenter, and J.M. Davila (NASA/GSFC) on models of stellar wind acceleration in cool stars. The aim of this work in progress is to apply the MHD models developed for the sun to the conditions believed to exist in cool stars, based on the Goddard High Resolution Spectrograph (GHRS) data (Airapetian *et al.* 1997).

D. Massa (RSTX), continued his collaborations with R. Prinja and I. Howarth (UCL), A. Fullerton (Johns Hopkins), S. Owocki (Bartol), and S. Cranmer (MIT) on the variability of OB star winds and their connection to photospheric activity. Their detailed analysis of an *IUE* time series of the wind lines in the B supergiant HD 64760 (Fullerton *et al.* 1997) showed that the data are consistent with the presence of enormous spiral structures (much like standing waves) in the wind of this star. Howarth *et al.* (1998) continued the analysis by examining the variability of the photospheric lines in the star using a cross-correlation technique. These results showed that photospheric disturbances with some periods similar to those found in the wind were also present in the photosphere. Massa, Prinja & Fullerton (1998) presented their results of a wind and photospheric time series analysis of a 30 day *IUE* time series of the B0 Ia HD 91969. The results demonstrated a perplexing relationship between the dominant periods in the wind (7.8 days) and the photosphere (3,9 days). While the 2:1 ratio is highly suggestive, it is not clear what physical mechanism could naturally explain this relationship.

Massa and R. Prinja (UCL) continued their investigation into the UV properties of B supergiants. Thus far, their effort has been primarily it the data selection and reduction phase. Progress reports on the project were presented at the Second Boulder-München Workshop this past summer (Massa & Prinja 1998, Prinja & Massa 1998).

Massa analyzed *HST* spectra of a main sequence B star in the young open cluster NGC 6231. He was attempting to uncover the origin of the extremely peculiar winds in several stars in the cluster. However, the result of the observations have only deepened the mystery of the origin of these winds (Massa, 1998).

Massa continued his collaboration with N. Evans (CfA) studying the physical properties of Cepheids. Their most recent project involved *HST* observations of the long period Cepheid T Mon (Evans *et al.* 1998). Massa also collaborated with C. Grady (Eureka Scientific) in the analysis of an *IUE* time series of the bright Herbig Ae star AB Aur (Grady *et al.* 1998).

3.5 Nebulae, Interstellar Medium and Galactic Structure

R. Arendt collaborated with E. Dwek and H. Moseley (NASA/GSFC) on analyzing the IR emission of the Cas A supernova remnant (SNR), as observed using *Infrared Space Observatory* Short Wavelength Spectrograph. This study has revealed strong line emission from several ionic species that have not been previously observed in Cas A, and continuum emission from silicate dust of an unusual composition. The observed gas and dust are associated with the stellar ejecta of the SNR, indicating that they are recent products of stellar nucleosynthesis and are contributing to the metal enrichment of the ISM.

Arendt, M. Almy (U. Wisc.) and L. Bronfman (U. Chile), performed a study led by Almy of X-ray shadowing of a distant molecular cloud observed with the *ROSAT*/PSPC. The analysis permits the determination of the fraction of the soft X-ray background associated with the Galactic halo.

Along with J. Brand (Bologna), E. de Geus (Leiden Obs.), A. Rudolph, D. Williams (Harvey Mudd College), P. Thaddeus (CfA), and J. Wouterloot (Cologne), Digel (RSTX) is participating in a study of *ISO* observations of IR lines toward H II regions in the far outer Galaxy. The goal of the observing project is to measure the metallicity far beyond the solar circle.

F. Varosi (RSTX) has developed a new Monte Carlo model to calculate escape and absorption of radiation in clumpy dusty environment. The model includes escape probability formulas due to extended megagrains. He has incorporated results from new computations that verify the equations for an effective clump albedo and an angular scattering parameter. Using Monte Carlo Radiative Transport simulations, he verified the use of a simple analytic approximation for the escape probability in the case of a single central isotropic source.

3.6 Galaxies and Extragalactic Astronomy

R.S. Hill (RSTX) completed his study of far ultraviolet (FUV) imagery of the irregular galaxy NGC 4449 obtained by the Ultraviolet Imaging Telescope (UIT) during the Astro-2 Shuttle mission. By comparing with ground-based narrow-band data at H-α and H-β from the Goddard Astronomical Fabry-Perot Imaging Camera (GAFPIC), he found that central and the northern regions of the optically bright part of the system have somewhat different recent star formation histories (Hill *et al.* 1998). Mr. Hill continues to work with the STIS Investigation Definition Team (IDT) on STIS parallel slitless spectra, including image combination and spectrum extraction techniques. Mr. Hill is also involved in a collaboration headed by S. Heap (NASA/GSFC/LASP) on the rest-frame FUV morphology of galaxy samples at various redshifts.

