ST-ECF Newsletter

Space Telescope European Coordinating Facility

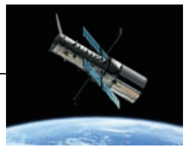
NASA, Holland Ford (JHU), the ACS Science Team and ESA

The interacting galaxy UGC 10214 was imaged as one of the Early Release Observations taken by the Advanced Camera for Surveys (ACS) shortly after it was installed aboard the NASA/ESA Hubble Space Telescope in March 2002. As well as revealing the peculiar juxtaposition of smooth spiral arms and chaotic clumps of star formation within the galaxy itself, the images show an extraordinarily rich backdrop of more remote galaxies. The number of faint galaxies revealed by these relatively short exposures is comparable to how many were found in the Hubble Deep Fields using the Wide Field Planetary Camera 2 and suggest that ACS will be a remarkably powerful tool for studying the remote universe.

Read more at ***http://hubble.esa.int*** *under "Releases" (heic0206)*

HST News and Status

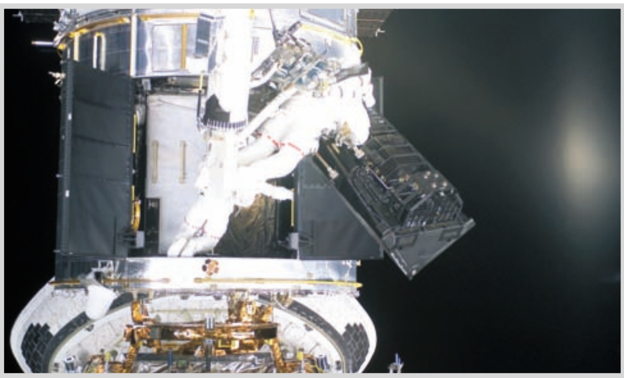
Jeremy Walsh



Credit: NASA

***Fig 1:** With an impressive backdrop of scattered clouds coloured pink by the rising sun the Space Shuttle Colombia was successfully launched on Hubble Servicing Mission 3B on 1 March 11:22 UT from the Kennedy Space Center in Florida.*

Since the last edition of the Newsletter the main HST event has been the fourth visit of the Space Shuttle to the observatory for major repairs and upgrades — servicing mission SM3B. Despite being the most complex servicing mission yet, SM3B, completed in March, was a resounding success both in terms of the maintenance performed by the astronauts and the resulting performance of the instruments. It has been demonstrated that even units that were not designed for astronaut servicing can be replaced (in this case the Power Control Unit). The plumbing of the NICMOS Cryocooler to the NICMOS dewar was believed by some to be potentially risky, but has successfully cooled NICMOS to around 75K and restored it to close to its original performance. The last instrument from the original suite, the Faint Object Camera (FOC), built by ESA, was removed and brought back to Earth. It is replaced by the Advanced Camera for Surveys (ACS), which is both a faint object camera and a large field camera, using CCD detectors instead of image intensifiers. A nostalgic look at the science from the FOC is presented in an article in this Newsletter as well as a sample of initial spectroscopic data from ACS.



Credit: NASA

***Fig 2:** The Faint Object Camera (FOC), the last of the original Hubble instruments, is removed during SM3B. FOC spent 4340 days in space. This is the longest time that any piece of hardware has spent in space before being retrieved and returned to the ground.*

Even before the release of HST and the return of the SM3B astronauts to earth, the ACS was shown to be 'alive'. The Servicing Mission Orbital Verification (SMOV) will be complete by the time this article appears and the very high expectations for this instrument have been amply rewarded. The spectacular Early Release Observations (EROs), which included the 'Tadpole' galaxy on the cover, have shown the real increase in survey efficiency of the camera. Whilst the interacting galaxy pair makes a majestic image, it is the sheer number of resolved small galaxies, more than in the smaller but deeper field of the HDF-N for example, which have surprised many astronomers. The comprehensive series of SMOV tests have shown this instrument to be performing very close to the optical model and ground-based tests. Whilst the charge transfer efficiency (CTE) of the Wide Field Channel (WFC) CCD chips (4096x2048 pixels) is very high, the removal of hot pixels by warming-up the chips (annealing) is proving to be less efficient than for WFPC2.

The ST-ECF is undertaking the support of the grism and prism modes of ACS and the SMOV observations, designed to test this mode, have been completed. These data are briefly described later in this Newsletter. The tests of the Solar Blind Channel, for UV image and slitless spectrometry, have begun but are not yet complete since a long period of outgassing must be allowed to prevent organic molecules polymerising on the optical surfaces when exposed to UV light.

After the successful turn-on of the NICMOS Turbo Brayton cooler (NCS), the cooling of NICMOS proceeded slower than anticipated. However, this was based on a thermal model which had not been fully tested. There was one glitch in the cool down, when the turbine of NCS halted, but it was restarted. There is no temperature gauge on the NICMOS detectors as such, but their temperature can be inferred from other probes. The most fundamental parameter is the detector dark current. This has stabilised at about $0.15e^-$/s/pixel, so the increased dark current seen during the warm-up (the 'bump') did not re-appear. The combination of quantum efficiency and dark current brings NICMOS sensitivity to close to its solid nitrogen values. All instrument functions appear to be operating as they did before the warm-up and the detector flat fields look very similar to the previous ones. NICMOS can now enjoy several years of deep near-IR imaging, polarimetry and slitless spectrometry before being largely superseded by the IR channel of WFC3, due for installation in early 2004.

Last, but not least, the three existing instruments aboard HST — FGS, STIS and WFPC2 — came through the servicing mission with essentially untarnished performance and were quickly recommissioned. They are busy with the Cycle 10 observations. Cycle 11 is due to begin on July 1, although some GO observations with ACS will begin before that date. The data rate from HST will then undergo a step increase as the ACS WFC data (16.8 Mpixels) pour into the archive.

Credit: NASA

Fig 3: *The external radiator for the NICMOS cooling system being put in place by the astronauts during SM3B.*

NGST

NGST News

Bob Fosbury & Peter Jakobsen (ESTEC)

Following the Announcement of Opportunity (AO) issued in October 2001, NASA have just announced the team selected to procure the near-infrared camera for NGST. The camera team includes members from the University of Arizona; Lockheed-Martin Advanced Technology Center, Palo Alto, California; EMS Technologies, Ottawa, Canada; and COMDEV, Ltd., Cambridge, Canada, and will be led by Marcia Rieke of the University of Arizona.

