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SPACE TELESCOPE SCIENCE INSTITUTE

Newsletter

Highlights of this issue:

A New Director for STScI

AURA has selected Steven V. W. Beckwith as the next Director of the Space Telescope Science Institute. We were fortunate to have a number of outstanding individuals who were willing to assume the responsibilities of running STScI. The short list of candidates remains confidential, of course, but Steve's qualifications demonstrate why he was a first choice.

Steve comes to STScI from the Max Planck Institut für Astronomie in Heidelberg, where he has been Managing Director since 1994, and a Director since 1991. His academic career is summarized as:

1973 — B.S. in Engineering Physics from Cornell (in 3 years)

1978 — Ph.D. in Physics from Caltech

1978-1984 — Assistant Professor of Astronomy, Cornell

1984-1989 — Associate Professor of Astronomy, Cornell

1989-1992 — Professor of Astronomy, Cornell

Among other distinctions, Steve was an Alfred P. Sloan Fellow from 1982 to 1985.

Steve is well known as an infrared astronomer and developer of instrumentation. While at Caltech as a graduate student, he designed and constructed a thermal IR photometer that he used at Mount Wilson. His thesis dealt with molecular hydrogen emission from many different sources, such as planetary nebulae, T Tauri stars, and the ISM. He continued this line of work when he went to Cornell and built a new spectrometer for the Kuiper Airborne Observatory to study molecular lines and broad dust features in the thermal IR.

The detection of scattered light from the pre-main sequence object HL Tauri (Beckwith et al. 1986, ApJ, 287, 793) and subsequently the millimeter-wave emission from the same object (Beckwith et al. 1986, ApJ, 309, 755) stimulated his work on circumstellar disks. The disk mass estimated from the dust emission appeared to be sufficient to build a planetary system, and a more thorough survey (Beckwith et al. 1990, AJ, 99, 924) demonstrated that almost half the young stars in Taurus had circumstellar disks that could lead to planets. The study of these disks and their properties has been fundamental for estimating the number of other planetary systems in the Galaxy. This study of proto-planetary disks continued with ISO and with instrument development for the Very Large Telescope Interferometer (VLTI). With the VLTI, his group will attempt to resolve circumstellar disks at 10 and 20 microns.

Steve acquired an interest in early galaxy formation while at Cornell and started a project to observe the IR signatures of primeval galaxies. This work continued after he went to Heidelberg, where two generations of wide-field IR cameras were built for the Calar Alto 3.5 m telescope. The first observations with these cameras led to detection of a starburst galaxy at redshift 2.4 and the start of the Calar Alto Deep Imaging Survey, a search for optical emission-line galaxies at redshifts greater than 5.

Steven Beckwith (left) and Bob Williams (right) at a recent visit of Steven to STScI.

Upon coming to Heidelberg, Steve's goals were to equip the Calar Alto Observatory, operated by MPI Heidelberg, with modern instrumentation by decreasing the time and cost needed for instrument projects, to establish collaborations with other institutes, and to diversify the staff of about 190 people. These changes led to a faster pace of scientific output by a staff acting with greater self-direction. New instruments have included IR

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Editor's Note:

This article is based on a letter Dr. Beckwith sent to the AURA Director Search Committee as part of his application to become Director of STScI. It is excerpted with permission.

Director's Perspective

Bob Williams

HST is entering an important phase in the life of the mission. In the coming year decisions will be taken that will affect how the telescope will be configured and operated in the final years after the last scheduled servicing mission in 2002. The cryogenic cooler proposed for installation on NICMOS during the third servicing mission in 1999 will be flight tested this October on the same Shuttle mission that will carry Sen. John Glenn back into space. The construction of a new facility-class imager, WFC3, recommended by the same external advisory committee that evaluated the 2002 instrument proposals, will be defined and developed if the Project is successful in identifying adequate funding, as now seems likely.

A realistic plan for operating *HST* far more cheaply than currently possible, beyond 2002 when the servicing missions (with their new hardware and associated commanding software) are not the large cost drivers they now are, is being developed jointly by the Project and the Institute. Called 'Cheap Ops' by us, the implementation of a substantially cheaper way of operating *HST* is absolutely essential if the mission is to be extended until 2010 and for the timely development of the Next Generation Space Telescope. The larger question of how best to maintain the high scientific productivity of *HST* in the era when it must be operated cheaply, when telescope hardware failures cannot be serviced and when budgetary constraints will not allow extensive software maintenance or development, is an important matter that will be addressed in the '*HST* Second Decade Study' that is being conducted by the Institute with wide community participation.

All of the above items are critical in defining what *HST*'s capabilities will be and how it can best be used scientifically after 2002. It is hoped that this epoch will also see collaborative programs jointly carried out on *HST*, SIRTF, and NGST. Our experience with *HST* has demonstrated the important effect that a highly productive mission can have on other related NASA space astronomy missions. I would say that the essential ingredients of this productivity have been: the unique capabilities of *HST*; broad community support, including European participation in the *HST* Project; adequate data reduction funding; and an aggressive outreach and education program.

Short term, the NASA data reduction funds for *HST* are projected to be very healthy in the coming years, and this augurs well for the vital soft money infrastructure that has developed in U.S. astronomy associated with *HST*.

Finally, we are very pleased with AURA's announcement that the next STScI Director will be Dr. Steven Beckwith, currently Managing Director of the Max- Planck-Institut für Astronomie in Heidelberg. Steve will assume his new responsibilities in early September, when I stand down at the end of my current term to devote more of my time to research activity.

We note two corrections related to items in the previous (1998 January) Newsletter.

First, in the article on NGC 5253 by Daniela Calzetti, what should have been Figure 1b appears as Figure 2. Therefore what is labeled as an Hα image is really through the F814W filter. The error occurred in production and is not the fault of the author.

Second, we would like to note that the appreciation of Chris Skinner in the January Newsletter was based on an obituary of Chris published in Astronomy and Geophysics, a publication of the Royal Astronomical Society.

Optical Jets in Blazars and Radio Galaxies

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BL Lacertae objects are believed to be radio galaxies viewed along their radio jet axis. As part of an *HST* snapshot survey of BL Lacertae objects, we used WFPC2 to observe the optical jet of two well-known extragalactic radio sources, PKS 0521-365 and 3C371. Both are relatively nearby (z=0.055 and 0.050, respectively), and can be studied with unprecedented detail with *HST*.

In the radio band, jets are observed in hundreds of radio galaxies and quasars. Based on their broad band flux energy distribution, and the high polarization that characterize the jet emission, astronomers think the emission is produced by relativistic electrons in a magnetic field via the synchrotron process. Synchrotron emission is very efficient at producing radio waves, while to produce optical radiation the electrons must be extremely energetic (up to ~10^7 times their rest energy). The higher the electron energy, the higher the frequency of the emitted radiation, and the faster they cool down by emitting light. This may be the reason why the optical counterparts of radio jets are observed only rarely. Indeed, probably the most remarkable property of optical jets is that they actually exist. It is well known that with usual intensity of the magnetic field of the order of 10^{-4} Gauss, the lifetime of the electrons emitting at these frequencies ($\nu \sim 10^{15}$ Hz) is extremely short (~100 years). Electrons, as everything else, must move at speed smaller than the speed of light, implying they can travel no more than ~100 light years before losing most of their energy. Nevertheless, optical jets are thousands of light years long. Two explanations are possible. Either the magnetic field is much weaker than what astronomers believe, or electrons are continuously reaccelerated along the jet. At present, the second hypothesis is preferred as hydrodynamic models show it is possible that shocks propagating through the jet are responsible for electron reacceleration.

The first object we observed, PKS 0521-365, has been known to have a large optical jet for some time (Danziger et al. 1979). At *HST* resolution (Fig. 1), the optical jet shows a knotty structure; it is resolved also orthogonally to the axis, and has an almost constant transversal size of ~1.2 arcsec. The total magnitude of the jet is m_R=19.9 ± 0.2. Assuming there is equipartition of energy among particles and magnetic field, we derive for each knot the intensity of the magnetic field. Surprisingly, despite the increasing distance from the center, the inferred intensity is almost constant, $B \sim 4 \times 10^{-4}$ Gauss.

The optical and radio (Keel 1986) images are similar, with the general shape and the total length of the jet almost exactly reproduced in the two bands. This is particularly true for the brightest knot, which is well resolved in both bands. Thanks to the superior resolution of present image, we were also able to estimate the radio-to-optical spectral index for each separate knot. The resulting values are similar and fully consistent with a single value (α_{ro} = -0.7).

The jet of 3C371, detected in the optical very recently by Nilsson et al. (1997), has a knotty structure and is also fully resolved perpendicular to the jet axis (Fig. 2). At least three bright knots are clearly visible. The intensity of the equipartition magnetic field is constant within the errors along the jet ($B = 3 \times 10^{-4}$ Gauss), as is the optical-to-radio spectral index (α_{ro} = -0.8). Radio and optical emission show a general one-to-one matching of all structure. However, a striking difference is present: the optical jet ends much earlier than its radio counterpart. Compared with PKS 0521-365 and M87, this is the most obvious difference. However, we note also that the radio flux fades off significantly beyond knot A. Based on

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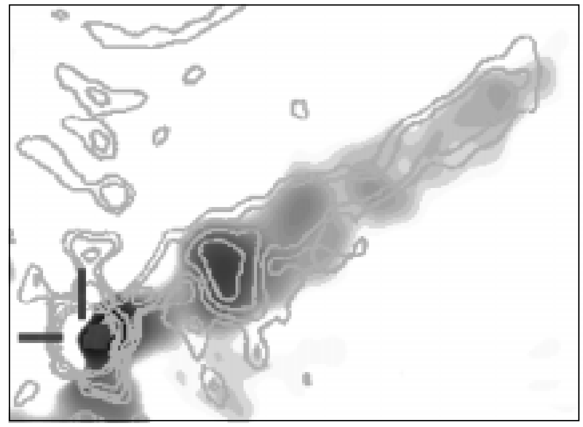

Fig. 1: The optical image (grayscale) overplotted with a 2-cm radio map (contour) of the jet of PKS 0521-365. The optical image was obtained in 300 seconds with the WFPC2 camera plus the F702W filter. The host galaxy and the bright central point source (indicated by two thick black pointers) has been subtracted from the image. The total length of the jet is 5.8 arcsec. North is approximately on the top and east on the left.

