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The following report covers activities from September 1997 through August 1998.

1. INTRODUCTION & PERSONNEL

Research in astronomy and the space sciences at USC is carried through in the Space Sciences Center and Department of Physics and Astronomy.

Scientists whose research is reported below include: 1) Space Science Center: Dr. Darrell L. Judge, Professor and Director of the Space Sciences Center, Dr. C. Y. Robert Wu, Research Professor, Drs. Geraldine J. Peters, Howard S. Ogawa, & Pradip Gangopadhyay, Research Scientists, Dr. Fang-Zhong Chen, Postdoctoral Fellow, & Donald McMullin, Project Manager, and 2) Department of Physics & Astronomy: Drs. Werner Däppen, Melvin Daybell, Professors, Tom Hung, graduate student, and Dr. Gibson Reaves, Professor Emeritus.

2. RESEARCH

W. Däppen continued his research on using the sun as a plasma physics laboratory. To pursue this goal, he participates in state-of-the-art solar modeling and the analysis of helioseismic data. Helioseismology is the first accurate "experiment" that puts strong constraints on the thermodynamic quantities of the plasma of stellar interiors. His own contribution to the field [the Mihalas-Hummer-Däppen (MHD) equation of state] is currently being used in collaboration with several international solar and stellar modeling groups. His most recent attention is devoted to the subtle thermodynamic effects of excited states in atoms and ions of the solar interior. Such effects have indeed been detected by helioseismology, and they have to be taken into account in the determination of the helium abundance of the solar convection zone.

H. S. Ogawa, M. Daybell, D. R. McMullin, and D. L. Judge have continued their work on solar EUV irradiance observations from sounding rockets, the Shuttle, and satellites. Various instruments have been and are being utilized to obtain absolute solar EUV flux data. These include Rare Gas Ionization Cells (RGIC) to obtain absolute integral irradiance in a wavelength region shortward of the ionization limit of the working gas used, Double Ionization Cells (HDIC) to obtain photoionization rates of Helium and Neon, Free Standing and Film Deposited Photodiodes to obtain absolute flux within the wavelength band pass of the metal filter used, an Optics Free Spectrometer (OFS) to obtain spectral irradiance data in the EUV and soft X-ray region, a low resolution ($< 10 \text{ \AA}$) normal incidence spectrometer, and a solar EUV Monitor (SEM) to obtain absolute solar EUV irradiance that has been securing high quality data for two years aboard the SOHO spacecraft. The calibration of this instrument has now been determined from the data obtained from two sounding

rocket underflights (1996 June 26 and 1997 August 11). A small change in efficiency in the first order channel and a less than 5 % change in the efficiency of the central order channel have been determined and will be reported in a forthcoming paper. [A complement of solar EUV instrumentation is aboard the STS-95 ("John Glenn") Shuttle flight and is currently obtaining quality data.] We have also recently obtained good news about the SOHO spacecraft. All contact with SOHO was lost on June 24 of this year. However, contact was regained in August and the EUV detector CELIAS/SEM became fully operational on October 25 and is now collecting high quality data.

In a recent paper, H. S. Ogawa, D. L. Judge, D. R. McMullin, P. Gangopadhyay, and A. B. Galvin present data obtained from the SEM spectrometer which is continuously monitoring the solar irradiance in an 8-nm wavelength band centered at 30.4 nm (first order), and in a broad wavelength band between 0.1 and 77 nm (central order). The data show evidence of persistent solar EUV/soft X-ray active regions throughout the solar minimum period which gives rise to both 27-day and short-term (minutes to hours) solar EUV irradiance variations.

P. Gangopadhyay, H. S. Ogawa, D. R. McMullin and D. L. Judge are currently working in the extraction of 0.1 to 8 nm soft X-ray data from the SEM central channel. The extracted soft X-ray data are being compared with the GOES 0.1 to 0.8 nm soft X-ray data.

G. J. Peters continued a study of short- and long-term wind variability in Be stars using NEWSIPS data from the *IUE* archives and *Voyager UVS* spectrophotometry. Results were summarized in two talks entitled "Cyclic Variability in Be Star Winds: The Observations" and "Evidence for Azimuthal Asymmetry in Be Star Winds" presented at the ESO Workshop on "Cyclical Variability in Stellar Winds" in Garching bei München, Germany in 1997 October and "Variable and Non-Spherical Stellar Winds in Luminous Hot Stars (IAU Colloquium 169)" in Heidelberg, Germany in 1998 June.

