July 2001

ST-ECF Newsletter

Space Telescope
European Coordinating Facility

The Double Cluster NGC 1850
The cover image shows the double cluster NGC 1850 in the Large Magellanic Cloud and its rich environment. This view was constructed from HST archival WFPC2 images in B, V, R and I as well as narrow-band Ha imaging of the HII emission, shown in blue.
Image processing by Martino Romaniello (ESO), Richard Hook, Bob Fosbury and the Hubble European Space Agency Information Centre.

*Read more on **http://hubble.esa.int** under "Releases" (heic0108).*

Credit: ESA & M. Romaniello

Editorial

Richard Hook

With this edition of the ST-ECF Newsletter Bob Fosbury is handing over the editorship after producing twenty-eight editions over a period of sixteen years. During this period the Newsletter rose from modest black-and-white beginnings, typeset with TeX, to a substantial publication, elegantly typeset using the facilities of the Macintosh. Bob will continue to be involved with the Newsletter as the main reporter on NGST issues and I am very grateful for his help and advice during the changeover. Another change with this issue is that the graphic design and page layout, formerly also done by Bob, will now be handled by the ECF's capable outreach team, Lars Lindberg Christensen and Martin Kornmesser, who know far more about these things than I ever will.

This issue comes just before a period of major change for HST. Early in 2002 the next servicing mission will not only install the new Advanced Camera for Surveys (ACS) but also revive NICMOS by the installation of a cryo-cooler. Jeremy Walsh summarises the status of the observatory and introduces the new facilities about to become available in the article below. The ACS has several powerful slitless spectroscopy options and the ECF is responsible for their calibration and provision of extraction software. This work is described in detail in this Newsletter by Norbert Pirzkal and the ECF ACS team. The Cycle 11 call for proposals has already appeared and the deadline is 7th September 2001. Details of the call, which includes not only the two new instruments but also new classes of proposal, are given on the back page. Although Europeans are not eligible for funding from NASA for HST archive research there are vigorous new initiatives in Europe in progress or beginning — ASTROVIRTEL and the Astrophysical Virtual Observatory — both funded by the European Commission, which are expressly designed to facilitate efficient exploitation of archives.

One activity that was mentioned back in 1985 in the very first Newsletter was instrument modelling. This work now forms a significant part of the ECF's remit and the Post-Operational Archives group, led by Michael Rosa, reports on the results of a major project to improve the calibration of data from the Faint Object Spectrograph (FOS) in this issue.

In the short-term, the aims of the Newsletter — to inform the European community of ECF activites and update them about the progress of the HST and NGST projects from a European perspective — will not change. The format of its presentation and type of content, with emphasis on technical articles, will also remain. The future will certainly bring a greater emphasis on the Next Generation Space Telescope as the project progresses and final contractors and designs are chosen. We are also looking forward to keeping you informed about the performance of ACS and the progress with the future instruments for HST — COS and WFC3.

I welcome any suggestions or comments about the Newsletter and any ideas for articles or additional content.

HST Status

Jeremy Walsh

HST activity at the time of writing is dominated by Cycle 9 observations with WFPC2 and STIS as the two chief instruments, while FGS performs astrometric programmes. Cycle 10 observations are beginning to be scheduled among those of Cycle 9. Towards the end of April 2001 however, the first of the new batch of gyros, installed in December 2000 in Servicing Mission 3A, showed some rapid increases in current over a period of a few days. This phenomenon is usually attributed to excess friction within the gyro lubricant, a fault which sometimes rights itself. However, in this case, the problem re-occurred with Gyro #5 five days later and HST entered Zero Gyro Sun Point when the gyro current exceeded the safe level. Gyro#2 was brought into the control loop to replace Gyro#5 and normal observations were resumed within three days. This early demise of one of the newly-installed gyros has raised concerns about the long term prospects for these gyros and Gyro#5 may be replaced in the next servicing mission.

The next servicing mission, SM3B, currently scheduled for January 2002, will see HST move from a working three-instrument complement to five with the installation of the Advanced Camera for Surveys (ACS) and the rebirth of NICMOS using a cryocooler. It is expected that the NICMOS detectors can be cooled to about 80K, which, although higher than the operating temperature of around 60K in its solid nitrogen cooled days, will result in only slightly lower sensitivity (the higher dark current being partly offset by higher DQE). ACS, which will occupy the bay currently held by the ESA Faint Object Camera, will bring a many-fold increase in the optical imaging survey capability of HST. The Wide Field Channel (WFC) has a field of 200”x200” and many filters, polarizers and a grism.
In addition to the WFC a High Resolution Channel (HRC) allows imaging with 0.027” pixels over the wavelength range 2000 to 10000 Å. A Solar Blind Channel (SBC) for 1150-1800 Å imaging and slitless prism spectrometry over a field of about 33” is also included in ACS. The ST-ECF has

responsibility for the calibration software for the ACS spectroscopic modes. Progress in this area of work is described by the ECF ACS team elsewhere in this Newsletter. The remaining redundant instrument, COSTAR, will be replaced during the subsequent servicing mission by the Cosmic Origins Spectrograph (COS).

Another and more serious hardware problem occurred aboard HST in June 2001 when STIS experienced a sudden blown fuse in a power supply. The speed of the event meant that diagnostics on the cause were not available from the HST on-board computer. It may simply be loss of a fuse or perhaps a short among wires or connectors. Since the exact cause is not yet established, a simple change-out of the fuse by an astronaut may not correct the problem. As a result it has been decided to transfer to the Side 2 power supply of STIS. This requires a reconfiguration of flight software and STIS will not be available until July or August 2001. The Side 2 power supply currently regulates the instrument temperature so, as a result, STIS will have to be operated without active thermal control. The lack of temperature regulation will mostly affect detector stability but also instrument repeatability. The exact implications for the scheduling of STIS must be awaited.

NGST News

Peter Jakobsen (ESTEC) & Robert Fosbury

Following the NGST rescoping exercise carried out by the project late in 2000 and described briefly in the last issue of this Newsletter, the Interim Science Working Group (ISWG) was asked to consider the impact of a reduced aperture and a slightly warmer telescope on the scientific performance of the observatory. The final report of the ISWG, following a detailed review and reanalysis of the Design Reference Mission (DRM) will be ready towards the end of July 2001.

The current competitive (and hence confidential) Phase A studies running in the US will finish at the end of 2001 and will be followed by a Mission Design Review and the down-select to a single prime contractor early in 2002. The Announcement of Opportunity (AO) for the Near-Infrared Camera will be made in mid-2001 with instrument selection taking place in February 2002.

In Europe, ESA is currently funding four industrial studies related to the NIR spectrograph, which it has undertaken to supply to the Observatory. These are:

- Microelectronic mechanical systems (MEMS)-based NIR multi-object dispersive spectrograph. This type of instrument was the primary recommendation of the initial Ad Hoc Science Working Group (ASWG). The first study contract was awarded to a consortium led by Astrium (Ottobrunn) and Laboratoire d'Astrophysique de Marseille with a second competitive contract being awarded to a consortium led by Alcatel (Cannes) and Laboratoire d'Astrophysique de Marseille.

- In the event that suitable MEMS devices do not become available from NASA in time, a third study covering: "Alternatives to MEMS for slitmasks for a NIR multi-object spectrograph", was awarded to a consortium led by Astrium (Toulouse) and Centre Suisse d'Electronique et de Microtechnique SA (CSEM, Neuchatel) with the Institut für Physikalische Hochtechnologie e.V. (IPHT, Jena).