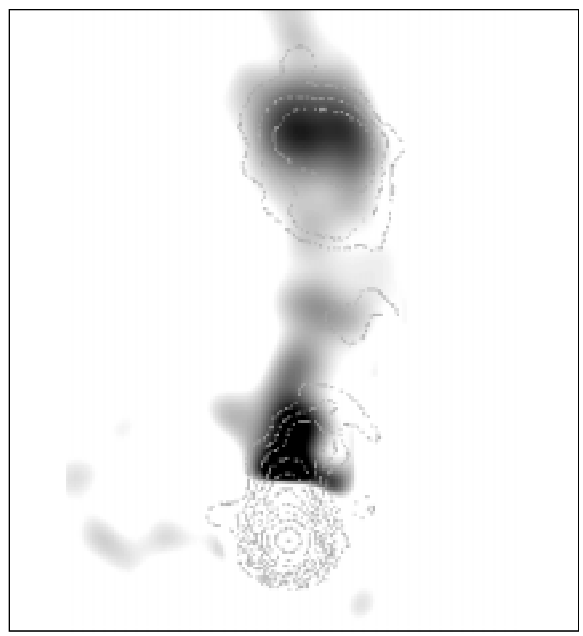

Fig. 2: The jet of 3C371. On the 300-second exposure optical image (grayscale), we overplotted a 18.7 cm radio map (contour) of comparable resolution. The host galaxy and the bright central point source, which is centered on the same position of the radio point source visible at the bottom, has been removed. The brightest knot on the top is 3.1 arcsec from the center of the point source. North is approximately on the left, east on the bottom.

HST Archival Pure Parallel Program

Peg Stanley, STScI pstanley@stsci.edu

There was a significant undersubscription of parallel observation opportunities in the original *HST* Cycle 7 TAC allocation. As a result, a community working group was formed to develop *HST* programs to optimize the use of pure parallel observing opportunities, with the data being non-proprietary and placed immediately in the archive. The *HST* Pure Parallel Science Working Group, chaired by Jay Frogel from Ohio State University, formulated recommendations on the optimum use of *HST* parallel observing opportunities. The recommendations, available on the WWW at `http://archive.stsci.edu/hst/parallels` were accepted by the STScI Director. These archival pure parallel programs are described in detail on the WWW at the same URL, and began executing in February 1998.

These pure parallel observations are the first observations to be obtained using the STScI's new pure parallel "crafting" system. *HST*'s original commissioning program concentrated on getting the prime science program up and running, followed by enabling very rudimentary pure parallel observing. At that time, pure parallel observers were required to specify the full details of every pure parallel visit creating programs with thousands of identical visits. In an effort to increase the scientific utility of parallel observing, an experiment was conducted to start crafting pure parallel observations to match the prime programs once the initial weekly science schedule was available. This experiment proved a great success and significantly increased the quality and amount of pure parallel science obtained. The experimental system required a specific software program to be written for each and every pure parallel program, with the observer providing observing strategies, requirements and constraints in an unformatted memo style.

STScI was able to continue supporting the experimental pure parallel program until installation of STIS and NICMOS in the second Servicing Mission (SM2). Prior to SM2, the vast majority of pure parallel observations were obtained with the FOS as prime and the WFPC2 in

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New STScI Director *from page 1*

cameras, an adaptive optics system with a laser-induced artificial star, multi-slit spectrographs, and a new top end for UKIRT that stabilizes the image motion and focus by real-time control of the secondary mirror. MPIA built the ISOPHOT camera for the ISO mission, launched in 1995, that included construction of a data center in Heidelberg, similar to STScI on a smaller scale. MPIA is also building instruments for ESO's Very Large Telescope project, the high-resolution infrared camera, CONICA, and the thermal IR instrument for the VLT Interferometer. The staff at MPIA now includes more than a dozen nationalities. A theory group was started three years ago under the leadership of Andreas Burkert to stimulate the research at MPIA. The research output at MPIA has more than doubled since 1992, and there has been a significant gain in work done by others at Calar Alto as well.

Steve has been involved with *HST* in several key ways. He was a member of the peer review panel that selected two IR instruments for further study in 1986. He then chaired the group that selected NICMOS for flight on *HST*. He was a member of the committee that selected COSTAR to correct *HST*'s spherical aberration. Steve has served on a number of high-level advisory committees in both the US and Europe. He recently chaired a subcommittee of ESA's Horizon 2000+ that covered ultraviolet through radio astronomy. Their recommendation was to build a passively cooled space telescope to work from 1 to 20 microns and to build space interferometers with enough precision (10 microarcsec) to image planetary systems. Although it appeared before the Dressler report in the US, it identified very similar goals. An interferometer is likely to be one of the cornerstone missions for Horizon 2000+, and there is strong European interest in NGST.

Steve is the chairman of ESO's Science and Technical Committee, which has oversight responsibility for ESO's instrumentation, operations, and new ventures. This role includes approving instruments for the VLT and helping to redefine the role of the La Silla facilities in the VLT era. The committee is also responsible for recommendations on ESO's role in supporting NGST. Since coming to Germany, Steve led a collaboration among German institutes to participate in the Large Binocular Telescope project, and he now directs the LBT partnership there.

Steve was born in 1951 in Madison, Wisconsin and grew up in Milwaukee. He has a lifelong love of the outdoors, including skiing, cycling, fishing, and camping. He is married to Susan McCormick and has two children, Martha (11) and Thomas (10).

To learn more about Steve, visit his MPIA homepage at:

`http://www.mpia-hd.mpg.de/MPIA/Projects/STARS/beckwith`

Pure Parallel Program *from page 4*

parallel. This was a very simple configuration to model to avoid onboard data readout conflicts. With the new instruments, we were unable to continue with this experimental system due to the complexity of the data readout and instrument models and the associated cost of dedicating more full-time software developer resources to the effort. As a result, the STScI embarked on a project to use the same user interface for pure parallels as the prime observing program, while still enabling crafting of pure parallel observations based on the prime science timeline. A small number of pure-parallel-specific keywords and descriptors have been added to the Remote Proposal System (RPS2) to enable the specification and prioritization of pure parallel visits based on the number of orbits available in the prime science timeline. STScI's Parallel Observation Matching System (POMS) was reworked to accept the input and produce pure parallel visits crafted to match the prime science timeline. Pure parallel observing programs are now processed by the same Program Coordinator resources allocated to prime observing programs rather than relying on specific software developer support.

In June 1997, shortly after the science commissioning of STIS and NICMOS, the STScI was able to create "canned" (i.e., non-crafted) pure parallel observing programs to help fill in the gap until the new parallel crafting system was online. Pure parallel science observing efficiency increased from an average of 6.5% for the year prior to SM2 to 24% between June 1997 and January 1998. The new pure parallel system was installed in January 1998 with resulting observations starting in February 1998. Experience is producing insight into the optimum way of specifying the visits in RPS2 to maximize pure parallel and prime science matching. *HST* continues to observe routinely with WFPC2, three NICMOS detectors, and STIS simultaneously.

From the Introduction to the report of the Parallels Working Group:

The Parallels Working Group (PWG) was convened by the STScI director to advise STScI on how best to use parallel observing time with STIS, NICMOS, and WFPC2 during the remainder of Cycle 7. The goal was to design a generic set of parallel observations that would provide a valuable data base for the HST archives with the potential to significantly impact many diverse scientific programs that the community at large could carry out. This report contains our recommendations for such a basic set of parallel observing programs (POPs) and describes some specific research topics proposed by the PWG which could make use of the resulting data. The POPs consist of coordinated observations with all of the non-prime instruments and were designed to address three broad, important areas of research:

- Young stars and star-forming regions in our Galaxy and other nearby galaxies:
- The stellar content of galaxies (including our own) in the local Universe:
- Large-scale structure in the universe and the distribution and evolution of galaxies.

The PWG hopes that the data that result from the parallel programs will be used by the astronomical community, not only to work on the specific scientific problems described in this report, but will also be used to address a much broader range of topics. There will not be any proprietary period for these data.

Optical Jets and Radio Galaxies *from page 3*

the peak radio flux (3.8 mJy, Wrobel & Lind 1990) from the final hot spot of the radio jet (much more distant from the center and not visible in the figure), the expected flux in the *V* band is roughly 1 magnitude fainter than the limiting magnitude of our F555W *HST* observation. Hence, present data cannot exclude that deeper images will confirm a general correspondence of radio and optical emission.

As a whole, present data show that the two jets have homogeneous properties in most, perhaps all their extension. Moreover, it is clear that the relativistic electrons responsible for the emission at visible frequencies are able to retain their energy up to the very end of the jet. This result alone shows that electrons are not subject to a slow deceleration but, rather, the emission at both radio and optical frequencies is well localized spatially, and constant reacceleration must apply.