K. Borne (RSTX) and his colleagues H. Bushouse (STScI), L.Colina (STScI, ESA), R. Lucas (STScI), A. Baker (Cardiff), D. Clements (Cardiff), A. Lawrence (Edinburgh), S. Oliver (Imperial College), and M. Rowan-Robinson (Imperial College) are continuing their intensive *HST* imaging study of a nearly complete sample of ultraluminous IR galaxies (ULIRGs), the most luminous galaxies in the universe. In addition to WFPC2 imaging in the I-band (8000Å), they have also obtained near-IR imaging with NICMOS in the H-band (1.6 μm). They are completing an analysis of the bright multiple cores (starburst knots or merger remnant nuclei?) at the centers of the ULIRGs. ULIRGs are strongly starbursting, heavily dust-enshrouded, and engaged in strong tidal/merger events. Borne and his team are deriving a variety of observational parameters for these cores: sizes, luminosities, colors, light profiles, separations, and frequency of occurrence. Such analyses of the I-band and H-band images are revealing the nature, physical properties, likely origin, and probable future evolutionary state of these cores. They are also completing a number of other research projects related to this sample of galaxies, including: AGN properties, super star clusters, compact group origin, multiple-merger scenarios, tidal features, and a new morphological classification scheme.

K. Borne and L. Colina obtained multi-fiber spectroscopic observations for several of the brightest ULIRGs using the new multi-fiber system at the William Herschel Telescope. The data consist of medium-resolution (1Å) spectra from 4000Å to 7000Å at over 100 positions within the central $10''$ of the field-of-view. Each fiber has a $0.4''$ FOV. Initial analyses of the ensuing large data cubes have revealed significant variations in the emission line ratios throughout the central regions of these intensely starbursting and chaotic galaxies. Line strengths, ionization parameters, excitation mechanisms, and kinematics will be derived from this rich collection of spatially resolved spectral data.

K. Borne, T. Boller, and W. Voges (MPE, Garching) have begun an analysis of the soft X-ray fluxes emanating from ULIRGs. They are using the flux values reported within the *ROSAT* All-Sky Survey (the RASS) for the sample of ULIRGs that Borne and his team are studying with *HST*.

K. Borne, M. Carollo (STScI), A. Grauer (Univ. Arkansas), N. Homeier (U. Wisc.), and R. Lucas (STScI) have begun a multi-wavelength multi-telescope investigation of an unusual and extreme *IRAS*-selected galaxy. The galaxy seems to defy the conventional wisdom relating to the IR Tully-Fisher Relation (IRTFR) and the ‘‘IR Luminosity – Star Formation Rate’’ correlation. It has 25 times higher luminosity than predicted from the IRTFR for its deprojected H I 21 cm velocity width; and it is underluminous (by a factor of several) in IR relative to its blue luminosity for a sample of IR-selected galaxies! Borne and colleagues are obtaining a wide variety of multi-wavelength observations of this galaxy in order to determine why it is ‘‘extreme.’’ Its coarse morphology appears as possibly some sort of collision/merger product, its IR properties suggest that it is deficient in dust and massive star formation, and its ‘‘relatively deficient’’ 21 cm velocity broadening suggests that it is not rotationally supported. The multi-wavelength approach will allow the team to address a wide variety of scientific questions: Is it a star-forming galaxy? Is it dusty? What morphological features serve as additional clues to the true nature of this galaxy? Is there a spiral pattern? Is there a polar ring? Is there a double nucleus? Are there dust lanes, and if so, what is their detailed structure and location within the galaxy? How does this object differ from the ULIRGs?

K. Borne, P. Appleton, R. Lucas, and C. Struck (Iowa State) are completing their detailed analysis of their famous *HST* observations of the Cartwheel ring galaxy. A comprehensive inventory of this intriguing galaxy’s morphological features, star formation history, color gradients, stellar population variations (around and across the ring), and other properties is nearing completion.

E. Shaya (RSTX) continued his collaboration with Brent Tully (U. of Hawaii) and J. Peebles (Princeton U.) on the Distribution and Motions of nearby galaxies and using the Least Action method to model the peculiar flow of galaxies out to $cz = 3000$ km s^{-1}. Recent results indicate a low density for the universe but a much higher mass-to-light ratio in clusters than in field galaxies, an antibiased universe.

Also, E. Shaya is continuing his study of nuclei of galaxies with *HST* spectra. Observations of stellar line widths in Fornax A show no indication of a supermassive blackhole despite the very strong radio source at the center.

R. Cornett and J. Hill (RSTX) collaborated with J. Parker (SWRI) to complete the analysis of the UIT fields of the Magellanic Clouds, focusing on the results of the initial mass function for the field and cluster stars of the LMC. Their work represents perhaps the most extensive study of the IMF in the LMC, involving 37,333 stars (10,620 in clusters, 26,713 in the field). They included a comparison of Hα and UV fluxes from stellar clusters, which shows excellent agreement with expected ages for the cluster stars. The analysis revealed thousands of previously unknown hot, massive stars not only in cluster, but also throughout the field (Parker *et al.* 1998).

Cornett (RSTX) completed a study of faint-object FUV imaging at the limits of existing UIT observations using combined exposures of the cluster Abell 2246 at $z = 0.225$, reaching magnitudes m(FUV) $\sim$ 19.5. This work compares Abell 2246 with the Coma Cluster and finds results consistent with the Butcher-Oemler effect.