- Lastly, a study to update the: "Integral field/multi-object spectrograph" concept to supply a spectral resolving power R~1000, led to a contract being awarded to the original Integral Field team, the consortium led by Laboratoire Astrophysique de Marseille and Astrium (Ottobrunn). Final presentations of of all of these ESA Spectrograph studies will take place at the end of September 2001.

Work is in progress with NASA on developing the procedure and schedule for MEMS down-select from the three current US studies, two mirror- and one shutter-based, by mid-2002. This will be by a joint NASA/ESA committee. There will then be a MEMS/no-MEMS down-select by mid-2003 using a procedure yet to be defined. During late-2001, ESA will commence a competitive Definition Phase (Phase A) with the result that one MEMS and one backup solution will be carried forward into ESA Phase B.

For the Mid-Infrared instrument, a steering committee (MISC) has been constituted — with participation from ESA, NASA and CSA — with the task of firming-up the basic instrument requirements. The MISC will meet in Edinburgh on the 16/17 July and its conclusions will be evaluated by the ISWG shortly thereafter. This will result in coordinated NASA and ESA definition studies commencing later this year.

Having read about this plethora of committees and studies, the reader will be forgiven for asking: "So, finally, who builds which instrument?". The scheme that emerges is:

N**ASA:** The NIR camera, with some contribution by CSA. Leadership, detectors and system responsibility and integration for the MIR instrument. The Integrated Science Instrument Module (ISIM), which provides the basic infrastructure and services for all the instruments.

ESA: The NIR spectrograph (with detector and MEMS arrays supplied by NASA in return for a solid-H cryostat for the MIR instrument).

ESA Member States (through national contributions): Optics, structure and mechanisms for the MIR instrument.

CSA: Guiding system for the science instruments. Some components for the NIR camera.

The Astrophysical Virtual Observatory

Piero Benvenuti

In the summer of 2000 the ST-ECF, on behalf of ESA and ESO, announced the opening of ASTROVIRTEL, a programme financed by the European Commission to support the scientific exploitation of astronomical archives. ASTROVIRTEL (**http://www.stecf.org/astrovirtel**) has rather limited resources and can only support a small number of research projects per year. However, it was not intended to be a stand-alone initiative, rather it has to be seen as a first step towards the construction of a more ambitious and rich "Astrophysical Virtual Observatory". Indeed ASTROVIRTEL has the dual purpose of raising awareness in the community of the ever increasing wealth of unexploited astronomical data that are available in the archives of space and ground observatories and also to give us clear indications, based on actual research projects, of the requirements for the design and implementation of tools and procedures that can "mine" archives efficiently and successfully.

The first cycle of ASTROVIRTEL proposals, now close to its completion, has already provided some useful hints as to which browsing tools are needed most and what improvements in the description and quality of the data are desirable. A new tool, QUERATOR (**http://archive.eso.org/querator**), has been implemented following interaction with the scientists participating in the first Cycle. We are confident that the second Cycle will give us additional interesting directions to follow in the construction of the Virtual Observatory.

A consortium of European organizations and institutes submitted a proposal to the European Commission in February 2001 for the design and implementation in three years of a pilot (or Phase A) Astrophysical Virtual Observatory, AVO, the next step beyond ASTROVIRTEL. The proposal, which is led by ESO and has ESA/ST-ECF, CDS Strasbourg, Terapix IAP Paris, UK Astrogrid Edinburgh and Jodrell Bank as co-proposers, has been accepted and will begin its activities over the next few months.

In designing the AVO proposal we realised that, while the merit of improving the capability and efficiency of exploitation of the existing archives is indisputable, the definition of what exactly AVO should provide as a scientific facility is much less clear and it is open to various interpretations. By its very nature an AVO is a multipurpose, as well as a multi-wavelength, observatory and it is therefore rather difficult, if not dangerous, to establish *a priori* what its "Science Reference Mission" should be. We therefore decided that, instead of attempting to build the "final" AVO on the basis of well defined, but possibly limiting requirements, we should proceed incrementally, always keeping actual research cases in sight and solving the most urgent and obvious problems in a structured and scalable fashion. In this way the AVO can begin to serve the scientific community at a very early stage and its expansion, both in terms of additional data and tools, will be constantly guided by scientific requirements.

The AVO proposal envisaged three areas of activities: AVO science, archive interoperability and technological infrastructure. As described above, the science activity will distill the scientific requirements from ASTROVIRTEL and similar multi-archive based research projects. It is likely that ASTROVIRTEL will be merged naturally into the AVO and the AVO science activity already includes the design of the operational or phase B of the project. In particular it will define the different ways in which the AVO can be accessed: either as an open on-line facility, similar, but much more powerful than the current individual archives, or as a controlled infrastructure that gives access and support (possibly with dedicated funds or specialized assistance) to large projects that are selected via a standard call for proposals. The activity in the area of archive interoperability will tackle the most obvious current obstacles to an efficient and uniform access to data archives which are different in both wavelength and physical location. Standards for interoperability will be defined, implemented and tested on the data holdings of the AVO participants. It is important to note that participants in a similar US initiative, as well as other European institutes, are in close contact with the interoperability AVO activity, which is led by CDS Strasbourg, and will effectively contribute to the definition of standards that eventually are to be followed by a large number of archives and data centres. The third activity is the testing of the new technologies that will become operational when a fully fledged AVO is offered to the community. These include the GRID paradigm: the proposed set of new web standards, new data storage technology that can stand the impressive increase in the data flow of the new observatories and the implementation of algorithms that are able to operate efficiently on large distributed databases.

It is our intention to keep the community constantly informed about the evolution of the AVO and to stimulate an active interaction and collaboration with the potential users. A dedicated AVO web portal is being prepared which will be announced and reachable via the ECF and ESO webpages. AVO, in particular its science, will be presented and discussed during a specific session at the next JENAM meeting (Munich, September 11-15, 2001) and at the ADASS XI meeting (Victoria, Canada, Sept 30-Oct 3, 2001). A conference dedicated to AVO, co-sponsored by ESO, ESA, US NSF and others, is being organised for spring 2002 in Munich and it will be widely publicised. We encourage all of you to use these opportunities to express your views on the AVO and help us to shape it into a competitive new scientific facility. Comments and suggestions can be directed by e-mail to:
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ASTROPHYSICAL VIRTUAL OBSERVATORY

Extracting ACS Slitless Spectra With aXe

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INTRODUCTION

The installation of the Advanced Camera for Surveys (ACS) in HST during the next servicing mission will introduce new and powerful slitless spectroscopy options to HST users. The ECF realised early on that new slitless spectroscopy extraction software would be needed to facilitate the use of this new instrument and that such software could build on experience already obtained in handling NICMOS slitless spectra. As part of a project level agreement between ST-ECF and STScI, the ST-ECF is committed to providing lifetime support for the ACS spectrometric modes. This involves the development of software for the routine extraction of spectra from ACS direct and grism/prism pairs, the wavelength and flux calibration of extracted spectra, the provision of the calibration files required to calibrate ACS spectral modes, support for the ACS spectral mode ground calibration, support for the SMOV tests for the ACS spectral modes, monitoring the performance of the ACS spectral modes and finally, the provision of user support and documentation at the ST-ECF. Here we give a brief overview of a few key aspects of this new slitless spectroscopy extraction software, which we have named aXe. Particular emphasis is given to the algorithms used and their implementation. Examples are also presented.

