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This report covers departmental activities for the period October 2002 through September 2003.

1. INTRODUCTION

The astronomy and astrophysics program at the University of Colorado exists within the structure of the Astrophysical and Planetary Sciences Department (APS), with its affiliated units – the Center for Astrophysics and Space Astronomy (CASA), the Joint Institute for Laboratory Astrophysics (JILA), and the Laboratory for Atmospheric and Space Physics (LASP). Previous Observatory Reports provide details on the organizational arrangement.

The APS Department offers an academic program leading to the PhD degree in a variety of areas of astrophysics and planetary sciences. Students obtain basic theoretical knowledge common to these related fields, before specializing. The department has developed a new undergraduate Astronomy degree, with two tracks (General Astronomy and Astrophysics/Physics). We now have 111 declared undergraduate majors and 49 graduate students. Our 24 faculty and 90 researchers have active research programs funded by NASA, NSF, and DOE.

In this year's report covering 2002-2003, we emphasize new developments and recent publications specifically within APS, CASA, JILA and its membership. In astrophysics, particular strengths of CASA lie in hot and cool stars, interstellar and intergalactic matter, galaxy formation, quasars, clusters, high-energy astrophysics, solar physics and UV/Xray/IR/sub-mm instrumentation. Particular strengths of JILA include theoretical studies of black holes and accretion flows, formation of stars and planetary systems, supernovae and supernova remnants, helioseismology, solar magnetism, stellar atmospheres, and astrophysical fluid dynamics.

2. SCIENTIFIC DEVELOPMENTS

2.1 Instrumentation

The Far Ultraviolet Spectroscopic Explorer (FUSE) mission was launched in summer 1999. The FUSE spectrograph was designed and built at CASA in a five year effort led by Dr. James Green. Other members of the FUSE science team are CASA astronomers Drs. Cash, Shull, and Snow, and JILA astronomer Dr. Linsky. The mission is an unqualified success, and many CASA professors, researchers, graduate and undergraduate students are deeply involved with the analysis of FUSE data. The CASA hardware team now is progressing well on the development of the Cosmic Origins Spectrograph (COS), to be installed in NASA's Hubble Space Telescope in 2005 or 2006. The powerful ultraviolet instrument has just been completed, in collaboration with Ball Aerospace and Technologies Corporation in Boulder. COS will bring the diagnostic power of UV spectroscopy to bear on such fundamental issues as the ionization and baryon content of the intergalactic medium and the origin of large-scale structure in the Universe; the ages, dynamics, and chemical enrichment of galaxies; and stellar and planetary origins. COS will build on the legacies of Copernicus, IUE, GHRS, FOS, STIS, and FUSE, giving HST the greatest possible grasp of faint UV targets, ensuring that Hubble retains a powerful UV spectroscopic capability through the end of its mission.

CASA also supports three instrumental programs in infrared, sub-millimeter, and millimeter-wave astronomy. Dr. Jason Glenn's programs focus on developing bolometer arrays (Bolocam) for mm-wave and sub-mm studies of high-redshift galaxies and star formation, used on the Caltech Submillimeter Observatory and on the Herschel/FIRST satellite later this decade. Drs. Albert Betz and Rita Boreiko work on far-infrared instrumentation for studies of star-forming regions. APS and CASA also are building a near-infrared camera and Fabry-Perot spectrograph (NIC-FPS) for installation on the Apache Point 3.5-meter telescope.

2.2 Space Astronomy

CASA astronomers continue intensive use of NASA spacecraft. In 2002-03, there were awards from the Hubble Space Telescope (HST), FUSE, Chandra, XMM, and Herschel/FIRST. Grants were received from other NASA programs including Astrophysics Theory, Origins of Solar System, Astrophysics Data, Long-Term Space Astrophysics, and High Energy Astrophysics.