NASA has selected the US portion of the joint European/US team that will construct the mid-infrared instrument (MIRI). The members of this team are Thomas Greene, NASA's Ames Research Center, Moffett Field, California.; Margaret Meixner, University of Illinois, Urbana-Champaign; Gene Serabyn, JPL and George Rieke (lead), University of Arizona. They will work with the European MIRI Consortium led by Gillian Wright at the UK Astronomy Technology Centre (UKATC) in Edinburgh, and NASA's Jet Propulsion Laboratory in Pasadena, with Gene Serabyn as the JPL Instrument Scientist.

The AO also solicited members to serve alongside the instrument teams and the Observatory Project Scientists on the NGST science working group. NASA, with support from ESA nominees, have selected the following astronomers to serve as Interdisciplinary Scientists during the development of the observatory: Heidi Hammel, Space Science Institute, Ridgefield, Connecticut.; Simon Lilly, ETH-Hoenggerberg, Zurich, Switzerland; Jonathan Lunine, Lunar and Planetary Laboratory, Tucson, Arizona; Mark McCaughrean, Astronomical Institute, Potsdam, Germany; Massimo Stiavelli, Space Telescope Science Institute, Baltimore; and Rogier Windhorst, Arizona State University, Tempe.

The selection of the NGST prime contractor in the US was originally expected to occur early in 2002, but is now not expected until later this summer.

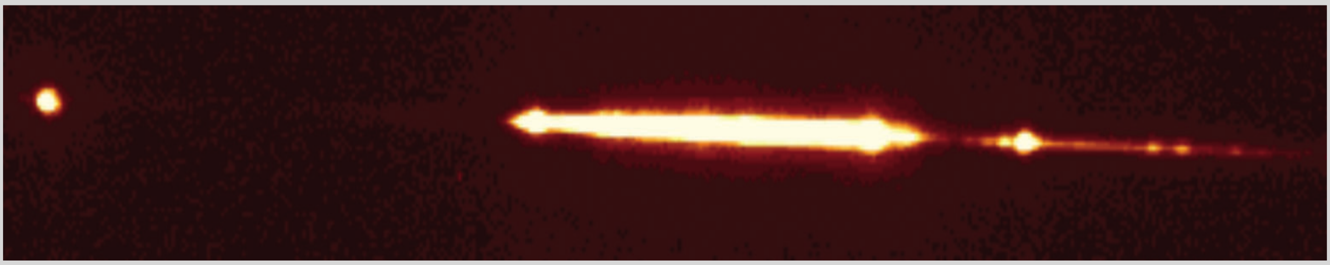
In Europe, the two independent ESA Definition Phase studies by Astrium GmbH and Alcatel Space of the near-infrared multi-object spectrograph (NIRSpec) are continuing with the goal of completion late in early 2003. A major development earlier this year was the selection, by the international MEMS review board, of the Micro-Shutter rather than the Micro-Mirror device as the preferred slit-definition mechanism for the spectrograph. This new technology development is being carried out by a team at the Goddard Space Flight Center led by Harvey Moseley. The ESA study science team (SST) and the ST-ECF are currently busy investigating a long list of NIRSpec performance issues in close collaboration with the industry teams. Some of these investigations are being published in a series of Instrument Science Reports (NGST-ISR; see back page for access details).

The ESA-funded Definition Studies of the MIRI Optics Module, led by the UKATC and Astrium UK, and the associated study of the MIRI cryostat being carried out by Air Liquide, are also on schedule for completion by September 2002, after which firm commitments from the ESA member states participating in the MIRI consortium will be sought.

First Light of the Grism Mode of the Advanced Camera for Surveys

A. Pasquali, N. Pirzkal & J.R. Walsh

The ST-ECF is responsible for the calibration and spectral extraction software for the spectral modes of the Advanced Camera for Surveys. The first data in this mode after the camera was successfully installed in HST during the SM3B servicing mission were eagerly awaited.



All images and diagrams: the ST-ECF ACS group

Fig 1: *WR45 grism spectrum obtained at the centre of the WFC field of view. Exposure time is 20s. The zeroth, first and second orders are visible from left to right across the picture. Note that the spectrum is tilted at about -2 degrees. The total extension along the X-axis (the wavelength axis) is 400 pixels.*

First light of the ACS grism mode took place during the Servicing Mission Orbital Verification (SMOV) phase in late April 2002. A galactic Wolf-Rayet star (WR45) and a white dwarf (GD153) were observed to check the post-launch dispersion correction and the sensitivity of the grism. Two images were acquired for each target, a direct image in the F775W filter and a slitless image with the G800L grism. A number of pointings were performed across both the Wide Field (WFC) and the High Resolution Channel (HRC). The targets were imaged both at the centre of each detector and close to its amplifiers. A detailed description of the ACS instrument layout is given in Pasquali et al. (2002). This grid of pointings was designed to map the field dependence of the grism dispersion and sensitivity, particularly for the WFC which suffers from severe geometric distortion. In the case of WR45, the spectroscopic exposure times were 20s and 60s for the WFC and the HRC respectively: long enough to detect all the grism orders between the -4th and +4th for the WFC and between the -2nd and the +3rd for the HRC. The data reduction and analysis are still in progress at the time of writing but spectra have already been successfully extracted using the aXe software developed at the ST-ECF (Pirzkal et al. 2001). The Wolf-Rayet two-dimensional spectrum, taken at the centre of the WFC, is shown in Figure 1, where the zeroth, first and second orders can be easily identified from the left to the right across the image. The extracted first order is shown in Figure 2 with the CIII and CIV emission lines typical of WR stellar winds being clearly seen. Similarly, Figures 3 and 4 display the grism first order spectrum of WR45 taken at the centre of the HRC.

The grism SMOV observations were planned using SLIM 1.0 (Pirzkal & Pasquali 2001) simulations based on ESO/NTT high-to-medium resolution spectra of WR45 (Pasquali et al. 2002). It is interesting to compare those simulations, made

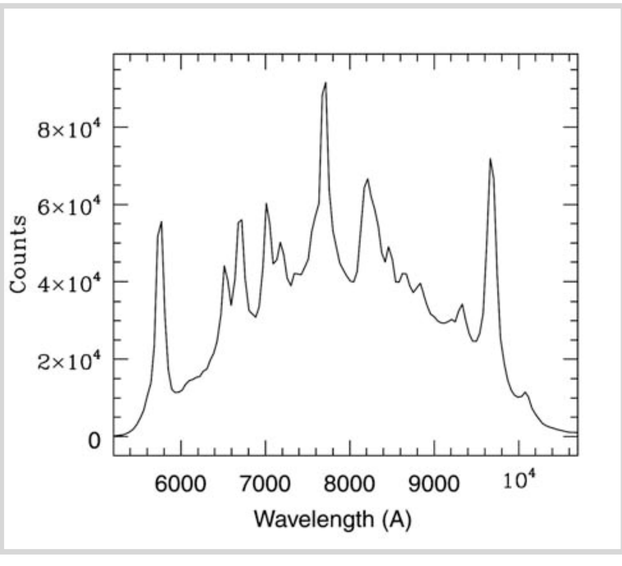


Fig 2: *WR45 grism first order spectrum acquired at the centre of the WFC field of view with a 20s exposure. The spectrum is background subtracted.*

