ST-ECF Newsletter

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This 4-colour image of the Crab Nebula, M1, is constructed from public data taken from the NASA Chandra satellite (violet epresenting X-ray emission), the ESO VLT (green, orange and red representing B-band, Hα and [SII] emission respectively from the FORS2 instrument), and the NASA/ ESA HST (the central part of the green channel from a F547M filter observation with WFPC 2).

Space Telescope European Coordinating Facility

HST news

Jeremy Walsh

Our entry into the second decade of European participation in HST orbital activities has seen a shift in emphasis. The ESA-NASA memorandum of understanding (MOU) had previously included a substantial hardware component in the form of the Faint Object Camera and the Solar Arrays. Although ESA provides a new Solar Array Drive Mechanism to be installed during the next servicing mission (3B), there is no direct instrument contribution to the second decade of HST. Consequently, a diverse suite of products is being provided, two of which are the ECF support of the archives for the decommissioned instruments and the establishment of the *Hubble European Space Agency Information Centre* (HEIC, see later in this Newsletter).

The support for Post-Operational Archives (POA) will include improved calibration and the creation of final archives. The first instrument to be 'finalised' is the Faint Object Spectrograph and the reality of establishing a homogeneous archive for this instrument is described in articles in this Newsletter. The small HST public information group has a service on the Web (http://hubble.esa.int/) to raise the level of European public awareness of HST towards those achieved in the US by the STScI Office of Public Outreach.

Whilst HST has reached maturity, its follow-up project, NGST, is still very much in the planning stage. The past year has seen intense activity on NGST particularly for the instrument package with European groups strongly involved.

Assuming that the new HST/NGST MOU is signed in 2001, European astronomers will continue to enjoy the same level of access to HST in its second decade. The time allocation of Cycle 9 observations, which are just beginning, showed a similar strong level of European participation. With the Cycle 9 allocation, a new category of Large (≥ 100 orbits) proposal was initiated. There was a very healthy input of European Large proposals and two European PI proposals were granted time — one for 111 orbits for nuclear morphology of short period comets and another, a 1200 orbit STIS pure parallel imaging proposal to measure cosmic shear. However, there was a slight reduction in the fraction of orbits awarded to European PI proposals in comparison with previous cycles; this suggests that European proposers are requesting fewer orbits than their US colleagues. The TAC process has some built-in subsidy that ensures that the discipline panels award time almost independently of proposal size over the range 30–99 orbits. Thus there is no basic reason why a well written and argued proposal requesting many orbits should not be as successful as a smaller one.

Following the very successful third HST servicing mission (3A) in December, when HST was revived from safemode by the replacement of all its gyros, the two European astronauts on the Shuttle mission STS-103 — Claude Nicollier, on his second trip to HST, and Jean-François Clervoy — visited the ST-ECF and ESO on the 27th of April. They gave a press conference and stunned everyone present with their superb pictures of HST hanging upside down over the 'Blue Planet'.

Next Generation Space Telescope — European news

NGST

Peter Jakobsen (ESTEC) & Robert Fosbury

At the NGST Science & Technology Exposition, held at Hyannis, Massachusetts in September 1999, the various US, European and Canadian instrument and technology studies were presented. This meeting gave an opportunity to identify pertinent technical challenges and to review the research programmes which had been developed by the *Ad Hoc* Science Working Group (ASWG) during the previous two years and packaged as the Design Reference Mission (DRM).

This all served as input to the succeeding ASWG meetings which culminated, just before the end of the year, in the recommendation to the Project Scientist of the preferred NGST instrument complement. The final recommendation, announced at the January meeting of the AAS, is given in:
`http://ngst.gsfc.nasa.gov/public/configured/doc_610_2/PSreportfinal.pdf`
This is summarised in the box as the basic, minimum three-instrument complement and the additional instruments/modules which were considered highly desirable to restore missing capabilities for the completion of the DRM, at most one of which was likely to be affordable.

During the first half of the current year, two important activities have been proceeding in Europe. At the end of January, the ESA Science Study Team (SST) submitted a proposal to the Agency for the funding of the European contribution to NGST in the form of one of the two announced 'Flexi-missions', F2/F3. All the submitted astronomy proposals were reviewed by the Astronomy Working Group during February as a result of which, NGST was ranked as top priority with the specific recommendation that ESA contribute to the core instrument payload. The next stages in the review process are the scrutiny by the Space Science Advisory Committee in September and the Science Programme Committee in October.

Meanwhile, ESA and NASA have been conducting high-level negotiations in order to determine the nature of the ESA contributions to the project. The provisional agreement anticipates that ESA will provide the NIR Spectrograph covering the 1–5µm range, together with support to the mission for the first two years of operations. A further European contribution to the instrument complement under study is for part of a Mid-IR camera/spectrograph covering the 5-28µm range. The possibility of ESA's member states contributing national funds to this instrument is being actively explored. The division of responsibilities among the partners and the procurement and management philosophy is being examined by the 'Mid IR Instrument Partnership Planning Group' consisting of US, European and Canadian scientists and NGST project/study personnel from the three partner agencies. While no firm decision on ESA's non-instrument related contributions has been taken, one option is a clone of the FIRST spacecraft bus.