THE ACS SPECTROSCOPIC MODES

The ACS is due to be installed in HST in January 2002. It will provide HST with three new imaging modes and both grism and prism slitless spectroscopy capabilities (Suchkov et al. 2001):

■ The Wide Field Channel (WFC) has a field of view of 202”x202” with a pixel size of 0.05”. The detector consists of two 2048x4096 CCDs which are sensitive to wavelengths ranging from 3500 Å to 10500 Å. The WFC can be used together with a grism (G800L) to perform slitless spectroscopy at wavelengths ranging from 5500 Å to 11000 Å. The resulting spectra have a dispersion of 39 Å/pixel in the first order and are approximately aligned with the detector x-axis.

■ The High Resolution Channel (HRC) consists of a single 1024x1024 pixel CCD and has a field of view of 26” x 29” with a pixel size of 0.027”. The HRC is sensitive to wavelengths ranging from 2000 Å to 10500 Å. It can be used with both a prism (PR200L) dispersive element (from 1600 Å to 3900 Å, dispersed size of 150 pixels) and with the same G800L grism disperser as the WFC (from 5500 Å to 10000 Å, 28 Å/pixel, at a dispersion angle close to 38 degrees to the detector x-axis).

■ The Solar Blind Channel (SBC) is a 1024x1024 pixel MAMA array (a STIS spare) providing a 31” x 35” field of view with a pixel size of 0.032”. It is sensitive to wavelengths between 1150 Å and 1800 Å. The SBC is also equipped with two prism dispersing elements (PR110L and PR130L) which can be used from 1150 Å to 1800 Å and 1250 Å to 1800 Å respectively (with a dispersed size of approximately 100 pixels and a highly non-linear dispersion).

The ACS optical design results in very significant distortion which will affect both direct imaging and slitless spectroscopy. In addition, each of the spectroscopic modes have individual features which will have to be dealt with during the spectral extraction phase. Examples include the large format of the WFC detector (each pipeline reduced WFC dataset is expected to have a size of 168 Megabytes) and the relatively low dispersion of its grism, which will result in a very large number of spectra in each WFC G800L exposure (Figure 1). The HRC on the other hand, while having a smaller field of view and a larger dispersion than the WFC, disperses grism spectra at an

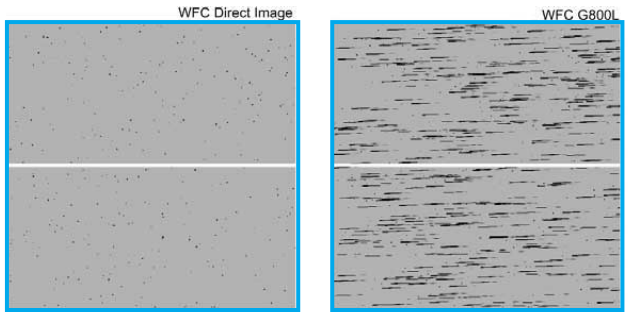
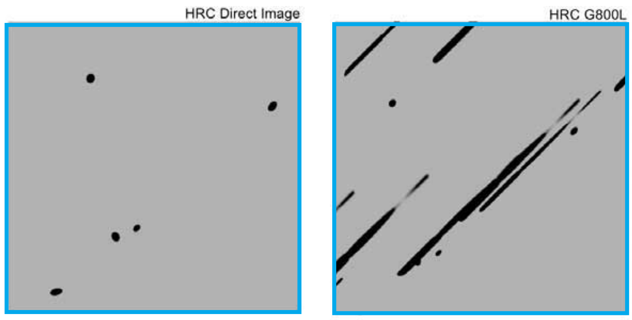


Fig 1: *WFC geometry: SLIM simulations of a direct and a grism (G800L) ACS Wide Field Camera observation.*

angle inclined diagonally to the pixel grid (Figure 2). Finally, HRC and SBC slitless prism modes will produce spectra with a highly non-linear dispersion that will require a particular treatment of their wavelength calibration (Figure 3). These factors combine to make currently available extraction software less than optimal for ACS, so the decision was made to develop software that would be specifically designed to deal with these challenges.



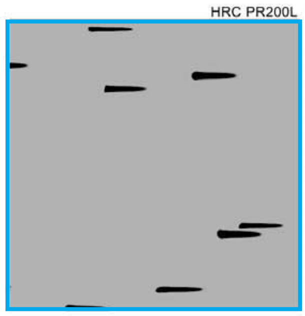


Fig 2: *HRC geometry: SLIM simulations of direct, grism (G800L) and prism (PR200L) ACS High Resolution Camera observations.*

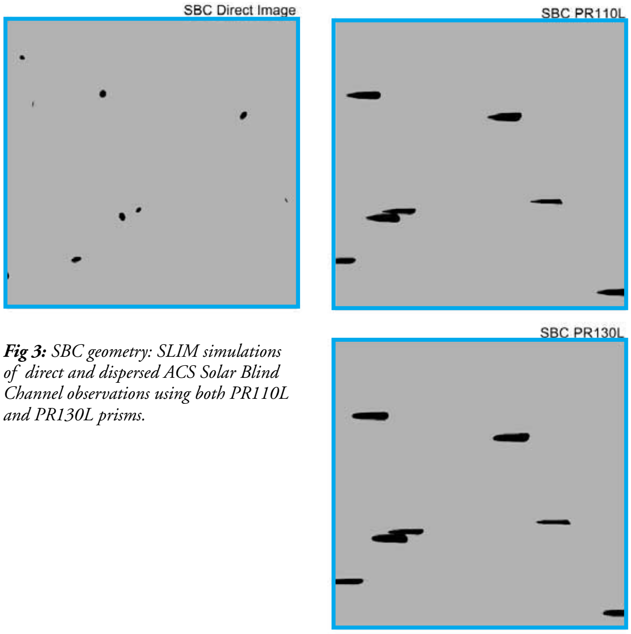


Fig 3: *SBC geometry: SLIM simulations of direct and dispersed ACS Solar Blind Channel observations using both PR110L and PR130L prisms.*

ALGORITHM DESCRIPTION

The aXe software was designed to extract spectra in a consistent manner from all the slitless spectroscopy modes provided by the ACS. aXe comprises a set of libraries containing C-level functions to perform the extraction process together with stand-alone programs that can be used in sequence to produce extracted spectra. This results in an extraction process that is decomposed into well isolated steps which can be individually applied and tweaked by the user (Figure 4). These tasks communicate through a set of user-readable configuration files and produce output which may be directly modified. The core of the software package is written in ANSI C and is highly portable from one platform to another. aXe uses the third-party libraries CFITSIO, PGPLOT, GSL and WCSLIB which have been used successfully under both Linux and Solaris.

The advantage of using separate tasks to perform the extraction process is that it allows one the option of implementing each task in several ways without affecting the entire extraction process. For example, a different background estimator could be devised once more knowledge is gained about the instruments, or a different flux calibration of the extracted 1D spectra, and so on.

Aperture File

The extraction process is designed to start from a pair of pipeline calibrated direct and grism images. The grism image is assumed to not be flatfielded since flatfielding is a wavelength dependent operation which first requires that each pixel be assigned a wavelength. The direct image is used to determine the position, size, and orientation of objects in the field and to select which objects to extract from the grism image. An Aperture File is produced at this point. This file contains a set of apertures (one per object), each potentially containing more than one "beam" (used to handle multiple dispersion orders such as in the case of the ACS grism modes). The aperture/beams of each object are, in essence, the coordinates of quadrilaterals containing the pixels to be extracted and combined together to form each object's spectrum/orders. In addition to these, each aperture/beam in the Aperture File also contains the coordinates of a wavelength Reference Pixel, as well as an analytical spectral trace description $P(\Delta x)$. The spectral trace description is a second degree polynomial that allows Δy to be computed as a function of Δx along the pixel row direction with respect to the Reference Pixel. This function is determined *a priori* using calibration data, but can in principle be refined in the case of a spectrum with strong continuum by performing a trace of the spectrum in the grism/prism image. Since each aperture/beam contains its own $P(\Delta x)$, field dependence of the dispersion relation can be accounted for here.