Fig 3: *WR45 grism spectrum acquired at the centre of the HRC field of view. Exposure time is 60s. The zeroth, first and second orders are visible stretching from the left upper corner to the right bottom corner of the picture. Note the spectrum tilt of about -38 degrees. The total extension along the X-axis (the wavelength axis) is 500 pixels.*

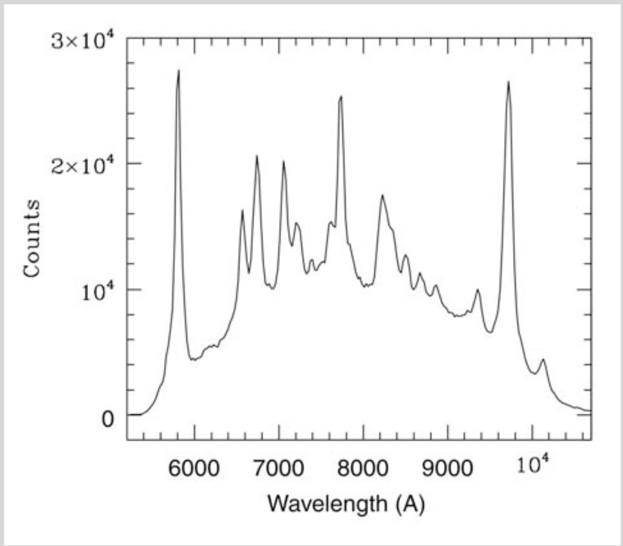


Fig 4: *WR45 grism first order spectrum acquired at the centre of the HRC field of view with a 60s exposure. The spectrum is background subtracted.*

before launch, with the real data obtained during SMOV. In Figure 5 the WR45 first order spectrum is plotted as simulated by SLIM 1.0 for the WFC (left panel) and as extracted from the WFC dataset (right panel). The similarity between the two spectra is quite striking, even for the ACS team at ST-ECF who planned the HST/ACS observations! This example demonstrates that the in-orbit ACS grism performance is almost nominal, with the exception of the grism throughput, which appears to be higher in the blue and lower in the red with respect to the instrument modelling predictions on which SLIM 1.0 is based.

These early results suggest that the ACS grism modes are working very well. The power of this facility was strikingly demonstrated by the discovery of a type Ia supernova (SN 2002dd) with z = 1.06 by Tsvetanov et al. (2002) in the Hubble Deep Field North. The grism mode allowed many spectral features to be well seen despite the object being as faint as m_{AB} = 24.15 in imaging through the Gunn z filter. The aXe software, in pre-release form, was used to help with spectral extraction of this exciting data.

References

• *Pasquali, A., Pirzkal, N., Walsh J.R., 2002, ST-ECF Newsletter, 30, 4*

• *Pirzkal, N., Pasquali, A., 2001, ST-ECF Newsletter, 28, 3*

• *Pirzkal, N., et al., 2001, ST-ECF Newsletter, 29, 5*

• *Tsvetanov, Z., Blakeslee, J., Ford, H., Magee, D., Illingworth, G., Riess, A., The ACS Science Team, 2002, IAU Circular 7912*

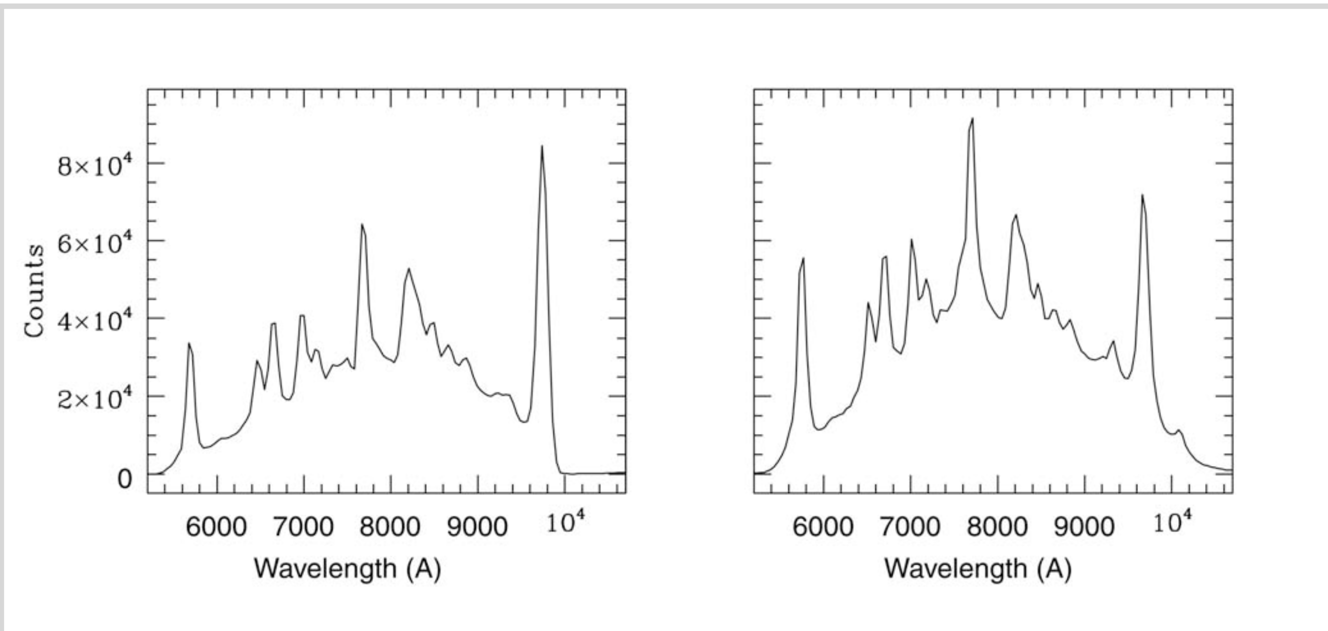


Fig 5: *Grism first order spectra of WR45: as simulated with SLIM 1.0 in the left panel, and as observed with the WFC during SMOV in the right panel. Exposure times are 20s.*

Looking Back: The ESA Faint Object Camera

Rudolf Albrecht & Peter Jakobsen (ESTEC)

The collaboration between NASA and ESA on the Hubble Space Telescope project dates back to the mid-seventies. The agreements were laid down in a Memorandum of Understanding that called for ESA to supply one of the science instruments, produce the solar arrays to generate power for the HST and to assign 15 ESA staff to the Space Telescope Science Institute, in exchange for 15 percent of the available observing time and access to the full set of science data.