As a result of these proceedings, ESA is in the process of commissioning three delta-studies by industry which will run for about seven months and position the Agency for the phase-A studies which would commence during 2001.

The Project Scientists' recommendations for the NGST instrument complement

Ranked, minimum three-instrument suite

1. Visible/NIR camera
   0.6–5µm, 30mas pixels (λ/2D @ 2.4µm), 4' x 4' FOV
2. NIR Multi-Object Spectrograph (dispersive)
   1–5µm, R ~ 1000, 100mas pixels, 3' x 3' FOV
3. MIR camera/spectrograph
   5–28µm, R ~ 1500, 150mas pixels, 2' x 2' FOV

a R~100 spectrographic mode to be included either in the camera or the NIR spectrograph

Small additional instruments/modules with equal ranking

NIR integral-field spectrograph
R ~ 5000, < 100mas pixels, ~ 2" x 2" FOV

Hi-resolution camera
0.6–1µm, ~10mas pixels, 1' x 1' FOV

MIR integral-field spectrograph
5–28µm, R = 3000–5000, 0."15 pixels, ~ 2" x 2" FOV

Post-Operational Archives for HST

Michael Rosa

During November 1998, ESA and NASA agreed to continue, up to the end of the projected 20 year HST lifetime, the cooperation that guarantees European astronomers a minimum of 15% of the observing time until 2001. ESA's contribution during this period consisted of hardware: principally the Faint Object Camera, two sets of solar arrays, and the provision of scientific support staff at the STScI. The refurbishments planned for the second decade do not include a substantial hardware contribution which could be provided by ESA. Therefore, the continuation of the European contribution will comprise products which support the operation. These include a deeper and two colour version of the guide star catalogue (GSCII), the provision of European public outreach and projects which enhance the scientific value of the data archives. The ST-ECF has been charged with major contributions in all three of these areas. This article describes one of them: the production of Post Operational Archives (POA) for the decommissioned ('legacy') HST instruments.

Legacy instruments and their archives

During the operational lifetime of HST, there are servicing missions during which scientific instruments (SI) are replaced with new or refurbished ones. The archive of data produced by each SI can be quite heterogeneous in terms of its calibration, the content the data headers and documentation. During the operational phase of an SI, the pipeline is restricted to the use of calibration reference data obtained prior to the scientific exposure in question, typically by a few months. Upgrades to the pipeline resulting from new insights into the instrument's performance were not usually applied retroactively. Although the recalibration with more appropriate reference data—usually obtained closer in time to the science observation—is the recommended way of working with archival data, the recalibration of individual data sets on demand does not necessarily achieve the goal of a homogeneously calibrated instrument archive.

After the decommissioning of an SI, its archive can be examined in its entirety and a global view of the calibration can be attempted. The calibration observations at any given epoch are always sparse due to the limits imposed on non-scientific HST observing time. Using all calibration data obtained during the operational phase in combination with preflight data enables a much deeper insight to be obtained. It also provides the opportunity to model long-term effects in a continuous rather than a step-wise fashion.

The Post-Operational Archive project

The goal of the Post-Operational Archive project (POA) is to significantly increase the scientific value of the archived science data of decommissioned HST instruments by a thorough and comprehensive review of calibration procedures and data content. The POA project is the task of the new 'Instrument Physical Modelling Group' at the ST-ECF, an initiative started early in 1999 with hiring completed by October. Florian Kerber has the task of scientific instrument data analyst and Anastasia Alexov is the scientific software systems specialist. Paul Bristow, as the scientific archive software specialist, is mainly responsible for the archive, documentation and web-based user interfaces. Our home page can be found at:
`http://www.stecf.org/poa`
With a staff of four we cannot possibly re-invent the pipelines, data structures and documentation for all HST instruments while simultaneously striving to improve the scientific value of the archives. Instead, the pragmatic strategy is to tackle obvious inconsistencies in the current calibration, providing solutions within the existing software and data environment. To the user, these will appear as upgrades to the pipelines and products currently provided by the STScI. Retrieval of archival data, software and documents for POA items, through either the STScI or the ST-ECF archive, documentation and user support systems, will default to these new products. The generic form of delivery of POA-recalibrated data will be through the ST-ECF 'On-the Fly' (OTF) mechanism.

HST users are aware of many shortcomings in the treatment of data by the pipelines, in the data themselves and in the associated documentation. Since the aim of the POA is to enhance the scientific value of the archive of a particular instrument, the group concentrates its forces on those problems that actually or foreseeably put in question the veracity of the scientific results. This is particularly important from the viewpoint of the archival researcher who does not have the background information available to the original observers. To assist in the classification of these issues we have remodeled a scale used originally for meteoritic impacts, replacing eg, 'global catastrophe' with 'certain damage to the majority of data'. The scale can be viewed on the POA website.

