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SPACE TELESCOPE SCIENCE INSTITUTE

Newsletter

Highlights of this issue:

Astronomy with HST

Climbing the Starburst Distance Ladder

C. Leitherer

Massive stars are an important and sometimes dominant energy source for a galaxy. Their high luminosity, both in light and mechanical energy, makes them detectable up to cosmological distances. Stars ~100 times more massive than the Sun are one million times more luminous. Except for stars of transient brightness, like novae and supernovae, hot, massive stars are the most luminous stellar objects in the universe.

Massive stars are, however, extremely rare: The number of stars formed per unit mass interval is roughly proportional to the -2.35 power of mass. We expect to find very few massive stars compared to, say, solar-type stars. This is consistent with observations in our solar neighborhood: the closest really massive star is the O4 supergiant (~50 solar mass) ζ Puppis at a distance of about 500 pc; large volumes need to be sampled to observe significant numbers of massive stars.

Our Galaxy does not qualify as a starburst, which is a term denoting powerful star formation events in galaxies. Even the most luminous star-forming regions in our Galaxy are tiny on a cosmic scale. They are not dominated by the properties of an entire population but by individual stars. Therefore stochastic effects prevail. Extinction represents a severe problem when a reliable census of the Galactic high-mass star-formation history is attempted, especially since massive stars belong to the extreme Population I, with correspondingly small vertical scale heights. Moreover, the proximity of Galactic regions — although advantageous for detailed studies of individual stars — makes it difficult to obtain integrated properties, such as total emission-line fluxes of the ionized gas. Nevertheless, observations in the Galaxy allow us to study individual massive stars in great detail — an important consideration before venturing out to distant populations.

The Carina region (= NGC 3372) hosts one of the more spectacular high-mass star formation regions in the Galaxy. Its proximity of about 2 kpc permits detailed studies of the stellar content. Several O3 stars have been found in Trumpler 14/16. They are the earliest and most massive species in the MK classification scheme. HD 93128, HD 93129A, HD 93205, and HDE 303308 have masses around 100 solar masses. The enigmatic object η Carinae is located in this region as well. η Car is a luminous blue variable (LBV), a short evolutionary phase when a substantial fraction of stellar mass is shed and ejected into the ISM.

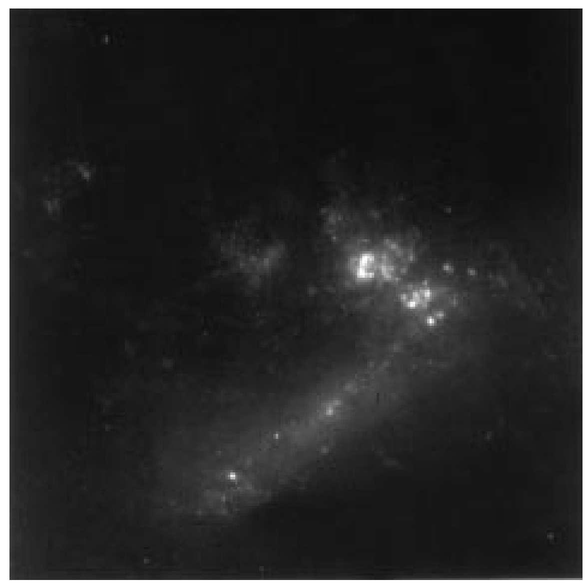

Figure 1. Composite B, V, I WFPC2 (PC) image of NGC 1741 obtained by P. Conti, in collaboration with the author and W. Vacca. Field size is 35 arcsec. North is up and east to the left.

30 Doradus: the Rosetta Stone

High-mass star-formation regions in the Local Group of galaxies are excellent laboratories to study starbursts: their proximity (with respect to galaxies in the Hubble flow) permits detailed studies of individual

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Editor's Note: Each year AURA makes two awards to the staff of STScI, one for scientific achievement, and one for functional performance. This year's science award went to Dr. Claus Leitherer, who provided the accompanying article on his work. The functional award was to Dr. Robert Hanisch, and his article appears later in this Newsletter.

Director's Perspective

The Cycle 7 TAC has now met and given its recommendations on the programs it reviewed that should be carried out on HST after the new instruments are installed. Notification letters to the PIs of all submitted proposals giving the TAC/panels recommendations should be received by early January. Not surprisingly, a number of Cycle 7 programs will make use of the long-slit and UV capabilities of STIS and the IR capabilities of NICMOS to make observations that were not possible before, and which are certain to produce interesting research in a number of areas.

The TAC, chaired this cycle by Dr. Mike Shull of the Univ. of Colorado, considered a number of large programs for implementation given that all of the previous Key Projects will soon have been completed, and it recommended time for one of them. To be carried out under the supervision of G. Gilmore of IOA, Cambridge, this program will obtain images of clusters in the Large Magellanic Cloud to construct color-magnitude diagrams of the systems. According to the new policy governing large programs recommended by the Institute Advisory Committee, the TACs of all succeeding cycles may recommend the allocation of time for up to as many as three large programs (>100 orbits) each cycle.

Launch of the second HST servicing mission, STS-82, is soon upon us. Preparations have been proceeding nominally, and both instruments are ready for installation in the telescope. Concerted efforts have already been underway for some time among the HST Project, the Institute, and the NICMOS and STIS instrument teams to prepare for bringing the new instruments on- line and commencing with their in-flight calibration. As was done after the first servicing mission an Early Release Observations program will be carried out, coordinated by Dr. A. Saha, which should give early demonstration of the capabilities of the new instruments. Thus some scientific results from the refurbished HST should be forthcoming a few months after the mission.

Institute staff are working with Goddard scientists and others to plan the next phase of studies for the Next Generation Space Telescope, the follow-up mission to HST recommended by AURA's "HST and Beyond" Committee. We have also decided to sponsor, jointly with GSFC, a conference devoted to the scientific program for a mission having the characteristics defined in the mission studies recently completed. Initial plans are to hold the meeting at Goddard in early April 1997; details will be available by the time of the Toronto AAS meeting in January. We hope for broad community participation to build appreciation for the promise of this mission.

Bob Williams, Mike Hauser

Starburst Distance *from page 1*

stars, yet their distance (with respect to Milky Way clusters) makes it possible to obtain integrated properties as well. Although more luminous than Galactic regions, they are still underluminous in comparison with the starburst prototypes below.

Numerous studies of the Rosetta Stone 30 Dor (with its ionizing cluster NGC 2070, whose massive center is R136) exist. Crowding becomes severe for stellar spectroscopy in the central R136 region. HST allows spatially resolved aperture spectroscopy of individual stars. Ultraviolet spectra of several hot, luminous stars suggest temperatures above 40 000 K, luminosities around 10^6 L_{Sun}, and masses above 50 M_{Sun}. The wind properties are particularly outstanding. Strong P Cygni profiles of C IV, N V, and He II indicate high mass loss at rates of 10^{-5} M_{Sun} per year and above. These wind lines are strong enough to be detectable in even the most distant starburst galaxies, as will be discussed below.

The interstellar environment in 30 Dor differs from that of smaller Galactic H II regions. Galactic regions, such as Trumpler 14/16 are not massive enough to form significant numbers of massive stars having strong stellar winds at the same evolutionary epoch, whereas in 30 Dor the collective effort of winds and supernovae is capable of initiating and maintaining large interstellar bubbles and supershells. The shell masses range from a few hundred to several thousand solar masses. The mechanical energy requirements are around 10^{51} erg. Supernovae, and possibly stellar winds, are the likely sources of energy.

If 30 Dor were observed at 10 Mpc, only HST could perform spatially resolved imaging and spectroscopy of R136, which would subtend an angle of only 0.05 arcsec.

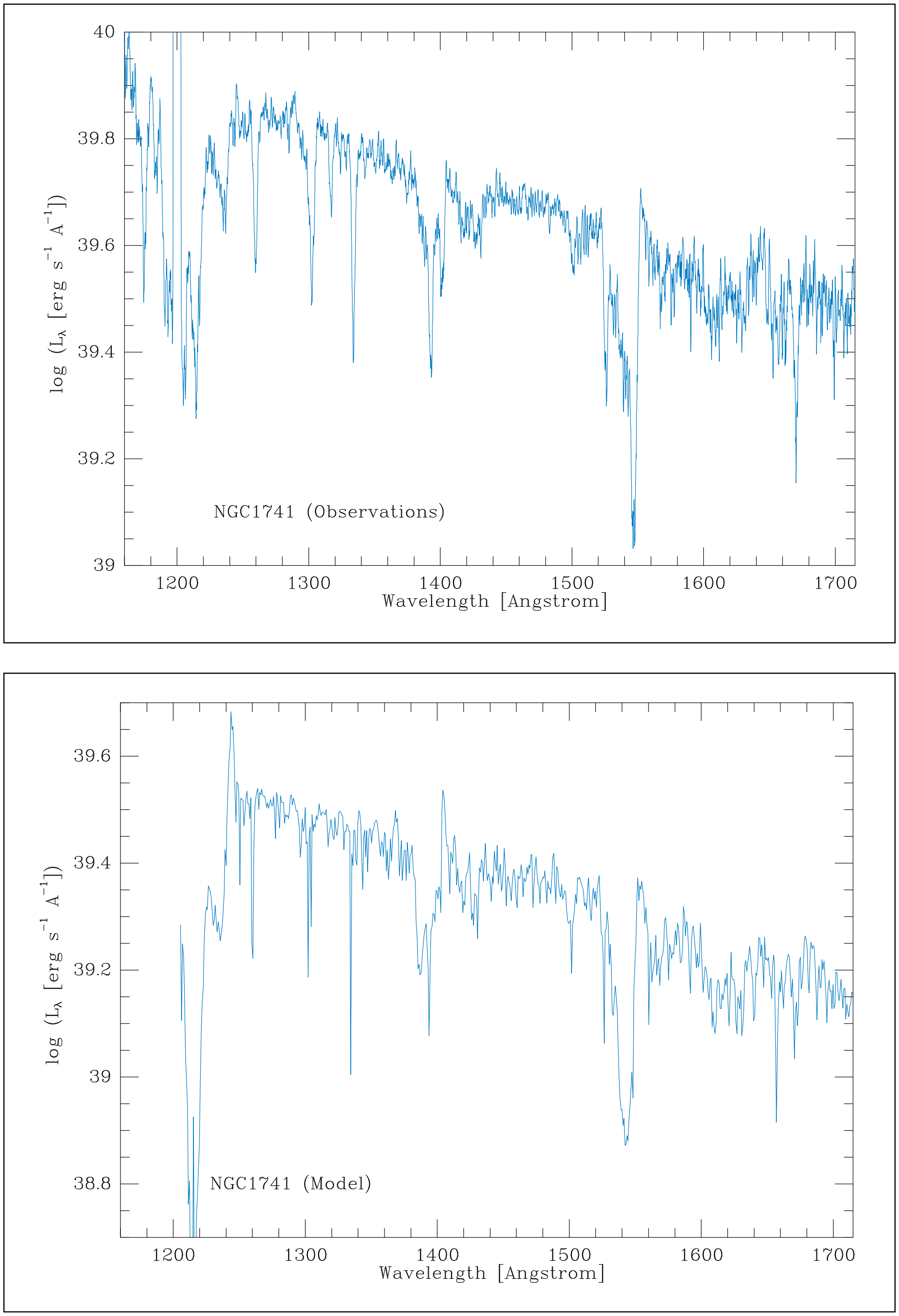

Figure 2. Ultraviolet spectral region of NGC 1741. Left: Observed spectrum taken with the GHRS. Right: Synthetic spectrum computed for a 5 Myr old instantaneous starburst following a Salpeter IMF. The main diagnostic lines of Si IV and C IV agree.

Starburst galaxies

Detailed spectroscopic studies of large numbers of individual stars are no longer feasible beyond a few Mpc:

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Starburst Distance *from page 3*

even the visually brightest star in Trumpler 14, HD 93129A, would appear at 1 Mpc as a *V*=18.6 star (assuming no extinction). The closest examples of the so-called starburst galaxy class are found in this distance range. Starburst galaxies form large numbers of massive stars that have a global effect on the galaxy, both in terms of their radiant and their mechanical energy output.

What would 30 Dor and the LMC look like if they were a factor of 1000 farther away? Figure 1 gives the answer. NGC 1741 is a luminous irregular at a distance of 50 Mpc, highly reminiscent of the LMC when seen on wide-angle photographs. It has two luminous H II regions at the NW end of the bar. The bar population is largely unresolved. NGC 1741 contains about 10^3 highly evolved Wolf-Rayet stars — more WR stars than known individually in all galaxies of the Local Group combined.

Individual stars (or even clusters) can no longer be investigated at distances of ~50 Mpc and beyond. Stellar and nebular properties are derived from the integrated light. A GHRS spectrum of the starburst region containing the WR population is shown in Figure 2 (left). The most conspicuous stellar lines are C IV, Si IV, N V, and He II. These lines have broad absorptions and/or emissions due to their origin in stellar winds from hot stars and permit a study of the hot-star population. A theoretical spectrum is also shown in this figure (right). It was calculated with a population of massive stars following a Salpeter IMF for masses above ~15 M_{Sun} (lower mass stars may also be present), and extending up to ~100 M_{Sun}; about 10^4 O-type stars are inferred from the ultraviolet luminosity.