Because of political considerations and due to schedule constraints the type of instrument which was to be supplied was negotiated rather than the result of a competition. It was clear that there should be at least one instrument on board with the capability to fully sample the PSF of the HST, and which, at the same time, could image the very faintest objects, in other words a Faint Object Camera. This was to be achieved with the primary mode of the FOC, an f/96 camera, operating in photon counting mode. It is evident that, given the limitations of storage technology in the seventies, this came at the expense of viewing area. In order to alleviate this restriction a fully independent f/48 mode was added. This mode also incorporated a long slit spectrograph.

An Invitation to Tender was issued to European industry. ESA encouraged the top contenders to collaborate and thus Dornier Systems (now Astrium) teamed up with Matra. From this contract subcontracts percolated throughout the ESA member countries.

ESA also formed a scientific and technological advisory group, which went by the name of Faint Object Camera Instrument Science Team. To be consistent with the American project terminology the name was later changed to FOC Investigation Definition Team (IDT). Henk van de Hulst was the first chairman, and it was his leadership and his considerable experience and influence that led to the development of a superb instrument. After Henk van de Hulst retired, Duccio Macchetto took the team through launch and deployment of the FOC. On the occasion of the recent retirement of the last remaining first generation HST instrument, it is perhaps appropriate to look back on the history and scientific accomplishments of this European contribution to the HST project. As with any obituary, the words that follow obviously reflect a highly biased personal view.

Credit: ESA

Fig 1: *FOC under post-flight investigation (after SM3B). Manfred Miebach from ESA/STScI is on the left along with Lothar Gerlach from ESA.*

The technical heart of the FOC is its unique two-dimensional photon counting detector, the pedigree of which can be traced back to Alec Boksenberg's Imaging Photon Counting System (IPCS) developed at University College London in the early seventies. The project's founding fathers exercised considerable foresight in correctly identifying the IPCS as a unique piece of European technology, far ahead of its time, and audacity in proposing to develop a ruggedised, space qualified version of the device for use on HST. With its 36 kV image intensifier and complex video camera readout, the IPCS was notorious for being an extremely finicky contraption, and its ground-based travelling predecessor was lovingly known as 'Boksy's Flying Circus' for this reason. By literally substituting a B52 bomb sight for the camera section and paying meticulous care in packaging the delicate high-voltage image tube, this not inconsiderable engineering challenge was successfully overcome. One wonders whether a similar degree of audacity would be possible in today's more conservative climate.

Early on, something of a transatlantic flap arose as to the best scientific use for the advanced detector on HST. The Europeans pushed for spectroscopy on faint objects, this being the clear scientific forte of the IPCS. However, HST spectroscopy was a scientific niche that NASA at the time wished to retain for its instruments (the Faint Object Spectrograph, FOS, and the Goddard High Resolution Spectrograph, GHRS), and hence the FOC as 'that other HST camera' was born.

Not to be deterred, the FOC team designed the FOC to have significantly higher angular resolution and better UV sensitivity than the CCD-based Wide Field Planetary Camera — and also included a long-slit spectrograph into one of the two channels along with a few other nice 'bells and whistles'. In spite of its complexity, the FOC has performed extremely well in orbit. The only significant mishap in eight years of the operation has (perhaps not surprisingly) been a high voltage discharge that developed in one of the detectors, resulting in a prolonged period of persistently high detector background in the (secondary) f/48 camera.

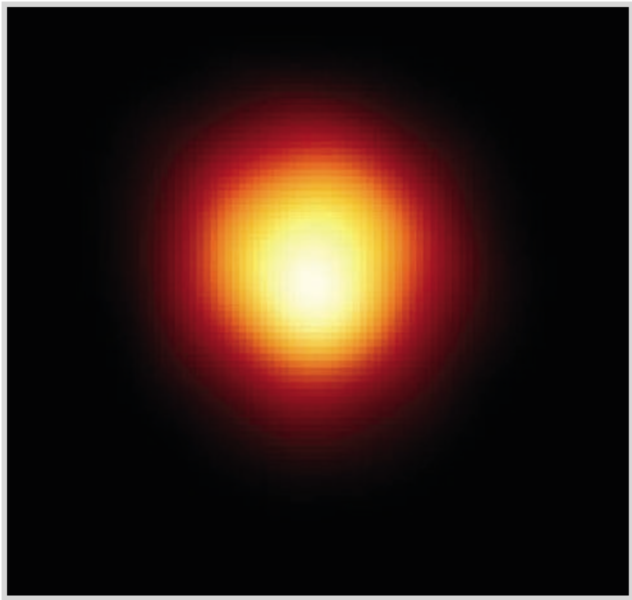
Because of its particular 'go for broke' scientific niche, the FOC was in several ways particularly hard hit by the HST spherical aberration — a fact that, however, also earned it acceptance with NASA as COSTAR's most demanding and key customer. The spectacular success of the servicing mission in 1993 led to essentially complete recovery of the (primary) f/96 imaging camera and its associated objective prism and polarimetry modes. The f/48 camera and its long-slit spectrograph was also recovered optically, but widespread use of this side was hampered by the detector problem mentioned above. The only observing mode of the FOC that was never utilised scientifically is the f/288 coronagraphic mode, the apodising mask of which was rendered useless, first by the spherical aberration, and later by the shift in pupil position introduced by the COSTAR optics.

An aspect which is not very well known is the impact of the development of the FOC as the European instrument on the HST on European astronomical data analysis technology. As the instrument was nearing completion it became clear that the European astronomical community was not equipped to utilise the data in the best possible manner: given the total cost of the HST and the FOC it was evident that the data had to be optimally exploited. Based on such considerations ESA formed an FOC Software Team and eventually let a contract to European industry to produce the FOC Image Processing System (FIPS). While FIPS itself never achieved any fame, it triggered and encouraged the development of image processing systems in various European scientific institutions. Among them were MIDAS (Munich Image Data Analysis System), produced by ESO, and, in particular, STARLINK in the UK and ASTROLINK in Italy. These were very successful exercises, not only in terms of software development and coordination, but also in providing, as early as 1980, distributed services to the scientific community, which were only surpassed by the introduction of the World Wide Web in 1994.

Starting with Cycle 8, the Faint Object Camera (FOC) was no longer offered as a general observing facility on HST. While the instrument was still fully functional and was being maintained as a backup, the point had now been reached where most of its capabilities had been superseded by various observing modes of STIS and WFPC2. The FOC was finally removed from the HST during Servicing Mission 3B in March 2002 in order to make room for the Advanced Camera for Surveys (ACS). This came after 4340 days in space, almost 12 years.