Schedule

The first SI archive to be analysed and recalibrated is that of the Faint Object Spectrograph (FOS), consisting of 24,000 exposures of which about 17,000 are science spectra. The work is based on the long history of experience with the FOS at the ST-ECF, including the corrective algorithms for scattered light and wavelength zero-points. Work is in progress on a substantially improved wavelength calibration which will be available through OTF recalibration in the summer of 2000. This initial release will be followed by similar improvements of the flux calibration to be finalised during 2000. The algorithms and supporting data are based largely on physical instrument models, for example the spectrograph ray trace model including the S-distortions in the Digicon tubes, an electron optics model of the Digicons (to correct for the geomagnetic field induced image motion) and a thermal model of the spectrograph optical bench and environment. The accompanying article describes the improvement in the FOS wavelength zero point, a result which was possible only with a post-operational archive.

The next instrument planned for the POA project will be the Goddard High Resolution Spectrograph (GHRS). Many of the models can be adapted straightforwardly from FOS. GHRS, however, recorded only one echelle order at a time, hence there is very little information in the archival data that can help to deal properly with the inter-order stray light. This problem is amenable to modelling using the generic echelle spectrograph photometric model, developed in collaboration with ESO, for use primarily with STIS, currently on HST, and UVES, the high resolution optical spectrometer on the ESO Very Large Telescope (VLT).

Later in 2000, the choice will have to be made for the third instrument to be tackled, followed by another in 2002. An advisory board will make recommendations based on the insight of experts from the HST project and the user community. The candidate instruments are the Faint Object Camera (FOC), any of the two versions of the Wide Field Planetary Cameras (WFPC1, 2) and NICMOS (prior to cryogen exhaustion at the end of 1998). It is important that users who have detailed experience of the calibration status of these instruments, through scientific use of the data, make themselves known and heard. We appreciate any comment on this matter from the community, as it will not only help in making the appropriate choices, but also in the reworking of the calibration of these instruments.

Outlook

It is obvious that any bug fixed, algorithm improved or header data issue resolved will benefit the calibration system (data, software and documentation) as maintained at STScI. This benefit applies not only to the legacy instruments, but also to instruments operating now or in the near future. Also, by making extensive use of the predictive power inherent in calibration strategies employing physical instrument models, we will be able to establish paradigms for the treatment of data from future instruments.

As an example, it now seems quite possible that the largely improved overall calibration of FOS, combined with up-to-date models of white dwarfs, will set new benchmarks for spectrophotometric standards in the 115 nm to 800 nm wavelength range. Similarly, the physical model-based methods of wavelength calibration have repercussions on the wavelength table entries currently forming the basis of the classical methods. It is well known that many 'laboratory standards' have quite a mix of accuracy in the UV wavelength region. Improved instrumental calibration can lead to flagging of close line bends and thus the establishment of more reliable wavelength line lists. Last but not least, the insights gained into instrumental characteristics, in combination with less empirical but more physical methods of calibration, will benefit the scientific exploitation of future instruments such as are planned for NGST.

Rectification of FOS wavelength scales

Florian Kerber & Michael Rosa

A status report on the ST-ECF Post-Operational Archive (POA) project to re-calibrate all Faint Object Spectrograph (FOS) data is presented. As a first step we have investigated the internal zero-points of the FOS on-orbit wavelength calibration between 1990 (launch) and 1997 (decommissioning). The analysis is based on more than 3,000 calibration and science exposures. For the FOS/BLUE channel, systematic shifts of the zero-points are present which amount to a maximum offset of 7 pixels (350 km sec^{-1}) over the instrument orbital life. In contrast, the zero-points for FOS/RED modes present an apparently random distribution with the same peak-to-peak range of 7 pixels. Both problems cannot be accounted for by mechanical or thermal instabilities, but have been traced to the influence of the geomagnetic environment of the spacecraft. A new version of the pipeline will be made available and used for a complete re-calibration of the FOS science archive.

Introduction

Calibrating astronomical data from instruments on spacecraft is complicated by the fact that only a small fraction of the time can be used for dedicated calibration exposures. Therefore a 'final' calibration is achieved only after years of operation, or even after the end of an experiment's operational life (eg, IUE, IRAS, ISO).

The POA project aims to improve calibrations for the decommissioned HST instruments. The FOS was chosen as the first instrument of the POA effort in part due to the expertise acquired at the ST-ECF since 1984. In order to achieve the comprehensive understanding required for a successful re-calibration of the 17,000 FOS science observations, all of the data are now being subjected to dedicated analyses. So far, the issue found to be most pressing is an unacceptably large uncertainty in the FOS wavelength calibration.

The FOS was designed primarily as a faint object spectrophotometer, with less emphasis placed on highly reproducable velocity measurements. Observers planning to use FOS data for radial velocity studies were advised to obtain their own dedicated wavelength calibration observations in sequence with the science exposures and without aperture or grating wheel movements. In reality, only very few FOS programmes obtained exposures planned in this manner.