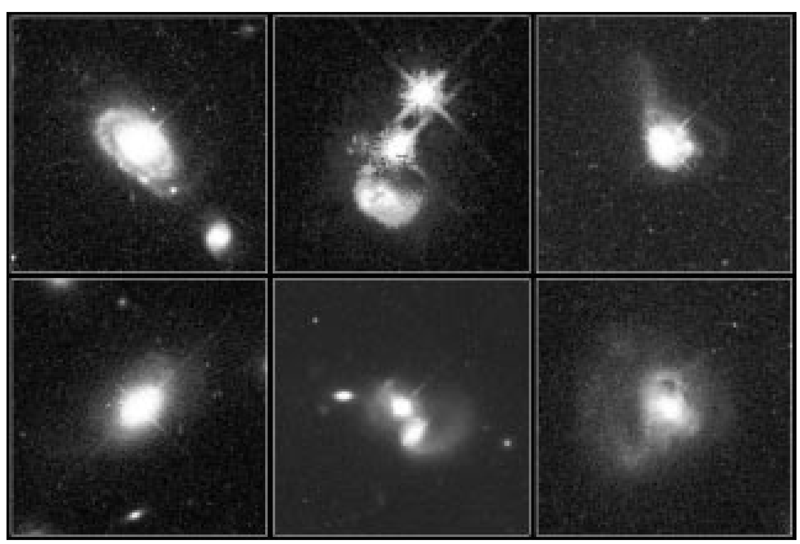
Star formation at the edge of the universe

We conclude with a brief look at the most distant star-forming galaxies known. They are the endpoint of our cosmic voyage, which began in the Carina star forming region. Few starburst galaxies have been studied in detail at large redshifts. Detecting galaxies in their initial star-formation stage (often called primeval or proto-galaxies) has been a major goal in observational cosmology during the past years. This goal has eluded almost everybody until very recently, when several groups independently announced the detection of promising candidate galaxies forming stars at high redshift. In all cases the presence of ultraviolet stellar-wind lines, such as those seen in Figure 2, was taken as evidence for massive stars.

The Hubble Deep Field (HDF) is an HST program to image an indistinguished field at high Galactic latitude in four passbands as deeply possible. The image shows a plethora of distant field galaxies, many of them having complex and disturbed morphologies. Spectroscopy of these star-forming candidates is required for analysis, an effort reaching the limits of our current observational capabilities. Possibly these observations will find the first generation of massive stars ever formed in the universe.

HST Recent Release: A Survey of Quasar Host Galaxies

Quasars reside in a variety of galaxies, from normal to highly disturbed. When seen through ground-based telescopes, these compact, enigmatic light sources resemble stars, yet they are billions of light-years away and several hundred billion times brighter than normal stars. The following Hubble Space Telescope images show examples of different home sites of all quasars. But all the sites must provide the fuel to power these unique light beacons. Astronomers believe that a quasar turns on when a massive black hole at the nucleus of a galaxy feeds on gas and stars. As the matter falls into the black hole, intense radiation is emitted. Eventually, the black hole will stop emitting radiation once it consumes all nearby matter. Then it needs debris from a collision of galaxies or another process to provide more fuel.



HST Programs and Observations

Duration of Cycle 7

R. Williams and P. Stanley

Most HST proposal/observing cycles have been approximately one year long. In fact, the community has expressed a desire for the Institute to try to fix established dates during the calendar year for the receipt of proposals, and we have adhered to this for the past two cycles. This becomes impractical in cycles for which there are servicing missions because of the fact that each servicing mission requires a 4-month period, called Servicing Mission Observatory Verification (SMOV), when the telescope and its new instruments and components must be brought on-line, thoroughly checked out, and initially calibrated. Maintaining the one year length of a cycle would therefore require that the science program of the cycle last only 8 months. A shortened science period for Cycle 7 would have required submission of proposals for Cycle 8 before much experience had been acquired with the new instruments STIS and NICMOS.

We considered a shortened science program for Cycle 7 but the quality of proposals received and the oversubscription rate were so high that we felt it compelling to have Cycle 7 consist of a full year of science observations. With the nominal 4-month period devoted to SMOV following the SM2 launch, this leads to a slip in our schedule for Cycle 8. Cycle 7 science observations should commence in July, 1997, as we complete the schedule of Cycle 6 programs. The Call for Proposals for Cycle 8 is now scheduled to be issued in October, 1997, with a proposal receipt date in early February, 1998. We realize that the calendar used for Cycles 6 and 7 may have been more convenient for the writing and submission of proposals, but we have tried to establish new calendar dates for the proposal process in Cycle 8 that will also not be too inconvenient. Cycle 8 observing will run from November, 1998, to November, 1999.

Panel and TAC Members for Cycle 7

The following individuals served on the Cycle 7 Time Assignment Committee. We thank them for their help in the difficult job of selecting the HST science program.

Telescope Allocation Committee

Mike Shull, Chair

TAC At-Large Members

TAC AT-Large Members
Art Davidsen - JHU
Anne Kinney - STScI
Bohdan Paczynski - Princeton
Anneila Sargent - Caltech
Don York - U. Chicago

PANELS

AGN 1

Bradley Peterson - Ohio State (Panel Chair)
Buell Jannuzi - NOAO/KPNO
Grzegorz Madejski - GSFC Simon Morris - Dominion Astro. Obs.
John Mulchaey - Carnegie Obs.
Marcia Rieke - U.Arizona/Steward
Thomas Soifer - Keck Observatory
Clive Tadhunter - U. of Sheffield, UK
Mark Whittle - U.Virginia

AGN 2

Rachel Webster - U. of Melbourne, Australia (Panel Chair)
Michael Eracleous - U. of CA, Berkeley
Gary Ferland - U. of Kentucky
Mauro Giavalisco - Carnegie Obs.
Frederick Hamann - U. of CA
George Rieke - U. Arizona Steward Obs
Joseph Shields - U. of Ohio
Stefan Wagner - Heidelberg, MPA, Germany
Donald Schneider - Penn State
Beverley Wills - U. of Texas

Binary Stars

Jonathan Grindlay - Harvard Obs (Panel Chair)
Paul Hertz - Naval Research Lab
Janusz Kaluzny - Warsaw
Anthony Moffat - U. of Montreal
Mirek Plavec - U. of CA
Paula Szkody - U. of Washington
Marten van Kerkwijk - Caltech
Janet Wood - Keele University

Clusters

Richard Mushotzky - GSFC (Panel Chair)
Thomas Broadhurst - UC, Berkeley
Jack Burns - NMSU
Hans Hippelein - MPIA
Tod Lauer - KPNO/NOAO
Gerard Luppino - University of Hawaii
Ann Zabludoff - Carnegie Obs.

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PANELS *from page 5*

Cosmology
George Efstathiou - U. of Oxford-Astrophysics (Panel Chair)
Arif Babul - NYU Lennox Cowie - U. of Hawaii
Andrew Hamilton - U. of Colorado
Saul Perlmutter - LBL Robert Schommer - CTIO
Peter Schneider - MPI
Joe Silk - U. of CA, Berkeley
Gary Wegner - Dartmouth College

Cool Stars
Andrea Dupree - SAO (Panel Chair)
Howard Bond - STScI
David Gray - U. of Western Ontario
Philip Ianna - U. Virginia
Ruth Peterson - Lick Observatory
Catherine Pilachowski - KPNO/NOAO
Neill Reid - Caltech
Klaus Strassmeier - Vienna U., Austria
Nicholas Suntzeff - CTIO

Galaxies 1
Rob Kennicutt - U. of Arizona, Steward Obs. (Panel Chair)
Jay Frogel - OSU
Jeff Kenney - Yale
David Merritt - Rutgers
Colin Norman - JHU/STScI
Renzo Sancisi - Kapteyn Astronomical Ins
Francois Schweizer - Carnegie/DTM
Jacqueline van Gorkom - Columbia
Dennis Zaritsky - UCSC

Galaxies 2
Rosie Wyse - JHU (Panel Chair)
Stephane Charlot - IAP
William Keel - U. Alabama
Carmelle Robert - U. Laval
Barbara Ryden - OSU
John Salzer - Wesleyan
David Sanders - U. Hawaii
David Van Buren - Caltech

Hot Stars
Rolf-Peter Kudritzki - U. of Munich-I for A&A (Panel Chair)
Bruce Bohannan - KPNO/NOAO
Martin Cohen - U. of CA, Berkeley
John Drilling - Louisiana St
Mario Livio - STScI
Wolf-Rainer Hamann - U. of Potsdam
Gloria Koenigsberger - UNAM
Rex Saffer - Villanova

Instellar Medium
Carl Heiles - U. of CA, Berkeley (Panel Chair)
Donald Cox - U. WI-Madison
Edward Fitzpatrick - Princeton
Thomas Henning - ESA (Jena, Germany)
Elizabeth Lada - U. of Florida
Manuel Peimbert - UNAM

Quasar Absorption Line
Craig Hogan - U. of Washington (Panel Chair)
Stefano Cristiani - ESA Observatory Dipadova
James Lowenthal - Lick Obs
Michael Rauch - Caltech
Gregory Shields - U. Texas
Lisa Storrie-Lombardi - Carnegie Observatory
Art Wolfe - U. of CA, San Diego

Stellar Ejecta
Robert Fesen - Dartmouth College (Panel Chair)
Dave Arnett - U. of Arizona, Steward Observatory
Bruce Balick - U. of Washington
William Blair - JHU
Claes Fransson - ESA, Stockholm Obs
Bruce Hrivnak - Valparaiso U.
Margaret Meixner - U. of Illinois
John Raymond - Cfa
Steve Shore - IN U.

Stellar Populations
Gerard Gilmore - Inst of Astr. (Panel Chair)
Bruce Carney - U. of North Carolina
Eileen Friel - National Science Foundation
Douglas Geisler - NOAO/KPNO
Deidre Hunter - Lowell Obs
Chris Sneden - U. Texas at Austin
Donald Terndrup - Ohio State
Monica Tosi - ESA, Bologna Obs
Bruce Twarog - U. of Kansas

Solar System
Philip Nicholson - Cornell University (Panel Chair)
Gordon Bjoraker - GSFC
Wendy Calvin - USGS Flagstaff
Anita Cochran - U. of Texas
Jean Claude Gerard - U. of Liege
Al Harris - JPL
Hal Weaver - JHU
Robert West - JPL

Young Stars and Circumstellar Material
Charles Lada - SAO (Panel Chair)
Fred Adams - U. of Michigan
Mary Barsony - UC Riverside
Chas Beichman - IPAC
Ian Gatley - NOAO
Bill Herbst - Wesleyan University
Anne-Marie LaGrange - Grenoble Observatory
Erick Young - U. of Arizona

Approved Observing Programs for Cycle 7

AGN 1

Borne	Hughes STX	Archival Study of Nuclear Morphology in Interactive Galaxies
Bower	National Optical Astronomy Observatories	Testing the Supermassive Black Hole Paradigm in Nearby Radio-Quiet AGNs
Cecil	University of North Carolina at Chapel Hill	Spectra to Constrain the Dynamics of Clouds in the Narrow-Line Region of NGC 1068
Edelson	University of Iowa	Continuous Ultraviolet Monitoring of NGC 3516
Falcke	Astronomy Department, University of Maryland	The connection between the obscuring torus and masing disk in H_2O Megamasers
Fanti	Universita di Bologna	Snapshot survey of the B2 sample of radio galaxies
Filippenko	University of California, Berkeley	An Archival Study of Nearby, Low-Luminosity Active Galactic Nuclei
Filippenko	University of California, Berkeley	Measuring Black Hole Masses in Broad-Lined AGNs
Ford	Johns Hopkins University	Kinematics of the HAlpha Nuclear Disk in M81: A Search for a MBH in the Nearest LINER
Hamann	Center for Astrophysics & Space Science	Intrinsic UV and X-ray Absorption in QSOs
Malkan	University of California	High Resolution IR Imaging Survey (IRIS) of the Centers of the Nearest Active Galaxies
McLeod	Smithsonian Astrophysical Observatory	The Relation Between Quasar Luminosity and Host Galaxy Mass
Mulchaey	The Observatories of the Carnegie Institution of Washington	The Fueling of Active Nuclei: A NICMOS Snapshot Survey of Seyfert and Normal Galaxies
Rix	Steward Observatory	The Nature of Nuclear Activity in Nearby Galaxies
Romanishin	University of Oklahoma	A New Technique for Photometry of Low Luminosity AGNs Using HST Reference Images
Schreier	Space Telescope Science Institute	Infrared imaging and polarimetry observations of the obscured nucleus of Centaurus A
Tadhunter	University of Sheffield	The nature of the compact infrared core sources in powerful FRII radio galaxies
Whittle	University of Virginia	STIS Spectroscopy of Markarian 78
Wilson	Astronomy Department	Kinematics of the Helical Jets in the Seyfert Galaxy ESO428-G14
Wilson	University of Maryland	The Molecular Torus and Ionized Gas in the Circinus Galaxy