2.3 Groundbased Astronomy

The Department of Astrophysical and Planetary Sciences, including CASA, has entered into a ground-based telescope consortium (ARC) at the 3.5-meter Apache Point Observatory in southern New Mexico. CU observing programs include studies of clusters of galaxies, stellar outflows, hot stars and the ISM. These and future observing runs on interstellar matter, infrared galaxies, and planets include undergraduate and graduate students in the observations and data analysis. CASA also is developing a near infrared camera to be installed on the telescope in 2004. APS scientists continue to make extensive use of other national ground-based optical and radio facilities for solar, stellar, interstellar, and extragalactic research.

2.4 Theoretical Astrophysics

Colorado has one the nation's premier programs in astrophysical theory. Our research groups are working on such topics as interstellar and intergalactic matter, cosmology (large-scale structure, galaxy formation, reionization by first stars/AGN), formation of stars and planetary systems, black holes and AGN, helioseismology and solar dynamo, plasma astrophysics, supernovae, and stellar atmospheres. Our faculty and researchers have strong funding for theoretical graduate students and postdocs.

3. EXAMPLES OF INDIVIDUAL RESEARCH BY TOPIC

3.1 Active Galactic Nuclei

Using UV, optical and X-ray observations Dr. Nahum Arav is studying a wide range of AGN outflow phenomena both in terms of luminosity (broad absorption line quasars to Seyfert galaxies) and in the degree of ionization (neutral atoms to X-ray warm absorbers). Dr. Arav is particularly interested in determining: the connection between the UV and X-ray warm absorbers seen in Seyfert outflows, and the chemical abundances, acceleration mechanism and kinetic luminosity of the outflows. These determinations provide the foundation for the long-range goal of his research program: Establishing the effects of AGN outflows on the growth and evolution of their host galaxies. His approach to research combines a strong theoretical background with detailed technical understanding of the observations to maximize the extraction of scientific knowledge from the data. Recently, Jack Gabel joined Dr. Arav's group as a postdoc.

3.2 Cosmology and Galactic Formation

Dr. Nick Gnedin continued his work on numerical modeling of early universe. He has been collaborating with Dr. A. Kravtsov from the University of Chicago in developing next generation cosmological numerical codes based on the Adaptive Mesh Refinement technique. With G. Harford he investigated the properties of simulated galaxies and compared them with the observational data at intermediate redshifts. Gnedin continued his work with K. Kohler on developing methods for modeling the effect of bright quasars on reionization of the universe. He also is collaborating with the group of theoretical astrophysiscs at the Institute of Astronomy (Cambridge, England) on modeling properties of first cosmological black holes.

Dr. Michael Shull's research group works on a wide range of theoretical and space-observational topics connected with the interstellar medium (ISM), intergalactic medium (IGM), and galaxy formation. With students and postdocs, his recent work includes theoretical models of the first stars and quasars and their effects on reionizing the IGM in hydrogen and helium, and on radiation feedback from galaxy formation. Shull, Gnedin, and Ricotti have investigated the radiative feedback from galaxy formation through the formation/destruction of H_2 by the first stars. Shull and recent PhD Jason Tumlinson studied the structure and ionizing radiation from the first stars. With postdoc Aparna Venkatesan and Tumlinson, he studied the effects of high-redshift quasars and low-metallicity stars on IGM reionization and the optical depth of the microwave background. With colleagues John Stocke and Steve Penton, Shull has investigated the baryon census of the IGM associated with the low-redshift Lyman-alpha forest. With Mark Giroux (CASA and East Tennessee State) and Tumlinson, Shull is investigating He II reionization, multi-phase intergalactic gas, and the metallicity of the IGM.