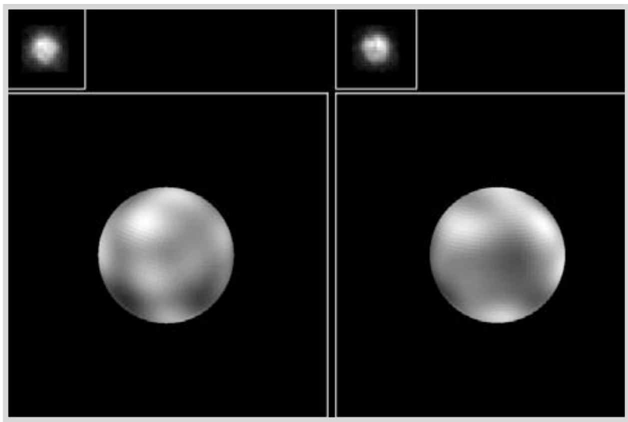
A cursory query of NASA's ADS system reveals that the total number of FOC-based papers in the refereed literature easily runs to several hundreds. A few personal pickings from this scientific harvest follow. In the interest of saving space, references are given in nameless shorthand.

The foremost scientific capability of the FOC was its very high angular resolution — a feature that was evident even in the central image cores of the early aberrated HST images. With the corrected optics of COSTAR in place, the FOC achieved essentially diffraction-limited image quality at visible wavelengths: 43 mas FWHM at 5000A (ApJ 435, L7). The superb FOC image quality has been put to use in providing unique close-up views of nearly every class of astronomical object, among other things, revealing surface features on Pluto (ApJ 435, L75, see Figure 3), the morphology of planetary nebulae in the Magellanic Clouds (ApJ 398, L41), and the first direct HST images of the atmospheres of the giant stars Betelgeuse (ApJ 463, L29, see Figure 2) and Mira A (ApJ 482, L175).



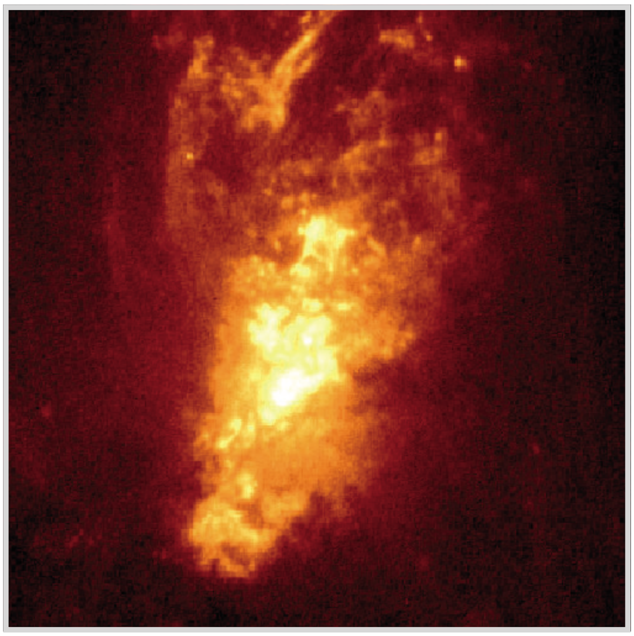
Credit: NASA & ESA

Fig 2: *The first direct image of the surface of a star other than the Sun. This picture of the red supergiant star Betelgeuse (Alpha Orionis) was made in ultraviolet light using the FOC. Credit: Andrea Dupree (Harvard-Smithsonian CfA), Ronald Gilliland (STScI), NASA and ESA.*



Credit: NASA & ESA

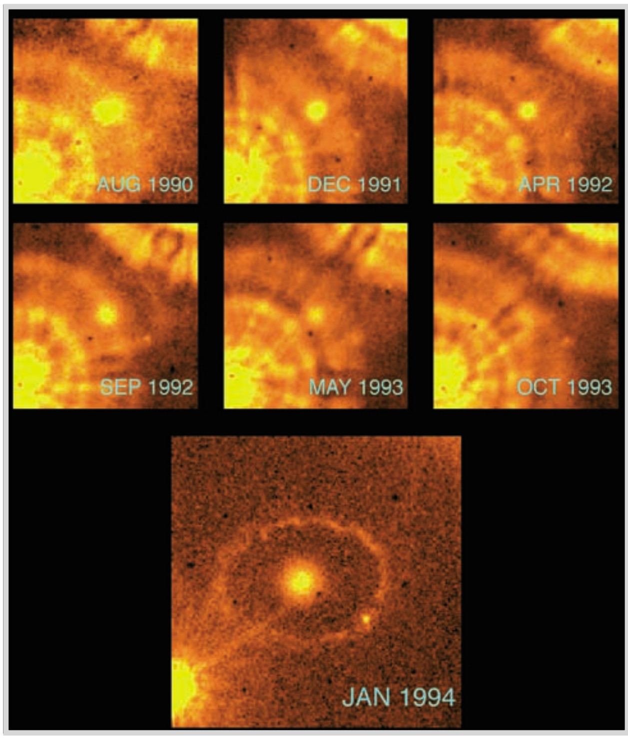
Fig 3: *The high-resolution imaging power of the FOC with COSTAR was exploited by Alan Stern and Marc Buie to take multiple images of the distant planet Pluto as it rotated and construct the first map of most of the planet's surface. The upper two inserts are examples of original FOC images and the lower images are reconstructed maps of each hemisphere.*



Credit: NASA & ESA

__Fig 4:__ The prototype Seyfert 2 galaxy NGC 1068 was studied intensively using the FOC for high-resolution narrow-band imaging, longslit spectroscopy and polarisation measurements.

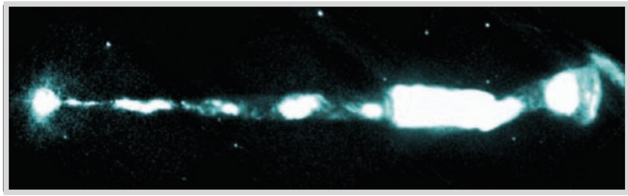
The first FOC exposures of SN 1987A (ApJ 369, L63) established that the circumstellar material known to surround the progenitor star is in the form of a well-defined ring - a fact that subsequently enabled a novel distance determination to the LMC to be made (ApJ 380, L23). The FOC also readily resolved the shape of the envelope of the supernova proper and followed its expansion over time (ApJ 435, L47, see Figure 5).



Credit: NASA, ESA & Peter Jakobsen

__Fig 5:__ Sequence of pre- and post-COSTAR FOC near-UV images of SN1987A. The FOC was extensively used to monitor the evolution of SN1987A, the ejecta of which was readily resolved at the spatial resolution of the FOC, allowing its expansion to be followed directly. Toward the end of 1993 the rapidly fading image of the supernova proper had almost become lost in the glare of the spherical aberration halo of the nearer of the two neighboring stars, but was dramatically recovered following the successful installation of COSTAR in early 1994.