AGN 2

Biretta	Space Telescope Science Institute	Secular Changes in the Jet of M87
Chambers	Institute for Astronomy	High Redshift Reflection Nebulae
Dey	Kitt Peak National Observatory	The Stellar Content of Powerful Radio Galaxies: A NICMOS Survey of $0.8 < z < 1.8$ 3CR Sources
Dressel	RJH Scientific, Inc.	Kinematics of Gaseous Disks in the Nuclei of Liners with Compact Flat Spectrum Radio Sources
Dunlop	University of Edinburgh	The cosmological evolution of quasar host galaxies
Ferland	University of Kentucky	FeII Emission in Quasars
Ho	Center for Astrophysics	Testing the Nature of Type 2 LINERs Using UV Spectroscopy
Jannuzi	National Optical Astronomy Observatories	The Unusual Absorption Line System of PG 2302+029 — Ejected or Intervening?
Junkkarinen	University of California, San Diego	Chemical Abundances in QSO Broad Absorption Line Regions
Leighly	Columbia University	A Search for Broad Absorption Lines in Narrow-Line Seyfert 1 Galaxies
McCarthy	The Carnegie Observatories	NICMOS Imaging Survey of Distant Radio Galaxies: Ellipticals at $z > 2$?
McHardy	University of Southampton	NICMOS Observations of PKS1413+135
Osmer	The Ohio State University	Quasar Candidates in the Hubble Deep Field
Stocke	University of Colorado, Boulder	Witnessing the Birth of Radio Galaxies: WFPC & NICMOS Observations of CSOs
Thomson	University of Hertfordshire	Polarization mapping of the infrared emission from the jet in M87
Webster	University of Melbourne	Microarcsecond Imaging of a Gravitationally Lensed QSO: 2237+0305
White	Space Telescope Science Institute	HST WFPC2 Observations of MilliJansky Radio Sources from the FIRST Survey

Binary Stars

Beuermann	Universitaets-Sternwarte Goettingen	The nature of the bright Supersoft X-ray Source RX J 0019+21
Bond	Space Telescope Science Institute	WFPC2 Observations of Astrophysically Important Visual Binaries
Chakrabarty	Massachusetts Institute of Technology	High-Speed UV Spectroscopy of the Ultracompact Binary 4U 1626—67/KZ TrA
Corradi	Instituto de Astrofisica de Canarias	Narrow band imaging of jets and bipolar outflows from symbiotic stars
Drew	Astrophysics Group, Imperial College	High resolution UV spectroscopy of the extra-ordinary central star of Abell 35
Edmonds	Space Telescope Science Institute	The Dense Core of M30

Approved Observing Programs for Cycle 7 *Continued*

Espey	The Johns Hopkins University	Improved Emission Line Diagnostics of Symbiotic Stars
Grindlay	Harvard University	Deep Survey for CVs and Compact Binaries in the Collapsed Core Cluster NGC6397
Harrison	New Mexico State University	The Distances to Dwarf Novae, and the Calibration of the Technique of Infrared Spectroscopic Parallax
Kaper	European Southern Observatory	Raman scattering and X-ray ionization in LMC X-4, Cyg X-1, and LMC X-1
Knigge	Space Telescope Science Institute	Demystifying the SW Sex stars
Margon	University of Washington	The Nature of Two New Optical Counterparts of Globular Cluster X-ray Sources
Margon	University of Washington	Intense Galactic X-ray Sources in Crowded Fields
McClintock	Smithsonian Astrophysical Observatory	Black Hole A0620-00 and Advection-Dominated Accretion
Rousseau	Universitaets-Sternwarte Goettingen	UV Cyclotron Spectroscopy of the High-Field Polar UZ Fornacis
Sams	Max Planck Insitute fuer Astrophysics	Jet Polarization and Emission lines in the Galactic Microquasar GRS1915+105
Schmidt	Steward Observatory, University of Arizona	Probing the 230 MG Accreting Magnetic White Dwarf in AR Ursae Majoris
Shara	Space Telescope Science Institute	Recovery and Characterization of Old Novae in the Globular Clusters M80 and M14
Shara	Space Telescope Science Institute	An Archival Search for Erupting Dwarf Novae in Globular Clusters
Still	University of St. Andrews	High resolution imaging of magnetically-propelled ejecta from the cataclysmic variable AE Aqr van
Teeseling	Universitaets-Sternwarte Goettingen	Ultraviolet spectroscopy of the supersoft X-ray source RX J0439.8-6809
Vrtilek	Smithsonian Astrophysical Observatory	High Resolution Ultraviolet Spectroscopy of Hercules X-1/HZ Herculis

Clusters of Galaxies

Blandford	Caltech	Galaxy Masses from Cluster Arcs
Broadhurst	Astronomy Dept	Modeling Cluster Mass Distributions
Dalcanton	The Observatories of the Carnegie Institution of Washington	Elliptical Galaxy Evolution at High Redshift: IR Imaging of 100 Distant Clusters
Donahue	Space Telescope Science Institute	Warm Molecular Hydrogen in Cluster Cooling Flow Nebulae
Fabian	Institute of Astronomy, University of Cambridge	The central mass profile in the lowest redshift cluster lenses
Ferguson	Space Telescope Science Institute	Intergalactic Stars in the Virgo Cluster
Franx	Kapteyn Institute	Fundamental Plane, Morphology-Density Relation, and Lensing in the z=0.83 Cluster MS1054—03
Fruchter	Space Telescope Science Institute	The Luminosity Function and Evolution of Rich Clusters to z ~ 1.0
Keel	University of Alabama	The Age and Content of a (Proto)Galaxy Cluster at z=2.39
Mackie	Smithsonian Institution Astrophysical Observatory	Structural Properties of Brightest Cluster Galaxies in the HST Archive
Owen	NRAO	The Impact of Cluster Substructure on Galaxies: A Case Study in Abell 2125
Ratnatunga	Carnegie Mellon University	Quantitative Morphology of Cluster Galaxies : Evolutionary Trends
Rosati	Johns Hopkins University	Probing Low Density Cluster Environments at Moderate-to-High Redshifts
Saunders	Mullard Radio Astronomy Observatory	The most powerful gravitational lens
Squires	Center for Particle Astrophysics	Dark Matter Distribution in A2218 from Gravitational Lensing

Cosmology

Bernstein	University of Michigan	Improved Hubble Constant from the 0957+561 Gravitational Lens
Broadhurst	University of California, Berkeley	Spheroidal Galaxy Evolution
Davis	University of California	The Nature of Faint, Blue, I-K>4 Galaxies: Age or Dust?
Falco	Smithsonian Astrophysical Observatory	A study of the gravitational lensing potential in MG 0414+0534
Ferguson	Space Telescope Science Institute	Deep UV Imaging of the Hubble Deep Field
Graham	University of California, Berkeley	IR Surface Brightness Fluctuations of Fornax Cluster Galaxies
Hu	University of Hawaii, Institute for Astronomy	High-resolution IR and optical imaging of the fields around a large sample of z > 4.5 quasars
Illingworth	Lick Observatory, University of California, Santa Cruz	The Nature of Galaxies in the HDF from HST Structural and Keck Kinematical Measurements
Jackson	Jodrell Bank, University of Manchester	NICMOS observations of JVAS/CLASS gravitational lenses
Kennicutt	Steward Observatory	Determination of the Extragalactic Distance Scale
Koo	Lick Observatory, University of California, Santa Cruz	Spatial Structures and Masses of Faint Field Galaxies
Lehar	Smithsonian Astrophysical Observatory	Survey of Gravitational Lenses as Cosmological Tools
Maoz	University of California, Berkeley	Calibration of the Cepheid P-L Relation with Observations of the Maser-Host Galaxy NGC 4258
McCarthy	The Carnegie Observatories	NICMOS Extragalactic Parallel Grism Survey
Moustakas	University of California	The Nature of Red Outlier Galaxies: Age vs Dust

Approved Observing Programs for Cycle 7 *Continued*

Moller	Space Telescope Science Institute	STIS images of 48 damped LyAlpha galaxies
Perlmutter	Lawrence Berkeley Laboratory	Cosmological Parameters Omega and Lambda from High-Redshift Type Ia Supernovae
Readhead	California Institute of Technology	NICMOS observations of the gravitational lens 1608+656
Sandage	Observatories of the Carnegie Institution of Washington	Calibration of Nearby Type Ia Supernovae as Standard Candles: The Next Three-Year Step
Schmidt	Mount Stromlo and Siding Spring Observatories	The Hubble Diagram for Distant Supernovae: Measuring Cosmic Deceleration and Global Curvature
Shara	Space Telescope Science Institue	The nature of the extragalactic UV background
Smail	Durham University	An Unbiased Redshift Survey of Ultra-Faint Galaxies
Tanvir	Institute of Astronomy	The distance to M96 from H-band Cepheid observations
Tonry	Institute for Astronomy	The SBF Hubble Diagram
Tsvetanov	Johns Hopkins University	The Surface Brightness Fluctuations and Globular Cluster Populations of Virgo Ellipticals
Turner	Princeton University Observatory	Gravitational Lensing Enhanced NICMOS Imagery of a Young, Rapidly Evolving Faint Blue Galaxy
Windhorst	Arizona State University, Dept. of Physics & Astronomy	NICMOS imaging of MuJy radio sources with R>= 29: The birth of AGN in pregalactic objects at z>=6-10?
Yahil	University at Stony Brook	Image Reconstruction and Photometry of the Hubble Deep Field
Zepf	University of California, Berkeley	Determining Peculiar Motions by Observing Cepheids at 3,000 km/s

Cool Stars

Basri	University of California	Ultraviolet Line Eclipses by Extra-Solar Planets
Bennett	University of Colorado	The 1997/98 Eclipse of VV Cephei
Boehm-Vitense	Astronomy Department, University of Washington	Chromospheres and transition layers in Hyades and Pleiades F stars
Bookbinder	Smithsonian Astrophysical Observatory	Eclipse Mapping of the Touchstone Binary System YY Gem
Brown	California Institute of Technology	A Search for Zodiacal Dust around Bright Nearby Stars
Clayton	Louisiana State University	Dust Formation Around R Coronae Borealis Stars: Where is the CO?
Dupree	Smithsonian Astrophysical Observatory	Direct Imaging of Betelgeuse
Edvardsson	Uppsala Astronomical Observatory	Boron in the extreme Pop II star HD 140283
Evans	Smithsonian Astrophysical Observatory	The Mass of the Classical Cepheid ADS 14859
Franz	Lowell Observatory	The Masses of the Brown Dwarf Candidate GL 623B and of the Low Luminosity Binary GL 831
Golimowski	Johns Hopkins University	A Near-Infrared Search for Very Low Mass Companions to Stars within 10 pc of the Sun
Henry	Space Telescope Science Institute	Calibrating the Mass-Luminosity Relation at the End of the Main Sequence
Jordan	University of Oxford, Department of Physics (Theoretical Physics	Epsilon Eri: Structure and Non-Thermal Heating
Leinert	Max-Planck-Institut fuer Astronomie	Infrared spectroscopic study of the very low mass triple system LHS 1070
Linsky	JILA	Physical Processes in Stellar Atmospheres: Comparative Analysis of the Sun and Alpha Cen A
Lopez	Observatoire de la Cote d'Azur	Infrared Imaging of the Dust Shell Structures of the Mira Stars o Ceti and R Leo
Parsons	Computer Sciences Corporation	Fixing the Mass of the Bright Giant HD 173764
Peterson	Astrophysical Advances	Chromospheric Activity in Old Stars: Halo Subdwarfs' Variability
Peterson	Astrophysical Advances	Mass Loss in Globular Cluster Giants: NGC 6752
Peterson	Astrophysical Advances	Chromospheric Activity in Old Stars: HD 106516
Reid	California Institute of Technology	Low-mass Halo Binaries

Galaxies 1

Allen	Space Telescope Science Institute	A Photometric Atlas of the Bright Galaxies , in the Deepest HST Fields
Bershady	The Pennsylvania State University	The Internal Kinematics of Distant Spiral Galaxies: Evolution of the Mass-to-Light Ratio
Carollo	Johns Hopkins University	The nuclear kinematics of kinematically distinct cores
Crotts	Columbia University	Understanding Halo Microlensing and Variable Stars in M31: 1) Snapshot Survey of Candidates
Geisler	Kitt Peak National Observatory	The Metallicity Distribution of the Globular Cluster Systems of Giant Elliptical Galaxies
Heap	NASA/Goddard Space Flight Center	UV Spectral Dating of Galaxies
Ibata	Dept. of Physics & Astronomy, Univ. of British Columbia	Proper Motion of the Sagittarius Dwarf Galaxy
Ibata	Department of Physics and Astronomy, University of British Columbia	Velocity Structure in High Redshift Galaxies
Kuijken	Kapteyn Institute	Nuclear kinematics and stellar population gradients in the recent merger remnants NGC 7252 & NGC 3921.
O'Connell	University of Virginia	Spatially-Resolved Spectroscopy of the UVX in Elliptical Galaxies
Odewahn	Arizona State University	Fourier-Based Neural Network Galaxy Classifiers: Archival studies of field galaxy evolution

Approved Observing Programs for Cycle 7 *Continued*

Olszewski	Steward Observatory, Univ of Arizona	Absolute Proper Motions of Nearby Dwarf Spheroidal Galaxies
Peacock	Royal Observatory Edinburgh	Structures and colours of the oldest galaxies at redshift 1.5
Peletier	Kapteyn Astronomical Institute	The formation of bulges of spiral galaxies: , Central visual-infrared color gradients
Richstone	University of Michigan	Black Holes and the Centers of Galaxies
Silk	University of California, Berkeley	The Globular Cluster Luminosity Function
Stiavelli	Space Telescope Science Institute	Near-IR properties of the bulges of spiral galaxies
van der Marel	Hubble Fellow, Institute for Advanced Study	Nuclear brightness profiles of merger remnants: do mergers form ellipticals ?
Zaritsky	University of California, Santa Cruz	A Search for Extended Stellar Galactic Halos