According to the instrument specification, the main intrinsic errors in the wavelength scale zero-points reflected the settling of the rotating filter-grating wheel assembly (FGWA), uncertainties in the centering of point sources in the aperture and the offsets between internal (calibration lamp) and external sources. These effects should amount to a total 1σ error budget not exceeding 2 pixels (0.5 diodes or approximately 0.25 resolution elements, cf. HST Data Handbook). The dispersion relations, monitored by calibration lamp exposures, did not directly show any suspicious behavior. Therefore, the original set of dispersion solutions, which were a product of the science verification (SV) activity, was used throughout the entire operational life of FOS as the default in the pipeline calibration.

Nevertheless, during the operating life, indications were accumulating that FOS wavelength scale zero-points might occasionally be considerably more in error than the fractional diode value mentioned above (eg, van der Marel, 1997).

Preparation of data

Usually FOS WAVECAL exposures are analysed by fitting low order polynomial dispersion solutions to the line center catalogues. Such a procedure may not reliably detect zero-point shifts from polynomial coefficients. Therefore, we chose to cross-correlate the raw exposures, taking as templates those exposures used during SV dispersion analysis (cf, CAL/FOS 67) which also defined the dispersion relations throughout the entire life of FOS in the *calfos* pipeline. The WAVECAL analysed cover the whole period between SV (August 1990) and the last on-orbit wavelength calibration observation obtained (December 1996). Cross-correlation of the data sets for all high resolution modes yields a very clean peak which can be positioned to better than 0.1 pixel (3σ) using Gaussian profile fitting.

We also prepared a sample of suitable scientific exposures for a complementary analysis. For this purpose we chose narrow emission line spectra (ie, H II regions and PNe) and extracted about 100 high S/N spectra from the archive. These data come from 15 different objects covering three different gratings (G400H, G570H, G780H), a number of apertures and a wide time span. Again, we used cross-correlation to derive the zero-point shift of the wavelength scale. We specifically built templates from the superposition of Gaussian profiles located at the laboratory wavelengths for all relevant lines in the observed spectra. With this approach, an accuracy of better than 0.1 pixel was achieved. The zero-points obtained were corrected for Heliocentric motion and the radial velocities of the targets taken from the literature. For extragalactic sources we adopted the values from the 'Third Reference Catalogue of Bright Galaxies' (de Vaucouleurs et al., 1991). Usually, the error margins for the sum of these corrections are between 5 and 30 km sec^{-1}. This is the largest source of uncertainty in the analysis of the scientific data set. For this reason we did not correct for the orbital motion of the HST.

Quick analysis

For the analysis, we broke down the samples according to detector, grating and aperture, and plotted the zero-point shifts of the WAVECALS versus the Modified Julian Date (MJD) of exposure start. This comprehensive view revealed substantial shifts for all FOS dispersers.

All of the FOS/BLUE dispersers show a very similar and conspicuous pattern with time (Figure 1). At any given epoch, the peak-to-peak scatter of the zero-point offset about the mean trend is approximately ±1 pixel (ie, 10 times the measurement error). The general trend amounts to an average drift of 0.75 pix yr^{-1} with respect to the zero-point of the pipeline wavelength scale for each disperser. An observation in Cycle 6 therefore might be off by more than 5 pixels from nominal (~300 km sec^{-1} for the high resolution dispersers, ~1400 km sec^{-1} for low resolution G160L and ~4000 km sec^{-1} for the little-used G650L).

Due to the apparent similarity in the pattern for all blue

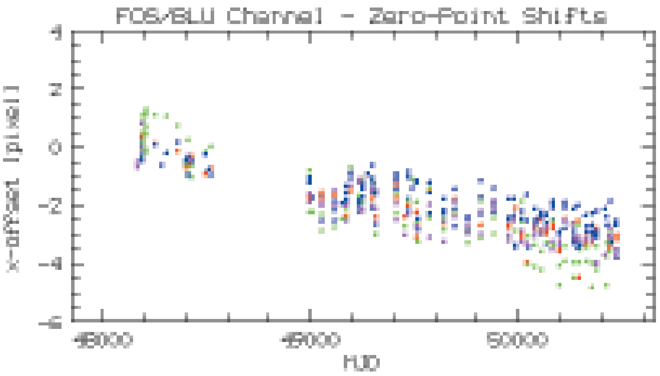

Figure 1. Zero-point offsets (in pixels) of the wavelength scale for high-resolution modes on the FOS/BLUE side as a function of time (Modified Julian Date). Different colours denote the various high-dispersion modes. Note the nearly linear trend and the segregation into 3 epochs, namely the time before on-board GIMP correction, the short period before SM 1, and the long timespan with on-board GIMP after CO-STAR installation during SM 1.

dispersers we combined all FOS/BLUE high-resolution and G650L grating data into a common dataset, depicted in Figure 1. This was done iteratively. A full combination, very similar to Figure 1, was used to define three windows in time within which the data appear to follow different linear trends.

