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I. INTRODUCTION

A highlight of the past year has been the restoration of large amounts of research space in Rowland Hall, as personnel and equipment of the Space Telescope Science Institute transferred to their new building a short distance away. The restored space has been helpful to the Hopkins Ultraviolet Telescope (HUT) space shuttle project; to the Sounding Rocket program, including a new space shuttle-borne cosmic ultraviolet background radiation project; and to many other disciplines of physics, whose practitioners graciously yielded temporary use of space for the start-up of the Institute.

The intellectual life of the Hopkins astrophysics group is being enormously enhanced by the presence of the Space Telescope Science Institute, through formal association of personnel, and through the informal interaction that is the consequence of propinquity. Interlibrary liaison, and coordination (and sometimes merging) of colloquia, are only two examples. This interaction will only increase over future years.

II. PERSONNEL

Drs. Holland Ford and Robert Brown, both of whom hold tenured positions in the Space Telescope Science Institute, have accepted appointments as Research Professors in the Physics Department of the Johns Hopkins University. Dr. S. T. Durrance has been promoted to Research Scientist, and is working on the HUT project. Other permanent staff members contributing to research in astronomy and astrophysics are: A. F. Davidsen, P. D. Feldman, R. Giacconi (Director of the Space Telescope Science Institute), R. C. Henry, C. W. Kim, and H. W. Moos, Professors; K. S. Long, Jr., Research Scientist; and W. G. Fastie, Adjunct Research Professor. Graduate students publishing over the past year include C. Bowers, R. P. Cebula, R. W. Eastes, W. Landsman, T. E. Skinner, P. D. Tennyson, and M. Urry.

III. RESEARCH AND ACTIVITIES

Arthur F. Davidsen conducts a research program in space astronomy, currently focused on ultraviolet spectrophotometry of extragalactic objects and development of new instrumentation applicable to such studies. He is a Co-Investigator on the Faint Object Spectrograph (FOS) for Space Telescope, and is P.I. for the Hopkins Ultraviolet Telescope (HUT) Project, which involves a 36-in. telescope to be flown aboard the Space Shuttle as part of an instrument package called the Astro Observatory. The HUT has evolved from an Aries rocket design. Astro-1 is expected to fly in March 1986. Additional missions are planned for late 1986 and mid-1987. The HUT will obtain spectra at $\sim$2-Å resolution on flat-spectrum objects as faint as $V \simeq 17$, primarily in the 900–1200-Å range, but with some capability from 500 to 1800 Å. The initial flight will concentrate on Halley's Comet, although a broad range of observations, including quasars and other active galactic nuclei, planets, stars, nebulae, and galaxies, is also planned. Davidsen is serving as a Councilor of the AAS, a member of the U.S. National Committee for the IAU, and as a member of the AURA Board of Directors, the AURA Executive Committee, and the Space Telescope Institute Council.

Samuel T. Durrance is currently concentrating his efforts in the design and construction phase of the Hopkins Ultraviolet Telescope. He also continues an observational program in planetary astronomy (with P. D. Feldman, H. W. Moos, and T. E. Skinner) conducting IUE observations of the outer planets. Studies have been made of the spatial and temporal variability of the Jovian aurora and the Io plasma torus; continued observations of the Uranian aurora show marked temporal variability; and most recently a coordinated IUE-EXOSAT observation of the Jovian aurora was conducted with A. E. Metzger of JPL.

William G. Fastie continued application of physical optics, particularly the Ebert spectrometer, to a wide variety of problems in auroral and planetary physics, and astrophysics. In addition to his work concerning Space Telescope and the STScI, he continued his work on evaluation of optical components, particularly gratings, and played his usual substantial role in the Johns Hopkins sounding rocket and Space Shuttle ultraviolet astronomy program.