3.7 Cosmology

J. Weiland and H. Freudenreich, N. Odegard, R. Arendt (RSTX), *et al.*, as part of the DIRBE team, have completed analysis of the *COBE*/DIRBE data. After removing interplanetary and Galactic foreground emission at 1.25 – 240 μm, they detect the isotropic Cosmic Infrared Background (CIB) at 140 and 240 μm. The intensity of the detected far-IR CIB suggests that cosmic star formation rates, inferred from optical and UV observations at high z, are underestimates of the true rates. The procedures and results of this long-term project are documented in a series of 4 papers, which will be published in Nov 1998.

Working with E. Dwek (NASA/GSFC), R. Arendt (RSTX) completed a reanalysis of the Galactic emission at near-IR wavelengths in the DIRBE data. A new procedure for the modelling and removal of this foreground yields a tentative detection of the CIB at 3.5 μm. Arendt and Dwek have also been awarded a NASA ADP grant to continue this research.

Fixsen (RSTX) *et al.* (1997) performed a detailed comparison of the *COBE* FIRAS and DIRBE instrument calibrations. This completed an essential step in determining the spectral properties and physical nature of irregularities in the cosmic background radiation.

S. Odenwald (RSTX) continues to work with A. Kashlinsky (NORDITA) and J. Mather (GSFC) on NASA LTSA and ADP support research aimed at detecting fluctuations in the cosmological infrared background using data from the *COBE*, 2MASS and *WIRE* programs.

As part of Medium-Scale Anisotropy Measurement – TOPHAT experiment, D. Fixsen (RSTX) participated in the design of several system elements and the development of a lightweight dewar necessary for high altitude, long duration balloon flights.

4. EDUCATION AND PUBLIC OUTREACH

S. Odenwald (RSTX) continues to work as the Education and Public Outreach Manager for the NASA *IMAGE* satellite program. During 1998, he worked with middle school teachers to design a new middle school math and science workbook entitled *Solar Storms and You!* which has been highly rated by curriculum evaluators and is now being widely distributed to interested teachers. He operates and maintains the *IMAGE* Education and Public Outreach website at

`http://image.gsfc.nasa.gov/poetry`

S. Odenwald is also a member of the NASA, OSS Sun-Earth Connection Education Forum and is the content developer of their web site at

`http://sunearth.gsfc.nasa.gov`

In May, W.H. Freeman published his book *The Astronomy Cafe: 365 questions and answers from Ask the Astronomer*, which is based on his award-winning web site at

`http://www2.ari.net/home/odenwald/cafe.html`

and has over 3000 FAQs about astronomy and space science. At the *IMAGE* web site, Odenwald's 'Ask the Space Scientist' contains over 1600 FAQs and he answers 20-30 new questions each day from students, teachers and the general public. He also works with the NASA QUEST program where he moderates an on-line program called 'The Sun Project'. He is currently working on a second book about solar storms and 'space weather' for the general public.

Brosius (RSTX) continued his Education and Public Outreach efforts by visiting several middle school science classes, and distributing copies of ''How Astronomers Use Spectra to Learn About the Sun and Other Stars.'' He also contributed this document, as well as summaries of SERTS science results, to NASA/GSFC's SERTS website. Brosius participated in GSFC's SUNBEAMS program by mentoring Gloria Allen, a District of Columbia public school science teacher.

`http://orpheus.nascom.nasa.gov/serts/`

PUBLICATIONS

Airapetian, V.S., **Ofman, L.**, Robinson, R., Carpenter, K., & Davila, J.M. 1997, ''Two-Component Winds from Luminous Late-Type Stars,'' BAAS, 29, 5

Arendt, R.G., Odegard, N., Weiland, J.L., Sodroski, T.J., Hauser, M.G., Dwek, E., Kelsall, T., Moseley, S., Silverberg, R.F., Leisawitz, D., Mitchell, K., Reach, W.T., & Wright, E.L. 1998, ''The *COBE* – DIRBE Search for the Cosmic Infrared Background: III. Separation of Galactic Emission from the Infrared Sky Brightness,'' ApJ, in press

Bilitza, D., ''International Reference Ionosphere - status 1995/96'' 1997, Adv. Space Res. 20, 1751

Bilitza, D., Bhardwaj, S. & Koblinsky, C. 1997, ''Improved IRI Predictions for the GEOSAT Time period,'' Adv. Space Res. 20, 1755

Bilitza, D., Koblinsky, C., Williamson, R. & Bhardwaj, S. 1998a, ''Improving the Topside Electron Density Model for IRI,'' Adv. Space Res. 22, 777

Bilitza, D., Hernandez-Pajares, M., Juan, M. & Sanz, J. 1998b, ''Comparison of the IRI and GPS-IGS derived electron content during 1991-97,'' Physics and Chemistry of the Earth, in press