The Pixel Extraction Table

During the extraction process, information about each aperture/beam is stored in a FITS binary table called the Pixel Extraction Table (PET). It is this table which is read and manipulated by many of the aXe tasks. When initially created, this table contains little more than the information originally available in the grism/prism image: basic pixel positions and counts for each aperture/beam to be extracted.

Adding information to the PET

The distances from each pixel in each aperture/beam to the spectral trace and the quantity $x_{i,j}$ shown on Figure 5, are now added to the PET. We compute, using $P(\Delta x)$ and the orientation α of the object in the direct image from the aperture file, the projection of the centre of a pixel at (i,j) onto the spectral trace. This allows the computation of the distance from the centre of the pixel to the intersect, as well as the path length $x_{i,j}$ (in pixels, computed analytically using $P(\Delta x)$) along the spectral trace function from the Reference Pixel to the intersect point. Each pixel in an aperture/beam in the PET is therefore assigned a value of the distance $d_{i,j}$ and of the path length $x_{i,j}$. Wavelength calibrating each pixel of the PET is then a matter of applying a wavelength dispersion function, $\lambda = f(x_{i,j}) + \lambda_{ref}$ to this pixel. λ_{ref} is the known wavelength of the Reference Pixel in the aperture/beam containing the pixel (with respect to which x is measured along the spectral trace $P(\Delta x)$) and $f(x_{i,j})$ is a polynomial, determined *a priori* for each prism/grism mode using calibration data. This function can be field dependent.

Additional Steps

Further steps of the extraction process can be performed separately using the aXe programs shown in Figure 4. They include the computation of the background for each aperture (aXe_BACK), the subtraction of this background estimate from the PET (aXe_BACKSUB), the flatfielding of the counts in the PET (aXe_FF), as the wavelength of each pixel has been determined, the construction of one-dimensional spectra using the information contained in the PET (aXe_MKSPC) and finally the flux calibration of the extracted, wavelength calibrated spectra (aXe_FCAL).

The geometry required to convert the contents of the PET to a set of one-dimensional spectra is shown in Figure 6. The method we use accounts for the geometrical rotation of the square pixel with respect to the spectral trace and appropriately projects each pixel onto the trace. To do this we use a weighting function $w(\varepsilon_1,\varepsilon_2)$ that is the fractional area of the pixel which, when projected onto the trace, falls within the bin points ε_1 and ε_2. The flux contained in each

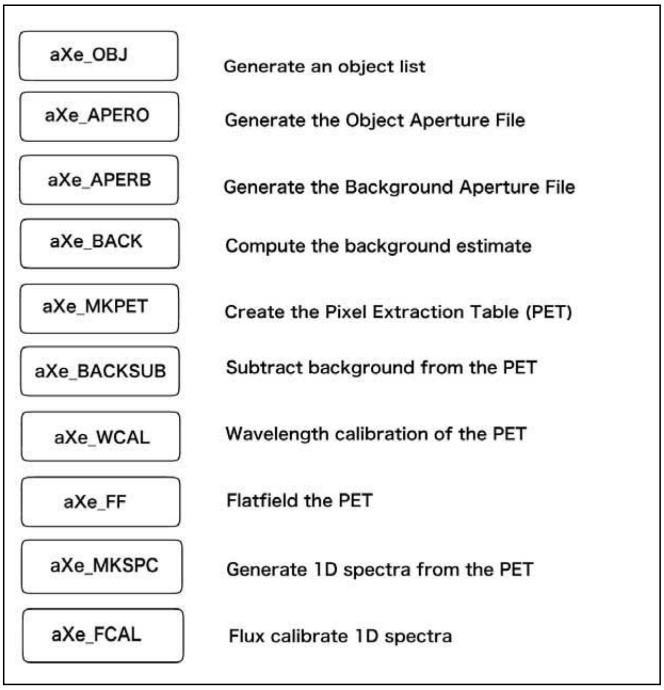


Fig 4: *Task list example: A list of aXe programs in the order in which they are likely to be run by a user when extracting spectra from an ACS direct/ grism image pair.*

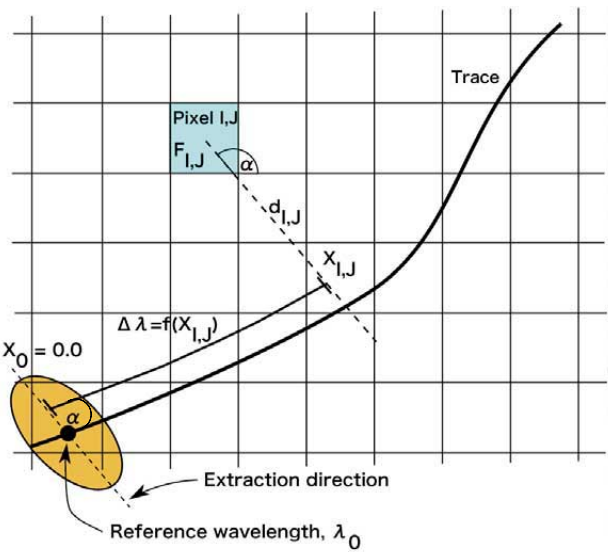


Fig 5: *Wavelength assignment: The method used by aXe to assign a single wavelength to each of the pixels which is within a given aperture. The method can follow an arbitrary direction α with respect to the pixel grid which allows the resolution of the final extracted spectrum to be optimised. In this figure we show α to be the orientation of an extended object.*

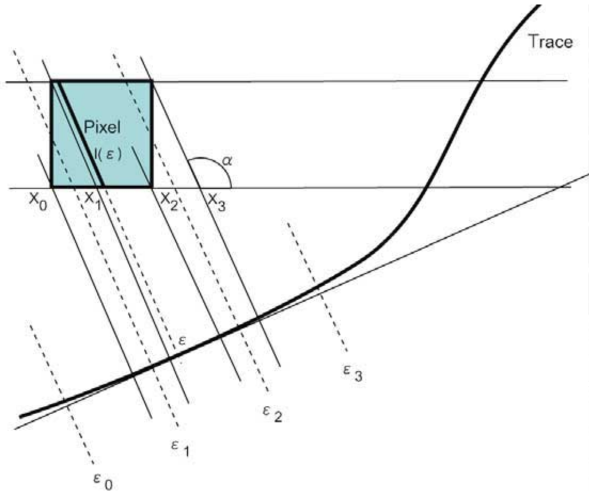


Fig 6: *Binning of the PET: This figure shows the crucial step of creating a one-dimensional spectrum using information from the Pixel Extraction Table. Each pixel in the table is projected onto the trace into separate bins. The number of counts in each pixel is weighted by the fractional area of that pixel which falls onto a particular bin.*

aperture pixel is weighted by this weighting function as it is projected onto separate bins (ε_0 to ε_1, ε_1 to ε_2, and ε_2 to ε_3 in Figure 6) along the spectral trace. The weight is computed by integrating over the length of the segments $l(\varepsilon)$ shown in Figure 6. The length of these segments is nonzero from x_0 to x_3, reaches a maximum value of $1/\sin(\alpha)$, and rises and falls linearly, such that it can be described by:

$$l(x) = \begin{cases} m(x - x_0) & \text{if } x_0 \leq x \leq x_1 \\ l_{max} & \text{if } x_1 \leq x \leq x_2 \\ m(x_3 - x) & \text{if } x_2 \leq x \leq x_3 \\ 0 & \text{otherwise} \end{cases}$$

$$\text{where } m = l_{max}/(x_1 - x_0)$$

Integration over this function $l(x)$ to compute $w(\varepsilon_0, \varepsilon_1)$, $w(\varepsilon_1, \varepsilon_2)$, and $w(\varepsilon_2, \varepsilon_3)$ is trivial once one has computed $x_0, \ldots, x_3$, which may be derived from simple trigonometry.