References:

Danziger I.J., Fosbury R.A.E., Goss W.M. and Ekers R.D. 1979 MNRAS 188, 415

Keel W. 1986 ApJ 302, 296

Nilsson K., Heidt J., Pursimo T., et al. 1997 ApJ 484, L107

Wrobel J.M. and Lind K.R. 1990 ApJ 348, 135

The Office of Public Outreach: Improving Scientific and Technological Literacy

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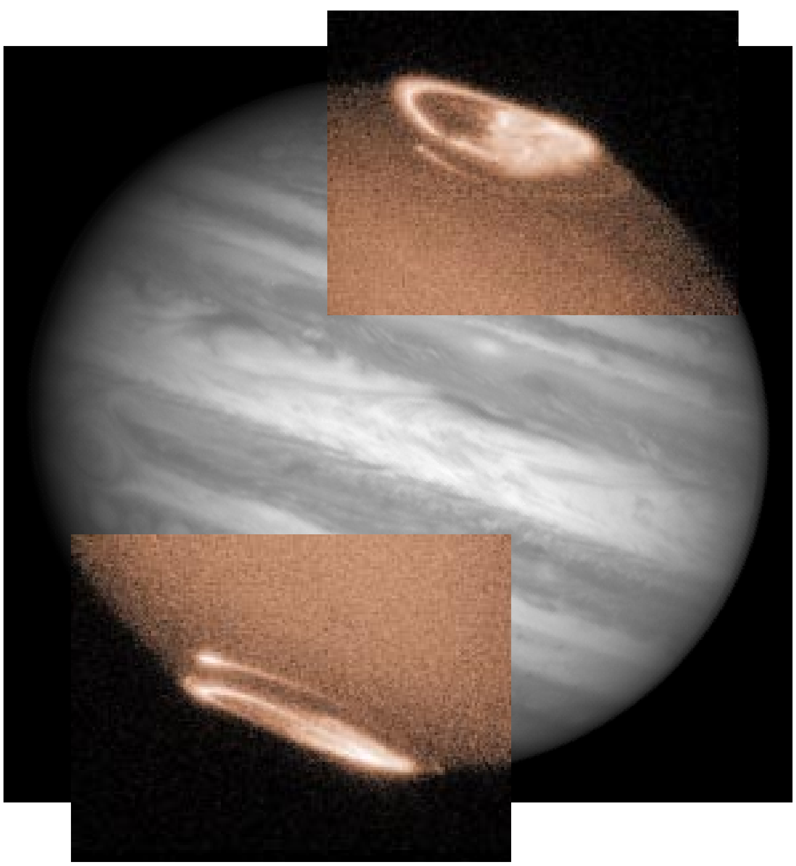
Is astronomy taught as part of your child's elementary, middle, or high school curriculum? Perhaps not, but that doesn't mean *HST* can't be used to teach math and science. The Office of Public Outreach (OPO) at STScI has shown that an Internet-based program can contribute to mathematics and science education and literacy. In this program, called Amazing Space, OPO staff members work with a team of experienced elementary, middle and high school teachers to create a series of interactive lesson plans that feature results from *HST*. Instead of focusing on the teaching of specific astronomical phenomena, the team uses *HST* images as a hook to help students develop their math and science skills. This addresses directly the skills that schools nationwide have identified as critical for students: classifying, estimating, predicting, interpreting, and evaluating.

By approaching the science curriculum in a general way, Amazing Space has produced useful products for teachers while exposing students to *HST* images and data. Amazing Space is one of many programs we have developed to educate the public. We routinely translate *HST* science into text, graphics, and animation used by others who interact with the public, including news reporters and museum directors.

We also administer the IDEAS grants program for NASA — IDEAS stands for the Initiative to Develop Education through Astronomy and Space Science — and experiment with new techniques to help us carry out public outreach more efficiently and effectively. For example, we use the World Wide Web to deliver *HST* news, background information, images and interviews with Hubble researchers and technologists electronically. In 1997, we worked with the San Francisco Exploratorium to provide a live Internet Webcast that provided an exclusive behind-the-scenes look at the second *HST* Servicing mission. The idea isn't to use technology for the sake of technology, but to study it in controlled and focused experiments before deploying it systematically.

By developing products that its customers can use, OPO's communications specialists, writers, artists, animators, programmers, and educators, working with the Hubble science community, has helped to make *HST* into a household word.



HST Recent Release: Jupiter's Auroras

Images taken in ultraviolet light by the Space Telescope Imaging Spectrograph (STIS) show both of Jupiter's auroras, the oval- shaped objects in the inset photos. While the Hubble telescope has obtained images of Jupiter's northern and southern lights since 1990, the new STIS instrument is 10 times more sensitive than earlier cameras. This allows for short exposures, reducing the blurring of the image caused by Jupiter's rotation, and providing two to five times higher resolution than earlier cameras. The resolution in these images is sufficient to show the "curtain" of auroral light extending several hundred miles above Jupiter's limb (edge).

Credit: J. Clarke (University of Michigan)

Office of Public Outreach: Programs At-A-Glance

Amazing Space

`http://oposite.stsci.edu/amazing-space`

Amazing Space is OPO's main curriculum development program. Each summer since 1996, OPO staff and K-12 teachers have participated in a five-week workshop to develop an online curriculum that supports teacher standards and makes Hubble discoveries useful in the classroom. We now offer five programs, which come with posters, lithographs and the like:

- Star Light, Star Bright
- Solar System Trading Cards
- Hubble Deep Field Academy
- Student Astronaut Challenge
- Galileo to *HST*

OPO shows teachers how they can use Amazing Space resources in the classroom through workshops at national teacher conferences.

Informal Science Education

`http://oposite.stsci.edu/pubinfo/education/informal-science/`

To reach an even broader audience, OPO is developing a traveling exhibit with the Smithsonian Institution and has completed with the Carnegie Science Center a planetarium show called "Through the Eyes of Hubble." Many teachers get their continuing education credits through courses taught at science museums, and OPO is establishing new ways to get information to these institutions quickly.

Technology Experiments

`http://oposite.stsci.edu/pubinfo/sm97/lbb.htm`

New techniques of reaching people are important to us. To test how technologies can be used in a curriculum or in a science museum setting, each year OPO sponsors an experimental, live, interactive program that uses the Internet in combination with other techniques. In 1997, OPO worked with the Exploratorium in San Francisco to create a Webcast that featured a behind-the-scenes look at the *HST* Servicing Mission. In 1996, OPO supported "Live from Hubble," which allowed students and teachers, interacting with scientists, to choose, observe, and analyze data on selected planets.

News

`http://oposite.stsci.edu/pubinfo/PR.html`

Reaching the public with results from *HST* begins with the news media. We work with Principal Investigators and NASA to develop press materials and supporting graphics to help explain a discovery in concise, straightforward language and make all the material available on the World Wide Web. Our goal is to provide about one release per week and about six major press events throughout the year.

Initiative to Develop Education through Astronomy and Space Science (IDEAS)

`http://oposite.stsci.edu/pubinfo/edugroup/ideas.html`

IDEAS is a grant program established in 1991 by the NASA Astrophysics Division to create opportunities for scientists to share the excitement of space research with students and the public. IDEAS encourages collaboration with partners in the professional education community, as well as links to active learning and education reform. Last year's grant recipients included scientists, educators, science supervisors, NASA education personnel and representatives from the Institute. In total, 94 IDEAS proposals were received and reviewed. Funding is available up to $40,000.

Origins Educational Forum NEW

`www.origins.stsci.edu`

Need information about NASA's Origins program? Learning more about the space agency's astronomy and astrophysics enterprise should be much easier under a new program managed by the Office of Public Outreach. With funding and support from NASA Headquarters, the Office will operate the Origins Educational Forum. This Web-based resource is intended to present coherent information on Origins research. It is headed by Terry Teays and is expected to be online by April. By visiting this site, organized like a computer helpdesk, people will be directed to more detailed information about specific Origins missions, such as the Next Generation Space Telescope, the Stratospheric Observatory for Infrared Astronomy, the Space Infrared Telescope Facility, and Planet Finder. The Forum is part of NASA's plan to create cohesion among its science enterprises. Instead of presenting missions individually, NASA packages them together according to the scientific problems they are designed to tackle.

Embrace Space

`www.spaceday.com`

Space Day, celebrated on May 21, 1998, is a day dedicated to the extraordinary achievements, benefits, and opportunities in the exploration and use of space. It is a special time for people of all nations and ages to *Embrace Space*, to mobilize enthusiasm about the wonders of the universe; to advance science, math and technology education through the excitement of space; and to inspire future generations to fulfill the vision of our space pioneers.

OPO is participating in Space Day by partnering with NASA, Lockheed Martin, the Boy Scouts and Girl Scouts and many other notable organizations in an interactive Webcast dedicated to space. The centerpiece for the international Space Day celebration is an eight-hour Intergalactic Teach-in broadcast over the World-Wide Web on May 21, 1998. Hosted by respected journalists, this international event will provide a unique opportunity for students of all ages to meet some of the most fascinating people in the universe: the men and women whose vision, talent and dedication have helped us reach for the stars and beyond.

Instrument News

Fine Guidance Sensors

Olivia Lupie and Ed Nelan, STScI
lupie@stsci.edu nelan@stsci.edu

FGS3

Fine Guidance Sensor #3 continues to meet our performance expectations as a science instrument, yielding high quality science and calibration data. Most GOs are using the interferometer in both TRANSFER mode and POSITION mode to study binary star systems. The TRANSFER mode data provide the relative orbit, i.e., the inclination, eccentricity, and period, along with the differential photometry (magnitude difference of the binary's components). The POSITION mode observations yield the parallax and therefore, along with the relative orbit, the total mass of the system. In some cases, when the reflex motion of the individual components relative to the background reference stars can be accurately measured (in POSITION mode), the relative masses can also be determined. A recently completed GO program (reported by J. Hershey, STScI), used this method to determine the individual masses of a faint, (12.5 and 14th magnitude) low-mass binary system to 2 to 3%. The FGSs have a well-defined niche within current ground and space-based capabilities: no other instrument or observing technique could achieve this result with such accuracy for faint systems with separations smaller than 0.3 arcsec.