Borne, K.D., Bushouse, H., Colina, L., & Lucas, R.A. 1997, ''An *HST* Imaging Survey of the Ultralumimous IR Galaxies: In Search of the Power Source,'' in *Extragalactic Astronomy in the Infrared*, eds. G.A. Mamon, T.X. Thuan, & J. Tran Thanh Van, p277

Borne, K.D., Bushouse, H., Colina, L., & Lucas, R.A. 1997, ''Morphological Similarities between HDF and Ultraluminous IR Galaxies,'' in *The Ultraviolet Universe at Low and High Redshift*, eds. W.H. Waller, M.N. Fanelli, J.E. Hollis, & A.C. Danks, p423

Borne, K., Bushouse, H., Colina, L., & Lucas, R.A., 1998, ''New Results from *HST* WFPC2 Images of Ultraluminous IR Galaxies,'' BAAS, 191, #21.02.

Borne, K.D., Bushouse, H., Colina, L., Lucas, R.A., Baker, A., Clements, D., Lawrence, A., Oliver, S., & Rowan-Robinson, M. 1998, ''Near-IR *HST* Imaging of Ultraluminous IR Galaxies,'' in *Astrophysics with Infrared Surveys: A Prelude to SIRTF*, in press

Borne, K.D., Bushouse, H., Colina, L., Lucas, R.A., Baker, A., Clements, D., Lawrence, A., Oliver, S., & Rowan-Robinson, M. 1998, ''Dynamics of Ultraluminous Galaxies,'' in *Galaxy Dynamics*, in press

Bowers, G.A., *et al.* 1998, ''Kinematics of the Nuclear Ionized Gas in the Radio Galaxy M84 (NGC4374),'' ApJ, 492, L111

Brosius, J.W., Davila, J.M., Thomas, R.J. & White, S.M. 1997, ''Coronal Magnetography of a Solar Active Region Using Coordinated SERTS and VLA Observations,'' ApJ, 488, 488

Brosius, J.W., Davila, J.M., Thomas, R.J., & White, S.M. 1997, ''The Measurement of Solar Active Region Properties with EUV Spectra and Spectroheliograms from SERTS,'' BAAS, 29, 1323

Brosius, J.W., Davila, J.M. & Thomas, R.J. 1998, ''Calibration of the SERTS-95 Spectrograph from Iron Line Intensity Ratios,'' ApJL, 497, L113

Brosius, J.W., Davila, J.M. & Thomas, R.J. 1998, ''Solar Active Region and Quiet-Sun EUV Spectra from SERTS-95,'' ApJS, in press

Brosius, J.W., Davila, J.M., Thomas, R.J. & White, S.M. 1998, ''Active Region Studies with SERTS: Calibration, Plasma Diagnostics, and Coronal Magnetography,'' Eos Suppl, 79, s290

Boardsen, S.A., Eastman, T.E., Sotirelis, T. & Green, J.L. 1998, ''An empircal model of the high latitude magnetopause,'' JGR, submitted

Brosius, J.W., & Woodgate, B.E. 1998, ''Using Temporal Variations of the Nonthermal Redshifted Lyman-Alpha Emission to Deduce Properties of Proton Beams Injected into a Stellar Atmosphere,'' ApJ, in press

Burrows, J.P., Weber, M., Hilsenrath, E., Gleason, J., Janz, S., **Cebula, R.P.**, Gu, X-Y & Chance, K. 1998, ''Global Ozone Monitoring Experiment (GOME): Comparison of backscattered measurements and O3 DOAS/BUV retrievals,'' in *Atmospheric Ozone*, eds. R.D. Bojkov & G. Visconti, p657

Bushouse, H., Colina, L., Lucas, R.A., & **Borne, K.D.** 1997, ''Simulations of *NGST* Observations of Ultraluminous IR Galaxies,'' in *Science with the Next Generation Space Telescope*, eds. E.P. Smith & A. Koratkar, p233

Cebula, R.P., & **DeLand, M.T.** 1998, ''Comparisons of the NOAA-11 SBUV/2, UARS SOLSTICE, and UARS SUSIM Mg II solar activity indexes,'' Solar Phys, 177, 117

Cebula, R.P., DeLand, M.T. & Hilsenrath, E. 1998, ''NOAA-11 Solar Backscatter Ultraviolet, model 2 (SBUV/2) solar spectral irradiance measurements 1989-1994, 1. Observations and long-term calibration,'' JGR, 103, 16, 235-16, 249

Cebula, R.P., Huang, L.-K. & Hilsenrath, E. 1998, ''SSBUV sensitivity drift determined using solar spectral irradiance measurements,'' Metrologia, in press

Cooper, J.F., Christian, E.R., & Johnson, R.E. 1998a, ''Heliospheric cosmic ray irradiation of Kuiper belt comets,'' Adv. Sp. Res., 21(11), 1611

Cooper, J.F., Mauk, B.H., Johnson, R.E. & Gehrels, N. 1998c, ''Energetic Ion and Electron Irradiation of the Icy Galilean Satellites,'' Science, submitted

Cooper, J.F., Sittler Jr., E.C., Maurice, S., Mauk, B. & Selesnick, R.S. 1998b, ''Local time asymmetry of drift shells for energetic electrons in the middle magnetosphere of Saturn,'' Adv. Sp. Res., 21(11), 1479

Cornett, R.H., Dorman, B. Smith, E.P., **Fanelli, M.A.**, Oegerle, W.R., Bohlin, R.C., Neff, S.G., O'Connell, R.W., Roberts, M.S., Smith, A.M. & Stecher, T.P. 1998, ''UIT Observations of the $z = 0.225$ Cluster Abell 2246,'' AJ, 116,44.