Interestingly, the boundaries of these windows coincide with the start of SV, the activation of on-board GIMP correction, the installation of COSTAR and the decommissioning of FOS. The gap between MJD 48,500 and 49,000 corresponds to the epoch where the geomagnetically-induced image motion problem (GIMP, see also below) was known, but before on-board correction became available. No FOS data were taken during this period. An empirical solution to the problem is rather straightforward: linear regressions were fitted to the data in these three windows, and were subsequently used to renormalise the shifts for each grating/aperture combination. The renormalisation usually was less then 0.2 pixel, for all but two gratings. This fix was made available in late 1998:
`http://www.stecf.org/poa/FOS/fosbl_wcorr.htm`
For a detailed description see CAL/FOS 149.

At first glance the data for the red side (Figure 2) appear to present a scatter-diagram with no obvious trends in time and with a full peak-to-peak range of about 6 pixels. A simple quick fix as provided for the blue side did not seem possible.

Detailed analysis

In preparing a refined version of the FOS POA, a proper analysis and corrective measures based on physical models is

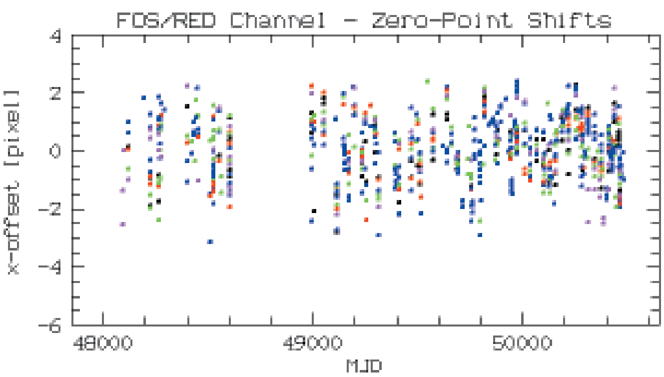

Figure 2. Zero-point offsets (in pixels) of the wavelength scale for high-resolution modes on the FOS/RED side as a function of time (Modified Julian Date). Different colours denote the various high-dispersion modes. Note the large scatter and the absence of an obvious correlation with epoch.

mandatory. In contrast to the original researcher who could tailor the observations to the scientific goals, such as bracketing the target exposures by WAVECALS for radial velocity studies, the archive reasearcher has no such influence on the data taking strategy. Consider for example a project to study velocities of emission lines in the sample of all AGNs ever observed with FOS. Even if the intrinsic width of the emission lines is around 1000 km sec^{-1}, a systematic, non-random error of the zero points of order 300 km sec^{-1}—as exists in the current version of the FOS archive—will seriously degrade the results. Therefore, the wavelength scale zero-point problem has been rated with a severity value of 6 on the POA scale:
`http://www.stecf.org/poa/images/poascale200.jpg`

The behavior of the FOS/RED and /BLUE channel wavelength zero-points are dramatically different, whereas the optical and mechanical layouts of the two channels are identical. Hence, the error is most likely to be associated with the detectors themselves. In particular, those parts of the system shared by both channels, eg, the apertures and the gratings, can be excluded as the cause of the scatter. The one known major difference between the two detectors is a factor of ten less efficient magnetic shield for the red Digicon. The lower shielding results in an imprint of the geomagnetic environment on the electron optics inside the Digicon. The related geomagnetically induced image motion problem (so-called GIMP) had been identified some time after launch, and a corrective procedure has been applied on-board to all observations from April 1993 (cf, CAL/FOS 098).

The secular trend in the blue channel may therefore be related to a slow magnetization of a near ideal mu-metal screen, while the red side Digicon data might suffer from a problem related to the on-board GIMP compensation. Unfortunately we found the on-board flight software to have been incorrectly implemented, leading to an artificial increase of the image motion for a substantial fraction of the observations. In the course of this investigation we therefore developed our own (POA) GIMP correction algorithm, which has been demonstrated to successfully correct data sets obtained prior to the on-board patch to better than a small fraction of a pixel. The residuals to be expected from a particular sequence of observations during half of an HST orbit with the flight software (FSW) algorithm are compared with the POA algorithm in Figure 3.

Additional insight is gained by analysing the science observations, since these were ‘pointed’ and obtained in only the ‘science’ parts of orbits, whilst the WAVECAL were mostly obtained during earth occultation. In Figure 4 the