Since the last *Newsletter*, several FGS3 Cycle 7 calibration visits have been executed. Red and blue reference TRANSFER Scans have been reduced and are available to GOs. The color/filter combination of the observations was tailored (to within 0.2 or 0.3 in *B-V*) to match Cycle 6 and Cycle 7 GO programs. Details and location of these data are provided in the Calibration and Products page of the STScI FGS web site. The colors of the reference single stars most recently acquired are *B-V* = 1.9, 1.7, 1.1, 0.5, 0.1, -0.1, and -0.3.

Both FGS3 TRANSFER and POSITION mode monitoring programs are continuing. Variations are within the expected tolerances: (1) S-Curve variability is within 2% and (2) the residuals of the distortion calibration are maintained to about 2 mas. Monitoring of the S Curve and POSITION mode stability will continue throughout Cycle 7.

Special FGS3 close-out observations are being planned (with the expectation of using FGS1R as the astrometer) for the end of the extended Cycle 7. These include Transfer Scan observations of the extreme red and blue reference stars, and a final absolute plate scale calibration using Hipparcos fields.

Soon an FGS/astrometry data reduction "pipeline" will be available to the GO through STScI's IRAF/SDAS interface. Several builds, each with more tools and analysis software are

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Figure 1

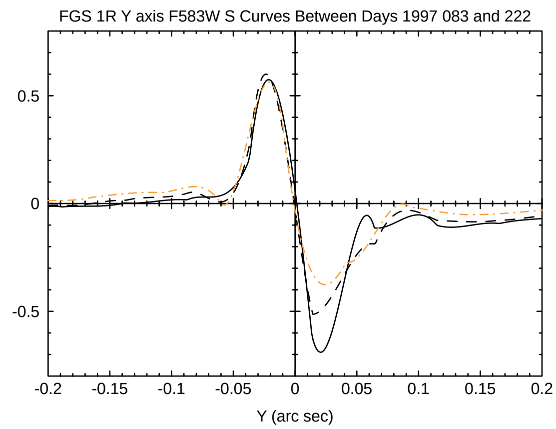


Figure 2

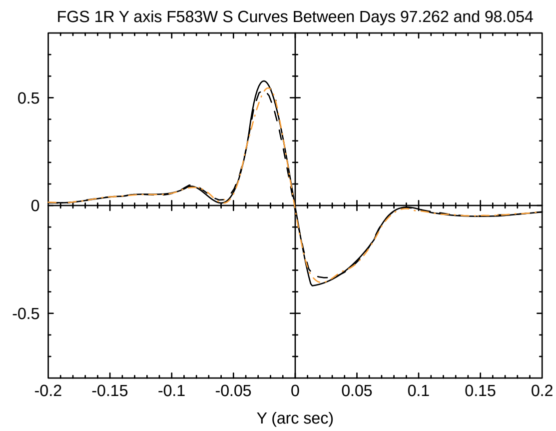
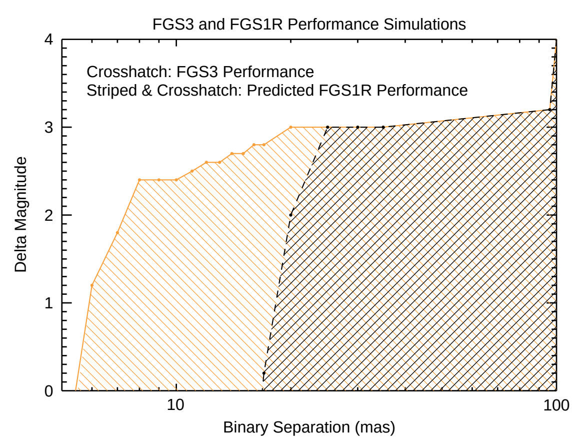


Figure 3



Instrument News

FGS from page 8

planned for completion this year. Announcements of availability of tools as well as instructions for use will be made available on the FGS Web site and in future versions of STScI's Data Handbook.

FGS1R

Since its installation in *HST* last spring, FGS1R's S-curves have degraded presumably due to desorption within the instrument's optical bench. Most of the evolution occurred over the first three months. The FGS1R Y axis S-Curve evolution is shown in Figures 1 and 2 where large deformations of the S Curve occurred between March 23 and Sept 14 in 1997 (Figure 1). Figure 2, a plot of the Y axis S curves at the end of 1997 through Feb. 23 1998, demonstrates that FGS1R has achieved stability from large-scale desorption effects. Unlike the other FGSs, FGS1R contains an articulating folding mirror designed and installed by Hughes Danbury Optical Systems. The mirror can be adjusted, via ground command, to optimize the alignment of critical optical components. With a stable FGS1R, STScI has initiated a series of special tests, occurring in early May, to re-optimize FGS1R and assess its performance as a science instrument. The performance test is designed to compare FGS3 to FGS1R by evaluating the resolution limits of FGS1R. On the basis of semi-empirical analysis conducted both at STScI and Lowell Observatory (Franz and Wasserman), we anticipate that FGS1R will be able to measure an angular separation of 6 or 7 milliarcsec for binary components whose magnitude difference is less than 1.5. The results of STScI's study are shown in Figure 3.The cross hatched region delineates the range of separation and delta magnitude that is within the FGS3 capability. The striped+crosshatched region is the predicted range accessible to FGS1R. The results of the optimization tests and assessment program will be discussed in the next *Newsletter*.

Near-Infrared Camera and Multi-Object Spectrometer

Luis Colina and Keith Noll, STScI
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Observations with the Near-Infrared Camera and Multi-Object Spectrometer continue to occupy about 50% of *HST* observing time. NIC1 and NIC2 continue to perform well and to deliver high-quality images. The NICMOS focus appears to be relatively stable with little change in NIC1 or NIC2. NIC3 has slowly moved back towards the accessible focus range but remains somewhat defocussed. Starting in early January, observations with NIC3 as the prime camera are being operated with the Field Offset Mirror (FOM) offset by +16 arcsec in the +y direction to eliminate the vignetting that was observed in that camera. A byproduct of this move of the FOM is a move of the effective focus by +1.5 mm which brings NIC3 closer to focus than at the previous nominal FOM position. With this offset, the best focus for NIC3 was at a PAM position of -11.31+/-0.05 mm. This is now less than 2 mm away from the most extreme negative position of the PAM at -9.5 mm.

The first NIC3 campaign took place during the last three weeks of January when the secondary mirror of *HST* was moved to place NIC3 at best focus. Among the many programs carried out during the NIC3 campaign was a large GTO program to observe a portion of the Hubble Deep Field using NICMOS. A specific calibration plan, designed to support NIC3 operation modes, was also executed both before and during the campaign. The pre-campaign supporting calibrations were processed in time to allow new reference files to be in place for the campaign itself. Analysis of the calibration data taken during the campaign is in progress. At the conclusion of the campaign, the secondary mirror was returned to nominal focus, re-enabling the other instruments on *HST*.

The re-test of the NICMOS coronagraph target acquisition was successfully executed on 06 February 1998, soon after the NIC3 campaign ended. The revised target acquisition sequence successfully found both the target star and the coronagraphic hole. A slew to move the star behind the hole was correctly computed and the subsequent science exposures show the star behind the hole. Independent checks of the flight software using an identical algorithm as well as several different IRAF routines confirm the results found by the flight software. There remain small (~0.5 pixel) residuals between the different methods that are the subject of continuing investigation, however these were considered to be sufficiently minor that we proceeded to fully enable the coronagraphic science program.

The first science observations with the coronagraph were made on 18 February 1998. Preliminary analysis of these observations indicates they were successful. A cosmic-ray induced persistence phenomenon has been identified in NICMOS images after South Atlantic Anomaly (SAA) passages. The extremely high rate of cosmic rays hits during the crossing of the SAA saturates the detectors and takes about half an hour to decay. This persistence shows up as faint, decaying images of cosmic rays and affects

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Instrument News

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observations of intrinsically faint targets taken very soon after emerging from the SAA (Najita et al. 1998, ISR NICMOS-98-001). A new mode of operation after SAA passages has been implemented starting Feb. 9th. In this mode of operation, detectors are returned to autoflush mode immediately after *HST* exits the SAA without waiting until the start of the next observation (as in the previous mode of operation). This strategy should help mitigate some of the instabilities induced by SAA passages.

Preparation of the NICMOS closure calibration plan is well under way. This plan includes additional calibrations needed to support Cycle 7 science observations before the cryogen is exhausted as well as some calibrations to be obtained during the detector warm-up (currently, this is expected to be around December 1998).

Several new WEB pages covering parallels, photometric monitoring, and image anomalies are presently under construction and will be ready shortly. Stay tuned and look for these new pages next time you visit the NICMOS WEB page.

WFPC2

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WFPC2 continues to function well. After the NIC3 campaign, the secondary mirror focus was restored to its nominal value. WFPC2 observations resumed with a goal of scheduling about 20 orbits per week.

Efforts continue to improve WFPC2 calibration. Monthly observations are made of the standard star GRW+70D5824 in filters spanning 1600 to 8410 Å. These provide a check of instrumental stability, but can also be used by observers to obtain a direct photometric calibration as a function of time. To assist observers in using this data, Shrireen Gonzaga led an effort to create an on-line database of all ~1500 WFPC2 photometric monitor measurements taken to date. The database contains measured countrates for 10 broad-band filters in all 4 CCDs from January 1994 to present. See `http://www.stsci.edu/ftp/instrument_news/WFPC2/Wfpc2_memos/wfpc2_stdstar_phot3.html`. As part of this effort, much of the monitoring data were reprocessed using the most recent reference files and software.

There is recent evidence that Charge Transfer Efficiency (CTE) has worsened with time; see the report in the October 1997 *Newsletter* and in ISR 97-08 by Whitmore and Heyer: `http://www.stsci.edu/ftp/instrument_news/WFPC2/wfpc2_bib.html`. The result of this effect is that sources are too faint due to charge which is lost in traps as it is clocked down the columns. Observers attempting accurate photometry on faint targets in the presence of low backgrounds in their images will want to correct for CTE using the equations given in the ISR. In order to track future changes in CTE, we have added a new calibration program starting in April 1998 to monitor CTE twice a year.