Another major theme for the FOC has been the study of Active Galactic Nuclei, where high-resolution, narrow-band (ApJ 435, L15; ApJ 440, 151, see Figure 4) and polarisation (ApJ 446, 155; ApJ 452, L87; ApJ 466, 169) images have proved invaluable in delineating the complex geometry of the innermost nuclear regions of these objects. The FOC polarisation images of AGN jets have also been spectacular (M87 especially, see Figure 6) and have revealed that the synchrotron jets closely maintain their structure throughout the radio and UV — thereby pointing to a localised in situ particle acceleration mechanism (A&A 261, 393; MNRAS 275, 921; A&A 317, 637). More recently, FOC long-slit spectra of M87 (ApJ 489, 579) as well as NGC 4151 (ApJ 487, L121) and NGC1068 (ApJ 496, L75) have enabled the most detailed studies yet of the kinematics of the narrow-line region and accurate measurements of the central masses of these objects.

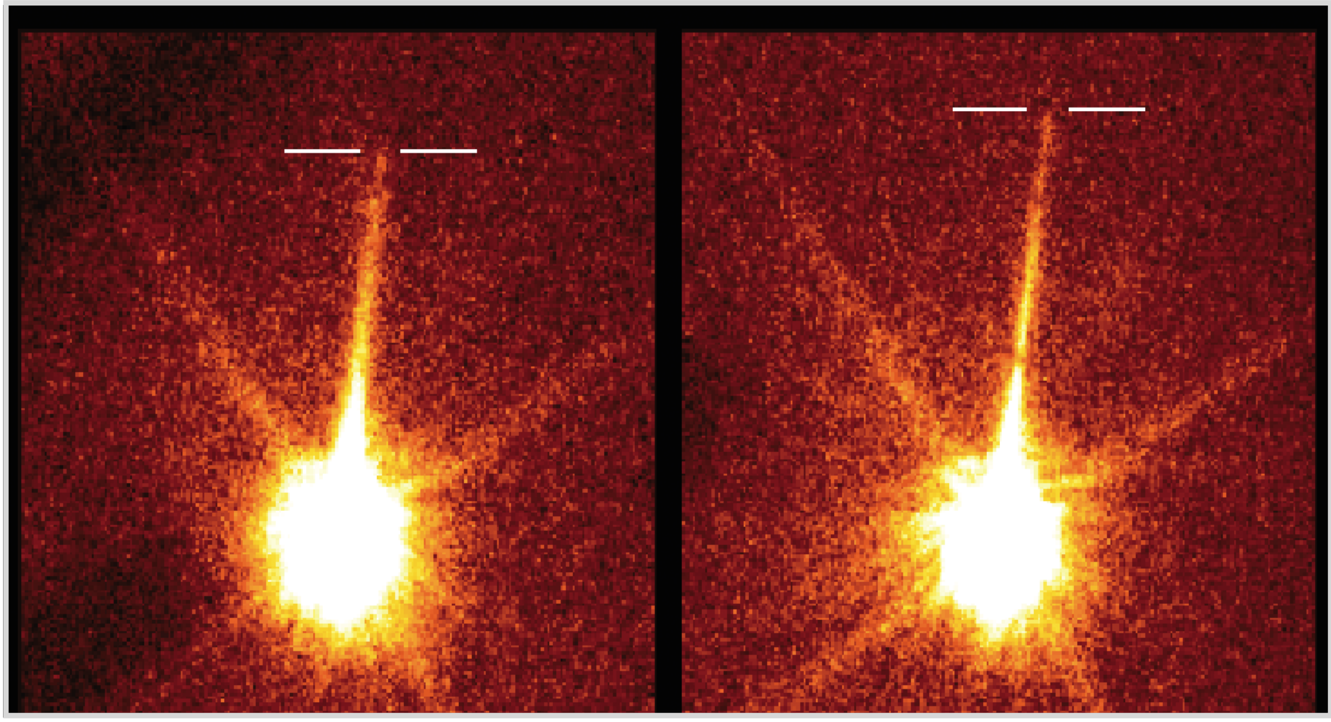


Credit: NASA & ESA

__Fig 6:__ FOC observations of the jet of M87 at five epochs between 1994 and 1998 provided direct evidence of superluminal motion. Some of the knots were found to have apparent velocities in the range 4c-6c implying a Lorenz factor greater than six and a jet orientation within 19 degrees of the line-of-sight (Biretta et al., ApJ 520,621, 1999).

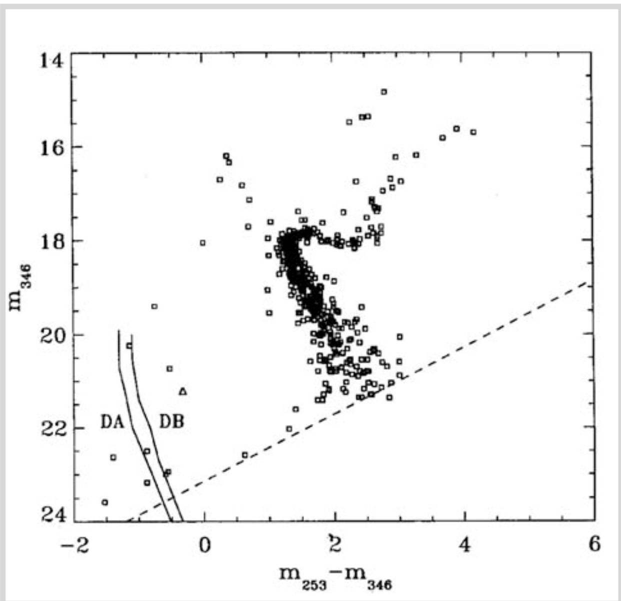
The second key feature of the FOC was its sensitivity down into the far-ultraviolet. The simple, but versatile, far- and near-UV objective prism modes of the FOC were, until the installation of STIS, the only two-dimensional spectroscopic modes on HST capable of detecting the very faintest UV fluxes approaching the sky background. This capability was extensively used to search for rare examples of very high redshift quasars whose extreme UV continua are not entirely absorbed by intervening neutral hydrogen (ApJ 417, 528), an effort that ultimately resulted in the first detection of singly ionised helium in the intergalactic medium (Nature 370, 35, see Figure 7). Of the only four quasars toward which intergalactic HeII absorption has been detected to date, both objects at $z > 3$ were first identified as UV bright by the FOC.