Dr. Aparna Venkatesan (NSF Astronomy and Astrophysics Postdoctoral Fellow) has continued her research on the evolution of cosmic stellar activity and its feedback on the intergalactic medium (IGM) and the cosmic microwave background (CMB). Venkatesan, in collaboration with Jason Tumlinson (now at The University of Chicago) and J.M. Shull, recently wrote two papers on the cosmological consequences of the first metal-free stars, which have unusually hard ionizing spectra. The study by Venkatesan, Tumlinson & Shull (2003) is the first to examine in detail the effects of such stars on the hydrogen and helium reionization of the IGM. In Venkatesan (2002), she proposed the use of an independent measurement of the reionization epoch, as well as of a reionization model, to break degeneracies in CMB parameter extraction and to improve constraints from the WMAP satellite data. With Keiichi Wada (National Astronomical Observatory of Japan), Venkatesan investigated the feedback from the first supernovae in high redshift galaxies, which has important consequences for the duration and detectability of metal-free star formation in the early universe. In addition, she showed that the case for first stars preferably forming with very large masses, a currently popular scenario, is weakened significantly when considering their ionizing efficiency in association with their large metal yield (Venkatesan & Truran 2003), or when considering the enrichment patterns in QSO broad emission-line regions (Venkatesan, Schneider & Ferrara 2003, in preparation). Her current research collaborations include: ongoing projects with Tumlinson and Shull on reionization and metal enrichment from the first stars, follow-up studies with Wada and Truran on feedback from the first stars and supernovae, and analysis of the metallicity of low-redshift IGM absorbers with the Colorado group.

3.3 Galaxies

Work by Jack Burns and Patrick Motl at CU for the year have included extensive efforts in the simulation of clusters of galaxies as well analysis of Chandra observations, in particular the poor cluster of galaxies AMW7. In terms of the simulations, they have pushed the spatial resolution to the level of approximately 1 kpc (in a simulation volume 256 Mpc on a side) and have extensively studied the impact of radiative cooling and star formation and supernova feedback on cluster properties. Presentations of their work were made by collaborator Michael Norman (University of California, San Diego) in a contributed talk at the second Carnegie Centennial symposium titled ''Numerical Simulation of Galaxy Clusters with Star Formation, Feedback and Chemical Enrichment'' and in a poster by Patrick Motl, ''The Form and Evolution of Cluster Correlations in Numerical Samples of Galaxy Clusters'' 2003, (http://www.ociw.edu/ociw/

symposia/series/symposium3/proceedings.html). Jack Burns gave an invited talk at the University of Virginia conference, ‘‘The Riddle of Cooling Flows in Galaxies and Clusters of Galaxies’’ titled ‘‘On the Formation of Cool, Non-Flowing Cores in Galaxy Clusters via Hierarchical Mergers’’ (http://www.astro.virginia.edu/coolflow/; astro-ph/ 0309836) and Patrick Motl presented a poster at the same meeting titled ‘‘The Impact of Star Formation on Cool Core Galaxy Clusters’’ (astro-ph/0309828). Motl also presented a talk at the workshop ‘‘Cosmology with SZ Surveys’’ hosted by the Center for Cosmological Physics at the University of Chicago (http://cfcpwork. uchicago.edu/workshops/sz03/talks/motl/index.html). Publications for the year include ‘‘A Universal Temperature Profile for Galaxy Clusters’’ by Chris Loken (CITA), Michael Norman, Erik Nelson (UCSD), Jack Burns, Greg Bryan (University of Oxford) and Patrick Motl (2002, ApJ, 579, p571), ‘‘The Formation of Cool Cores in Galaxy Clusters via Hierarchical Mergers’’ by Patrick Motl, Jack Burns, Chris Loken, Michael Norman and Greg Bryan in press with the Astrophysical Journal (astro-ph/0302427), and ‘‘Simulated versus Observed Cluster Eccentricity Evolution’’ by Steven Floor (University of Kansas), Adrian Melott (University of Kansas) and Patrick Motl (submitted to the Astrophysical Journal, astro-ph/0301547).