Paul D. Feldman directs the NASA-supported sounding rocket program, which has as its main focus the development of new instrumentation for far- and extreme-ultraviolet astronomy. Within this program work was begun on UVX, a pair of Space Shuttle-borne experiments by Johns Hopkins and the University of California at Berkeley to study diffuse ultraviolet background radiation. These experiments will be housed in GAS (Get Away Special) containers and launch is scheduled for autumn 1984. Feldman has continued his observational program of ultraviolet spectroscopy of comets (with M. F. A'Hearn of the University of Maryland) and planets (with H. W. Moos, S. T. Durrance, and T. E. Skinner) with IUE. The most exciting event of the year was the apparition of the Earth-approaching comet IRAS-Araki-Alcock (1983d), which, when observed by IUE at perigee, was found to emit strong bands of S_2 in the wavelength region 2800–3200 Å. The S_2 was found to be confined to a region of $\sim$100 km about the nucleus due to its short photochemical lifetime and appears to have been vaporized directly from the cometary ice. As far as is known, this is the first observation of the sulfur dimer in any astronomical source.

Holland Ford does research on active galaxies, superclusters, and stellar populations in Local Group galaxies. He is an instrument scientist for the Faint Object Spectrograph (FOS) at the Space Telescope Science Institute, and a Co-Investigator on the FOS. Ford and D. Lawrie (OSU) used a "Velocity Modulating Camera" to find and measure the radial velocities of planetary nebulae in the central 300 pc of M31. In a study of galactic planetaries, Ford and G. Jacoby (KPNO) measured chemical compositions in the remarkable nebulae Abell 30 and Abell 78. They found that recently ejected clouds do not have any hydrogen. This material, which was once in the core of the central stars, has been processed to the point that all hydrogen has burned to helium and heavier elements. Ford, in collaboration with R. Ciardullo (STScI) and R. Harms (UCSD), investigated quasar "pairing" and clumping near NGC 2639. The hypotheses that the "pairings" are due to ejection from a companion galaxy or due to background superclusters were rejected when their observations showed that the published paired redshifts were erroneous. In another study of superclusters, Ford, R. Ciardullo, F. Bartko (Martin Merietta Corp.), and R. Harms presented the results of a complete redshift survey of the rich superclusters 1415 + 22 and 1615 + 43. Ford collaborated with W. Romanishin (GSFC), R. Ciardullo, and B. Margon (UW) in investigating the nature of the nebulosity surrounding the low-

redshift (and heavily reddened) quasar 0241 + 662. They found that the nebulosity is almost certainly an underlying spiral galaxy, rather than an elliptical galaxy, or ionized gas. Ford, R. Ciardullo, and G. Jacoby (KPNO) continued a program wherein they use H-alpha photographs to find recent novae in M31's bulge. Because a nova's envelope opacity decreases more slowly in Balmer lines than in the continuum, they can find novae up to six weeks after outburst. They plan to use their H-alpha magnitudes of 15 novae to establish the suitability of nova H-alpha luminosities for standard candles. Ford gave an invited paper on "Planetary Nebulae in Local Group Galaxies" at IAU Symposium No. 103 (Planetary Nebulae). Ford, R. Harms, and R. Ciardullo gave an invited paper on "The Dynamics of Superclusters" at IAU Symposium No. 104 (Early Evolution of the Universe and Its Present Structure).

Riccardo Giacconi, as Director, hosted the Dedication Day ceremonies of the new building of the Space Telescope Science Institute on 15 June 1983. A science symposium in the morning drew hundreds of astronomers from around the world. At the afternoon ceremony and reception, George Keyworth, Science Advisor to the President; James Beggs, NASA Administrator; and Roger Bonnet, ESA Director of Scientific Programs, headed a list of several key speakers. Located on The Johns Hopkins University campus, the six-story, 67 000-square-foot facility will house more than 200 staff members, including some 35 scientists from 23 educational or research institutions. Giacconi has still found time to continue research in x-ray astronomy with his former collaborators at CFA. This past year he received the A. Cressy Morrison Award in Natural Sciences from the New York Academy of Sciences, and in June was awarded an Honorary Degree of Doctor of Science from the University of Chicago.