Peters continued to serve as Editor-in-Chief of the *Be Star Newsletter*, a periodical published for the Working Group on Active B Stars of the IAU Division IV (Stars) in both paper (D. R. Gies, Georgia State University, technical editor) and electronic (<http://www.limber.org/benews/>, D. McDavid, technical editor) editions.

G. J. Peters also continued to investigate the circumstellar material in Algol binary systems. Peters and R. S. Polidan (GSFC) completed an initial study of the FUV spectra (900–1220 \AA) of five Algols (AU Mon, Z Vul, U CrB, TX UMa, and TT Hya) that were observed with the Berkeley spectrometer during the ORFEUS-SPAS II mission on STS-80. Peters combined ORFEUS data on AU Mon with NEWSIPS data from the *IUE* archives to complete a study of the long-term disk & photospheric variability in this system.

G. J. Peters and J. A. Grigsby (Wittenberg Univ.) continued a study of the abundances of the iron group elements in the ultrasharp-lined early B stars ι Her, HR 1886, and HR 1887 using coadded high resolution *IUE* data, the Kurucz SYNTHE code, and Kurucz model atmospheres. The abundances of all iron group species appear to be generally lower than the solar values, however Co & Ni are significantly depleted in ι Her. Peters, J. Cassinelli, and D. Cohen (Univ. Wisconsin) began an investigation of variability in the EUV spectrum of β CMa (B2 II) throughout its 49 day beat period. Five observations made with the EUVE spectrometers during a single beat period will allow us to accurately determine the periods and amplitudes of the star's three pulsation components, constrain the temperature variations, and assess the extent to which shocks from pulsations drive the wind and cause the excess in the Lyman continuum.

G. Reaves continues his study of dynamical problems related to asteroids. He attended the San Diego meeting of the AAS, gave a paper there summarizing the early activities of the AAS Committee on Education and, while in San Diego, used the Zinner Collection on the history of astronomy at San Diego State University. Reaves also continues as an active member of the Lowell Observatory Advisory Board.

C. Y. Robert Wu has continued his work with F. Z. Chen, D. L. Judge, and other collaborators to obtain (1) temperature-dependent cross sections of allene, methylacetylene, and benzene in the UV region, (2) temperature-dependent cross sections of gaseous and liquid H₂O and D₂O in 1600–1800 Å region, and (3) ultrahigh resolution (FWHM = 0.003), high (555 K), and room temperature (295 K) absorption cross-sections of O₂ in the 834 Å region. Much of the above data have been analyzed and will be made available to the planetary community. The data have been applied in modeling various planetary atmospheres such as Earth, Saturn, Mars, Io, Titan, Jupiter, and Neptune and in the evaluation and modeling of the effect of the recent Comet SL-9 impact on Jupiter's atmosphere.

Wu, F. Z. Chen, T. Hung, and D. L. Judge have continued their studies of fluorescence produced through photoexcitation of CO in the 28-100 eV region. They have observed, for the first time, fluorescence processes correlated with excited electronic states of doubly and triply-charged molecules. This observation was possible because the newest, brightest tunable synchrotron radiation source available at the Photon Factory, Tsukuba, Japan, was employed in the experiment.

Wu, Chen, and P. Scoggins have continued their investigation of the absolute solar photon sputtering/desorption yield of H₂O ices, D₂O ices, and CH₄ clathrate hydrates in the inner valence and core electron regions using intense tunable VUV photon source provided by synchrotron radiation.

PUBLICATIONS

The publication list includes all papers published or submitted between 1997 September 1 & 1998 August 31 by permanent staff.

Arndt, S., Däppen, W., & Nayfonov, A., 1998, "On Density and Temperature-Dependent Ground-State and Con-

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Basu, S., Däppen, W., & Nayfonov, A., 1998, "Helioseismic Signature of the Presence of Excited States in the Adiabatic Exponent," in *Structure and Dynamics of the Interior of the Sun and Sun-Like Stars*, ed. S.G. Korzennik & A. Wilson, ESA SP-418 (Noordwijk: ESA), in press.

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