3.4 Galactic Astronomy

Dr. Philip Maloney worked on a variety of topics over the past year. In collaboration with Chris Reynolds (UMd), he analyzed a moderately deep CHANDRA X-ray observation of the edge-on spiral galaxy NGC 5775; this observation clearly detected luminous diffuse emission, as well as some remarkably hard point sources. Maloney and Reynolds are also analyzing a CHANDRA observation of NGC 1808, a galaxy that exhibits a powerful superwind. With Kazushi Iwasawa (IoA), he collaborated on the analysis of a short CHANDRA observation of the galaxy IC 2560, which exhibits luminous water megamaser emission. These data clearly show that the source is seen only in reflection and possesses one of the largest EW Fe iron lines ever measured. Masatoshi Imanishi, Chris Dudley and Maloney have continued their study of ultraluminous infrared galaxies using 3-4 micron spectroscopy. Maloney has been working on new models of CO and dust emission from high-redshift galaxies. He also has been collaborating with Jason Glenn (CU) and other members of the Bolocam team on the development and testing of data analysis and mapping algorithms and software, for both Galactic and extragalactic data sets.

Dr. Jessica Rosenberg continues her work on the connection between galaxies and the intergalactic medium, and the properties of gas-rich galaxies in the local universe. Rosenberg has been involved with an HST archive study of low redshift Lyman-alpha absorbers that have high resolution spectra. This project has included work, in collaboration with Ganguly, Giroux, and Stocke, of an intriguing pair of quasars at the edge of the Virgo Supercluster which exhibit 10 absorbers in the velocity range of the cluster. In Rosenberg *et al.* (2003) they show that these sightlines, only one of which seems to have a nearby galaxy, indicate that there might be many small clumps of metal-enriched gas that are coherent along a filament stretching over at least 350 kpc. In collaboration with Stocke, Keeney, McLin, Weymann, and Giroux, Rosenberg also has been involved in a study of the post-starburst galaxy found near one of these sightlines and its associated Lyman-alpha and metal lines seen in absorption at the quasar. Rosenberg and Putman have initiated a search for gas-rich galaxies near low redshift absorbers. They have taken several hundred hours of 21cm observations using Arecibo, the VLA, Parkes, and the ATCA telescopes around the sightlines towards 30+ nearby Lyamn-alpha absorbers to derive a statistically significant sample for investigation.

3.5 Interstellar Astronomy

Dr. Joe Collins’ research (with Shull and Giroux) attempts to understand the origin of the high-velocity clouds (HVCs) seen in HI emission and UV absorption lines. Towards this goal, he has completed a survey of sightlines through HVC Complex C utilizing archival FUSE and HST data. Results of this survey indicate that Complex C is likely a mixture of infalling material from the intergalactic medium (IGM) and ejecta from the Galactic disk. More recently, his research has centered around a class of highly-ionized HVCs that are not detected in H I. It has been proposed that such objects may trace shock-heated remnants of Local Group formation in the IGM. A paper investigating such objects in the PKS 2155-304 and Mrk 509 sightlines has recently been submitted (Collins, Shull, and Giroux 2003), and concludes that these objects are low column density analogs to the H I HVCs in the Galactic halo. In order to better understand the population as a whole, he currently is investigating the ionization and kinematics of a larger sample of these highly-ionized HVCs.

Dr. Charles Danforth is involved in several ongoing studies of the ISM and IGM. With Shull, he is assembling an archive of extragalactic FUSE observations to measure Lyβ, OVI, and other far-UV lines in low-redshift absorbers along the lines of sight to distant AGNs. This work will provide important data on the metallicity, density, and thermal conditions in the local IGM and help relate observations of the higher-redshift universe to more modern conditions. Charles also is continuing research into the structure and kinematics of the warm-hot ISM in the Magellanic Clouds using a large set of FUSE observations he put together for his dissertation. These sight lines probe many different ISM structures in the Clouds including superbubbles, supergiant shells, H II regions and supernova remnants and sample regions of dramatically differing ionization and depletion.