Once the one-dimensional spectra have been generated, a known response function for the actual observing mode is applied as the final steps in the flux calibration process (aXe_FCAL). The output product of the aXe extraction process is a FITS binary table containing the set of extracted and calibrated spectra.

EXAMPLES

We have tested the extraction principles described in this article (and shown in Figure 5 and 6) on a set of regression data (point sources and extended objects, all generated using our ACS simulator SLIM, Pirzkal et al. 2001) and have verified that this implementation can be used to extract spectra that are dispersed along a wide range of directions, and moreover following arbitrary extraction angles (as shown in Figure 4).

We have also used aXe to successfully extract ground test ACS data of both WFC (horizontal spectra) and HRC (inclined spectra). Figures 7 and 8 show actual WFC and HRC grism images of an Argon calibration lamp. The HRC spectrum is presented rotated so that it appears horizontal, but the actual extraction was performed using the original non-rotated image. Multiple orders are visible in both images: zeroth, first, and second order in the WFC spectrum, and first and second order in the HRC image. The extracted first order spectra are shown above the respective images. The extraction of both spectra was performed in the direction perpendicular to the spectral trace in order to preserve as much of the spectral resolution of the disperser as possible (Pasquali et al. 2001),

CONCLUSION

We have described how the wide variety of the ACS slitless spectroscopic modes, as well as the challenges which each of them present, has made it desirable to develop new spectral extraction software. The ST-ECF is currently preparing a set of C libraries and stand-alone programs known as aXe to extract spectra from ACS grism and prism images. aXe is currently in development and its initial release is scheduled for late November 2001. However, aXe has already been successfully used to extract real, ground-based calibration ACS data. aXe will be made available on the ST-ECF ACS web pages (**http://www.stecf.org/instruments/acs**).

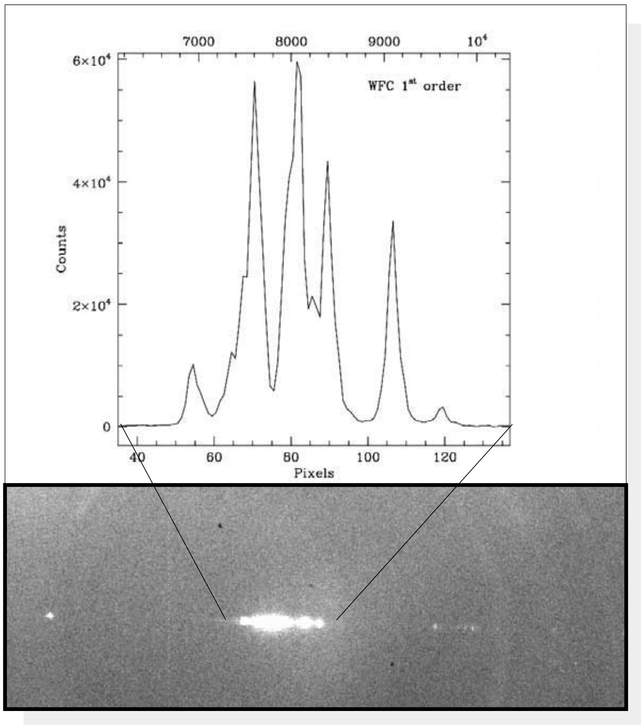


Fig 7: WFC image of a grism observation of an Argon lamp. Multiple orders are visible. The aXe extracted first order spectrum is shown above.

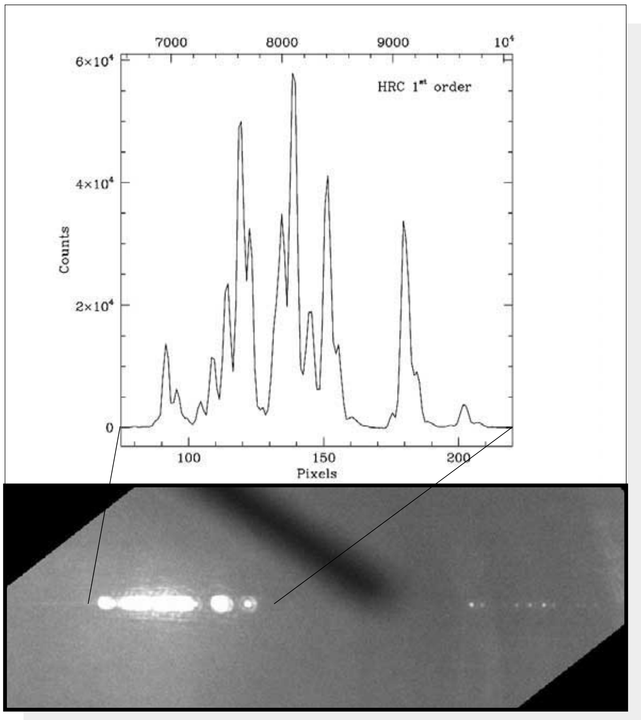


Fig 8: HRC image of a grism observation of the same Argon lamp shown rotated 38 degrees. The aXe extracted first order spectrum is shown above. The difference in resolution between the WFC (Fig. 7) and the HRC is readily apparent.

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FOS Blue-side Spectroscopic Data

Recalibrated by the Post Operational Archive Project

Michael Rosa, Anastasia Alexov, Paul Bristow & Florian Kerber

INTRODUCTION

In summer 2000 we reported on the initial phase of the Post-Operational Archives (POA) Project for HST and on the progress made in understanding calibration issues with data from the first generation Faint Object Spectrograph (FOS) (Kerber & Rosa, 2000). The ST-ECF took up the task of providing, on behalf of ESA under the continued ESA/NASA agreement on HST, improved versions of the calibration and science data from HST instruments. The FOS/BLUE channel was chosen as the first instrument and also intended to demonstrate the validity of the "physical model based" calibration concept (see for example **http://www.stecf.org/poa/gendocs/predforward/index.htm**.

Today we are in the final phase of checking some 11,000 POA-recalibrated FOS datasets from the blue channel (1100 Å to 5000 Å), with a target date of September 2001 for their delivery to STScI and the HST user community. This ST-ECF Newsletter provides us with an opportunity to describe the important aspects of the product. A major section of the present article addresses the "How and Where" to retrieve the software and the data for your use and how to obtain the associated information from the comprehensive FOS documentation database. This is followed by detailed information on the calibration issues resolved. While demonstrating the quality of the new calibration for FOS/BLUE, the examples of the greatly enhanced scientific value of the recalibrated data are mainly intended to awaken your interest in this "entirely new" repository of astronomical observations.

THE POA PROJECT

The Instrument Physical Modelling Group (IPMG) at the ST-ECF runs the POA project with a staff of four. Three main areas need to be covered: (a) instrument scientist tasks such as analysing data to establish calibration solutions and to verify the scientific validity of pipeline products, (b) documentation and user interface, i.e., your resources on the web, and (c) the integration of algorithms, reference data and documentation into the software environment and its distribution. The team is small enough to allow each member to participate in all three areas, guaranteeing a smooth transition from concepts to products.