Galaxies 2

Beaulieu	Johns Hopkins University	The inner region of the starburst galaxy NGC5102.
Bershady	Penn State University	The Rise of Blue Nucleated Galaxies: Evidence for Merger-Induced Evolution?
Casertano	Space Telescope Science Institute	Star Formation, Mass Distribution and Dark Matter in Galaxies at z ~ 0.6
Charlton	The Pennsylvania State University	From Globular Clusters to Tidal Dwarfs: Structure Formation in Tidal Tails
Ellingson	University of Colorado	Star Formation in a Protogalaxy Candidate at z=2.72
Gallagher	University of Wisconsin-Madison	Structures of Starburst Galaxies Heap NASA/Goddard Space Flight Center Morphological and Spectral
Evolution of Galaxies		
Keel	University of Alabama	Do Massive Star Clusters Form in Young and Weak Galaxy Interactions?
Koo	Lick Observatory, University of California, Santa Cruz	Sizes and Structures of Faint Blue Compact Galaxies that are New Candidates for Proto-Spheroidal Galaxies
Leitherer	Space Telescope Science Institute	The Stellar Content Of Giant HII Regions
Miller	Department of Terrestrial Magnetism	Dwarf Elliptical Galaxy Snapshot Survey II
O'Connell	University of Virginia	The Fossil Starburst in M82
Schweizer	Carnegie Institution of Washington	Young Globular Clusters in Merger Remnants — Part 4
Scoville	California Institute of Technology	Spiral Structure and OB Star Formation in M51

Hot Stars

Bolte	University of California, Santa Cruz	The White Dwarf Luminosity Function in NGC 188
Bond	Space Telescope Science Institute	Sakurai's Novalike Object: Real-Time Monitoring of a Stellar Thermal Pulse
Drissen	Universite Laval	NGC 2363 V1: a rare case of major LBV eruption
Gies	Georgia State University	The Masses of the O-type Binary 15 Monocerotis
Hamann	Lehrstuhl Astrophysik, Universitaet Potsdam	UV Spectroscopy of Wolf-Rayet-Type Central Stars in the Magellanic Clouds
Heber	Astronomisches Institut der Universitaet Erlangen- Nuernberg	Resolving sdB binary systems
Jordan	Universitaet Kiel, Institut fuer Astronomie und Astrophysik	HST observations of the DAB white dwarf HS 0209+0832: testing explanations for the DB gap
Koenigsberger	Instituto de Astronomia UNAM	The Changing Wind Structure of the Erupting SMC WN/LBV system HD 5980
Kudritzki	Universitaets-Sternwarte Muenchen	The Wind-momentum Luminosity Relationship for M31 and M33 B-supergiants
Moffat	Universit e de Montr eal	Dust Formation in Hot Stellar Winds: Infra-Red Imaging of the Wolf-Rayet Binary WR137
Pena	Instituto de Astronomia, Universidad Nacional Autonoma de Mexico	LONG SLIT OBSERVATIONS OF THE WR CENTRAL STAR OF THE LMC-PN N66
Shara	Space Telescope Science Institute	A Continuing Snapshot Survey for Compact Stellar Groups and Clusters around Wolf-Rayet Stars
Shipman	University of Delaware	White Dwarf Stars in Visual Binaries: Testing Stellar Degeneracy
Venn	Macalester College	Evidence from Boron for Massive Star Evolution
Walborn	Space Telescope Science Institute	Compact Stellar Groups in the 30 Doradus Nebula and their Nebular Environment
Walter	State University of New York	Parallax, Proper Motion, and Spectral Energy Distribution of an Isolated Old Neutron Star
Winget	University of Texas at Austin	A Critical Test of Crystallization in White Dwarf Stars

ISM

Bomans	University of Illinois at Urbana-Champaign	Interfaces Between Hot and Cold Gas: The Superbubble N51D in the LMC
Boulanger	Institut d'Astrophysique Spatiale	High-Velocity Gas and Dust Evolution in Chamaeleon Clouds
Danks	Hughes STX/GSFC	Studies of the Characteristics of the Interstellar Medium in the Carina Nebula

Approved Observing Programs for Cycle 7 *Continued*

Guhathakurta	UCO/Lick Observatory, University of California, Santa Cruz	Probing the Fine-Scale Structure and Colors of Interstellar Cirrus Clouds
Haller	Steward Observatory, University of Arizona	Distribution of Forbidden Iron Fe II Emission at the Galactic Center
Herbig	University of Hawaii	Imagery of IC 349
Holberg	University of Arizona	A STIS Probe of Unique ISM Lines-of-Sight Having Measured H and He Ionization Fractions
Keenan	The Queen's University of Belfast	Spectroscopy of the interstellar medium in the Magellanic Bridge
Linsky	JILA	Exploring the Outer Heliosphere with STIS
Meyer	Northwestern University	The Physical Characteristics of Small-Scale ISM Structure
Rubin	NASA Ames Research Center	HST Observations of Orion — Probing the Origin of Abundance Anomalies in H II Regions
Savage	University of Wisconsin-Madison	Abundances and Physical Conditions in the Low and Intermediate Velocity Gas Toward Mu Columbae
Sembach	The Johns Hopkins University	The Origin of Highly Ionized Gas in the Milky Way and Its Relationship To Large Galactic Structures
Walsh	Space Telescope European Coordinating Facility	Parallel high resolution imaging of diffuse objects in the Magellanic Clouds
Walter	South Carolina State University	UV-Optical Spectra and Imagery of the Bubble Nebula NGC 7635
Walterbos	New Mexico State University	Massive Stars as Ionization Sources for Diffuse Ionized Gas in Spiral Galaxies
Walterbos	New Mexico State University	The Stellar Populations Inside Expanding HI Shells in the Spiral Galaxy M33

Quasar Absorption Lines

Barcons	Instituto de Fisica de Cantabria (CSIC-UC)	CIV in extensive gaseous halos of QSO Lyman alpha absorbing galaxies
Bechtold	Steward Observatory, University of Arizona	Molecular Hydrogen in the Damped LyAlpha Absorber of Q1331+170
Bregman	University of Michigan	Cooled Gas in X-Ray Emitting Elliptical Galaxies
Burles	University of California San Diego	Measurement of the Cosmological Baryon to Photon Ratio
Cohen	University of California, San Diego	Observations of a BL Lacertid with a Unique Absorption Line System
Cote	ESO	Galaxy Rotation Curves at Large Radius using Ly-alpha Absorption Lines
Deharveng	Laboratoire Astronomie Spatiale	A snapshot survey for UV bright Quasars at redshift below 3
Hogan	University of Washington	Helium Absorption by Protogalactic Gas
Lanzetta	State University of New York at Stony Brook	The Chemical Content of the Universe at $z < 1.6$
Lowenthal	UCO/Lick Observatory	H-alpha Imaging of an Elusive Damped Ly-alpha cloud at z=0.6
Malkan	University of California	The Nature of the Damped LyAlpha Absorbers — A New Study of Young Galaxies
Pettini	Royal Greenwich Observatory	The Primordial Abundance of Deuterium From a Metal-Poor Damped Lym= an=20 Alpha System
Reimers	Hamburger Sternwarte	STIS Snapshot Search for UV-bright High Redshift Quasars
Smette	Kapteyn Astronomical Institute	Gravitational Lensing by Damped Ly-Alpha Absorbers
Steidel	California Institute of Technology	NICMOS Imaging of QSO Absorption—Selected Galaxies at $z > 1$
Stocke	University of Colorado, Boulder	Origin and Physical Conditions in the Local Ly-alpha Forest

Stellar Ejecta

Blair	Johns Hopkins University	Spatially-resolved FUV Spectra of the Primary Shock in the Cygnus Loop
Brage	University of Lund	Hyperfine Induced Transitions as Probes of Low Density Plasmas
Davidson	University of Minnesota	STIS observations of Eta Carinae: Good spectral coverage at last
Dinerstein	University of Texas at Austin	Observations of Circumstellar UV Absorption Lines from the Neutral Envelopes of Planetary Nebulae
Ferland	University of Kentucky	Abell 39 — The Theoretician's Nebula Confronts The Theoreticians
Fesen	Dartmouth College	A WFPC2 Search for Surviving Binary Companions in SN Ia Remnants
Fesen	Dartmouth College	High-Resolution Imaging of Ejecta Knots in the Cassiopeia A SNR
Grebel	Astronomisches Institut der Universitaet Wuerzburg	Sher #25 in NGC 3603: A Galactic counterpart of SN 1987 A's progenitor
Hajian	United States Naval Observatory	Expansion Parallax Distances to Planetary Nebulae
Hamilton	JILA	Far UV Echelle Spectroscopy of Ejecta in SN1006
Harrington	University of Maryland	Collimation of Astrophysical Jets: The Proto-Planetary Nebula He 3-1475
Hester	Arizona State University	Continuation of Temporal Monitoring of the Crab Synchrotron Nebula
Humphreys	University of Minnesota	High Resolution Imaging and Spectroscopy of Cool Hypergiants Near the Top of the HR Diagram
Kirshner	Harvard College Observatory	SINS: The Supernova INtensive Study - Cycle 7
Latter	NASA Ames Research Center	Unscrambling the Egg and Other Young Planetary Nebulae
McCaughrean	Max-Planck Institute for Astronomy	Infrared H_2 imaging of the highly symmetric proto-stellar jets HH212 and HH111

Approved Observing Programs for Cycle 7 *Continued*

Morse	University of Colorado	The Distribution of Heavy Elements in Supernova Ejecta
O'Dell	Rice University	Spectrophotometry and Imaging of Cometary Knots in the Helix Nebula
Panagia	Space Telescope Science Institute	The TRUE three-dimensional structure of the Eta Carinae nebula
Ringwald	The Pennsylvania State University	A Snapshot Survey of Nova Shells
Sahai	Jet Propulsion Laboratory, California Institute of Technology	CRL2688: The Rosetta Stone for the Evolution of AGB Red Giants into Bipolar Planetary Nebulae Van
Winckel	Instituut voor Sterrenkunde, K.U.Leuven	Understanding the Red Rectangle and its central binary HD 44179

Stellar Populations

Bennett	University of Notre Dame	Snapshot Survey of Microlensed Source Stars
Bragaglia	Osservatorio Astronomico Bologna	White Dwarf Distance and Precision Age for Globular Clusters
Cook	Lawrence Livermore National Laboratory	Halo Microlens Source Systems and their Underlying Stellar Backgrounds
Da Costa	Mt Stromlo & Siding Spring Observatories	The Horizontal Branch of the M31 Dwarf Spheroidal Companion And III
Fullton	Space Telescope Science Institute	Ages of extreme metallicity globular clusters near the Galactic Center
Landsman	Hughes STX	A Complete Sample of Hot Post-AGB Stars in Globular Clusters
Lennon	Universitaets-Sternwarte Munich	Understanding high-redshift and starburst galaxies: A UV spectroscopic survey of O-stars in the SMC
Massey	National Optical Astronomy Observatories	The Evolution of Massive Stars as a Function of Metallicity: Closing the Loop Observationally
Meylan	European Southern Observatory	Precise Astrometry in the Core of the Globular Cluster 47 Tuc: A Complete Census of High-Velocity Stars
Oestlin	Astronomiska observatoriet	A Search For Old Stars in IZw18
Paresce	European Southern Observatory	Searching for Low Mass Stars: the Mass Function at the Hydrogen Burning Limit
Seitzer	University of Michigan	Extragalactic Open Clusters: A Catalog of Clusters in M31 and M33
Skillman	University of Minnesota	Star Formation Histories of Dwarf Irregular Galaxies II: the Old Populations of IC 1613 and Sextans A
Smecker-Hane	University of California	The Star-Formation History of the Large Magellanic Cloud
Sosin	University of California, Berkeley	A Snapshot Survey of Galactic Globular Clusters
Tosi	Osservatorio Astronomico di Bologna	NGC 1705: a Benchmark for Galaxy Evolution
van Altena	Yale University	Tangential Velocities of Globular Clusters: Preliminary Analysis for First-Epoch Material
van Altena	Yale University	Internal Velocity Distribution in Globular Clusters
Worthey	University of Michigan	NICMOS Imaging of Red Giants in M32
WYSE	Johns Hopkins University	The Low Mass Stellar Luminosity Function in Dwarf Spheroidal Galaxies

Solar System

Ballester	University of Michigan	H-Lyman Alpha Emission from the Upper Atmosphere of Uranus
Beebe	New Mexico State University	Study of Jovian Dynamics by Combining Global and Temporal HST Observations with Galileo Data
Bosh	Lowell Observatory	Albedos and Sizes of Planetary Ring Particles
Clarke	University of Michigan	HST Far-UV Imaging and Spectra of Jupiter's Aurora Coordinated with GALILEO
Elliot	Massachusetts Institute of Technology	Triton's Atmospheric Structure: Problems with Present Models
Elliot	Massachusetts Institute of Technology	Triton's Distorted Atmosphere
Feldman	The Johns Hopkins University	A Campaign to Determine the CO and CO_2 Abundances in Cometary Nuclei
French	Wellesley College	Saturn's Rings
G erard	Universite de Liege	Mapping of the H_2 Emission and Color Ratio in the Jovian Aurora
Goguen	Jet Propulsion Laboratory	Composition and Heterogeneity of Io's Volcanos from Polarimetry of Their Thermal Emission
Harrington	NASA Goddard Space Flight Center/National Research Council	Jovian Planetary Waves
James	University of Toledo	Synoptic Monitoring of Seasonal Phenomena on Mars
LAMY	Laboratoire d'Astronomie Spatiale	The nucleus of comet 55P/Tempel-Tuttle, the parent of the Leonid Meteors
Lemmon	Lunar and Planetary Laboratory	Spatially resolved multispectral investigation of Titan's troposphere and stratosphere
McCarthy	The University of Arizona	Mineralogic Mapping of Asteroid 4 Vesta
Noll	Space Telescope Science Institute	Saturn's Satellites: Alteration of the Surface by Ion Irradiation on Enceladus and Tethys
Noll	Space Telescope Science Institute	Spatial Distribution of Ozone and Sulfur Dioxide on Ganymede and Europa
Olkin	Lowell Observatory	The mass ratio of Charon to Pluto
Spencer	Lowell Observatory	Global Mapping of Molecular Oxygen on Ganymede
Sromovsky	University of Wisconsin	Multispectral Investigation of Dynamics and Cloud Structure on Neptune