Davila, J.M., Thomas, R.J., **Brosius, J.W.** & Thompson, W.T. 1998, ''First Results from the November 1997 Flight of SERTS,'' Eos Suppl, 79, s289

DeLand, M.T., & **Cebula, R.P.** 1998a, ''Solar UV activity at solar cycle 21 and 22 minimum from NOAA-9 SBUV/2 data,'' Solar Phys, 177, 105

DeLand, M.T., & **Cebula, R.P.** 1998b, ''NOAA-11 Solar Backscatter Ultraviolet, model 2 (SBUV/2) solar spectral irradiance measurements 1989-1994, 2. Results, validation, and comparisons,'' JGR, 103, 16, 251-16, 273

DeLand, M.T., Cebula, R.P. & Hilsenrath, E. 1998a, ''Solar UV contribution to stratospheric ozone variations 1989-1994,'' in *Atmospheric Ozone*, eds by R.D. Bojkov & G. Visconti, p263

DeLand, M.T., Cebula, R.P. & Hilsenrath, E. 1998b, ''SSBUV and NOAA-11 SBUV/2 solar variability measurements,'' Studia geoph. et geod., 42, 83

Digel, S.W., Grenier, I.A., Hunter, S.D., Dame, T.M., & Thaddeus, P. 1997, ''Diffuse High-Energy Gamma-Ray

Emission in Monoceros,'' in *Proceedings of the Fourth Compton Symposium*, ed. C.D. Dermer, M.S. Strickman, & J.D. Kurfess, AIP Conf. Proc. 410 (New York: AIP), 1188

Digel, S.W., Grenier, I.A., Hunter, S.D., Dame, T.M., & Thaddeus, P. 1998, ''Diffuse High-Energy Gamma-Ray Emission in Monoceros,'' BAAS, 192, #40.14

Digel, S.W., Hunter, S.D., & Snowden, S.L. 1998, ''Tracing the Interstellar Medium in Ophiuchus Across 14 Orders of Magnitude in Frequency,'' in 179th IAU symposium, *New Horizons from Multi-Wavelength Sky Surveys*, ed B.J. McLean *et al.* (Dordrecht: Kluwer)

Dwek, E. & **Arendt, R.G.** 1998, ''A Tentative Detection of the Cosmic Infrared Background at 3.5 μm from *COBE*/DIRBE Observations,'' ApJ (letters), in press

Dwek, E., **Arendt**, R.G., Hauser, M.G., **Fixsen**, D., Kelsall, T., Leisawitz, D., Pei, Y.C., Wright, E.L., Mather, J.C., Moseley, S.H., **Odegard, N.**, Shafer, R., Silverberg, R.F., & **Weiland, J.L.**, 1998, ''The *COBE*/DIRBE Search for the Cosmic Infrared Background: IV. Cosmological Implications,'' ApJ, 508, in press

Eastman, T.E., **Boardsen, S.A.**, Chen, S-H., Fung, S.F. & Kessel, R.L. 1998, ''Configuration of high-latitude and high-altitude boundary layers,'' JGR, submitted

Evans, N.R., Robinson, R.D., Carpenter, K.G., Vinko, J,, **Massa, D.** & Wahlgren, G.M. 1998, ''Toward a Mass for the High Luminosity Cepheid T Mon'' BAAS, 192, #82.04

Falconer, D.A., Jordan, S.D., **Brosius, J.W.**, Davila, J.M. Thomas, R.J., Andretta, V. & Hara, H. 1998, ''Using Strong Solar Coronal Emission Lines as Coronal Flux Proxies,'' Sol. Phys., 180, 179

Fixsen, D.J., Weiland, J.L., Brodd, S., Hauser, M.G., Kelsall, T., Leisawitz, D.T., Mather, J.C., Jensen, K.A., Schafer, R.A., & Silverberg, R.F. 1997, ''Comparison of the *COBE* FIRAS and DIRBE Calibrations,'' ApJ, 490, 482

Fullerton, A.W., **Massa, D.**, Prinja, R.K., Owocki, S.P., & Cranmer, S.R. 1997, ''Wind variability of B supergiants. III. Corotating spiral structures in the stellar wind of HD 64760'' A&A, 327, 699

Fung, S.F., Tan, L.C., **Bilitza, D.**, Boscher, D., **Cooper, J.F.** & Spjeldvik, W.N. 1998, ''An investigation of the spatial variations of the energetic trapped electrons at low altitudes,'' Adv. Sp. Res. 21(12), 1661

Garcia, A., Jordan, S., **Brosius, J.** & Andretta, V. 1998, ''Observational Support for 'Velocity Redistribution' of He II Ions,'' Annales Geophysicae, Part III, Supp. III, 16

Gardner, J.P., *et al.* 1998, ''The STIS Parallel Survey: Introduction and First Results,'' ApJ, 492, L99.