Richard C. Henry conducts research on the interstellar medium, cosmology, and ultraviolet background radiation. The past year saw publication of "Progress in Cosmology," the proceedings of the Oxford International Symposium on cosmology. Henry presented Apollo 17 observations of ultraviolet spectra of both the Coma and Virgo clusters of galaxies. Combining these data sets a lower limit of 2×10^{25} s on the lifetime of 15.5–20-eV/c^2 heavy neutrinos against decay into photons. More sensitive experiments of this kind are easily possible, and are being planned. Henry described this work at an elementary level in an article in *The Physics Teacher*, an outgrowth of his 1981 invited paper for the American Physical Society. The "Progress in Cosmology" article also addresses the controversial question of the scattering properties of interstellar grains in the ultraviolet. Henry's student, P. D. Tennyson, presented first results of an Aries rocket measurement of the diffuse ultraviolet background at the June 1982 American Astronomical Society meeting in Troy, New York. This represents the first spectroscopy of the diffuse background in the 1700–2900-Å region of the spectrum. A very low value for the background at high galactic latitude was found. The radiation is very likely extragalactic in origin, and perhaps represents the integrated light of distant galaxies. Henry continued as Editor-in-Chief of the journal *Astrophysical Letters*, with Davidsen (JHU), Pounds (Leicester), and Jugaku (Tokyo) as Editors. Submissions to *Astrophysical Letters* are increasing in number and the quality remains very high. Henry completed his service on the Committee on Space Astronomy and Astrophysics of the Space Science Board.

Chung W. Kim has been interested in applications of grand unification and supersymmetric theories to cosmology. He is currently investigating symmetry-breaking patterns which are crucial for the success of the inflationary scenario of the very early universe and the role of R symmetry of supersymmetry models in the axion cosmology. He has also worked on the Brans-Dicke cosmology with emphasis on the role of the cosmological constant and on the possibility of solving the horizon problem.

Knox S. Long is currently working primarily on the Hopkins Ultraviolet Telescope (discussed above), for which he is the Project Scientist. In addition, he is continuing his studies of the x-ray properties of normal galaxies and of supernova remnants, using data from the Einstein Observatory.

H. Warren Moos is continuing to use the IUE satellite to study the outer planets. Studies have been performed on the stability of the hot central part of the Io torus, the longitudinal location of the Jovian aurorae, and auroral emissions from Uranus. Moos served as a member of the Far Ultraviolet Spectroscopic Explorer Working Group. Recent laboratory work is concerned with the development of pulse-counting intensified two-dimensional solid-state arrays for space astronomy. Moos is also continuing to use ultraviolet diagnostics to study high-temperature-tokamak plasmas; the physics of the highly ionized atoms studies in this program is of direct relevance to astrophysics.

IV. PUBLICATIONS

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Durrance, S. T., Feldman, P. D., and Weaver, H. A. (1983). "Rocket detection of ultraviolet emission from neutral oxygen and sulfur in the Io torus," Astrophys. J. Lett. **267**, L125.

Feldman, P. D. (1983). "Ultraviolet spectroscopy and the composition of cometary ice," Science **219**, 347.

Feldman, P. D., and Davidsen, A. F. (1983). "Planned observations of P/Halley with the Hopkins Ultraviolet Telescope on Space Shuttle," in *Cometary Exploration*, edited by T. I. Gombosi (Central Research Institute for Physics, Hungarian Academy of Science, Budapest), Vol. 3, pp. 65–72.

Ford, H. C. (1982). "Remote operation of telescopes: long-distance observing," in *Advanced Technology Optical Telescopes*, edited by L. Barr; Proc. Soc. Photo-Opt. Instrum. Eng. **332**.

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Lawrie, D. G., and Ford, H. C. (1982). "Planetary nebulae in Local Group galaxies. IX. Velocity modulated photographs of the center of M31," Astrophys. J. **256**, 120.

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Skinner, T. E., Durrance, S. T., Feldman, P. D., and Moos, H. W. (1983). "Temporal variation of the Jovian H I Lyman-alpha emission (1979–1982)," Astrophys. J. Lett. **265**, L23.

Tennyson, P. D., Henry, R. C., Hartig, G. F., and Feldman, P. D. (1982). "Cosmic ultraviolet (1700–2850 Å) background radiation," Bull. Am. Astron. Soc. **14**, 644.

Data Survey

(1) No. of faculty/staff: tenured or tenure-track 5 (M), 0 (F); post-doc 0 (M), 0 (F); res. assoc. 0 (M), 0 (F); other Ph.D.'s 2 (M), 0 (F).
(2) No. of graduate students: first year 0 (M), 0 (F); total 10 (M), 0 (F).
(3) No. of degrees awarded: terminal Master 0 (M), 0 (F); Ph.D. 0 (M), 0 (F).