Spectrographs: STIS, FOS, GHRS

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After a northern fall and early winter in which STIS users received data only sparingly, *HST* began a steady diet of roughly 30 orbits of STIS externals per week as of February. STIS observations are expected to continue at that rate through the end of this year, at which time STIS observing will pick up even further. At the same time, the not-so-good news for observers was that changes in the long-range plan to accommodate other scheduling needs have been ongoing, and some GOs will find that their observations have moved out further on the plan again as adjustments continue to accommodate the need to complete NICMOS Cycle 7 science before the demise of the cryogen.

Much progress has been made on the calibration of STIS. We have now completed the initial sensitivity and wavelength calibration of our most frequently used configuration, the first-order L modes (G140L, G230L, G230LB, G430L, and G750L). We expect first-round updates for the first-order M modes, the echelle modes, and the STIS imaging modes to trickle in throughout the northern spring and into the early summer. There is a tremendous amount to be done, but we are chipping away at it steadily and we ask your patience in the meantime.

At the same time, much progress has been made:

- We have developed robust techniques for fringe flattening the G750L and G750M data at wavelengths longward of 7000 Å.
- Software has been written and exported to allow easy production of daily darks from data in the archive.
- We have produced numerous updates to user information based on the regular monitors of STIS that we conduct (e.g., on such issues as wavelength shifts and flux stability over multi-orbit observations, the accuracy of acquisitions and acq/peaks, the rate of hot pixel growth for STIS, etc.).

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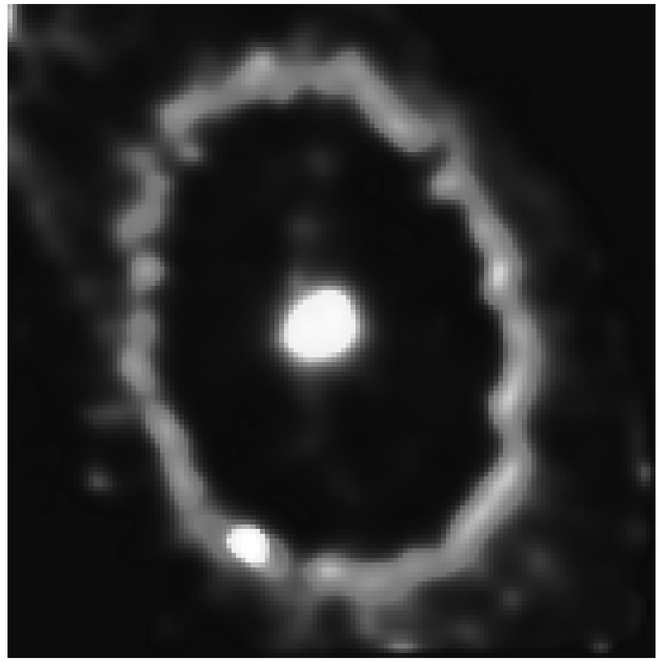
Instrument News

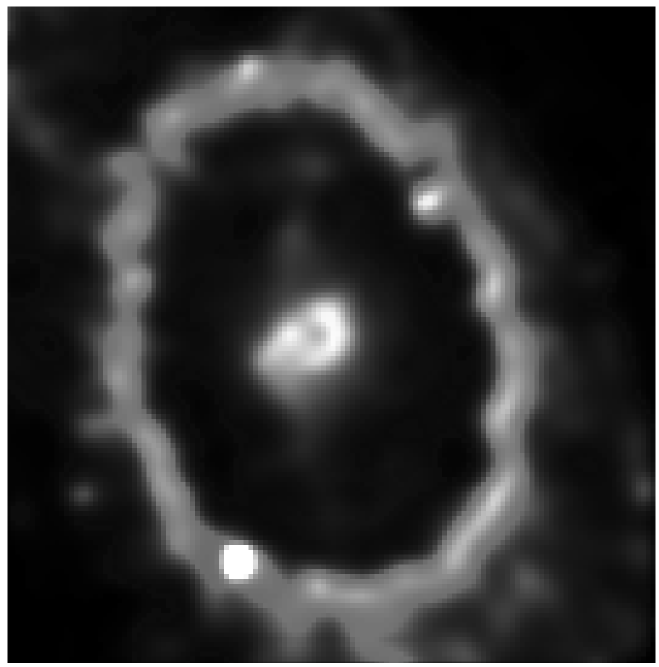
Spectrographs *from page 10*

- We have updated the autowavecal settings to assure more robust wavecals with the minimum overhead times.
- The STIS Flight Software has been modified to ensure even more robust acquisitions (the acquisitions and peakups to date have been remarkably robust for STIS with only one failure to date and that one due to a hot pixel update problem, which was remedied in the new flight software).
- We have noted some new STIS data peculiarities (which we term ‘foibles’) as well.

Finally, our calstis pipeline has undergone major improvements, and we recommend that GOs check out the latest STSDAS software and reference files before beginning to work with their STIS data, as there have been and will continue to be many important updates of reference files from on-orbit data and refinement of the software. All of this (and yet more!) is regularly announced in the STAN series and posted to our STIS instrument WWW page. We encourage you to visit our WWW page which has been recently revamped and includes what we hope will be an improved search capability to allow you to find all the information and updates relevant to your particular observing mode more easily. Check it out!

Users contacting “help” and receiving STANs may have noticed that the STIS Group has changed its name to the Spectrographs Group. This is because we are now responsible not only for STIS, but also for any GHRS and FOS user, archival, and calibration questions. And those questions indeed continue at a good rate! We bring to FOS and GHRS users’ attention the *HST* Data Handbook Volume II, which covers the archival instruments, including FOS and GHRS; this was released in January 1998. Accompanying that documentation release were numerous updates to the calibration reference files from the close-out calibrations for FOS and GHRS. We refer readers to the WWW Instrument pages and the Data Handbook itself where the reference file updates are described. We recommend that FOS and GHRS archival users recalibrate their data before beginning analysis, using the most up-to-date files from the close-out calibrations to get the highest accuracy. We expect to continue activity on FOS and GHRS calibration, albeit at a low level as allowed by resources and working with the ECF where appropriate. The next updates expected are the calibration of spectropolarimetry data for FOS as well as updates to the wavelength solutions to FOS, and updates to the LSFs for the GHRS. Stay tuned to the *HST* Spectrograph STANs and the FOS and GHRS WWW Instrument pages for further updates.





HST Recent Release: Supernova 1987A

1994 *(top) — This NASA Hubble Space Telescope Wide Field and Planetary Camera 2 image shows the glowing gas ring around supernova 1987A, as it appeared in 1994. The gas, excited by light from the explosion, has been fading for a decade.*

1997 *(bottom) — Recent Hubble telescope observations show a brightening knot on the upper right side of the ring. This is the site of a powerful collision between an outward moving blast wave and the innermost parts of the circumstellar ring. The collision heats the gas and has caused it to brighten in recent months. This is likely to be the first sign of a dramatic and violent collision that will take place over the next few years, rejuvenating SN1987A as a powerful source of X-ray and radio emissions.*

Credit: Peter Garnavich (Harvard-Smithsonian Center for Astrophysics), and NASA

Report from the *HST* Project Scientist

Dave Leckrone, NASA-GSFC, deleckrone@hst.nasa.gov

The Second Decade of HST:

In the last issue of the STScI *Newsletter,* I described the initiatives being taken by the *HST* Project to prepare for the second decade of *HST*: to insure that the observatory will continue to function in orbit, continue to produce first-rank science and continue to educate and inspire the public until it is de-orbited in 2010. We have made a great deal of progress and passed some important milestones in this planning activity in the past several months, particularly with regard to the new instruments to be inserted into *HST* during our fourth servicing mission, currently scheduled for November 2002.

Our approach has been to investigate low-cost means to back up the primary instruments for UV-Optical imaging and UV spectroscopy, so that significant failures in one instrument will not leave *HST* blind or without the diagnostic tools of spectroscopy. Here we are guided by the recommendations of the "HST and Beyond" study, chaired by Alan Dressler:

"The HST should be operated beyond its currently scheduled termination date of 2005. An emphasis on ultraviolet imaging and spectroscopy, and wide-field, high-resolution optical-light imaging makes the HST an essential astronomical tool through the first decade of the next century. Present budgeting shows that this premier scientific tool could be operated in a "no repair, no upgrade" mode at approximately 20 percent of the current cost of operation and maintenance, which would yield a highly cost-effective, continuing return on the investment in HST."

The 2002 servicing mission will be the last in-orbit maintenance of *HST*. We will then be operating in a low-cost mode, which we have dubbed "cheap-ops," using our new Vision 2000 ground system and a very capable new spacecraft 486 computer, to be installed during Servicing Mission 3 in 1999. By foregoing any further servicing of *HST* after 2002, NASA has created a budget wedge which will allow a new start for NGST in 2003 and its launch in 2007. We are especially excited about the prospects for synergistic scientific investigations carried out in tandem by *HST* and NGST during the several years when the two missions will overlap.

We expect the Space Telescope Imaging Spectrograph (STIS) to continue its present superb performance as our prime spectrograph for a long time. However, by 2010 it will be 13 years old. Similarly, the Advanced Camera for Surveys (ACS), the prime imager after 1999, will be 11 years old, and the Wide Field and Planetary Camera (WFPC2) will be 17 years old by 2010.