Dr. Mary Putman currently is working on a number of projects to trace the gaseous component of galaxy halos. With John Stocke and Jessica Rosenberg the environment of low-redshift absorbers is being surveyed to determine the connection between galaxies and the intergalactic medium. The ionization and enrichment of galaxy halos is being investigated in collaboration with Emma Ryan-Weber (U. Melbourne), Gerhardt Meurer (JHU), and Ken Freeman (ANU) by observing halo H II regions discovered in the Survey for Ionization in Neutral Gas Galaxies (SINGG). Dr. Putman is also tracing the gaseous trail of the Sagitarius dwarf galaxy with the northern extension of the HI Parkes All-Sky Survey (HIPASS). Finally, she is planning future surveys with the Arecibo L-Band Feed Array (ALFA) with a large collaboration of international scientists to survey the high-velocity clouds around our Galaxy and others.

Dr. Brian Rachford continues his involvement in numerous observational studies of gas and dust in the interstellar medium. This work includes studies of abundances and physical and chemical conditions in heavily reddened lines of sight with in collaboration with T. Snow; a major study of the diffuse interstellar bands led by D. York at the University of Chicago; and a study of ultraviolet dust extinction led by G. Clayton at Louisiana State University.

Dr. Michael Shull's observational work includes studies with Hubble Space Telescope and FUSE on a variety of topics: interstellar molecular hydrogen, hot interstellar gas (O VI), interstellar deuterium, metallicity of high-velocity clouds, the distribution, baryon content, and metallicity of low-redshift Lyman-alpha forest, and intergalactic He II absorption at redshifts $z = 2\text{-}3$.

Shull is a member of the Science Teams for FUSE, the Cosmic Origins Spectrograph on Hubble, and the SPIDR Small Explorer Mission (to study diffuse emission from the ISM and IGM). He also is a member of study teams for the Constellation-X (X-ray spectroscopy) and Space Ultra-Violet Observatory (SUVO) missions.

Dr. Ted Snow's research continues to be centered on the interstellar medium, with emphasis on the densest clouds that can be explored using absorption-line techniques, lab studies of chemical reactions, and his perennial favorite topic, the diffuse interstellar bands (DIBs). Snow's activity in the past year was divided among three general areas: ultraviolet studies of interstellar gas using data from the FUSE satellite; laboratory measurements of ion-neutral reactions of astrophysical importance; and an extensive team survey of the DIBs, using data from the ARC 3.5-m telescope. Snow also is a member of the Science Team for Colorado's Cosmic Origins Spectrograph (COS), which will be installed aboard the Hubble Space Telescope after the Space Shuttle resumes operations, and is responsible for studies of dense interstellar clouds based on UV spectra from this instrument. Time was spent in 2002-2003 planning this observing program.

Snow's FUSE-based research completed in 2002-2003 included a broad survey of molecular hydrogen abundances (see the Rachford *et al.* reference below) and a study of interstellar H_2 in the Magellanic Clouds (Tumlinson *et al.* 2002). In addition, Snow, Rachford, and Figoski (2002) completed an analysis of the depletion of iron from the gas onto dust, again using data from FUSE. Additional FUSE studies are under way, to measure molecular hydrogen in different environments, to determine the abundance and dust depletion of oxygen making use of far-UV transitions, and to determine the possible abundance of the negative ion H^- in space (Baker *et al.* 2003, in preparation).

Snow's lab astro program, carried out in collaboration with V. M. Bierbaum of Colorado's Department of Chemistry and Biochemistry, yielded important results during the 2002-2003 period. A comprehensive modeling paper for the ionization and hydrogenation of complex organic molecules in the interstellar medium, specifically the polycyclic aromatic hydrocarbons (PAHs), was completed (Le Page *et al.* 2002), and was based largely on chemical reaction rates measured in the lab. Additional studies of carbon chain ion-neutral reactions and of generalized ion-neutral (Langevin) reactions also were completed (Eichelberger *et al.* 2003a,b; in preparation). At this writing, Snow's lab program is completing carbon chain anion measurements and gearing up for the study of large PAH cation reactions with neutrals.