Gass, J.E., Weiland, J.L., Schneider, G.L., Blackwell, J.H., Kargatis, V.E., Shaya, E.J., Cheung, C.Y., & White, R.A. 1998, ''Recent Enhancements to the Catalog Services of the ADC, BAAS, 192, 3803

Gioia, I.M., **Shaya, E.J.**, Le Fevre, O., Falco, E.E., Luppino, G.A., & Hammer, F. 1998, ''The Lensing Cluster MS 0440+0204 Seen by *HST*, *ROSAT*, and *ASCA*. I. Cluster Properties,'' ApJ, 497, 573

Grady, C.A., Perez, M.R., Bjorkman, K.S., **Massa, D.** 1997, ''The beta Pictoris Phenomenon in AB Aurigae'' 1997, BAAS, 191, # 47.01

Hammer, F., Gioia, I.M., **Shaya, E.J.**, Teyssandier, P., Le Fevre, O., & Luppino, G.A. 1997, ''Detailed Lensing Properties of the MS 2137-2353 Core and Reconstruction of Sources from Hubble Space Telescope Imagery,'' ApJ, 491, 477

Hauser, M.G., **Arendt, R.G.**, Kelsall, T., Dwek, E., **Odegard, N., Weiland, J.L., Freudenreich, H.T.**, Reach, W.T., Silverberg, R.F., Moseley, S.H., Pei, Y.C., Lubin, P., Mather, J.C., Shafer, R.A., Smoot, G. F., Weiss, R., Wilkinson, D.T., & Wright, E.L., 1998, ''The *COBE*/DIRBE Search for the Cosmic Infrared Background: I. Limits and Detections,'' ApJ, 508, in press

Heap, S.R., Brown, T.M., Hubeny, I., **Landsman**, W., Yi, S., **Fanelli, M.**, Gardner, J.P., Lanz, T., Maran, S.P., Sweigart, A., Kaiser, M.E., Linsky, J., Timothy, J.G., Lindler, D., Beck, T., Bohlin, R.C., Clampin, M., Grady, J., Loiacono, J., & Krebs, C. 1998, ''Ultraviolet Spectral Dating of Stars and Galaxies,'' ApJ, 492, L131

Hill, R.S., Fanelli, M.N., Smith, D.A., Bohlin, R.C., Neff, S.G., O'Connell, R.W., Roberts, M.S., Smith, A.M., & Stecher, T.P. 1998, ''Ultraviolet Imaging of the Irregular Galaxy NGC 4449 with the Ultraviolet Imaging Telescope: Photometry and Recent Star Formation History,'' ApJ, in press.

Holman, G., Dennis, B.R., Mariska, J.T., McTiernan, J., **Ofman, L.**, Petrosian, V., & Schwartz, R.A. 1998, ''A Numerical Package for Modeling Solar Flares and Interpreting HESSI Data,'' EOS Transactions Supplement, AGU, 79, 17

Howarth, I.D., Townsend, R.H.D., Clayton, M.J., Fullerton, A.W., Gies, D.R., **Massa, D.**, Prinja, R.K. & Reid, A.H.N. 1998, ''Time-dependent structure in ultraviolet absorption lines of the rapid rotators HD 64760 (B0Ib) and HD 93521 (O9.5V),'' MNRAS, 296, 949

Hutchings, J.R., *et al.* 1998, ''Gas Cloud Kinematics near the Nucleus of NGC4151,'' ApJ, 492, L115

Jaross, G., **Cebula, R.P., DeLand, M.**, Wellemeyer, C.G., Taylor, S.L., McPeters, R.D., Krueger, A.J., Bhartia, P.K., Hilsenrath, E. & Herman, J.R. 1998, ''BUV instrument solar diffuser degradation,'' Proc. SPIE Int. Soc. Opt. Eng., 3427, in press

Jenkins, E.B., *et al.* 1998, ''Ultraviolet Absorption Lines from High-velocity Gas in the Vela Supernova Remnant: New Insights from Space Telescope Imaging Spectrograph Echelle Observations of HD72089,'' ApJ, 492, L147

Kashlinsky, A. 1998, ''Reconstructing the Spectrum of the Pre-galactic Density Field from Astronomical Data,'' ApJ, 492, 1

Kelsall, T., **Weiland**, J.L., Franz, B.A., Reach, W.T., **Arendt**, R.G., Dwek, E., **Freudenreich, H.T.**, Hauser, M.G., Moseley, S.H., **Odegard, N.P.**, Silverberg, R.F., & Wright, E.L. 1998, ''The *COBE* – DIRBE Search for the Cosmic Infrared Background: II. Model of the Interplanetary Dust Cloud,'' ApJ, 508, in press