Last December the Cosmic Origins Spectrograph (COS) team (Jim Green, Principal Investigator) from the University of Colorado and Ball Corporation completed their studies of the technical feasibility and costs of upgrading COS, as recommended by the 2002 Instrument Peer Review Committee, to make it more robust and durable, and to improve its utility as a potential, modest backup for the two UV (MAMA) channels on STIS. COS, which will fly in 2002, was originally designed for only a three-year tour of duty in orbit when it was thought that the *HST* mission would terminate in 2005.

In December we also completed a brief technical design and cost study of an innovative, low-cost new Wide Field Camera (WFC-3), which would replace WFPC2 in 2002, thus insuring the continuation of *HST* imaging science until 2010 (and conceivably beyond that time, if the mission should be extended further). This latter study was led by the *HST* Project teaming with JPL, Ball Corporation, STScI, and ESA. I will briefly describe the results of these studies a little later in this article.

Early in January, NASA Headquarters reconvened the original 2002 Instrument Peer Review Panel, whose proposal review in June of 1997 had led to the selection of COS. The panel was asked, as a representative group of senior members of the community, to evaluate the scientific merit and programmatic desirability of the proposed upgrades to COS, as well as of the WFC-3 concept. It strongly endorsed both, but with the caveats that WFC-3 should not impact the ongoing development of ACS, and the addition of a second, near-ultraviolet (NUV) channel to COS should not impact the development of its primary, far-ultraviolet (FUV) capability.

There was, of course, keen interest in the question of where the funding for COS upgrades and for WFC-3 development would come from. The COS was originally proposed as an extremely low-cost instrument (on the premise, according to the P.I., that NASA might then be able to choose two instruments instead of just one). Despite this, it was ranked scientifically far ahead of its competitors, and was the only instrument chosen in that original competition last year. Consequently, adequate funds already exist within the budgetary guidelines described in the 2002 Instrument Announcement of Opportunity to allow us to pay for these very important upgrades which will allow COS to operate until 2010 and to backup STIS.

Funding for WFC-3 will be obtained from *HST* science program reserves, at some (tolerable) risk to the program. The funding will have no effect on money available to fund grants for *HST* General Observers, Guaranteed Time Observers, Archival Researchers, or Hubble Fellows. We are committed to continuing the funding of grants at the present level, allowing for growth with inflation, into the foreseeable future. And, at the same time, we will create a more robust suite of instruments which, hopefully, will insure *HST*'s continued availability to observers for first-rank research for a very long time.

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Project Scientist Report *from page 12*

As a result of the Peer Review recommendations, NASA Headquarters authorized the *HST* Project to proceed with the upgrades to COS. However, Associate Administrator Wes Huntress requested one additional review of the WFC-3 plan by the Origins Subcommittee (OS) of the Space Science Advisory Committee (SSAC), particularly with regard to the funding approach. Wes, Program Scientist Ed Weiler, and I want to be certain that the astronomical community, as represented by NASA's scientific advisory groups, is comfortable with this plan. The review by the OS, chaired by David Black, took place on February 24 and resulted in a recommendation that we should proceed with WFC-3.

The most significant upgrade to COS is the addition of an NUV channel, which will extend its wavelength span to 1150 to 3200 Å. For this purpose, a flight spare NUV MAMA detector, left over from STIS development, will be incorporated into COS. The added detector will enable COS to provide a backup to STIS for NUV spectroscopy at resolving powers of 20,000 and 1,000. Its sensitivity will also extend down to about 1150 A, overlapping and providing a backup to the COS FUV channel, with a sensitivity exceeding that of STIS at R = 20,000 by a factor of 4 to 5. Thus, if the FUV detector in COS should fail, it can provide its own internal backup with the NUV detector, which would allow a large fraction of its science program to proceed.

It is now well known that STIS's NUV detector suffers from a higher-than-expected, radiation-induced fluorescence background which has adversely affected STIS's ability to observe the faintest targets. By adding the NUV MAMA to COS, we are mitigating this problem. Thus, COS will be 20 to 40 times more sensitive than STIS for faint-object spectroscopy across the entire FUV AND NUV wavelength range. The added COS channel will greatly strengthen COS's primary science capabilities by tripling the range of redshifts that it can access and by allowing observation of multiple diagnostic spectral lines, widely separated in wavelength, in the same object over a much wider range of redshifts than would be allowed by the FUV channel alone.

Additional upgrades to COS include selectable entrance apertures. The entrance apertures and grating carrousel will be mechanized to allow in-orbit alignment and to allow periodic shifts of the spectrum format on the detectors to extend their lives. Improvements will also be made to COS's internal calibration system and target acquisition capabilities.

The new Wide Field Camera (WFC-3) is intended to insure continued, long-term *HST* imaging capability over the 2,000 to 10,000 Å range. Its low-cost development results from the extensive re-use of *HST* instrument assets that we have already paid for once. These include -

1. The WFPC-1 enclosure and external radiator, which were returned from orbit in 1993,
2. The returned flight WFPC-1 filter wheel (SOFA) and shutter assem blies, which will be torn down, refurbished, and reassembled for WFC-3,
3. A flight spare 4096 x 4096 CCD drawn from the ACS program, hopefully with a coating that will give high sensitivity in the 2000 to 3000 Å range, as well as in the visible,
4. A flight spare WFPC2 pickoff mirror, but not articulated as in WFPC2,
5. An internal tip/tilt focus and alignment mechanism built to drawings from STIS and NICMOS development,
6. Standard M1 and M2 mirrors to correct for spherical aberration, similar to those used in COSTAR, STIS, and NICMOS,
7. Electronics from ACS, which are more fully redundant than those in the prior two WFPCs.

The 160 x 160 arcsec field-of-view of WFC-3 exceeds that of WFPC2, but is somewhat smaller than the Wide-Field Camera mode of ACS. With a pixel size of 0.04 arcsec, WFC-3 will have Planetary-Camera resolution over this very large field. A variety of flight spare filters are available from the WFPC2 and ACS programs for possible use on WFC-3. But there will be at least 17 slots available for newly-defined filters.

The WFC-3 will be developed entirely as a facility instrument. There will be no GTO time or budget allocation for it. It will be developed by a "badgeless team" of highly experienced *HST* veterans from the *HST* Project, the Jet Propulsion Laboratory, Ball Corporation, and the Space Telescope Science Institute, with the Project providing overall team leadership. Because WFC-3 will be developed for the benefit of the general *HST* user community, it is very important that the community play a significant role in providing scientific oversight, and by participating in key performance trade decisions, filter selection, development of a set of design reference observing programs for operations development, etc. The STScI will shortly issue a call to the full community offering a competitive opportunity for you to propose to serve on the WFC-3 Science Oversight Committee (SOC). We will cover the expenses of your participation. But otherwise this will be an opportunity for you to provide voluntary service, on behalf of the entire *HST* community, to help shape the future imaging capabilities of *HST*. I hope you will be able to help.

For additional information on the Cosmic Origins Spectrograph, go to

`http://cos.colorado.edu`

Next Generation Space Telescope: The Design Reference Mission

Peter Stockman and John Mather, Co-Chairs NGST Ad Hoc Science Working Group

The NGST Design Reference Mission (DRM) is a summary observing plan that addresses the prime NGST mission goals. Developed in 1996 as part of the initial NGST concept study, the DRM is a powerful tool for comparing different observatory architectures and cost trades (Stiavelli, Stockman, & Burg, ST-ECF Newsletter, March 1997). The NGST Project anticipates that performance of the DRM will be a major metric for design, development, and construction of the NGST Observatory. For the NGST "Pre-Phase A" study, the NGST Ad Hoc Science Working Group (ASWG) is refining the DRM and seeks community input on the key scientific goals for the NGST. While the ASWG expects that the near-IR core of the NGST DRM will remain similar to that described by the report of *HST* & Beyond Committee, we wish to explore the opportunity and requirements for NGST to do unique observations at visible and mid-IR wavelengths. Just as important are the types and properties of key observations (e.g. moving targets, crowded fields, large intra-scene dynamic range, etc.) Each observation has engineering consequences, and the DRM will be used to find and weigh their needs. The prioritization of DRM observations will be done by the ASWG and will be based upon 1) the overall scientific importance of the program and 2) the unique ability of NGST to achieve the desired measurements. We anticipate that most of the DRM observations will be accomplished as medium or large programs within a broad NGST GO program.

We have developed a LaTeX template for inputs to the DRM. You can request a template through Piero Madau (`madau@stsci.edu`) or from the NGST web page, `http://ngst.gsfc.nasa.gov/`. Instructions for completing the form and using the web-based exposure calculator (currently on `http://augusta.stsci.edu/`) are attached to the template. Alternatively, you should contact members of the ASWG who are working in your area of interest. Phil Nicholson (Cornell), Peter Jakobsen(ESTEC) and Bob Fosbury(ST-ECF) have recently joined the ASWG. The next STScI *Newsletter* will include the names and interests of new ASWG members from the ESA NGST study team and the selected US instrument study teams. Finally, you may send any suggestions or concerns directly to us (`stockman@stsci.edu` or `john.mather@gsfc.nasa.gov`) and we will ensure their review and consideration. Our goal is to complete the Pre-Phase A revision of the DRM this summer. The results will be available on the NGST Web-site in October/November.