The FOC's unique combination of high spatial resolution and UV sensitivity has perhaps most dramatically been put to use in the study of globular clusters, where the FOC has been able to 'shoot straight through' the dense cores of these objects and reveal their contents and structure. FOC imaging in the ultraviolet has enabled the ready identification of the more exotic denizens of the cluster population, be they novae (ApJ 369, L71), cataclysmic variables (ApJ 441, 617), X-ray binaries (ApJ 413, L117), or blue stragglers (Nature 352, 297; A&A 287, 769). Highlights of these efforts were probably the first detections of white dwarf stars in globular clusters and the confirmation of the dynamical mass



Credit: NASA, ESA & Peter Jakobsen

Fig 7: *FOC far-UV objective prism spectra of two high redshift quasars revealing the intense Gunn-Peterson absorption at z>3 due to singly ionized helium in the intergalactic medium. The position of the redshifted HeII 304 line - shortward of which the redshift-smeared absorption sets in - is marked in both cases. Such quasars whose lines of sight are sufficiently devoid of intervening neutral hydrogen to allow their rest frame continua to be traced into the extreme ultraviolet are exceptionally rare. Q0302-003 and PKS1935-692 were both identified as UV bright using the FOC, and have since been extensively studied in more detail using STIS. Intergalactic HeII Gunn-Peterson absorption has also since been detected toward a further two objects at lower redshift, but Q0302-003 and PKS1935-692 remain to this day the only two such "clear quasars" discovered so far at z>3.*



Credit: NASA, ESA & Francesco Paresce

Fig 8: *Colour-magnitude diagram of the globular cluster 47 Tuc obtained from UV FOC images taken through the F253M and F346M filters. A total of 442 stars are plotted. The dashed line is the photometric detection limit in the F253M filter (5σ above background). The object plotted as a triangle is a dwarf nova. The solid lines in the lower left show the expected location of the cooling sequence of 0.5 solar mass white dwarfs of types DA and DB, as indicated. From Paresce et al. (ApJ 442, L57, 1995).*

segregation predicted to take place in the central regions of these objects (ApJ 442, L57; AJ 113, 1328, see Figure 8).

In summary, while the images obtained with the FOC have only rarely been as photogenic as those from the WFPC, it is hopefully evident from this short summary that 'that other HST camera' has served the astronomical community well and brought home its share of scientific 'firsts'.

Editor's Note: this article is based on one that first appeared in the ESA Astronews newsletter.

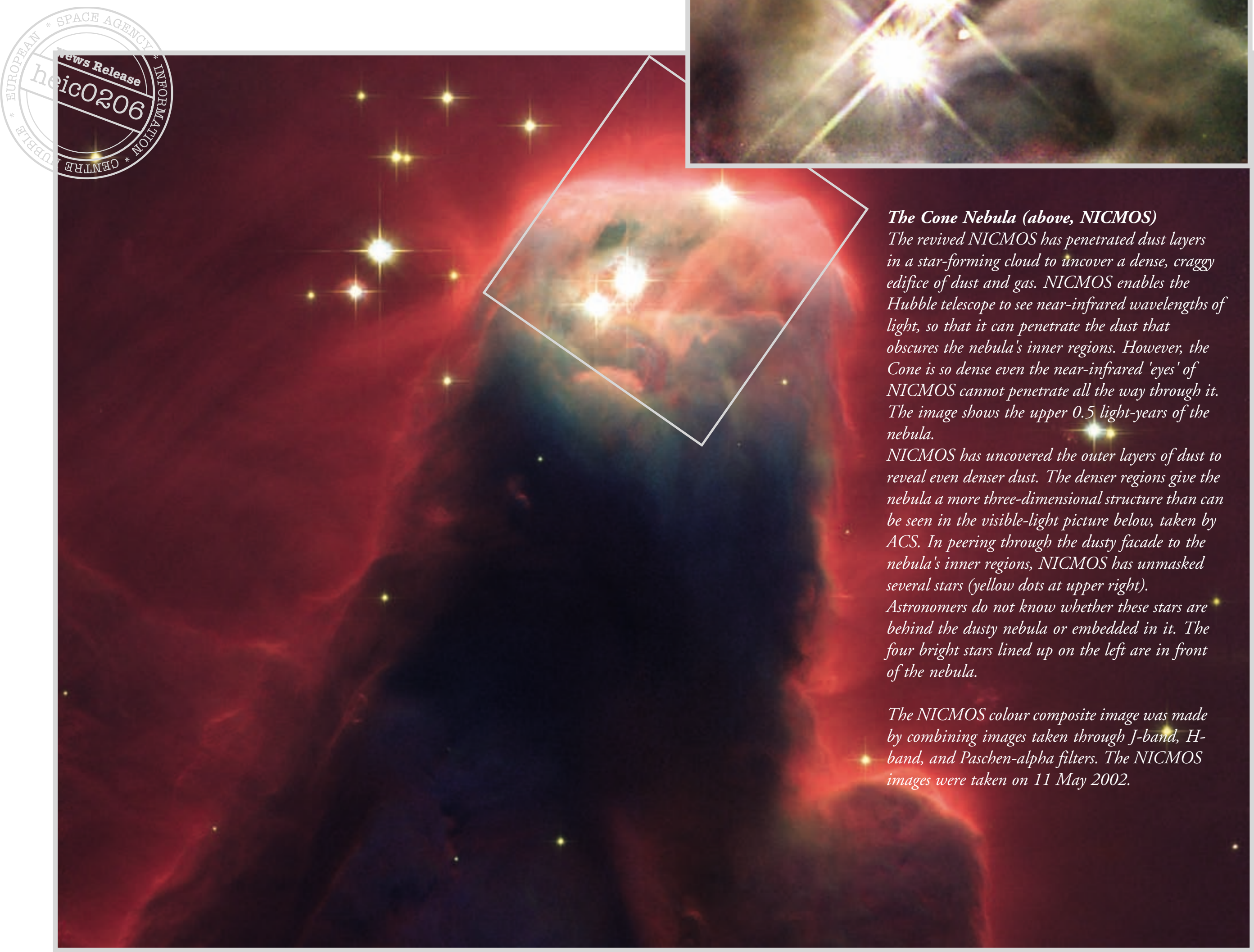
HUBBLE
European Space Agency Information Centre

First Light for ACS and NICMOS after SM3B

On 30 April the first Advanced Camera for Surveys (ACS) images were released to the public and shortly afterwards on 5 June the first Near Infrared Camera and Multi-Object Spectrometer (NICMOS) post-Servicing Mission 3B images appeared. Several different objects were on display, and one, the Cone Nebula, was portrayed by both ACS and NICMOS.

Read more at http://hubble.esa.int under “Releases” (heic0206 and 07).