Approved Observing Programs for Cycle 7 *Continued*

Tomasko	Lunar and Planetary Lab	Uranus' Vertical Haze Structure and its Variation with Latitude
Weaver	Johns Hopkins University	Investigating Volatile Depletion in Two Periodic Comets: 2P/Encke and 103P/Hartley 2
Weaver	Johns Hopkins University	Systematic Investigation of C/1995 O1 (Hale-Bopp) : Part 3
West	Jet Propulsion Laboratory, California Institute of Technology	Jovian Global Photometry During the Galileo Epoch
Wolff	Space Science Institute	A New Look at Martian Ice Clouds
Zappala	Osservatorio Astronomico di Torino	A search for main-belt binary asteroids
Young Stars and Circumstellar Material		
Brandner	Astronomisches Institut der Universitaet Wuerzburg	An HST/NICMOS search for young brown dwarfs and giant planets
Carr	Naval Research Laboratory	Water in Protoplanetary Disks
Figer	University of California, Los Angeles	Compact Young Clusters and the r^-2 Cusp near the Galactic Center
Ghez	University of California Los Angeles	Circumbinary Disks: Tracing the Mass and Energy Transfer in Young Binary Systems
Hartigan	Space Physics & Astronomy, Rice University	The Interaction of Accretion Disks with Protostellar Binaries
Hartmann	Smithsonian Astrophysical Observatory	The Dusty Environments of Protostars
Kalas	Max-Planck-Institute for Astronomy	NICMOS and WFPC2 Imaging of a New Beta Pic-like Circumstellar Dust Disk
Lagrange	laboratoire d'Astrophysique; BP53X	STIS observations of Beta Pictoris
Mathieu	University of Wisconsin - Madison	Dynamical Masses for the Stars in the Pre-Main- Sequence Spectroscopic Binary 045251+3016
McCaughrean	Max-Planck-Institute for Astronomy	Multi-wavelength imaging of circumstellar disks in the Orion Nebula
Meyer	Max—Planck—Institut fuer Astronomie	Probing the Very Low Mass IMF: Brown Dwarf Stars in Star—Forming Regions
Mundt	Max-Planck-Institut fuer Astronomie	Spectroscopic Imaging of CW Tau — Clues to the Structure and Collimation of T Tauri Star Winds
Najita	Center for Astrophysics	The IMF Below 1M odot in Young Clusters: 1.9Mum H_2O Band Imaging of IC348
Padgett	Jet Propulsion Laboratory	NICMOS Imaging of Young Stellar Object Circumstellar Nebulosity
Reipurth	European Southern Observatory	Thackeray's globules in IC 2944: HAlpha imaging with WFPC2
Simon	State University of New York	Orbits of Pre-Main Sequence Binaries
Simon	State University of New York	The Nature of T Tau S
Stapelfeldt	Jet Propulsion Laboratory	T Tauri Star Snapshot Survey: A Census of Protoplanetary Disks
Terebey	California Institute of Technology	The Small Scale Structure of Protostellar Disks and Infall Envelopes
Weintraub	Vanderbilt University	Coronagraphic, Polarimetric Imaging of T Tau with NICMOS
Wood	University of Wisconsin	The Morphology Of Protostellar Environments
Zinnecker	Astrophysikalisches Institut Potsdam	The low-mass pre-MS stellar content of the 30 Dor starburst cluster

GO and AR Statistics of PI by country

Country	*Submitted*	*Approved*
Australia	14	3
Belgium(*)	3	2
Brazil	2	0
Canada	31	4
Chile	2	1
China	2	0
Denmark(*)	1	0
France(*)	37	5
Germany(*)	78	24
India	2	0
Israel	7	0
Italy(*)	33	4
Japan	4	0
Mexico	4	2
Netherlands(*)	23	4
New Zealand	1	0
South Africa	3	0
Spain(*)	18	2
Sweden(*)	13	3
Switzerland(*)	4	0
United Kingdom(*)	105	15
United States	911	228
Total	1298	297

(*) ESA member state

Proposal Statistics by Panel

	AGN1	AGN2	BIN	COS	CS	CLUS	GAL1	GAL2	HS	ISM	QAL	SE	SP	SS	YS	TOTAL
Proposals Received																
GO	80	90	65	79	75	47	79	76	66	49	68	92	104	88	86	1144
SNAP	8	6	9	5	8	3	7	6	3	1	6	2	4	0	4	72
AR	5	10	3	10	4	8	15	3	1	6	2	1	6	7	1	82
Proposals Accepted																
GO	14	14	20	22	18	9	12	11	14	13	13	21	16	24	20	241
SNAP	3	0	0	0	3	1	2	1	2	1	3	1	2	0	1	20
AR	3	3	2	7	0	5	5	2	1	3	0	0	2	2	1	36
Primary Orbits Requested																
	1243	1859	923	2475	1062	1230	1750	1304	810	822	1957	1241	2452	1203	1403	21734
Panel Fraction of Total Accepted																
	8%	9%	4%	13%	5%	5%	8%	4%	4%	3%	8%	7%	9%	5%	7%	—
Primary Orbits Accepted																
	253	301	148	442	169	174	280	144	148	103	255	218	289	157	223	3304
Fraction of Orbits Accepted/Requested																
	20%	16%	16%	18%	16%	14%	16%	11%	18%	13%	13%	18%	12%	13%	16%	15%
ESA PIs Accepted																
	2	3	8	4	4	3	4	1	4	3	6	5	6	3	8	64
ESA Primary Orbits Accepted																
	7	68	30	49	29	56	49	12	38	15	59	21	94	14	94	635
Fraction of ESA Orbits Accepted																
	3%	23%	20%	11%	17%	32%	18%	8%	26%	15%	23%	10%	33%	9%	42%	19%

Preparatory Support Available For Funded Programs

Ray Beaser

Many Cycle 6 General Observers using the WFPC2 and the FOC had their Programs delayed until after the servicing mission in February. Due to a funding shortage, no preparatory grants were awarded for Cycle 6 funded Programs. Funds for those Programs were to be released only after the first observation was obtained for each Program. However, we heard from numerous investigators that funding delay is creating substantial financial problems. After reviewing the improved funding situation for the current fiscal year, the Director decided to authorize preparatory funding of up to 10% of the approved allocation for GOs who need to prepare for the receipt of Cycle 6 data. We realize that this will not solve the financial problems of GOs, but we hope it will be of some help. E-mail will be sent shortly to the GOs who are affected informing them of the availability of preparatory funding. GOs may send their requests for preparatory funding directly to the E-mail address of the Grants Administration Branch: `grantinfo@stsci.edu`. The request should include a description of the specific preparatory activities which need to be accomplished prior to the receipt of data. Please note that because of the improved availability of funding, the Director also approved the award of 10% preparatory funding for Cycle 7 General Observers.

Electronic Submission of Performance Reports

Ray Beaser

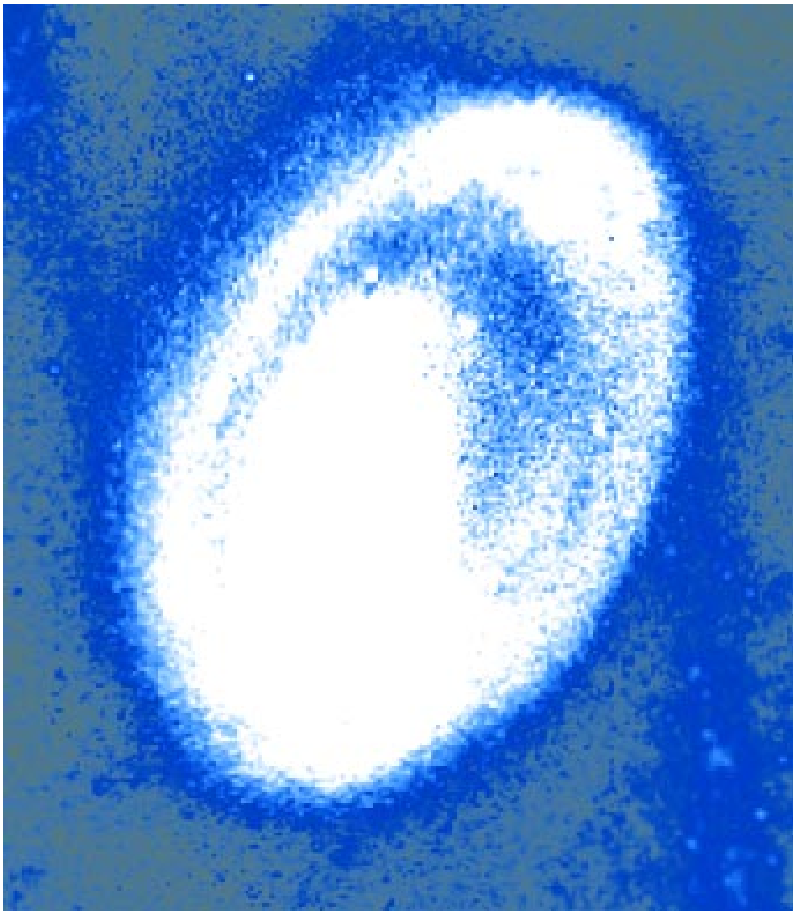
In a continuing effort to improve our procedures and to decrease the administrative burden on investigators, interim and final Performance reports may be submitted electronically to the following address:

`goarperform@stsci.edu`

Reports sent by e-mail to the above address are automatically sent to the Grants Administration Branch and to several scientists for review. An automatic reply will be sent acknowledging the receipt of the report. If you need a performance report template, please send e-mail to the above address typing “send template” in the subject line.

If you have any questions concerning the submission of the report, please send e-mail to `grantinfo@stsci.edu` or call (410) 338-4200.

HST Recent Release: Hubble Images Reveal Supersonic Comet-like Objects in the Heart of Galaxy



Researchers analyzing the Hubble Space Telescope's dramatic pictures of the Cartwheel galaxy have discovered immense comet-like clouds of gas speeding through the heart of the galaxy at nearly 300 km s^{-1}.

This close-up image of the galaxy's nucleus reveals the comet-like knots of gas. These knots are mostly confined to the core's left side and appear as white streaks inside the blue ring. The "heads" are a few hundred parsec across; the tails are more than ~1 kpc light-years long, the longest of which is nearly 15 kpc. The structures look like comets because they probably were spawned by a collision between high-speed and slower-moving material. This collision created an arrowhead-shaped pattern called a bow shock, which is similar to the wake of a boat speeding across a lake.

Credits: Curt Struck and Philip Appleton (Iowa State University), Kirk Borne (Hughes STX Corporation), and Ray Lucas (Space Telescope Science Institute), and NASA

Second Servicing Mission

SM2

HST's Second Servicing Mission—Overview

Carl Biagetti

Launch of NASA's Space Shuttle Discovery is currently scheduled for 13 February 1997. Discovery is the name of Orbiter Vehicle No. 103 and the Shuttle flight is listed as STS-82.

At the highest level, the mission has two primary goals: 1) the enhancement of HST's science capabilities by installation of two new orbital replacement instruments (ORIs), and 2) enhancement of HST's long-term scientific productivity through the replacement of failed or degraded orbital replacement units (ORUs) with new technology units.

The two new ORIs are of course NICMOS and STIS, both designed as HST axial instruments. NICMOS is an advanced infrared camera, developed by the University of Arizona, that will enable the HST to exceed the sensitivity and spatial resolution in the near-IR of both present and planned ground based facilities. STIS, developed by the NASA's Goddard Space Flight Center (GSFC), enhances HST's spectrographic capabilities by providing simultaneously wide spectral coverage and high spectral resolution, including long-slit imaging with an emphasis on the ultraviolet. More technical information on the development status of these two new instruments is found elsewhere in this newsletter. NICMOS will replace the FOS in HST's instrument bay 2. STIS will replace the GHRS in bay 1.

Both NICMOS and STIS are equipped with their own special optics designed to correct for the spherical aberration of HST's primary mirror, and, as a result, will not require the correction provided by the Corrective Optics Space Telescope Axial Replacement (COSTAR), which was installed during the first servicing mission in December, 1993. Therefore, after a nominal SM2, COSTAR's only purpose will be the optical correction for the Faint Object Camera (FOC). The FOC and the Wide Field Planetary Camera 2 (WFPC2), which also has its own corrective optics, along with NICMOS, STIS, and the Fine Guidance Sensor (FGS) system, will form the new complement of HST science instruments (SIs).