In DIBs research, Snow has been involved in several studies, some based on data from the ARC telescope and others derived from observations made elsewhere. Utilizing data obtained at Kitt Peak and at the Anglo-Australian Telescope, Snow completed two studies of the strongest DIB at 4428 Å, finding that this band has no internal fine structure, and that its profile is invariant and fits a Lorentzian profile, suggesting that this spectral feature is formed by a molecule having very short-lived excited states (Snow 2002; Snow, Zukowski, and Massey 2002). In the first, of what will be a series of DIBs papers based on the ARC consortium study led by Don York (University of Chicago), Snow authored a study of the unusual DIBs toward the star HD 62542, and was a co-author on a paper discussing DIBs associated with diatomic carbon (C_2; Thorburn *et al.* 2003). As part of another consortium using the European Southern Observatory's Very Large Telescope, Snow was co-author of a first paper on DIBs in the Magellanic Clouds. Ongoing work in the DIBs programs include a comprehensive atlas of DIBs observed at ultra-high S/N using the ARC telescope (York *et al.* 2003a, in preparation), studies of correlations between the DIBs and atomic and molecular hydrogen (York *et al.* 2003b, in preparation); correlations among the DIBs (McCall *et al.* 2003, in preparation); and an analysis of probably molecular rotational excitation effects in the DIBs formed in one particularly hot interstellar cloud. Snow also is pursuing extragalactic DIBs, in the Magellanic Clouds and out to high redshifts, as a means of determining when organic material first appeared in the universe.

3.6 Millimeter Astronomy

Dr. Jason Glenn is involved in millimeter-wave astronomy and instrumentation. His main efforts over the past year have been observations with Bolocam design of Z-spec, and testing of feedhorn arrays SPIRE on the Herschel Space Observatory. Bolocam is a large-format, millimeter-wave bolometer camera built by a collaboration including CU, Caltech, the University of Massachusetts, and the University of Wales. He has commenced a survey with Bolocam at the Caltech Submillimeter Observatory for galaxy clusters via the Sunyaev-Zel'dovich effect, a survey for submillimeter galaxies via their dust emission, and a map of the Galactic

Center. Z-Spec is a millimeter-wave grating spectrometer for measuring the redshifts of submillimeter galaxies and serves as a demonstration of a compact waveguide-coupled grating for a future far-infrared orbital mission. Glenn is building it in collaboration with JPL, Caltech, ISAS in Japan, and CEA in France. Prototype submillimeter feedhorn numerical simulations and testing for the SPIRE bolometer array instrument on the ESA Cornerstone Herschel Space Observatory is nearly complete. Glenn recently has joined the Atacama Cosmology Telescope project for measuring secondary anisotropies in the cosmic microwave background.

3.7 Star Formation

Work in Dr. John Bally's group has focused on determining the role of protostellar outflows in star formation feedback. They have used the wide field MOSAIC imagers at Kitt Peak and Cerro Tololo to survey several nearby molecular clouds in narrowband filters looking for shocks from protostellar outflows. They have cataloged dozens of new shocks and are using these data to determine whether shocks can drive turbulence within the molecular cloud. Bally also has successfully proposed for a narrowband survey of the Orion Nebula using the Hubble Space Telescope (HST). With the superior resolution of HST, this survey will complement their groundbased data and will provide a census of the protoplanetary disks in Orion.

Dr. Nathan Smith's studies of star formation have focussed mainly on investigations of the Carina nebula, which is the giant H II region where Eta Carinae resides. Until the past few years, the Carina nebula was assumed to be an evolved H II region mostly devoid of star formation, but recent work in collaboration with Dr. Bally (CU) and Dr. Morse (CU and now ASU) has revealed several signposts of active star formation, including the discovery of the first stellar jets in Carina, embedded infrared sources, and numerous small cocoons that may harbor young stars and protoplanetary disks.

3.8 Stellar Astronomy

Dr. Stephen Skinner's research focuses on observational studies of star-forming regions, Wolf-Rayet (WR) stars, and solar-like stars using a variety of space and ground-based telescopes. In addition, he continues to serve as editor of CoolNews, a monthly electronic research newsletter on cool stars distributed to more than 700 astronomers and institutions worldwide.