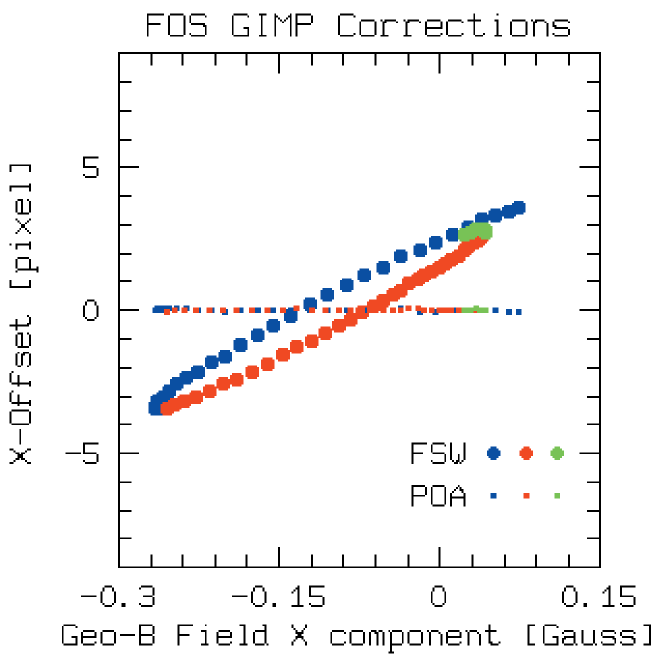

Figure 3. Comparison of the residual zero-point shift after a GIMP correction has been applied to a continuous sequence of observations during approximately half an orbit. The colours depict the location of the spacecraft in 3 of the 4 quadrants in geocentric longitude. In the case of the flight software (FSW) correction, major deviations and a dependency on the x-component of the magnetic field remain, indicating that the GIMP corrections was not successfully implemented. For our new algorithm (POA) the residuals correspond to only a small fraction of a pixel.

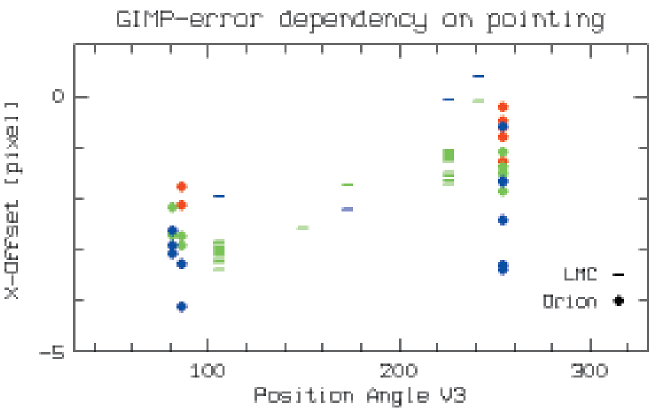

Figure 4. Dependence of the GIMP error on the pointing of the HST for a sample of scientific observations of targets in the LMC and the Orion nebula taken at different dates. Observations in the LMC show a considerably smaller internal scatter but a pronounced linear dependency on the position angle of the spacecraft. Again colours are used to differentiate between different gratings.

offsets of the wavelength scale are shown as a function of the roll angle of the HST for a subsample of science observations performed with GIMP on-board correction. If the on-board correction had worked as intended, there should be only a minimal range of residual offsets (ie, fraction of a pixel) and there should in no case be a dependency on roll angle of the spacecraft.

Corrective measures

At this point it is obvious that, in principle, the way to correct all observations is to first undo the on-board correction and then apply the new POA-GIMP correction. The geomagnetic environment of the FOS detector is directly related to HST's position in orbit and its orientation. Therefore a successful re-calibration not only rests upon correct algorithms, but equally well on the knowledge of the pertinent parameters used for the on-board GIMP procedure in the first place.

An improved *calfos* pipeline that rectifies the wavelength scales as discussed above has already been set up. It is planned to make it available to the community in 2000. The main reason for not releasing it right now is related to evidence that crucial header information (eg, time, ephemeris and pointing) occasionally is inconsistent or incorrect. Once this issue has been resolved the new *poa-calfos* pipeline will restore the accuracy of the wavelength calibrations of all scientific observations to within one pixel. Scientifically this will recover the original specification goal of the FOS and reduce the current uncertainty 300 km sec^{-1} down to the design value of 60 km sec^{-1} for the FOS high resolution modes.

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All referenced Instrument Science reports CAL/FOS are available online at the POA site:
`http://www.stecf.org/poa/FOS/fos_bib.html`

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Hubble's 10th anniversary celebrated at ST-ECF

Lars Lindberg Christensen & Piero Benvenuti

On the 27th of April, Hubble's tenth birthday was celebrated with a press conference and public lectures at ST-ECF in Garching, Munich. On this occasion, which marked the midpoint of Hubble's planned operational life, the Hubble European Space Agency Information Centre was opened, and a retrospective look at the last ten years of outstanding Hubble science was presented.

Present at the celebrations were the two ESA astronauts Claude Nicollier and Jean-Francois Clervoy who have both done outstanding jobs during the Hubble Servicing missions, the ESA Director of Science, Roger Bonnet, and the ESO Director General, Catherine Cesarsky.

ESA astronauts Claude Nicollier (middle) and Jean-François Clervoy (background) hand over a collage of images from Servicing Mission 3A to the ESO Director General, Catherine Cesarsky.

We have all seen and enjoyed the spectacular images and scientific results produced by the Hubble Space Telescope and — more importantly — so have the public. Today, public outreach plays an important rôle in every large scientific project.

In the US there has been a long-standing tradition of public outreach and individual scientists are encouraged to share their results and discoveries with the public. The Hubble project has been exemplary in its ability to bring science to the notice of a wide audience. Among the public there is a general perception, containing a healthy measure of truth, that the beautiful Hubble images represent the fruits of the scientific exploitation of Hubble. The aesthetic appeal of these images has played a major role in the promotion of the 'Hubble brand' amongst the public, and is one of the most important reasons why Hubble has become one of the best known science projects ever.