Credit: NASA, ESA, the NICMOS Group (STScI, ESA) and the NICMOS Science Team (Univ. of Arizona)



The Cone Nebula (above, NICMOS)
The revived NICMOS has penetrated dust layers in a star-forming cloud to uncover a dense, craggy edifice of dust and gas. NICMOS enables the Hubble telescope to see near-infrared wavelengths of light, so that it can penetrate the dust that obscures the nebula's inner regions. However, the Cone is so dense even the near-infrared 'eyes' of NICMOS cannot penetrate all the way through it. The image shows the upper 0.5 light-years of the nebula.
NICMOS has uncovered the outer layers of dust to reveal even denser dust. The denser regions give the nebula a more three-dimensional structure than can be seen in the visible-light picture below, taken by ACS. In peering through the dusty facade to the nebula's inner regions, NICMOS has unmasked several stars (yellow dots at upper right). Astronomers do not know whether these stars are behind the dusty nebula or embedded in it. The four bright stars lined up on the left are in front of the nebula.

The NICMOS colour composite image was made by combining images taken through J-band, H-band, and Paschen-alpha filters. The NICMOS images were taken on 11 May 2002.

Credit: NASA, Holland Ford (JHU), the ACS Science Team and ESA

The Cone Nebula (above, ACS)
This object gets its name from its appearance in ground-based images. It is a monstrous dark pillar within a turbulent star-forming region. This picture, taken by the newly installed Advanced Camera for Surveys (ACS) aboard the NASA/ESA Hubble Space Telescope, shows the upper 2.5 light-years of the Cone. The entire pillar is seven light-years long. Radiation from hot, young stars (located beyond the top of the image) has slowly eroded the nebula over millions of years. Ultraviolet light heats the edges of the dark cloud, releasing gas into the relatively empty region of surrounding space.There, additional ultraviolet radiation causes the hydrogen gas to glow, which produces the red halo of light seen around the pillar. A similar process occurs on a much smaller scale to gas surrounding a single star, forming the bow-shaped arc seen near the upper left side of the Cone. This arc, seen previously in Hubble images, is 65 times larger than the diameter of our Solar System. The blue-white light from surrounding stars is reflected by dust. Background stars can be seen peeking through the evaporating tendrils of gas, while the turbulent base is pockmarked with stars reddened by dust. Over time, only the densest regions of the Cone will be left. But inside these regions, stars and planets may be in the process of forming. The Cone Nebula is 2500 light-years away in the constellation Monoceros.

The ACS made this observation on 2 April 2002. The colour image was constructed from three separate images taken through blue, near-infrared, and hydrogen-alpha filters.

SCISOFT

Richard Hook

SCISOFT IV SOFTWARE COLLECTION AVAILABLE

The ESO Scisoft Collection of astronomical software tools is now available in its fourth release featuring updates up to April 2002. More details of this collection appeared in the ECF Newsletter 29, p21 and can be found on the web at http://www.eso.org/scisoft. Unfortunately the collection had to be frozen before IRAF 2.12 and this could not be included.

If you would like a copy of this collection, which is available for Solaris 8, HPUX 11 and Linux, please send an email to scisoft_request@eso.org and let us know the versions you would like and your postal address. If you are currently a Scisoft user please mention this in your email.

HUBBLE
European Space Agency Information Centre

First view of a newborn millisecond pulsar?

Combining Hubble Space Telescope images with radio observations has revealed a highly unusual system consisting of a fast spinning pulsar and a bloated red companion star. The existence of the system is something of a mystery — the best explanation so far is that we have our first view of a millisecond pulsar just after it has been 'spun up' its red companion star.

Although more than 90 specimens of the exotic species of fast-spinning 'millisecond pulsars' are known today, no observations have yet been made to back up the theory of how they reached this state. A series of observations of the millisecond pulsar PSR J1740-5340 and its companion star from the NASA/ESA Hubble Space Telescope and the Parkes radio telescope seem to show the final stage of the pulsar acceleration process for the first time.

The artist's impression (right) shows the pulsar (seen in blue with two radiation beams) and its bloated red companion star.

Read more at ***http://hubble.esa.int*** *under "Releases" (heic0201)*

Credit: European Space Agency & Francesco Ferraro (Bologna Astronomical Observatory)

NGST Documentation from ECF

A repository with a number of European contributions to the NGST project has been created in the ST-ECF web pages. The address is: **http://www.stecf.org/ngst/stecf.html**

At present it contains:

Instrument Science Reports
ISR NGST 2002-01: *Pixels, slits and facets for a MEMS-type spectrograph for NGST*, Santiago Arribas, Peter Jakobsen, Robert A.E. Fosbury, Wolfram Freudling
Appendix: *Extension to different PSF and detector properties*

ISR NGST 2002-02: *The effects of 'on' failures in a MEMS array for the NGST NIRSpec slit and facets for a MEMS-type spectrograph for NGST*, Santiago Arribas, Robert A.E. Fosbury, Peter Jakobsen

ISR NGST 2002-03: *Contrast issues and confusion limits for the NGST NIRSpec*, Wolfram Freudling, Stefano Cristiani, Robert A.E. Fosbury, Peter Jakobsen, Norbert Pirzkal

ISR NGST 2001-01: *Parasitic Light in NGST instruments: the accuracy of photometric redshifts and the effect of filter leaks in the visible and near IR camera*, Stefano Cristiani, Stephane Arnouts, Robert A.E. Fosbury, astro-ph/0106298.

Other Topics:
A trade-off study of the Integral Field (IFS) and Multi-object (MOS) spectrograph concepts in the context of the Design Reference Mission (DRM)

CONTENTS

ST-ECF

Head
Piero Benvenuti
+49-89-320 06 290
Piero.Benvenuti@stecf.org

Science Data and Software
Rudolph Albrecht
+49-89-320 06 287
Rudi.Albrecht@stecf.org

Science Instrument Information
Robert A.E. Fosbury
+49-89-320 06 235
Robert.Fosbury@stecf.org

Public Outreach
(Hubble European Space Agency Information Centre):
Lars L. Christensen
+49-89-320 06 306
lars@stecf.org

The Space Telescope-European Coordination Facility
Karl-Schwarzschild-Str.2
D-85748 Garching bei München, Germany

Website
http://www.stecf.org

Telephone
+49-89-320 06 291

Telefax
+49-89-320 06 480

Hot-line (email)
stdesk@stecf.org

Email
<user>@stecf.org

ST-ECF Newsletter

Editor
Richard Hook, Richard.Hook@stecf.org

Editorial assistant
Britt Sjöberg, Britt.Sjoeberg@stecf.org

Layout, illustrations and production
Martin Kornmesser &
Lars L. Christensen

Printed by
TypeSet, München

Published by
ST-ECF