At present we only have resources to release a subset of the improved FOS archive — the FOS/BLUE channel data (excluding the spectropolarimetry mode). Several groups at STScI, along with the ST-ECF Users Committee, are involved in the process of prioritising the long list of issues which might be tackled when reviewing any large system such as the calibration and pipeline of a HST instrument. Within the FOS/BLUE side dataset we had to concentrate on resolving the most pressing issues with wavelength scale, flatfields and darks.

During the past 18 months the POA project team investigated the feasibility of improving the scientific utility of the FOS data archive. This involved resolving important calibration issues not properly handled by the STSDAS off-line FOS calibration pipeline ("calfos"), upgrading the supporting reference files and updating documentation and establishing long term FOS user support for the world-wide community.

STPOA – Versions and Features

In its first version (v1.0), the "poa_calfos" calibration pipeline software fixed zero-point uncertainties in the dispersion direction for most FOS/BLUE data. It took into account the residual effects from the Geomagnetic Image Motion Problem (GIMP), the offsets introduced by the electronic setup of the detector (YBASE values), and the variations of the ambient temperature of the FOS optical bench.

The second software release (v1.1 May 2001) contained substantial improvements for additional calibration items:
■ Wavelength Scale: An entirely new algorithm for calculating the dispersion relation has been implemented in the pipeline. New dispersion coefficients have been derived for all the FOS BLUE gratings as well as the PRISM.

■ Flatfields: New flats have been derived, appropriate to POA shift-corrected data. These are available for all post-COSTAR data. Pre-COSTAR flats are being derived for the final POA FOS release later in 2001.

■ POA Log File: Running the "poa_calfos" calibration pipeline now produces a new output file with suffix ".poa" which contains a record of the POA related calculations in lieu of "header keywords" for each subexposure. All these POA corrections are available with the current version of the "poa_calfos" pipeline.

The software currently can process the following types of FOS data:
■ Detector: BLUE
■ Groundmode: SPECTROSCOPY, RAPID-READOUT, IMAGE
■ Filter-Grating-Wheel Identifier: H13, H19, H27, H40, H57, L15, L65, PRI
■ Aperture Identifier: A-1, A-3, A-4, B-1, B-2, B-3

By September 2001, "poa_calfos" will be able to extend the processing to all FOS/BLUE apertures. In total, the POA FOS calibration pipeline will be able to apply the above corrections to over 90% of all FOS/BLUE science data.

STPOA — THE PIPELINE SOFTWARE, ENVIRONMENT & RELEASES

The scientific improvement of the FOS/BLUE archive has been quite significant since the first release of STPOA (for details see below). In July 2000, we released a new IRAF external package, called STPOA (v1.0). It contained a replacement of the standard FOS calibration pipeline called "poa_calfos" along with other tools for FOS re-calibration. Further improvements to the web pages and documentation

were released in March 2001 and the software was substantially upgraded with v1.1 in May 2001. A final worldwide POA-FOS/BLUE release is anticipated by September 2001.
Most of our corrections are based on solutions derived from physical models supported by HST engineering data streams. The improvements reduce the systematic deviation in the dispersion direction zero points from as much as five pixels, to less than one pixel. Figure 1 compares the results obtained using the old pipeline "calfos" (open symbols) and the new pipeline "poa_calfos" (closed symbols). The different gratings are indicated by different colours and the time range is from April 1993 to the end of the FOS lifetime in January 1997. "Poa_calfos" corrects the drift in the zero-point to ~1 pixel. This is an enormous improvement – especially for data taken towards the end of the FOS lifetime.

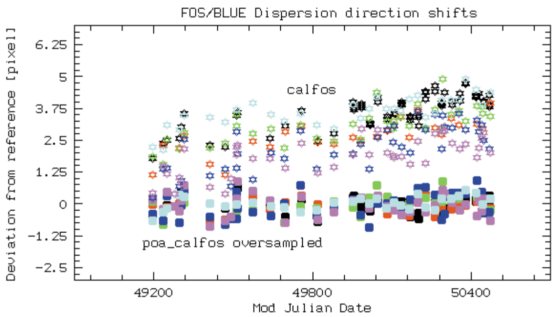

Fig 1: *Comparison of wavelength zero-point offsets using "calfos'"(open symbols) and "poa_calfos" (closed symbols).*

An example of the implications for the scientific use of the data is shown in Figure 2. The raw data were taken in Rapid-Readout mode, spanning approximately 40 minutes, observing the same object. A well known spectral line was used to compare the wavelength position with the expected value from the literature.

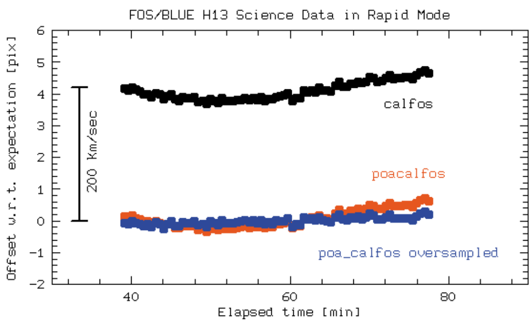

Fig 2: *Science Case: wavelength zero-point offsets using "calfos" (black symbols) and "poa_calfos" (red symbols) and "poa_calfos" oversampled (blue symbols) on a rapid-readout dataset spanning some 40 minutes of exposure time. The residual GIMP is visible as the slight curvature in the the data. Only oversampling is able to remove these sub-pixel residuals.*

The standard "calfos" results (black symbols) are offset by 4.3 pixels or 230 km/sec, while the "poa_calfos" pipeline (red symbols) decreases the offset to ~0.5 pixels or 50 km/sec. The curvature of the results shows the residual sub-pixel GIMP – it is only removed when the data are oversampled (results shown in blue). Oversampling of the data has not yet been implemented in the current STPOA release. We demonstrate this potential improvement with the FOS calibration to show that it is feasible to create an even better FOS recalibrated archive. However, the implementation of oversampling would involve a large overhaul of the current software and IRAF/STSDAS tasks for spectral data analysis depending on the FOS data structure. For these reasons the implementation of oversampling has been postponed.

The POA project has officially taken over the user support of the FOS. Our website contains the current FOS software as well as the most up to date and searchable FOS documentation and technical information. Our team also operates a new FOS helpdesk; the email address for questions and issues is **ecf-poa@eso.org.** For more information on our website as well as on documentation and FOS user support, please see below.

Obtaining POA Recalibrated Versions of FOS Data

Two options exist to obtain POA recalibrated data for further analysis. One can either simply retrieve recalibrated FOS data from a repository or process the raw data using the new software.

The STPOA external IRAF package can be downloaded from: **http://www.stecf.org/poa/software/index.html** or from our ftp area: **ftp.eso.org/pub/stpoa**. The STPOA package can be installed at any site with a recent IRAF installation. The May 2001 (v1.1) release is already in place and being used at ST-ECF and STScI. Any site which would like to run "poa_calfos" must already be able to run the old pipeline "calfos". The calibration reference files are needed by both the old and new software to properly process the data.

The ST-ECF HST archive supports FOS data retrieval with On-The-Fly (OTF) re-calibration using either the new pipeline "poa_calfos" or the old pipeline "calfos": **http://www.archive.eso.org** (HST Science Archive). After September 2001 the default FOS OTF will be set to "poa_calfos". The current default is the old calibration pipeline "calfos" with "poa_calfos" as a second option. FOS/BLUE datasets reprocessed with "poa_calfos" will also be re-ingested into the STScI archive.