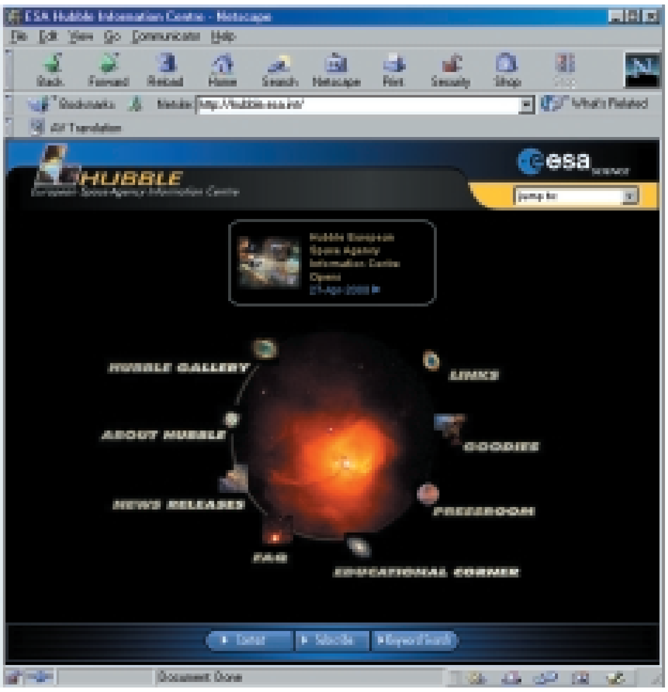
At the midpoint of Hubble's planned 20 year operating life, the European Space Agency (ESA) will, with the help of this 'Hubble-factor', publicise results and images from many European users of the observatory.

As part of a new Memorandum of Understanding between ESA and NASA concerning both Hubble and the Next Generation Space Telescope (NGST), ESA has agreed to fund several new HST-related projects in Europe. One of these is a

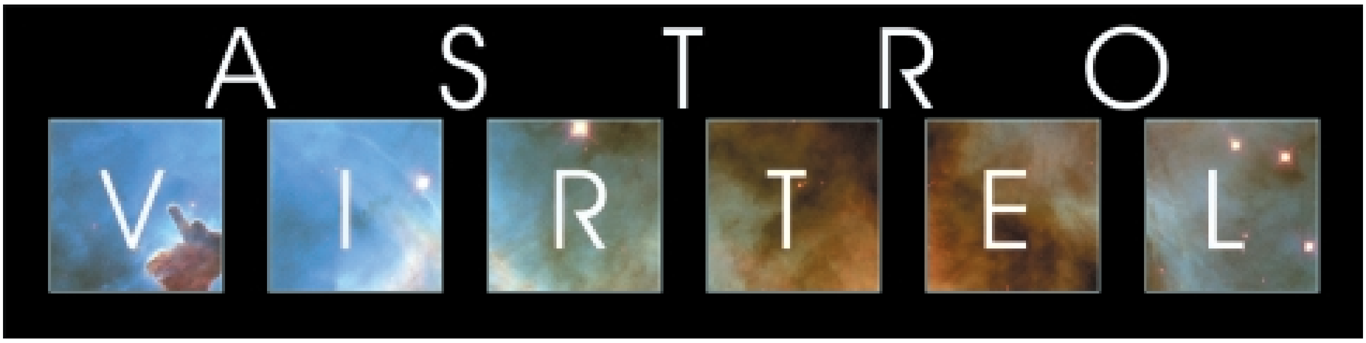
significant effort on public outreach and education in Europe. This work will be carried out in a collaboration between the ST-ECF and the Science Programme Communication Service (SPCS) based at ESTEC in the Netherlands. The Hubble outreach service has been named the *Hubble European Space Agency Information Centre* and will offer many different services and products. The distribution of news, images, videos, educational material, screensavers etc. will mainly be through the website based at ESA Science:
`http://hubble.esa.int/`
Printed material like the recently published NGST leaflet, *NGST – Observing the First Light in the Universe*, or the Hubble 10 year anniversary brochure, *10 Years that Changed our Vision – Europe & Hubble,* is available upon request from the Hubble European Space Agency Information Centre.

We strongly encourage European HST observers having obtained interesting HST results or images to take advantage of our abilities to write popular science stories and to enhance and cosmetically improve images. The European Hubble science deserves to be shared with a wider audience.

Contacts:
`Web: http://hubble.esa.int/`
`e-mail: hubble@stecf.org`



The entrance web page of the Hubble European Space Agency Information Centre.



The Science Archives of the major Observatories are becoming more and more uniform both in the quality of the data they contain and in the user interface through which they are accessible on the web. The quantity of data that are becoming available in this way is staggering. For example, the ESO/ST-ECF Archive currently contains more than 7 TB of scientific data obtained with the ESA/NASA HST, with the ESO NTT, VLT and with the Wide Field Imager on the ESO/MPI 2.2m Telescope. The growth rate is 4.5 TB per year with an anticipated increase to 6 TB per year within the next two years.