Kimble, R., *et al.* 1998, ''The On-orbit Performance of the Space Telescope Imaging Spectrograph,'' ApJ, 492, L83

Komjathy, A., Langley, R. & **Bilitza, D.** 1998, ''Ingesting GPS-derived TEC data into the IRI for Single Frequency Radar Altimeter Ionospheric Delay Corrections,'' Adv. Space Res. 22, 793

Landsman W., Bohlin, R.C., Neff, S.G., O'Connell, R.W., Roberts, M.S., Smith, A.M., & Stecher, T.P. 1998, ''The Hot Stars of Old, Open Clusters: M67, NGC 188, and NGC 6791,'' AJ, 116, 789

Leisawitz, D., **Digel**, S.W., Guo, Z., Mendez, B., & Hanson, M.M. 1998, ''A Study of the Infrared Spectral Energy Distributions of H II Regions,'' in Proc. *Star Formation with the Infrared Space Observatory*, ed. J. Yun & R. Liseau (San Fransisco: ASP), 101

G. Lu, **Tsyganenko, N.A.**, Lui, A.T.Y., Singer, H.J., Nagai, T. & Kokubun, S. 1998, ''A time-evolving magnetic field model for substorm studies,'' JGR, submitted

Luhmann, J.G., Russell, C.T. & **Tsyganenko, N.A.** 1998 ''Disturbances in Mercury's magnetosphere: Are the Mariner 10 ''substorms'' simply driven?,'' JGR, 103, 9113

Massa, D. 1998, ''The Mysterious Winds of the Main Sequence B Stars in NGC 6231,'' *Unsolved Problems in Stellar Evolution: The STScI 1998 May Symposium*, in press

Massa, D., Fullerton, A.W., & Prinja, R.K. 1998, ''Rotational Modulation of B Supergiant Winds'' 1998, in *Cyclical Variability in Stellar Winds*, eds L. Kaper & Fullerton (Springer: Berlin), p121

Massa, D. & Prinja, R.K. 1998a, ''A UV Survey of B Supergiants: Continuum Properties'' in in *Boulder-Munich II: Properties of Hot, Luminous Stars*, ed. I. Howarth, (ASP Conf. Ser.:San Francisco), p208

Massa, D. & Prinja, R.K. 1998b, ''UV Wind Variability in B Supergiants and its Implications for Wind Structures,'' in *Variable and Non-spherical Stellar Winds in Luminous Hot Stars*, IAU Coll. 169, in press

Massa, D., Van Steenberg, M.E., **Oliversen, N.** & **Lawton, P.** 1998, in ''Ultraviolet Astrophysics Beyond the IUE Final Archive,'' eds. Wamsteker and Riestra,'' (ESA SP-413, ESA Pubs. Div., Noordwijk, The Netherlands), p723

Moehler, S., **Landsman, W.**, & Napiwotzki, R. 1998, ''Hot UV bright Stars in Globular Clusters,'' A&A, 335, 510

Ofman, L. 1997, ''Excitation of Nonlinear MHD Waves in the Solar Wind by a Broad Band Alfvén Wave Source,'' EOS Transactions/Supplement, AGU, 78, 18

Ofman, L. 1997, ''Fast Solar Wind Acceleration by Nonlinear Waves in Coronal Holes,'' BAAS, 29, 5

Ofman, L., & Davila, J.M. 1998a, ''Solar Wind Acceleration by Large-amplitude Nonlinear Waves: Parametric study,'' JGR - Space Physics, 103, 23677

Ofman, L., & Davila, J.M. 1998b, ''Two-fluid 2.5D MHD Simulation of the Solar Wind in Coronal Holes,'' EOS Transactions/Supplement, AGU, 79, 17

Ofman, L., & DeForest, C.E. 1998, ''Numerical Simulations of Trapped Sound Waves in Solar Coronal Plumes,'' 32nd COSPAR Scientific Assembly, Advances in Space Research, submitted

Ofman, L., Klimchuk, J.A., & Davila, J.M. 1998, ''A Self-Consistent Model for the Resonant Heating of Coronal Loops: the Effects of Coupling with the Chromosphere', ApJ, 493, 474

Ofman, L., Kucera, T.A., Mouradian, Z., & Poland, A.I. 1998b, ''SUMER Observations of the Evolution and the Disappearance of a Solar Prominence,'' Solar Physics, in press

Ofman, L., Mouradian, A., Kucera, T.A., & Poland, A.I. 1998c, ''Observation of a Prominence Heating and the Heating Mechanism,'' IAU Colloquium 167, *New Perspectives on Solar Prominences*, eds. D. Webb, D. Rust, & B. Schmieder, (ASP Conf. Ser. 150), p159

Ofman, L., Nakariakov, V., & DeForest, C.E. 1998, ''Slow Magnetosonic Waves in Coronal Plumes,'' ApJ, in press

Ofman, L., Romoli, M., Poletto, G., Noci G., & Kohl, J.L. 1997, ''UVCS Observations of Density Fluctuations in the Solar Wind, ApJ, 491, L111