Preliminary NGST DRM Science Topics and ASWG Members

The Epoch of Reionization: Jakobsen, Loeb, Madau

Early Formation of Stars and Galaxies: Fall, Gardner, Lilly, Loeb, Madau, Stiavelli

Formation of Quasars: Loeb

Galaxy Dynamics at High Redshift: Fall, Lilly, Rieke, Stiavelli

AGN: Rieke

Supernovae: Kirshner

Dust-enshrouded star formation regions: Lilly, Rieke

Intergalactic Stars: Margon

Stellar Populations in Nearby Galaxies & the Milky Way: Rich

The Galactic Center: Rieke

Stellar Astrophysics: Margon

Brown & White Dwarfs: Rich

Initial Mass Function, Star & planet formation: Meyer

Planets around Nearby Stars: Meyer, Rich

Kuiper Belt Objects and the Solar System: Nicholson

Calendar

Archival Program: Proposers notified	May 1, 1998
Cycle 8:	
Call for Proposals released	June 17, 1998 (firm)
Phase I proposals due	Sept. 11, 1998 (firm)
Proposers notified	Dec. 15, 1998 (tentative)
Cycle 9	
Call for Proposals issued	May 1, 1999 (tentative)
Phase I proposals due	July 30, 1999 (tentative)
Proposers notified	Oct. 31, 1999 (tentative)

Meetings and Symposia

Space Telescope Users Committee	May 18-19, 1998
STScI May Workshop	May 4-7, 1998

SPACE TELESCOPE SCIENCE INSTITUTE

Partners in *HST*: Europeans at STScI

Since the very first time a space telescope was planned for flight, the European Space Agency (ESA) has been a partner with NASA in its design and construction. Key elements of that partnership are the people of ESA who work at STScI to help serve the needs of the *HST* observatory and the user community. In future issues of the *Newsletter*, I will profile some of those individuals so that you can more fully understand their roles.

It is impossible to mention *HST* and ESA in the same breath without thinking of Duccio Macchetto. Duccio has been at STScI since 1983, when he came to head the Instrument Support Group. He continued in that position through several reorganizations and became the Associate Director for Science Programs about four years ago. His primary responsibility is to ensure that *HST* is used effectively and efficiently. His background prepared him well for this work and is worth recounting as an example of a multinational career path.

Duccio was born in 1942 in Biella, a small cloth-making town near Turin, Italy. His family moved to Argentina in 1949, where Duccio grew up and had his education. He received a Licenciado degree in Physics from the University of Córdoba in 1963 — essentially the equivalent of a Masters without a thesis. He received a Ph.D. from the University of Rome in 1965 after having done thesis work on stellar interiors (he created an analog computer model). Duccio then spent two years as a post-doc at the Institute for Space Astronomy in Frascati.

In 1968, Duccio went to the Culham Laboratory, near Oxford, as a Royal Society Fellow. At the time, Culham had an astrophysics group, where he designed and built payloads for ultraviolet astronomy that flew on sounding rockets. He participated in four flights from Australia (and has a piece left from one of those whose 'chute didn't deploy as a souvenir). During this time, Robert Wilson asked Duccio to design a UV telescope to operate in space. It was a Cassegrain design with a single spectrograph, and was to become the International Ultraviolet Explorer.

Duccio returned to Frascati in 1970 as head of a small group of stellar astronomers, but in 1973 he was urged to apply to lead efforts on IUE, becoming ESA's Project Scientist and Deputy Project Manager. This took him to ESTEC, ESA's main project development facility in the Netherlands. While there he oversaw the plans for the IUE ground station near Madrid ("VILSPA"), IUE's calibration program, and the plans for orbital verification of IUE. Those with a technical knowledge of space astronomy will recognize shadows of these IUE plans in present-day *HST* operations.

IUE was launched on a long and very successful life in 1978, but before that happened, in 1975, Duccio had already become a study scientist and manager at ESA for what was then called the Large Space Telescope. As both NASA and ESA involvement grew, Duccio helped draft the Memorandum of Understanding (MOU) between the two organizations that has been essential for effective cooperation. When the MOU was signed in 1976, Duccio became the ESA Project Scientist of *HST*, as well as being Principal Investigator for the Faint Object Camera. He gave up his IUE roles in 1979 in order to spend full time on *HST*, and then left ESTEC in 1983 to come to STScI.

Duccio Macchetto

Duccio shares an appreciation of Renaissance art with his wife, Anna Maria, who is a docent at the National Gallery. They also share a love of opera and classical music, and he applies his hands to making flowers grow.

He suggested two papers as examples of his scientific research and its context: "The Supermassive Black Hole of M87 and the Kinematics of its Associated Gaseous Disk" (Macchetto et al. 1997, ApJ, 489, 579), and "Active Galactic Nuclei and Optical Jets" (a review paper in Science with the *HST* II, ed. P. Benvenuti et al., 1996, p. 59).

Attention: STIS and NICMOS General Observers

It has been well over a year since the successful Second Servicing Mission to *HST*. As you may recall, STIS and NICMOS received a lot of media interest as the first "technologi cally up-to-date" science instruments to fly on *HST*. This raised expectations for the great new science that would follow SM2 that would also capture the interest of the public that has been so supportive of our work.

If you have any results from STIS or NICMOS that may be of interest to the public, I urge you to contact me, Ray Villard (villard@stsci.edu; 410-338-4514) or Dave Leckrone (dleckrone@hst.nasa.gov) as soon as possible. Please do not wait for the June AAS meeting because results released at those meetings tend to get buried with many other press releases. The chances for major TV coverage of your work are much higher if you work with STScI and NASA to publicize your science.

Edward J. Weiler Director, Origins Program *HST* and SIRTF Program Scientist NASA Headquarters, Code SA Washington DC 20546

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The Second Digitized Sky Survey Approaches Completion

Barry Lasker, STScI lasker@stsci.edu

The second Digitized Sky Survey (DSS-II) is now sufficiently complete that it is a significant resource to the community. The DSS-II consists of full-plate images, digitized with 1 arcsec sampling, from the blue, red, and infrared plates of the second Palomar Sky Survey (POSS-II) and from the red plates of the southern sky surveys taken with the UK Schmidt (AAO SES and SERC/PPARC ER). Additional information on the surveys may be found in previous issues of the STScI Newsletter, in Reid, et al. (1991, PASP, 103, 661), and in Morgan (1995, Proc. IAU Colloq. 148, p. 137). The uncompressed images (1 Gbyte each) are archived, primarily on magneto-optical discs, at STScI.

Nearly all available plates will be scanned by early northern summer, with completion of the remaining fields being dependent on observing conditions at Palomar and at Siding Spring and on the production of certain glass copy plates. However, the Table shows that until now the Palomar *I*-band has received lowest priority, with substantial observing and scanning remaining; for these we expect scanning to approach 80% completion this northern summer and thereafter to keep up with observing progress.

The DSS-II, in addition to its use by STScI and collaborators in constructing the GSC-II (second Guide Star Catalog, see Lasker, et al. in ESA SP-379, 1995), is being compressed by approximately a factor of ten, written onto a small number of write-once CD-ROMS, and distributed to cooperating institutions. The Table shows that our first priority for this project - all sky coverage in the R-band - is now at the 79% level and will catch up fully with plate scanning by May. The next priority will be the *J*-band, to be completed by October, after which the effort will turn to the *I*-band (projected for completion in the spring of 1999).

In order to make the compressed images available to the community, the CDs are being distributed to six institutions, which also have made substantive contributions to the completion of this program, namely CADC (which also serves as the data-replication facility for the DSS-II), ESO, CDS, NAOJ, an Australian consortium led by the AAO, another institution in the final stages of negotiation — and, of course, STScI. Some of these maintain the DSS-II on openly available web servers, namely

Summary of Plate Scanning and CD ROM Preparation

Telescope	*Plate + Filter*	*Band*	*λ (Å)*	*Completion Percentage Scanned*	*Completion Percentage Compressed*
Palomar	*IIIaJ+GG385*	B_J	*4690*	*97*	*28*
Palomar	*IIIaF+RG610*	*R*	*6585*	*96*	*86*
Palomar	*IVN+RG9*	*I*	*8095*	*74*	*0*
UK Schmidt	*IIIaF+OG590*	*R*	*6500*	*88*	*72*

STScI
http://www-gsss.stsci.edu/dss/dss.html

CADC
http://cadcwww.hia.nrc.ca/dss

ESO
http://archive.eso.org/dss/dss

NAOJ
http://dss.mtk.nao.ac.jp

Additionally, plans are being developed to make the DSS-II available at the CDS (cdsweb.u-strasbg.fr/Aladin.ht ml), while Raylee Stathakis (ras@aaocbn.aao.gov.au) may be contacted regarding the DSS-II sets in Australia.

Also under consideration is a mass-produced printing of the DSS-II on DVDs at the completion of the project. This may be undertaken around 2000 if there is sufficient community interest to support the production costs. We shall report on this after the DVD technology matures further.

Ultraviolet-Optical Space Astronomy Beyond *HST*

Boulder, Colorado, August 5 to 7, 1998

This topical meeting is being convened to discuss UV-optical space astronomy missions in the post-*HST* era, ranging from small missions to large-aperture telescopes. The main goals are to frame the scientific questions and to assess the technological issues for such missions.

The conference will be organized around four topics:

1. Developing the scientific rationale for future UV-optical space missions;
2. Identifying key technologies, including spin-offs from NGST development;
3. Assessing spacecraft orbital and operational requirements; and
4. Fostering international partnerships.

More information may be found at the meeting's web page:
http://casa.colorado.edu/~uvconf

The AGN/Galaxy Connection

Anne Kinney (Main Scientific Organizer, STScI) and Luis Ho (Deputy Organizer, CfA) kinney@stsci.edu

As part of the Committee on Space Research (COSPAR) meeting to be held July 12 through 19th in Nagoya, Japan this year, we are organizing a session together with Y. Uchida (Science University of Tokyo), S. Ikeuchi (Nagoya University), and H. Schmitt (STScI), on the relation between normal and active galaxies.

We aim to address in this meeting the connection between normal and active galaxies from a number of different viewpoints: the demographics of black holes in all galaxies, the demographics of activity in spiral and elliptical galaxies both locally and at high redshift, the host galaxies of the currently active objects, the conditions and events that lead to the formation of Supermassive Black Holes (SMBHs) and activity in galaxies, and the fueling mechanisms of galactic nuclei. To begin to explore these many interconnected issues, we have assembled a diverse group of experts in the respective areas.