In addition to STIS and NICMOS, there are a variety of ORUs which provide the upgrades for failed or degraded units.

First, FGS-1 will be replaced with an upgraded flight spare. All three FGSs have shown, to one degree or another, evidence of degradation that implies the need for eventual replacement of at least one of them in order to maintain the FGS system's astrometric and vehicle guiding capabilities. (See the last issue of this Newsletter for more details on the FGS problems the decision to replace FGS-1.) The flight spare is upgraded with an adjustable mirror designed to compensate for the spherical aberration of HST's primary optics.

The Data Interface Unit No. 2 (DIU-2) will be replaced with an upgraded version of the same device. The DIUs provide common command and data interface between the Data Management Unit and other HST equipment. During SM1, DIU-2 suffered a Side-A failure caused by an over-voltage state resulting from a power conditioning unit (PCU) relay failure. The replacement unit will have over-voltage protection circuitry to help prevent the recurrence of this type of problem.

The HST's data recording and playback systems will be extensively serviced. The current system consists of three Engineering/Science Tape Recorders (ESTRs), each with a capacity of about 1 .2 gigabits, used to record and play back HST science and engineering telemetry. ESTR-1 has exhibited several tape-speed anomalies and ESTR-2 had experienced problems with reliability of track 2 recording before, experiencing what is apparently a hard failure. These anomalies, combined with the increased data demands during NICMOS and STIS operations, dictate an upgrade to a new system. Current plans are to replace ESTR-2 with a flight spare and ESTR-1 with a solid state recorder (SSR). The SSR is a prime example of a "new-technology" upgrade. It will have a 12-gigabit capacity and will offer the considerable operational advantages of simultaneous record and playback and simultaneous recording of science and engineering data to a single device.

Finally, the Solar Array Drive Electronics No. 2 (SADE-2) will be replaced by the original SADE-1 unit, removed during SM1 and refurbished with heat sinks to prevent the recurrence of problems it experienced on orbit.

SM2, as currently planned, is a ten-day mission with a seven-person crew led by Commander Ken Bowersox (See the October issue of this Newsletter for more on the crew members and their September visit to the Institute). The shuttle launch is scheduled for 13 February 1997. The current launch window is between 7:59 to 9:00 UT (2:59 - 4:00 am EST). A little less than two days after launch, the HST will be configured for capture while the Space Shuttle approaches for rendezvous, capture, and berthing. On flight day 4, the astronauts will begin the first of four scheduled six-hour extra-vehicular activities (EVAs), one per day, during which they exit to the Shuttle bay to go about the work of HST refurbishment. The first EVA is dedicated to the installation of both STIS and NICMOS, in that order. (Note that these activities include the removal of the GHRS and FOS during the same EVA.) The second EVA

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Space Telescope Imaging Spectrograph (STIS) Update

Stefi Baum

After an extended (4.5 month!) period of ground characterization and testing, STIS passed its preship review and was packed up and shipped to Kennedy Space Center on December 10. At the Cape, STIS will go through its final paces before insertion in the Shuttle for its February 13, 1997, launch.

The final months of STIS's ground calibration were carried out at GSFC, in both air and nitrogen purge. The science data obtained during the ground calibration showed that STIS should meet or exceed its scientific expectations, almost across the board, with the detectors performing beautifully, the measured sensitivities as predicted to within ~20%, the optical performance (Line Spread Functions and Point Spread Functions) outstanding, and the throughput at Lyman-alpha showing no signs of temporal degradation due to contamination. The extended period of STIS operations also provided an opportunity to test the STIS Flight Software. Problems were identified and fixed, with several open areas still under investigation.

During the GSFC ground calibration, extensive work was done characterizing and trying to optimize the CCD performance, as well as obtaining much needed CCD and NUV-MAMA data to build the basic reference files for calibration (e.g., flats, darks, dispersion solutions). Considerable effort was devoted to trying to understand the nature of the fringing and extended PSF halo seen at long (λ > ~8000 Å) wavelengths with the CCD, to optimize observing strategies for NIR observations. Excellent high signal-to-noise flat fields were produced for the NUV-MAMA. For the FUV-MAMA, the lack of additional calibration time in vacuum and the slightly different nature of the detector suggest that only rudimentary flats will be available for the FUV-MAMA at launch. A more complete set of flats for the FUV-MAMA will be obtained once STIS flies, most likely early on in the Cycle 7 calibration program.

Plans for the Servicing Mission Orbital Verification (SMOV), to be carried out between deployment and June, 1997, are in full development now. STIS will be characterized on orbit in an extensive SMOV with roughly 50 proposals, and ~350 orbits (predominantly internals) planned, leading up to the July 1, 1997, start of Cycle 7 science. Characterization on orbit starts first with the CCD and is followed a month later with the start of MAMA characterization, once sufficient vacuum is obtained to allow turn on of the MAMA high voltage.

STIS was heavily subscribed for Cycle 7 science, with fully 1/2 of the accepted GO proposals being STIS prime. At STScI, we have been preparing for the STIS GO era, with contact scientists now assigned to all the proposals and activity to ready our ground systems for STIS science continuing at a near-frenzied pace. To allow us time to react to the many changes coming out of STIS's extended ground calibration and to give us time to ready our systems and our understanding for GOs, STIS GOs will find staggered CCD and MAMA Phase II deadlines. CCD-only STIS Phase II proposals are due on March 25, with STIS MAMA (or MAMA plus CCD) proposals due later: May 1, 1997. STIS GOs can expect to receive updates with our latest knowledge and advice roughly 6 weeks prior to the Phase II deadlines. Just two months to launch and six months to the first STIS GO science now!

SM2 Overview *from page 16*

includes the installation of the new FGS and its associated optical control electronics kit, thereby achieving the highest-priority mission items within the first two EVA periods. ESTR-2 will also be replaced during the second EVA. EVA 3 is dedicated to the DIU-2 replacement and the SSR installation. The SADE-2 replacement will be performed in EVA 4, the last of the planned EVAs.

As a result, all refurbishments are scheduled for completion by the end of flight day seven. The next day, HST is unberthed and, after its aperture door is re-opened, is released and separated from the Shuttle. NASA's Goddard Space Flight Center (GSFC) re-establishes control of the observatory while the Shuttle stays aloft for two more days, de-orbiting and landing about ten full days after launch. The mission thus designed allows for one contingency EVA and one deployment contingency.

NICMOS

K. Noll

The successful installation of the Near Infrared Camera and Multi-Object Spectrograph (NICMOS) on HST will add significant new infrared observing capabilities to the observatory. Preparations for the inauguration of this new instrument are continuing.

NICMOS successfully passed centifuge testing at Goddard Space Flight Center and has been returned to the test facilities at Ball Aerospace. Both optics and electronics tests have confirmed nominal performance. Installation of flight software and testing for the set of pre-defined MULTIACCUM sequences (see below) has been completed.

Current plans are for NICMOS to arrive at Cape Canaveral by the end of December. After additional testing NICMOS will proceed to the payload processing facility in mid-January. A final cool down to 50 K will take place 5 days prior to launch.

Updated information on preparing NICMOS proposals was mailed to successful cycle 7 proposers. This information is also available on the STScI World Wide Web site under the NICMOS page. (The NICMOS home page can be found at `http://www.stsci.edu/ftp/instrument_news/NICMOS/topnicmos.html`) In the update the new MULTIACCUM sequences were described, recommendations for thermal background observations were made, and small revisions to suggested parallel observing strategies were announced.

Based on a review of accepted proposals, we now expect that the MULTIACCUM readout mode will be the most heavily used of the available readout modes. Observers will be required to use one of a set of sixteen pre-defined readout sequences in order to receive calibrated dark frames for their observations. These sequences have been designed to cover the complete range of desireable observing sequences and are described in detail both in the Phase II proposal instructions and in Instrument science reports, both available on the STScI WWW site.

Observations using NICMOS longward of 1.7 microns will be background limited. It will be possible to remove thermal backgrounds by obtaining background measurements using either dithering or chopping patterns to move the telescope is steps as large as 24 arcminutes. Although we will not be able to measure the stability of the thermal environment in the telescope until after launch, we currently recommend that observers who work at background-limited wavelengths obtain a background measurement after every 5 minutes of on-source integration. Updated recommendations based on on-orbit performance will be posted on the STScI WWW site under the NICMOS instrument page.

Because NICMOS has a limited lifetime, it is important to maximize the scientific return by taking advantage of all significant observing opportunities. Observers who are making long exposures of ten minutes or more in a single camera are required to add parallel observations in the remaining two cameras. Details of how to do this are contained in the NICMOS Instrument Handbook and the GO update, both available on the STScI WWW site. An cut-and-paste example of a completed attached parallel program and other example programs are available on the NICMOS Web pages.

NICMOS observers, like those using other instruments on HST, will be supported by a designated contact scientist (CS) and a program coordinator (PC). The CS will be one of the NICMOS instrument scientists and will be able to help with questions concerning instrument capabilities and observing strategies. The PCs are members of PRESTO, the scheduling branch within STScI, and are experts in the use of RPS2 proposal processing software. The PCs will also handle most of the detailed preparation and scheduling of your proposal. Both the CS and PC will be familiar with your proposal and should be the first people you turn to for help.

Late News: *As this Newsletter goes to press an addition has been made to SM2 plans.*

A late addition to EVA3 is the swap out of Reaction Wheel #1 with a flight spare. This change-out is occasioned by recent glitches with RW1 that have resulted in observatory safings. While the spacecraft can operate with only 3 of its complement of 4 reaction wheels, slewing takes much longer with an overall loss of observing efficiency. And since it cannot operate with only 2 reaction wheels, which are designed as orbital replacement units, the decision has been made to make the relatively straightforward change-out in the third EVA.

A reboost of HST's orbit using the Vernier Reaction Control System jets will be attempted in three separate steps, after each of the last three EVAs. The lower thrust of the VRCS system is necessitated by the fact that the solar arrays remain deployed during the servicing mission. The reboost, expected to amount to approximately 5 or 6 miles, is expected to minimize the reboost needed in the 1999 mission, which occurs during the solar maximum.

Instrument News

FGS Status

FGS3 astrometry performance is nominal. The completed cycle 6 calibrations include the red transfer reference scans, the spatial and long-time-scale dependence of the transfer function, and the monthly position-mode stability checks (for field angle distortion monitoring). Blue transfer reference scan calibrations and some special servicing mission calibrations will execute in January.

The Space Telescope Astrometry Team (STAT) is continuing to monitor the position mode stability. We graciously welcome Ed Nelan who has joined Olivia Lupie as an FGS instrument scientist. His work for the Astrometry team over the last several years has been crucial and and Ed will be instrumental in implementing the STAT Pos mode pipeline (semi-automated reduction of Position mode data) at the STScI.

FGS3 performance issues which are under investigation are the optical field angle distortion stability (STAT), and temporal stability of the S curves (STAT, STScI). Plans for 1997 include introduction of FGS data paper products which incorporate jitter and diagnostic data, enhancement of the STScI Trans mode pipeline, installation of the POS mode pipeline, and recalibation of the astrometer after the servicing mission. The new FGS (FGS1R) has been shipped to Cape Kennedy to await the February shuttle launch. Ground tests were nominal and performance is expected to exceed that of FGS3 primarily due to the introduction of a special folding flat mirror for optical alignment. The new FGS will be commissioned during the orbital verification period and science assessment tests will ensue. If proven to have greater astrometric capability, the new FGS will be available for Trans mode in cycle 8 and Pos mode in late cycle 8 or 9. The calibration of FGS3 will be maintained for several more cycles.

Faint Object Camera

M. Voit

As the February servicing mission approaches, the FOC's performance has been virtually trouble-free. The f/96 camera continues to gather high-resolution imaging data, and during the last six months we have returned the f/48 camera to regular service. Several programs have successfully used the f/48 spectrograph and its 0.06 x 12 arcsec slit to gather spectra with unprecedented spatial resolution.

For up-to-date information on HST's science instruments, check ST ScI's web pages. You may also wish to subscribe to one or more STANs (Space Telescope Analysis Newsletters). Subscriptions are done through a listserver, the instructions for which may be found on each instrument's web page.

Faint Object Spectrograph

Tony Keyes

The FOS has continued to perform well. Usage has continued at quite high levels in order to complete Cycle 6 programs prior to SM97.

During the past three months FOS ACQ/PEAK acquisitions have again been affected by loss-of-lock events associated with FGS1. PRESTO is preferentially biasing away from FGS1 for FOS observations, however FGS1 occasionally must be used. Approximately 5% of visits since mid-October have been lost or seriously affected by FGS1-related loss-of-lock problems. Unfortunately, the Oct/Nov cycle 6 FOS/BL flat field and photometric monitor visits were lost completely due to loss-of-lock events. These calibrations will be repeated as soon as possible.

As we enter the period of final on-orbit calibration measurement for the FOS, please refer to the FOS Web pages for updates relating to the status of instrument calibration.

Goddard High Resolution Spectrograph

D. Soderblom

The group within STScI that supports the GHRS is diminishing because of the needs of STIS. After February 28, 1997, the GHRS Group will consist of myself as Instrument Scientist and Lisa Sherbert as Data Analyst. Our work in 1997 is intended to provide the information that archival users of GHRS data will need in the future. Those plans will be discussed further in the next Newsletter.