On-line Support

As the main portal for POA user support we have created a comprehensive and easy to use website at **http://www.stecf.org/poa**

The latest calibration software releases are featured on the webpage and made available immediately for download. Along with installation and usage instructions, the software release pages also include discussions of the science behind the calibration improvements and examples of the possible scientific gain.
(see e.g., **http://www.stecf.org/poa/pcrel/scicase.html**)

COMPREHENSIVE FOS DOCUMENTATION

The POA project has also created a comprehensive documentation archive, available on the website. It has taken some time to collect together documents spanning the 20-year period of design, use and post-analysis of the FOS and its data. Initially in 1999, we mirrored the STScI FOS pages to make the same on-line material available. We then augmented this with further online documentation from a variety of sources including other groups at STScI at Goddard Space Flight Center and at the Center for Astrophysics & Space Sciences.

We also accumulated a large volume totalling some 6000 pages of documentation from these sources that was only available in paper form. Putting this information on-line posed quite a problem, but we believe that any Final Archive should provide this information in searchable form. The quantity of material that needed scanning was considerable, so we had to find an efficient and cost-effective solution. Supervised OCR would have been expensive and unjustified but unsupervised OCR produces documents without illustrations and documents with too many mistakes to be suitable for users. Our documentation archive therefore contains both simple image scans for reading and printing, and searchable text files resulting from blind OCR.

There is clearly no unique way of categorising and sorting the broad range of documents concerning the FOS. We believe that encouraging the use of search engines is the easiest way to ensure that a user finds what is needed. We therefore provide prominent interfaces and ensure that all of the documents can be located through this interface.

FOS Documents available on-line
(**http://www.stecf.org/poa/FOS**)

- Installation and usage instructions for POA calibration products
- Scientific justification and examples of application to scientific data for POA calibration products
- Instrument Science Reports extant
- Instrument Definition Team (IDT) reports
- ST-ECF Instrument Science Reports related to POA
- All relevant Handbooks including all versions of the FOS Instrument Handbook
- Documents pertaining to important moments in the history of the project including those prepared before launch and those relating to calibration, science verification and the GIMP problem
- FOS Advisories and FAQs
- Trend Reports
- Telescope and Instrument Performance Reports (from STScI TIPS meetings)
- Space Telescope Advisory Notes (STANs, from STScI)
- HST Calibration Workshop proceedings
- Guides to FOS Calibration Reference Files and Tables
- Source code for some IDL/IRAF calibration software
- Non-technical “Museum” documents including an overview of the history of the project and images of the instrument
- A modified interface to ADS that searches for publications which have made use of FOS data
- Links to all of the sources for FOS science and calibration data, FOS proposal information and HST engineering data

Museum

http://www.stecf.org/poa/FOS/museum.html

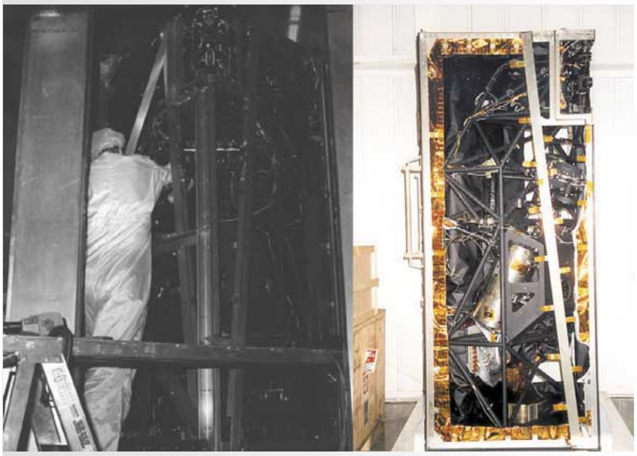

Fig 3: *Left: A technician inspects the FOS before launch (about 1986). Right: The FOS safely returned to Earth and ready for inspection at the Smithsonian Museum (1999) (from the “POA-FOS Museum” pages).*

The FOS now has a considerable history which may be of interest to a larger community, not just HST users. The POA website contains a non-technical “Museum” area covering the development of the project, its milestones and achievements. Images of the instrument itself, both before launch and after decommissioning, are available with some detailed explanation and close-ups of its many components.

Fig 4: Detail of the Filter-Grating-Wheel showing the reflective surface of a tri-partite grating (from the "POA-FOS Museum" pages).

CALIBRATION ISSUES — TACKLED AND SOLVED

Zero-Point Shifts in Dispersion Direction

The considerable uncertainty of the zero-points in the dispersion direction along the diode array was a known calibration issue at the start of the POA project. It was clear that solving this specific problem would have the largest impact on the data quality of the FOS archive. The history of this issue, its detection, investigation and the final recovery is long and very convoluted. With hindsight it is clear that the data would suffer from this particular problem and why it went undetected for such a long time.

Three effects, unaccounted for in the standard "calfos" pipeline, made the electronic image of a spectrum move in the X-direction along the diode array. Firstly there was the so-called GIMP (Geomagnetic Image Motion Problem). Secondly the adjustment of the vertical alignment of spectra with the diode array by applying magnetic fields in the X-direction, the YBASE adjustment, led to shifts due to a Lorentz force cross product. Finally, any thermally induced mechanical bending of components along the optical path introduced an X-zeropoint shift as well.

GIMP correction was introduced in the on-board FOS electronics in April 1993. For the blue detector, the GIMP effect was intrinsically small, with a maximum deflection of 1 pixel and hard to measure in orbit. POA evaluation of all the blue wavelength calibration observations, about 1500, revealed that the on-board GIMP correction was overestimated by a factor of 2. As a result, data taken after April 1993 still suffered from a GIMP effect of comparable size but with the opposite sign. The YBASE effect on X-zero points was predictable from electromagnetic theory, but was never considered during the calibration of the FOS. Between 1990 and 1996 the YBASE tweaking increased the initial X-zero points for each grating mode by almost 5 pixels. This was the largest component of the zero point shift. The thermal component is of the order of half a pixel for the HST aftshroud temperature range covered during the FOS lifetime. The latter component can only be seen clearly once the other two effects have been corrected.

Our new pipeline "poa_calfos" corrects for these three effects by utilising physical models of the geomagnetic field, the attitude and orbital position of HST as well as the electromagnetic forces in the Digicon detectors. Corrections can be predicted to better than 0.1 pixel, but the standard HST calibration software does not allow resampling, so the current versions of "poa_calfos" computes fractional pixel corrections, but only applies the nearest integer value when re-shifting the raw data arrays. This round off of the solution corresponds to an intrinsic velocity uncertainty of 50 km/sec for the high resolution (R=1000) POA-FOS/BLUE data (see Figures 1 and 2). Analogous processing with the standard "calfos" calibration has an uncertainty up to 600 km/sec. Since the corrections are derived in a physically consistent manner and not as empirical adjustments to each particular observational mode, the same intrinsic uncertainty of only 50 km/sec applies to the zero-points between different modes. Therefore, the velocities derived from emission lines seen in the G190H grating and the G270H grating, will have the same uncertainty.

Dispersion Relations

After correcting the zero-point uncertainties it was possible to address problems with the wavelength dispersion relations. The standard "calfos" pipeline uses 3rd order polynomial fits (5th order polynomials for the prisms) to a list of a few Pt-Ne-Cr lines, taken as wavelength calibration exposures during the Science Verification (SV) phase of FOS in late 1990. Updates to the dispersion coefficients never took place because of obvious zero-point uncertainties, which at the time were believed to be "Grating wheel non-repeatability", but are now known to be the GIMP, YBASE and temperature effects.