In addition to 'public' data arising from General Observer programmes whose one-year proprietary period has elapsed, the HST and ESO Archives contain some large datasets resulting from programmes approved with a reduced or zero proprietary period — this includes 'parallel' data from a second instrument obtained simultaneously with pointed observations by the primary instrument, the ESO Imaging Survey and VLT Science Verification and Commissioning data. Large public datasets are expected to accumulate ever faster during the second decade of HST operations and after operations start for ground-based, wide-field imagers like the VLT Survey Telescope.

In addition, good network connections allow archive users to retrieve data from other active archive centres such as ISO. Intermediate data sets can be staged on fast access, robotic devices. This unique (in size and quality) collection of diversified astronomical data can now be seen as a 'virtual observatory', capable of responding to requirements for observations as if it were a 'real' first-class telescope.

The emerging concept of a Virtual Observatory will be discussed this year at two dedicated Conferences: "Virtual Observatories of the Future", Pasadena, June 13–16, and "Mining the Sky", Garching, July 31 – August 4, the latter being co-sponsored by ESO.

While the characteristics of these future facilities are currently being defined, it is important that the community realises the hidden potential of the current archives and helps to drive the design of the Virtual Observatory on the basis of their scientific requirements. Perceiving this dual purpose of immediate, widespread use of data and guiding the technical development, ESA and ESO have launched the ASTROVIRTEL initiative, a programme funded by the European Commission.

ASTROVIRTEL will support a number (6–8 per year) of competitively selected, genuine archive research projects. The details of the programme can be found on the ST-ECF web pages at:
`http://www.stecf.org/astrovirtel/`
ASTROVIRTEL is just a small step towards the implementation and operation of a more sophisticated Virtual Observatory that will require both a firm commitment by the operators of large telescopes and a substantial funding by a multinational Consortium. Now is the time for the astronomical community to express clearly its opinion on the scientific merit and on the features of such a concept.

Piero Benvenuti

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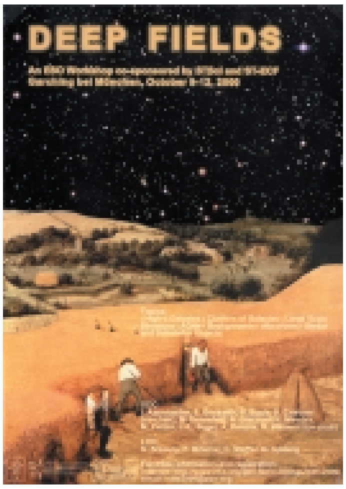
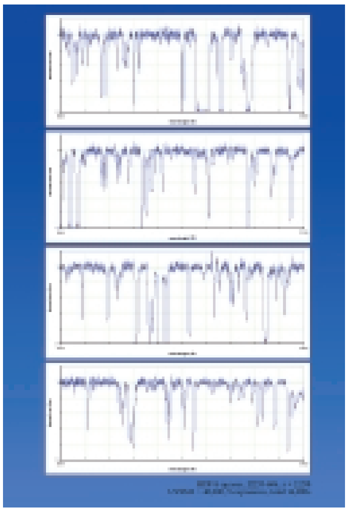
The cover picture, showing a combination of HST, CHANDRA and VLT images of the Crab nebula, was prepared by Richard Hook and Bob Fosbury. Multiple images have been combined using different spectral tints.



ESO/ST-ECF/STScI Workshop on Deep Fields

European Southern Observatory
Garching bei München, Germany
Monday, 9 October – Thursday, 12 October, 2000
See:

`http://www.eso.org/gen-fac/meetings/hdfs2000/`



Spectroscopy of the HDF-S QSO at the VLT

High-resolution spectroscopy (R ~ 45000) of the QSO J2233-606 has been carried out with the VLT UV-Visual Echelle Spectrograph (UVES), during the commissioning of the instrument in October 1999.

These data are publicly available and can be accessed via the ST-ECF website at:

`http://www.stecf.org/hstprogrammes/J22/J22.html`

ST-ECF IRAF package released

The various items of IRAF software, developed in the past few years by members of the ST-ECF, have been released as an IRAF package which can be easily added to an existing IRAF installation. The aim is to increase the visibility of these software products and to support them for wide usage.

Within the **iraf.stecf** package there are four subdirectories offering the latest version of drizzle and tools for tracking drizzle transformations (**driztools**), a new package for reducing and simulating imaging polarimetry data taken with HST instruments or ground based polarimeters (**impol**), two-channel photometric image restoration based on the Richardson-Lucy method and tasks for constructing Point Spread Functions (**imres**) and a directory of applications for post-pipeline processing of NICMOS data (**nictools**).

In addition, a quick-look slitless spectral extraction tool (**slitless**) is also made available. The package is supported by information on the Web and by html-based help files. The package is foreseen as dynamic and already there are plans for new tools for spectral extraction in the next release. See:
`http://www.stecf.org/software/stecf-iraf/`
for details.

We should like this Newsletter to reach as wide an audience of interested astronomers as possible. If you are not on the mailing list but would like to receive future issues, please write to the editor stating your affiliation.

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