We are now redetermining the sensitivity and vignetting functions for grating G140L. A GO discovered a problem with the current sensitivity calibration files that lead to discrepancies in standard star spectra of ~5% over scales of ~50 Å, with deviations of ~10% in some cases. New calibration files are being created, and all of this will be presented in greater detail on our Web page.

We are also now working on:

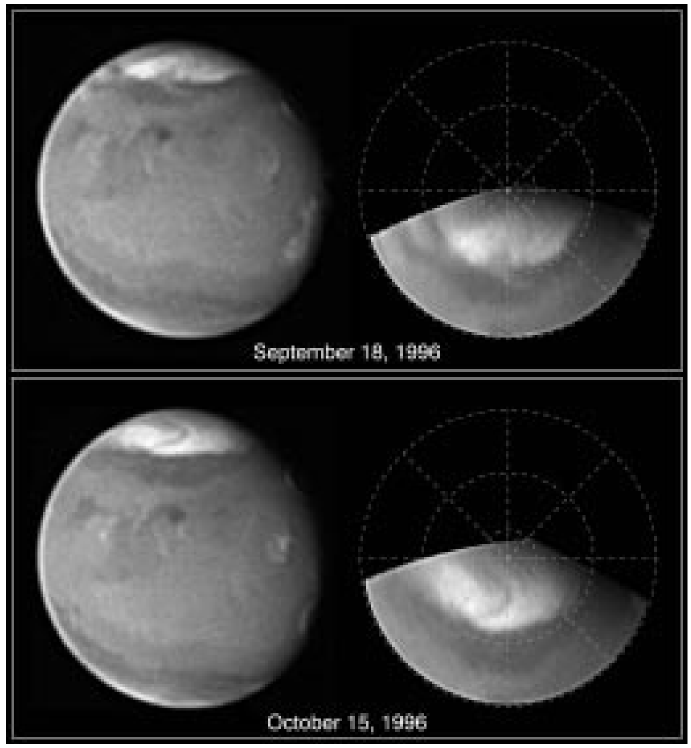
- A comprehensive examination of wavelength calibrations since Cycle 2.
- Calibration of the wavelength offsets between the LSA and SSA.
- Sensitivity and vignetting for grating G140M.

Instrument News

WFPC2

B. Whitmore

A new model for the WFPC2 polarization characteristics has been developed by John Biretta. Measuring the true polarization of a source with WFPC2 is challenging because the pickoff mirror introduces considerable instrumental polarization into the image. This and other instrumental effects are included in the new model. Comparisons between the model and limited on-orbit data suggest accuracies of 1 to 5 % can be attained, depending on the filter and observing configuration. A Web page has been created which describes this model, and it will be updated as our understanding of the calibration evolves. There are also two Web tools which can be used to calibrate polarization observations with the above model. A bug has been discovered in the pipeline calibration software for a small fraction of WFPC2 images. This bug was introduced in the December 1994 version (version 1.3.0.7) of the CALWP2 program, and affects the processing of all single-chip, non-PC images produced by the non-standard (engineering only) options READ=2, READ=3 or READ=4. As a consequence of the bug, the calibration proceeds as if the first group represents the PC (DETECTOR=1), regardless of the detector actually used. As a result, the pixel noise may be larger than in a correctly reduced image, and an offset zero point of several percent may exist. Also, images taken with partially rotated, quad, or Woods filters may have an incorrect vignetting function applied, which may result in significant non-uniformity of the background and of the throughput. A new version of the calibration routine CALWP2 is now being tested, and should become available in January. Meanwhile, if you have single-chip images in one of the WF cameras, and you suspect the incorrect calibration program was applied, please contact help@stsci.edu. PIs of affected programs have been notified.



HST Recent Release: Springtime Dust Storm Swirls at Martian North Pole

Two Hubble Space Telescope images of Mars, taken about a month apart on September 18 and October 15, 1996, reveal a state-sized dust storm churning near the edge of the Martian north polar cap. The polar storm is probably a consequence of large temperature differences between the polar ice and the dark regions to the south, which are heated by the springtime sun. The increased sunlight also causes the dry ice in the polar cap to sublime and shrink.

Top (September 18, 1996) - The salmon colored notch in the white north polar cap is a 1,000 km long storm — nearly the width of Texas. The bright dust can also be seen over the dark surface surrounding the cap, where it is caught up in the Martian jet stream and blown easterly. The white clouds at lower latitudes are mostly associated with major Martian volcanos such as Olympus Mons. This image was taken when Mars was more than 300 million km from Earth, and the planet was smaller in angular size than Jupiter's Great Red Spot!

Bottom (October 15, 1996) - Though the storm has dissipated by October, a distinctive dust-colored comma-shaped feature can be seen curving across the ice cap. The shape is similar to cold fronts on Earth, which are associated with low pressure systems. Nothing quite like this feature has been seen previously either in ground-based or spacecraft observation. The snow line marking the edge of the cap receded northward by approximately 200 km, while the distance to the Red Planet narrowed to 275 million km.

Credit: Phil James (University of Toledo), Steve Lee (University of Colorado) and NASA

HST Data Archive

Archive Branch News

Megan Donahue

Upgrade Your StarView in February

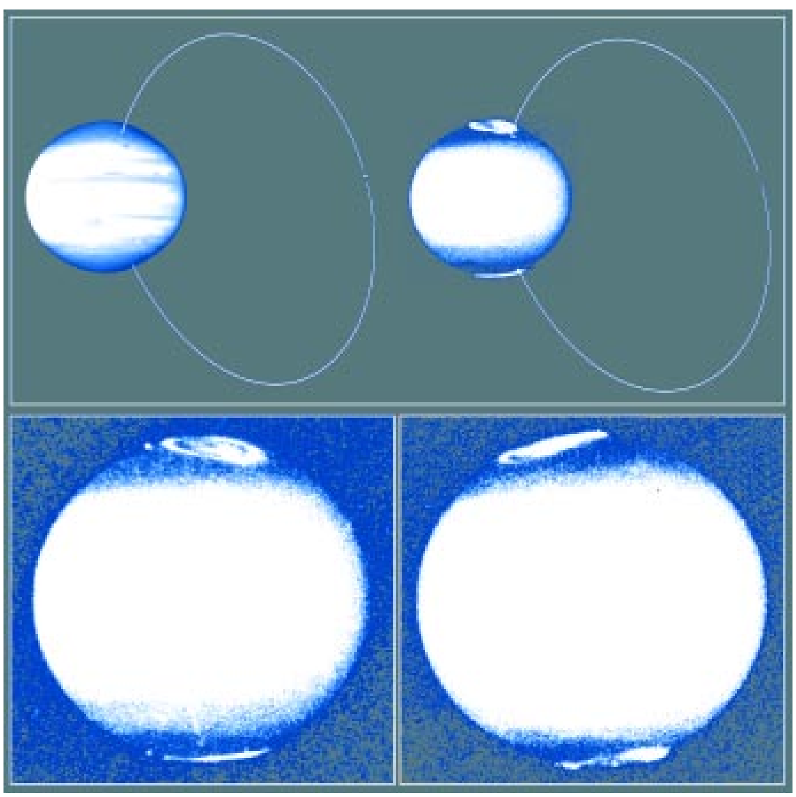
StarView 5.0 will be available by mid-February, 1997. All users of the distributed version of StarView are asked to update their version at that time. The new version has screens for STIS and NICMOS. The format of the database and the screens must accommodate the STIS and NICMOS data structures, such as "products," "intermediate products," and "associations."

We rarely require all users of StarView to upgrade, but these changes are significant, so that backward-compatibility would have been very expensive. We will notify all active users of the archive of the upgrade requirement, but only users of the distributed version are affected. The distributed version of StarView is faster than using it through archive.stsci.edu, and installation is only a matter of copying over the executables appropriate to your system. No recompilation is required!

Access the new StarView from the WWW page `http://archive.stsci.edu/dist_starview.html`. While you're there, register as a distributed StarView user so we can keep you informed of any changes or new releases of distributed StarView.

New Phase II Data Distribution

In completing your Cycle 7 Phase II proposals, note that the new data distribution default is electronic retrieval. We will automatically notify you when your data are ready for retrieval from the Hubble Data Archive within 24 hours of its arrival, making it available days earlier than the typical tape delivery. If your internet link is slow, or the quantity of HST data is large, you can opt to receive an Exabyte or DAT tape. We have gone from only one data distribution medium (Exabyte) in Cycle 6 to three (electronic, Exabyte, or DAT) in Cycle 7, so do not neglect to select your preferred data distribution option in your Phase II proposal.



HST Recent Release: Hubble Images Reveal Jupiter's Auroras

These images, taken by the Hubble Space Telescope, reveal changes in Jupiter's auroral emissions and how small auroral spots just outside the emission rings are linked to the planet's volcanic moon, Io. The images represent the most sensitive and sharply-detailed views ever taken of Jovian auroras.

The images were taken by the telescope's Wide Field and Planetary Camera 2 between May 1994 and September 1995.

Credits: John T. Clarke and Gilda E. Ballester (University of Michigan), John Trauger and Robin Evans (Jet Propulsion Laboratory), and NASA.

Public Outreach and Education

Public Outreach on the World Wide Web

P. Pengra

In response to this growing interest in the World Wide Web, the Office of Public Outreach is setting up a new Hubble Space Telescope site specially designed for the public. The site, called the Hubble Space/Time Explorer, features the telescope and science images, but is stylistically distinct from the Space Telescope Electronic Information Service (STEIS) familiar to most astronomers. (See the other Web article in this issue for news on these other STScI Web pages.)

At the very top level, we've put links for kids, teachers, and reporters, and we've provided a quick way to get to the latest Hubble pictures and news. The glowing "network" design that begins at the top with the constellation of stars framing the telescope (shown on the right) is carried forward into other page designs, such as the ones for kids, the picture gallery, and Amazing Space. Amazing Space is an on-line collection of educational resources for teachers and students. It includes student activities (described in the last edition of this newsletter) featuring the Hubble Deep Field, Solar System Trading Cards, the Second Servicing Mission, and Stars.

The new site will soon include a search capability so that site visitors can readily find what they're looking for. And to make sure that frequent visits don't slow down the primary work of the Institute, the site will be supported by a dedicated server.

Check it out. The URL is:
`http://www.stsci.edu/pubinfo`

The Internet is everywhere.
And "surfing" has become a national pastime.

Institute News

Saving Lives with IRAF: Innovative Uses of Astronomical Software

R. Hansich and R. White

Over the past year and a half, we have been collaborating with JHU computer scientist Steven Salzberg and Georgetown University radiologist Matthew Freedman to explore the application of astronomical image processing methods and automated detection and classification algorithms to the analysis of digitized mammograms. An early diagnostic for the likely development of breast cancer is the appearance in a mammogram of faint, point-like objects called microcalcifications. These objects can be difficult to see, however, especially since virtually all analysis of mammograms is by visual inspection of an x-ray film. When microcalcifications occur superimposed on regions of structural complexity, even experienced radiologists can overlook them. Moreover, clinical experience has shown that as smaller and smaller microcalcifications are detected (and they are even more difficult to detect by visual inspection), they continue to serve as a good diagnostic of the eventual development of cancer.

We got involved with this work owing to the intervention of Ben Snavely, program manager for advanced technologies and instrumentation in the Astronomy Division of the National Science Foundation. Ben's previous experience in developing medical imaging equipment at Kodak, combined with his work at NSF, led him to believe that there may be some benefit from applying image processing methods developed in astronomy to medical image analysis problems. He made the introductions between those of us at STScI, JHU, and Georgetown, and supported our initial work with an exploratory research grant. Of the wide variety of medical image analysis problems, our interest was drawn to the detection of microcalcifications in digitized mammograms owing to the similarity with detection of faint cosmic ray hits in CCD images. There are some significant differences, however. First, in mammography one does not have the advantage of using separate, independent exposures to isolate spurious events like cosmic rays. The microcalcifications are true objects, and would appear the same in multiple exposures, at least to the extent that two exposures can be made under identical conditions. Standard mammography involves two separate images of the breast, taken from two viewpoints. In principle one can correlate features in these two perspectives, but the geometry of the two views is non-trivial to determine empirically. Thus, the problem of microcalcification detection relies primarily on developing a suitable high-pass filter.

The high-pass filter must not be biased against the detection of microcalcifications in regions of the image with low image intensity. The filtering approach that we have developed involves three steps. The first is to compute a conventional unsharp mask by median-window-smoothing the image and subtracting the smoothed image from the original. The second step is to fit a normalization function to the distribution of locally-computed variances versus the image median intensities. These variances are a measure of the "structural noise" in the image, which increases linearly with intensity above some low-level noise background and up to some saturation value. The unsharp-masked image is then divided by the normalization function to create an image in which the pixel intensities are an unbiased measure of that pixel's deviation from the local median. Some sample variance normalization functions are shown in Figure 1.

This filtered image is then processed by the DAOPHOT "find" routine to identify the strongest point-like objects. Because the cancer diagnostic involves the detection of clusters of microcalcifications rather than isolated objects, we compute distance measurements for each object to its nearest neighbor objects. The object list with distance measurements is then classified by Steven Salzberg's decision-tree algorithm to identify likely microcalcification clusters using a training set of microcalcification clusters identified by experienced radiologists.

One of our initial results is shown in Figure 2. At left is the original mammogram, and at right is our filtered version of the image in which the confusing background structures have been removed. In both images the microcalcification clusters identified by radiologists have been overlaid. We detect microcalcification clusters where the radiologists do, and also see some clusters that the radiologists may have missed.