Ofman, L., Romoli, M., Poletto, G., Noci G., Kohl, J.L., Howard, R.A., St.Cyr, C., & DeForest, C.E. 1998a, ''*SOHO* Observations of Density Fluctuations in the Solar Wind,'' in *SOHO 7 Workshop: Coronal Holes and Solar Wind acceleration*, Northeast Harbor, Maine

Parker, J. Wm., **Hill, J.K., Cornett, R.H., Hollis, J.**, Zamkoff, E., Bohlin, R.C., O'Connell, R.W., Neff, S.G., Roberts, M.S., Smith, A.M. & Stecher, T.P. 1998, ''UIT Observations of the Magellanic Clouds,'' AJ, 116, 180

Prinja, R.K. & **Massa, D.** 1998, ''A UV Survey of B Supergiants: Time-Averaged Stellar-Wind Properties'' in *Boulder-Munich II: Properties of Hot, Luminous Stars*, ed. I. Howarth, (ASP Conf. Ser.:San Francisco), p218

Rawer, K. & **D. Bilitza** (ed.), ''Quantitative Description of Ionospheric Storm Effects and Irregularities,'' Adv. Space Res. 20, #9, 1997

Rawer, K. & **D. Bilitza** (ed.), 1997, ''Quantitative Description of Ionospheric Storm Effects and Irregularities,'' Adv. Space Res. 20, #9

Ruderman, M.S., Goldstein, M.L., Roberts, D.A., Deane, A. & **Ofman, L.** 1998, ''Alfvén Wave Phase Mixing Driven by Velocity Shear in Two-Dimensional Open Magnetic Configurations,'' JGR - Space Physics, submitted

Sahu, K.C., *et al.* 1998, ''Imaging and Spectroscopy of Arcs around the most Luminous X-Ray Cluster, RX J1347.5-1145,'' ApJ, 492, L125.

Schultz, A.B., *et al.* 1998, ''First Results from the Space Telescope Imaging Spectrograph: Optical Spectra of Gliese 229B,'' ApJ, 492, L181

Shaya, E., Kargatis, V., Blackwell, J., Borne, K., White, R.A., & Cheung, C. 1998, ''ADF/ADC Web Tools for Browsing and Visualizing Astronomical Catalogs and NASA Astrophysics Mission Metadata,'' BAAS, 192, #38.02

Shaya, E., Kargatis, V., **Borne, K.**, & White, R.A. 1998, ''IMage PeRimeters of Sky Surveys (IMPReSS): A Web Tool for Visualizing the Locations on the Sky of NASA Missions' Data,'' BAAS, 191, #57.05

Sonneborn, G., *et al.* 1998, ''Spatially Resolved STIS Spectroscopy of SN 1987A: Evidence for Shock Interaction with Circumstellar Gas,'' ApJ, 492, L139

Thompson, W.T., Thomas, R.J., Davila, J.M., Jordan, S.D. &

Brosius, J.W. 1998, ‘‘Coordinated Observations with *SOHO*/CDS and SERTS,’’ BAAS, 30

Tsyganenko, N.A. 1997, ‘‘An empirical model of the substorm current wedge,’’ JGR, 102, 19935

Tsyganenko, N.A. 1998, ‘‘Data-based models of the global geospace magnetic field: Challenges and prospects of the ISTP Era,’’ in: *Geospace Mass and Energy Flow: Results From the INternational Solar-Terrestrial Physics Program*, Geophysical Monograph 104, publ. by AGU, 371

Tsyganenko, N.A. 1998, ‘‘Modeling of twisted/warped magnetospheric configurations using the general deformation method,’’ JGR, 103, 23551

Tsyganenko, N.A. 1998, ‘‘Toward real-time magnetospheric mapping based on multi-probe space magnetometer data,’’ AGU Monograph on Science Closure and Enabling Technologies of the Constellation Mission, submitted

Tsyganenko, N.A., Karlsson, S.B.P., Kokubun, S., Yamamoto, T., Lazarus, A.J., Ogilvie, K.W. & Russell, C.T. 1998, ‘‘Global configuration of the magnetotail current sheet as derived from *GEOTAIL*, *Wind*, *IMP-8*, and ISEE 1/2 data,’’ JGR, 103, 6827

Tsyganenko, N.A., Le, G., Russell, C.T. & Iyemori, T. 1998, ‘‘A study of the inner magnetosphere, based on data of *POLAR*,’’ JGR, submitted

Tully, B. & **Shaya**, E. 1998, ‘‘Antibiasing: High Mass-to-Light Ratios in Dense Clusters,’’ in *Evolution of Large Scale Structures* (Garching), in press

Walborn, N.R., *et al.* 1998, ‘‘Space Telescope Imaging Spectrograph Observations of the Interstellar Velocity Structure and Chemical Composition toward the Carina Nebula,’’ ApJ, 492, L169

Weber, M., Burrows, J.P. & **Cebula, R.P.** 1998, ‘‘GOME solar UV/VIS irradiance measurements in 1995 and 1996-First results on proxy solar activity studies,’’ Solar Physics, 177, 63

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