The Ubiquity of Supermassive Black Holes in Galaxies

Black holes appear to be ubiquitous in the centers of galaxies. High-resolution kinematic observations have been accumulating showing that massive dark objects, most likely black holes, appear to be quite common (Kormendy & Richstone 1995; Miyoshi 1997; Magorrian et al. 1997, and references therein). The kinematic evidence has been bolstered by photometric studies of early-type galaxies using the *HST* that suggest that most or all bulge-dominated systems contain SMBHs (Faber et al. 1997). Remarkably, the SMBH mass appears to be correlated with the mass of the bulge of the host galaxy.

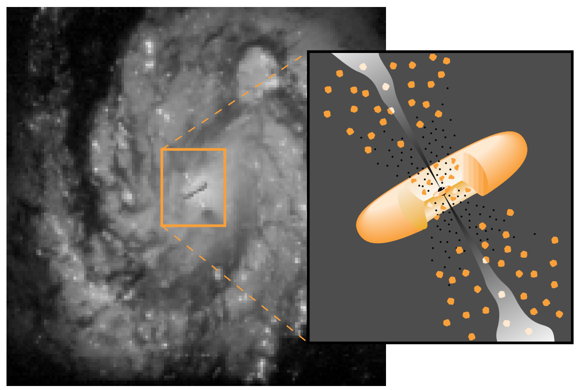
Meanwhile, ground-based surveys of nearby galaxies at optical (Ho 1996 and references therein) and radio (Sadler et al. 1989; Wrobel & Heeschen 1991) wavelengths have continued to show that a large fraction of galaxy nuclei contain low-level nuclear activity resembling the much more powerful active galactic nuclei (AGNs) found in “classical” Seyfert galaxies, radio galaxies, and quasars; Ho et al. (1997a) estimate that over 40% of all bright galaxies contain AGNs. While these small AGN have lower luminosity than is traditionally thought of as an AGN or quasar, the evidence is overwhelming that the majority are truly accretion-powered sources (Filippenko 1996; Ho 1996). Within the conventional AGN paradigm, widespread nuclear activity implies that SMBHs are a common component of many present-day massive galaxies.

We aim to provide a comprehensive update of the status of AGN surveys both at low and high redshifts. This will set the stage for future discussions of the cosmological and physical evolution of AGNs, and it will provide a framework for discourse on the connection between the “normal” and “active” galaxy populations. Among the presenters on the ubiquity of black holes are Drs. Faber, Lake, Morris, and Genzel. Evidence for activity in galaxies will be discussed by Drs. Ho, Sadler, Awaki, Nakagawa, Ikeuchi, Maoz, and Haiman, as well as a number of contributing presenters.

Properties of the Host Galaxy and Clues to the Formation of SMBHs

The prevalence of SMBHs in nearby galaxies opens a Pandora’s box of questions. Do all galactic bulges, large and small, contain SMBHs? If not, why do some galaxies have them and others not? Are SMBHs an inevitable by product of the formation of bulges? The correlation between the masses of SMBHs and the masses of the spheroidal component of the host galaxies, if verified by observations soon to become available from the Space Telescope Imaging Spectrograph (STIS) on *HST*, will represent a truly astounding breakthrough in our understanding of nuclear activity. Host galaxy properties will be presented by Drs. Dunlop, Antonucci, Jannuzi, MacKenty, and Miller, as well as by contributed presentations.

How are SMBHs formed? The possible correlation between black hole mass and bulge mass strongly suggests examination of the bulges or the spheroidal component in galaxies for evidence of cusps, the main parameter governing the Hubble sequence. While cuspy light profiles do



not uniquely signify SMBHs (e.g., Kormendy 1993), it is nevertheless likely that bulges with SMBHs should have central light profiles that differ systematically from those that do not. In support of this, evidence has been mounting from *HST* imaging studies that the central regions of galaxies fall into two families (e.g., Jaffe et al. 1994; Lauer et al. 1995; Faber et al. 1997). These data suggest that the spheroidal components in galaxies are formed via different paths during the process of galaxy formation (e.g., dissipative vs. non-dissipative mergers). Thus it is reasonable to postulate that the properties of the SMBH (e.g., its mass), or their very presence, depend on the galaxy’s evolutionary history.

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An attractive scenario for the formation of SMBHs is that a massive central object might be the natural end state of the coming together of stellar remnants (neutron stars and stellar-sized black holes) in the cores of galaxies. SMBHs might be seeded and ultimately grow from the normal formation and evolution of galactic bulges. Such a picture would provide a simple explanation for the black-hole mass vs. bulge-mass correlation.

Feeding the Central Engine

Once the black hole has formed, it must also be fueled for the object to appear as an AGN. Numerical simulations predict that bars effectively deliver gas to the center of a galaxy (e.g., Wada & Habe 1992; Barnes & Hernquist 1992; Bekki & Noguchi 1994; Wada & Habe 1995). Since bars are common in disk galaxies, bar-driven inflow is a promising mechanism for fueling AGNs. This expectation seems not to be supported by recent ground-based observations (MacKenty 1990; Ho et al. 1997b; Mulchaey & Regan 1997), which find that active galaxies have the same bar fraction as normal galaxies. The ground-based observations are likely probing the galaxies on the wrong scale: the large-scale stellar bar is effective in delivering material only down to a scale of about few hundred parsecs. Further angular momentum transport evidently requires secondary, nuclear bars (Noguchi, 1988, Shlosman et al. 1989; Friedli & Martinet 1993). Recent observations from high-resolution studies of the gas content in nearby galaxies will be reviewed.

The optically-thick, geometrically thin disk has successfully described the accretion process in standard AGNs (Begelman 1985). However, these thermally emitting accretion disks are inappropriate for most nearby, low-luminosity, low-accretion rate systems. AGNs such as those in M81, NGC

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The Next May Symposium: Unsolved Problems in Stellar Evolution

Mario Livio, STScI mlivio@stsci.edu

STScI May Symposium
May 4-7, 1998

The next STScI May Symposium will take place May 4-7, 1998, and will be devoted to the topic of: Unsolved Problems in Stellar Evolution. All aspects of stellar evolution, from birth to death, will be discussed, with an emphasis on important open questions. A list of the confirmed talks is shown below.

The deadline for registration is April 1, 1998. People interested in participating should contact Cheryl Schmidt at STScI by mail: STScI 3700 San Martin Drive Baltimore, MD 21218 USA

e-mail: (`schmidt@stsci.edu`), or phone (410-338-4404)

The registration fee is $150. More information may be found at:
`http://www.stsci.edu/ftp/meetings/meetings.html`

Confirmed Talks

Ed Salpeter	*Introduction*
Frank Shu	*Review of Star Formation*
Steve Stahler	*Pre-Main Sequence Evolution*
Joan Najita	*YSOs: Low-Mass*
Ed Churchwell	*YSOs: High-Mass*
Bruce Elmegreen	*The IMF*
Jim Liebert	*Brown Dwarfs*
Ian Bonnell	*Binaries in Star Formation*
Johannes Andersen	*Calibration of the M-L Relation*
Yveline Lebreton	*Results from Hipparcos*
John Bahcall	*The Solar Neutrino Problem*
Tim Brown	*Asteroseismology*
Juri Toomre	*Convection and Rotation*
Andre Maeder	*Input Physics and Parameters*
Peter Eggleton	*Evolution to Red Giants*
Catherine Pilachowski	*Abundance Anomalies*
Rolf Kudritzki	*Mass Loss: Hot Stars*
Lee Anne Willson	*Mass Loss: Cool Stars*
Ed van den Heuvel	*Evolution of Binaries*
Mario Mateo	*Stellar Exotica*
Alvio Renzini	*Ages of Globular Clusters*
Howard Bond	*AGB Stars and Planetary Nebulae*
Don Winget	*White Dwarfs*
Don Figer	*The Pistol Star*
Guillermo Gonzalez	*FG Sge*
Stan Woosley	*Supernovae*
Steve Thorsett	*Pulsars*
Ramesh Narayan	*Black Holes*
Icko Iben Jr.	*Conference Summary*

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4258, and M87 (Ho et al. 1996, Lasota et al. 1996, and Reynolds et al. 1996, respectively) emit markedly different spectral energy distributions (SEDs) compared to the "canonical" AGN SED (e.g., Elvis et al. 1994). The most promising models for this regime in accretion physics are the "advection-dominated" accretion disks (Narayan & Yi 1995, 1995b; Takeuchi & Mineshige 1997), and we intend to incorporate these timely developments into the overall program. Fueling mechanisms and the formation of black holes will be presented by Drs. Ishizuki, Scoville, Sofue, Mineshige, Uchida, and Noguchi as well as a number of contributed presenters.

Meeting Agenda

We will start with a session on the demographics of active galaxies. What percentage of spirals and ellipticals are active at various cosmological times? What is the role of transition objects that have traits of both normal and active galaxies? The next session will focus on observational studies of the host galaxies of more distant objects, namely quasars and blazars. Reviews will be presented of optical and near-infrared imaging studies, as well as spectroscopic efforts using large ground-based optical facilities. This will be followed by a session on searches for SMBHs, an update on evidence for a SMBH at the Galactic Center, photometric studies of bulges and what these might teach us about conditions that lead to the formation of SMBHs, and more general discussions on formation of galaxy bulges, dense stellar clusters, and their possible evolution into SMBHs. The final session will be devoted to observations of gas content in the central regions of galaxies, fueling processes, and accretion mechanisms.

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ST-ECF Newsletter

The Space Telescope — European Coordinating Facility publishes a quarterly newsletter which, although aimed principally at European Space Telescope users, contains articles of general interest to the HST community. If you wish to be included in the mailing list, please contact the editor and state your affiliation and specific involvement in the Space Telescope Project.

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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:

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`fwalter@sbast1.ess.sunysb.edu`
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John Clarke, U. Michigan
Bob Fosbury, ESO
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