The next step in this project is to expand the suite of test data sets and compute the receiver operating characteristic (ROC) curves for our filtering and detection methods. Ideally one will detect true microcalcification clusters only, missing none and having a minimal number of false positives. To date, most automated microcalcification detection algorithms have failed to find 5 to 10% of the true clusters, and they tend to include a

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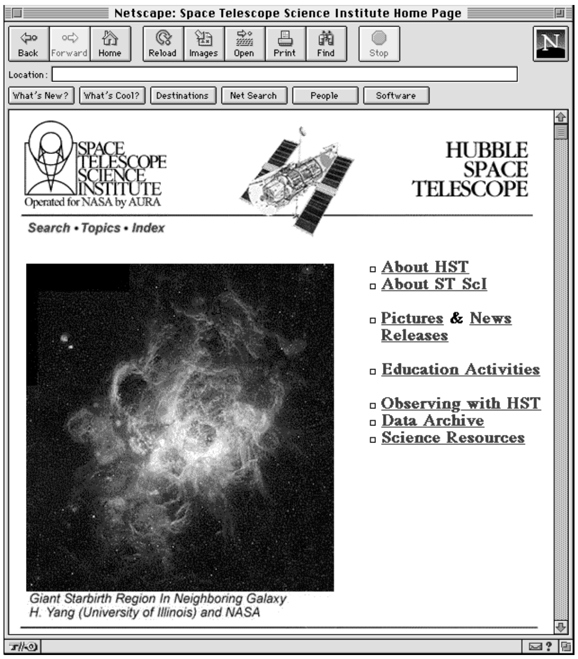
Editor's Note: Dr. Hanisch is the 1996 recipient of the AURA Achievement Award for functional work at STScI. I asked him to provide this description of some of the work that led to that award.

New Design for the STScI Web Site

Dick Shaw and Harry Payne

Those of you who visit the STScI Web site `http://www.stsci.edu/` will notice a set of new, high-level pages. These pages were released at the beginning of 1997 after extensive discussion and experimentation by members of the Institute's STEIS Steering Committee. These pages give



a new look to the Institute's Web presence, and present what we hope is a Web site that is informative, enriching, and in keeping with the best interests of the STScI mission.

The previous design served us well for two years, which is an eternity in the Web provider community. During that time, the state of the art in Web site design and navigation technologies has advanced considerably. The STScI Web site has grown substantially during that period as well: the number of HTML pages, manuals, images, etc. offered through STScI grew from a few hundred in the early 1990s to over 30,000 internal and external resources at the end of 1996. There is every reason to believe this growth will continue. Thus, in just a few years the World-Wide Web has become one of the primary means through which STScI reaches its user community.

The community we serve through the Web has also changed and expanded dramatically. The STScI Web site is now one of the most popular on the Internet and has come to serve the needs and interests of a very broad audience, including students, educators, the broadcast and print media, and the general public. The Web site usage statistics show that the vast majority (typically more than 90%) of the roughly 200,000 daily requests come from this broader audience, rather than from members of the professional astronomy community that were the focus of the previous-generation Web pages. Interestingly, the average daily volume of information retrieved from the STScI Web site rivals the volume of data retrieved from the Hubble Data Archive, and sometimes exceeds it by a factor of up to five.

Serving so many resources to such a large and diverse audience puts ease of navigation at a premium, and necessitates a clearer statement of identity, which is reflected in the new Web design. The goals were to create a clean, well-organized site, to better accommodate the needs and interests of the public, to add a number of navigation aids, to be friendly towards non-graphical browsers and users reaching us over low-speed connections, and to put important and interesting information of a timely nature into prominent locations. The new Web pages, in their sum, now contain links to all the previous (and many new!) Web resources. Though these links are arranged somewhat differently than before, the intention is that information and other resources are now easier to locate.

New Resources

Members of the scientific community, especially users of HST, will find most links of interest by following either the link to "Science Resources" or to "Observing with HST" from the new home page. The latter link brings together the resources that observers need in all phases of their programs, from the Call for Proposals for each cycle, proposal preparation resources, details of the science instruments, to the data reduction and analysis pages. This page (as with many of the higher level pages) will feature important announcements, deadlines, and news items near the top, just under the banner. Users of HST may wish to establish a "bookmark" in their browser to this page.

Their are also new navigation aids to find resources, including a search engine, a "Topics" page and an index, which are all accessible from the "banner" at the top of all the high-level pages. These navigation aids provide different, but complementary views of Institute Web resources. The "Topics" page presents a large number of links on one page, in the form of a table where the column headings correspond to the major links offered on the home page. This flatter view of the STScI Web space should make it easier for you access a resource when you know where it is, with traversing a hierarchy of pages to get to it. The "Index" page is arranged like a book index, in that the links are arranged alphabetically by topic, and many of the links are present more than once. This page is more appropriate when you know what category of information you want, but do not necessarily know what path to take to find it. Neither the "Topics" nor the "Index" page lists all possible STScI Web resources, but focus instead on higher-level pages that provide links to the primary resources (e.g., the manuals, the software distributions, etc.). The STScI "search" facility will enable you to find any

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The 1997 STScI May Symposium: The Hubble Deep Field

M. Livio, STScI

Our May Symposium this year is on the Hubble Deep Field. The intent is to cover all the types of objects in the HDF, namely, galaxies, stars, and sub-stellar objects.

The confirmed invited speakers are listed to the right.

The symposium will take place at the Institute, on May 6-9, 1997. The deadline for registration is April 1, 1997, and the registration fee is $150. Those wishing to attend should contact the following as soon as possible:

Cheryl Schmidt,
Symposium Coordinator

Space Telescope Science Institute
3700 San Martin Drive
Baltimore, MD 21218, USA.
Tel. (410)338-4404
Fax (410)338-4767
e-mail: schmidt@stsci.edu

For further information see:
`http://www.stsci.edu/ftp/meetings/may97/announcement.html`

Speaker	***Tentative Topic of talk***
Allan Sandage	A Historical Overview
Andy Fruchter	Technical Aspects of the HDF
Richard Ellis	An Introduction and Motivation
Kenneth Kellermann	Radio Observations in the HDF
Garth Illingworth	Kinematics of HDF (and other) distant galaxies
Lennox Cowie	Review of results from redshift surveys
Judith Cohen	Review of angular and redshift clustering of HDF and other deep surveys
Michael Rowan-Robinson	ISO observations of the HDF
Mike Fall	Cosmic Chemical Evolution: HDF & QSO abs. lines
Simon Lilly	HDF and its relation to previous redshift surveys
Charles Steidel	Spectroscopy of $z>2$ galaxies
Simon White	Galaxy luminosities and number densities at high redshift from hierarchical models
Mauro Giavalisco	Galaxy ages and morphologies of $z>2$ galaxies
Rogier Windhorst	Results from parallel surveys and other deep HST surveys
Kenneth Lanzetta	Review of photometric redshifts
John Bahcall	Stars in the HDF
Matthias Steinmetz	Model predictions for clustering and morphologies at HDF depths
Steven Kawaler	White Dwarfs in the HDF
Harry Ferguson	Selection effects and robust measures of galaxy evolution in the HDF
Joseph Silk	Disk galaxy and dwarf galaxy evolution
Piero Madau	Global measures of star-formation history from the HDF
George Efstathiou	Are hierarchical models vindicated or vitiated by deep HST observations?
Mark Dickinson	Evolution of the luminosity function at high z
Guinevere Kauffmann	Semi-Analytic models of galaxy formation
Mike Brown	Search for Sub-Stellar Objects in the HDF
Roger Blandford	Gravitational Lensing
Megan Donahue	Educational uses of the HDF
James Peebles	Conference Summary

Notice:
STScI recently issued a preprint containing poster papers from last May's symposium titled "The Extragalactic Distance Scale." Unfortunately, for technical reasons, two posters were not included. Those have now been put into a small separate edition. Libraries interested in obtaining the new preprint should contact the STScI library. The e-mail address is library@stsci.edu.

Tenure for Abhijit Saha

Abhijit Saha was recently granted tenure as Associate Astronomer at STScI. He came to STScI as an Assistant Scientist in 1988, joining a newly-formed User Support Branch. In 1990, Abhijit became an Assistant Astronomer, in recognition of his research accomplishments. In 1992, Abhijit took over as Chief of USB and was promoted to Associate Astronomer. He now splits his functional time between SMO, the Servicing Mission Office, and OPO, the Office of Public Outreach. He is coordinating the Early Release Observations that will be done with STIS and NICMOS next year. He is also Deputy Editor of the PASP.

Born in Calcutta India, he comes from a family with many scientists and academics, including his parents, grandfather, aunts, and uncles (but the Saha of equation fame is not among them). He has a brother in theoretical astrophysics. Doubtless this background influenced Abhijit to study physics at St. Stephen's College at the University of Delhi. This was also his route to pursue astrophysics, an interest that was seeded early and made concrete after reading Patrick Moore's "The Amateur Astronomer" at age 14. He obtained both bachelor's and master's degrees in Delhi, during which studied General Relativity and was introduced to formal astronomy. He attended two summer schools at the Indian Institute of Astronomy, where contact with M. K. V. Bappu and others reinforced the choice of astronomy as a career. He then came to Caltech to work on his Ph.D. He finished in 1983, after completing work on RR Lyrae stars as probes of the Galactic halo, supervised by J. B. Oke.

Abhijit has continued to work on RR Lyrae stars as probes of various astronomical problems, first as a post-doc at Kitt Peak, then as a Carnegie Fellow at the Observatories of the Carnegie Institution of Washington, in Pasadena. He is currently working on the cosmological distance scale with HST data as part of two different investigation teams and involved in a major effort to establish Cepheid-based distances to all galaxies (where possible) within approximately 3 Mpc, using ground-based facilities.

Abhijit reads on philosophy and comparative religion when he has the chance, and is fond of music and theatre, especially the absurd and avant garde. He is a keen enthusiast of cricket, which he misses, and considers a sacrifice to his cultural migration.

IRAF *from page 23*

large number of false positive detections. Our collaborators at Georgetown University have begun assembling a much more extensive mammography database, which includes complete follow up studies to allow more accurate measurements of the diagnostic value of microcalcification detection. We have submitted a proposal to the Army Breast Cancer Research Program to follow up on what has been, thus far, a demonstration of the potential value of applying our knowledge of astronomical image processing methods to the down-to-earth problem of diagnosing breast cancer.

Calendar

Cycle 7

Phase II proposals due	Check the Cycle 7 Phase II Proposal Instructions
Start of science observations	1 July 1997 (approximate)

Cycle 8 (tentative):

Call for Proposals issued	October 1997 (tentative)
Phase I proposals due	February 1998 (tentative)

Second HST Servicing Mission Launch

13 Feb 1997, 07:59 UT (tentative)

Meetings and Symposia

STScI May Workshop The Hubble Deep Field	6 to 9 May 1997
Space Telescope Users Committee	12 to 13 May 1997

New on the WEB

Some items on STScI's web pages you may find of interest:

1 First and foremost, check out the **all-new STScI Web design** (see articles on pages 22 and 24).

2 Results from the **Medium Deep Survey** can be found at: http://archive.stsci.edu/mds/index.html

3 For information on the **1997 Summer Student Program** at STScI, see the previous Newsletter, and on the Web look under "About STScI" then "STScI and the Astronomical Community"

New Web Design *from page 24*

Institute Web resource; the advantages of this utility over generic Web search engines are that the search is limited to the "stsci.edu" domain, and our master search index is updated more frequently.

There is one other navigation aid of note. The higher-level pages contain two textual navigation bars near the bottom of each page: one allows direct access to the home page or to the navigation aids described above, and the other provides access to "sibling" pages without first following a link to a higher-level, "parent" page. Note also that you can always reach the STScI home page by clicking on the STScI logo in the banner at the top of an inside page.

We expect that the STScI Web pages will continue to evolve (indeed some aspects, such as the home page graphic and the news items, were designed to be updated several times per year), though always in response to the needs and interests of our Web communities. The new Web pages attempt to balance the needs of our largest audience — students, educators, amateur astronomers, reporters, and interested members of the general public — with those of the audience our institution was created to serve: the international community of professional astronomers. They are all important to us, and we are grateful for their continuing interest in STScI and the Hubble Space Telescope.

STScI invites you to offer your thoughts to us about these new pages, or about any aspect of the STScI Web site. Please direct your comments to the webmaster@stsci.edu, or click on the "user comments" link near the bottom of the home page.

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How to contact us:

First, we recommend trying our Web site: `http://www.stsci.edu` You will find there further information on many of the topics mentioned in this issue.

Second, if you need assistance on any matter send e-mail to `help@stsci.edu` or call 800-544-8125. International callers may use 1-410-338-1082.

Third, the following address is for the HST Data Archive:
`archive@stsci.edu`

Fourth, if you are a current HST user you may wish to address questions to your Program Coordinator or Contact Scientist; their names are given in the letter of notification you received from the Director, or they may be found on the Presto Web page (`http://presto.stsci.edu/public/propinfo.html`).

Finally, you may wish to communicate with members of the Space Telescope Users Committee (STUC). They are:

Fred Walter (chair), SUNY Stony Brook,
`fwalter@sbast1.ess.sunysb.edu`
John Bally, U. Colorado
John Clarke, U. Michigan
Alex Filippenko, U.C. Berkeley
Bob Fosbury, ESO
Marijn Franx, Kapteyn Astron. Inst.
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