During 2003, Skinner completed a Chandra X-ray study of the young embedded infrared cluster in NGC 2024 (Orion B), in collaboration with Dr. Marc Gagne (West Chester Univ.). This cluster is less than a million years old and contains several hundred embedded young stars, almost all of which are still surrounded by disks. Skinner currently is analyzing Chandra data of massive young O-type stars in the Sigma Orionis cluster and the young southern cluster NGC 6193 in the Ara OB1 association. The goal of this study is to determine the physical mechanisms that produce X-rays in massive young stars, with emphasis on distinguishing between X-rays arising in shocked winds and higher-temperature emission that could originate in magnetically-confined plasma. Skinner also is undertaking the first systematic survey of X-ray emission from single (non-binary) WR stars using the Chandra and XMM-Newton observatories. He continues to collaborate extensively with Dr. Manuel Guedel (Paul Scherrer Inst., Switzerland) on a variety of observations of star-forming regions. During 2003 - 2004, Skinner will participate in a large international effort led by Guedel which will use the XMM-Newton observatory to undertake the most detailed X-ray survey to date of star-formation in the Taurus-Auriga molecular clouds. During 2004, Skinner will also begin a search for accretion-induced X-rays in FU Orionis stars using XMM-Newton. These young stars undergo rapid optical brightenings that are thought to be due dramatic increases in the accretion rate through a circumstellar disk.

Dr. Nathan Smith has concentrated on observational studies of star formation and mass loss from evolved stars. To study mass loss from evolved stars, he has been using UV and visual spectroscopy and imaging with HST, combined with ground-based optical, near-infrared, and thermal-infrared imaging and spectroscopy. The goal of this work is to constrain the geometry, excitation, abundances, and mass of circumstellar nebulae, and the physical properties of stellar winds. In addition to some planetary nebulae, the primary objects of interest have been evolved massive stars like Luminous Blue Variables, especially the enigmatic massive star Eta Carinae.

3.9 Ultraviolet Astronomy

Dr. Erik Wilkinson is the Project Scientist for the HST Cosmic Origins Spectrograph. The HST COS instrument is a fourth generation instrument for the Hubble Space Telescope that will be installed during the next servicing mission to the HST. Once installed, COS will the be most sensitive UV spectrograph ever flown and will carry out a science program aimed at probing the distribution of baryonic matter in the modern Universe, as well as extreme environments within our own galaxy. As the COS Project Scientist, Dr. Wilkinson is actively engaged in supporting the COS instrument, mission, and future science program. Dr. Wilkinson also is involved in the study of supernova remnants (SNR) using the 3.5 meter telescope at the Apache Point Observatory.

3.10 Education

Dr. Venkatesan has had a long-standing interest in education and public outreach, and issues pertaining to the representation of women in science. As part of the outreach component of her NSF postdoctoral fellowship, Venkatesan teaches summer courses on astronomy for the University of Colorado Upward Bound (CUUB) Programs. CUUB targets Native American high school students from economically disadvantaged backgrounds, typically from schools which are on or near major reservations across the nation. In recent years, as many as eighteen Native American tribes and ten states have been represented. Venkatesan also is an associate member of the Science Integration Institute (SII), based in Portland, Oregon. SII is a nonprofit organization dedicated to helping people use the scientific process, and its insights, as an integral part of their daily lives. For press and publications on these topics, please see her CASA webpage (http://casa.colorado.edu/∼aparna).

4. PERSONNEL CHANGES DURING 2002

New Research Associates:

Dr. James Aguirre (University of Chicago); Dr. Charles Danforth (Johns Hopkins University); Dr. Douglas Duncan (University of Chicago); Dr. Jack Gabel (NASA Goddard Space Flight Center).

Research Associate Departures:

Dr. Jon Morse (Arizona State University); Dr. Mark Vincent (New Mexico State University).

New Graduate Students: Bradley Dayhuff, Daniel Licht, Nick Moeckel, Nishanth Rajan.

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