Since the FOS is a very simple single pass grating spectrometer, we decided to establish physical model based dispersion relations. The model involves two components. The first is an optical model of the lightpath from the aperture via the collimator and grating to the photocathode. The second is an S-distortion model for the Digicon image tubes, to describe the transformation of the spectral images from the photocathode to the diode array. The optical and the electro-optical parts of the model both have 5 parameters, requiring 10 coefficients per grating. Fortunately we can simplify these models because all the gratings are mounted in the same optical path, many of the engineering parameters are known extremely well and almost all the gratings are used in both the red and blue beams. The general form of S-distortions of image tubes is very well known from theory and the distortions had been measured for the FOS Digicons before launch. As a result the number of free parameters per grating and mode shrinks down to only one which is effectively the angle at which the disperser is mounted in the grating wheel. Using the predictive power of such a global dispersion analysis, we have increased the number of useful reference lines, particularly those shortward of 1350 Å. To demonstrate the accuracy gained with the new FOS dispersion model, we compare the residuals of measured line positions with respect to the predicted location using the standard "calfos" dispersion solutions (Figure 5), and the "poa_calfos" solutions (Figure 6). Different colours indicate different high resolution gratings. These figures show that the intrinsic accuracy of the predicted location of a spectral feature has been greatly improved.

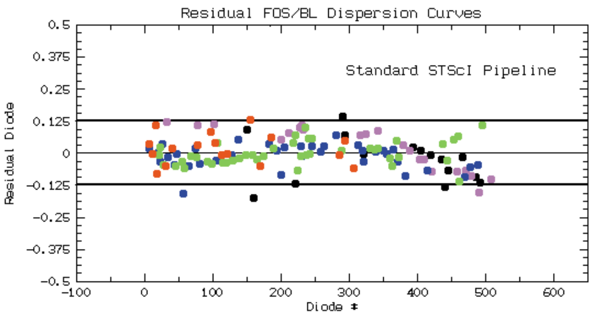

Fig 5: *Residuals of measured line positions with respect to the predicted location when using the standard "calfos" dispersion solutions. Different colours indicate different gratings (sequence: black, purple, blue, green, red stand for G130H, G190H, G270H, G400H, G570H).*

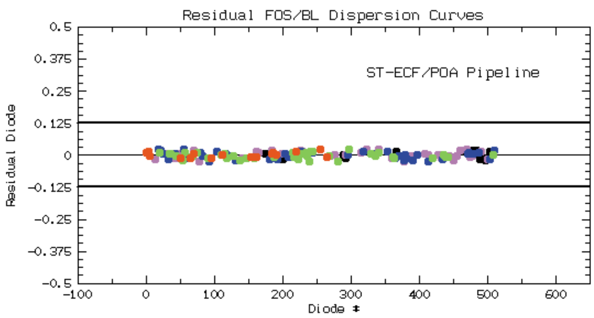

Fig 6: *Residuals of measured line positions with respect to the predicted location when using the physical model based "poa_calfos" dispersion solutions. Colours as in Figure 5. The flatness and large improvement in local and global accuracy in comparison to Figure 3 are the result of the predictive power of the optical model.*

Science Testing for Radial Velocities

The combination of corrected X-zero-points and improved dispersion solutions provided by the new "poa_calfos" pipeline for FOS/BLUE data has a dramatic impact on the scientific versatility of the spectrometric data. We chose an example from the large body of FOS spectra of QSOs that can be used to study the composition and ionisation state of the Milky Way halo along differing lines of sight.

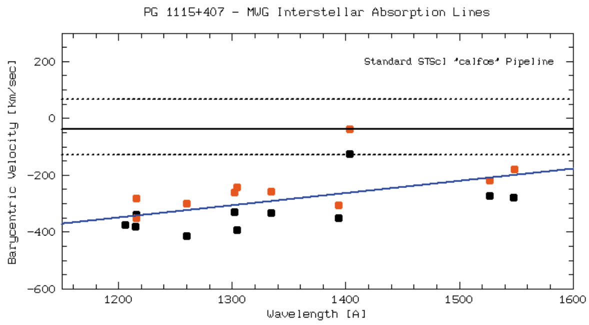

Fig 7: *Two successive exposures with the G130H grating of the QSO PG1115+407 calibrated using "calfos". The data points are barycentric velocities determined for the halo using several absorption lines. The solid horizontal line and the two dashed lines above and below, are the expected bulk velocity with a true velocity range taken from the analysis of 21cm HI data in the same pointing direction. It is evident that with only one exception all measurements fall short of expectation by more than 200 km/sec and that there is a clear unphysical trend velocity with wavelength.*

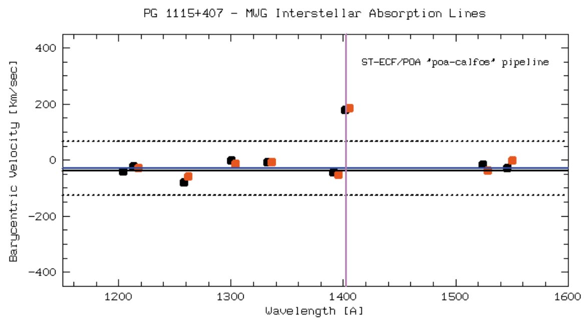

Fig 8: *Measurements obtained from the identical data set re-calibrated with "poa_calfos". Not only do the velocities trace very closely the expected 21cm HI velocity range (with one exception), but there is no longer any discernible dependence on wavelength. The only concern about the new results is the single absorption line at seemingly positive radial velocities if interpreted as Si IV (1403 Å). The answer, indicated in purple, is that this is the wavelength at which Lyman alpha would be seen as an absorber in the host galaxy of the QSO.*

We conclude that the POA-FOS/BLUE archive, thanks to the major improvements to wavelength calibration, can also be seen as an entirely new HST instrument. The prospects are now bright that something unexpected could be found, even by re-analysing data that have already been utilized for a scientific publication. In particular the long duration exposures should be revisited. In these cases the effect of zero-point drifts, variable during the exposure, leads to a dilution of faint features. When re-processed, these faint spectral features are seen much more clearly above the noise or continuum. This enhancement, when combined with much more accurate wavelength information, can help to identify faint features with much higher success rate.

Flat Fields

From the start, the derivation and use of flat fields in the calibration pipeline was identified as an area for the POA project to examine, with a medium high priority. In keeping with the "Instrument Modelling" philosophy, the original motivation was the possibility that a more physical model could be applied to derive appropriate flats and to distinguish between cathode and diode components.

However, the implications of the GIMP, YBASE and temperature corrections to the X-zero-points made the re-derivation of the flats essential, regardless of other considerations.

Diode/Cathode components

All FOS flat field observations result from the combination of the spectral energy distribution of a standard star and the response of the cathode and that of the diode array. The signature of the cathode depends on which part is illuminated and is a function of the grating and aperture. The two detectors have to be dealt with completely separately. For a given grating/aperture combination the cathode component is, in principle, fixed if the ageing of the cathode is disregarded. Unfortunately, because of GIMP/YBASE/temperature variations in the X-location of spectra, the image of the cathode signature on the diode array was variable and hence the combination of the two components also varied.

After detailed investigations we concluded that the only significant component is that of the cathode. There was therefore no advantage to be gained from trying to separate out the diode component as the flat fields, as classified already according to grating/aperture, were appropriate for removing the cathode component.

Shifted Flats

Although the diode component can be neglected, the flat field still needs to be aligned with the signature of the cathode component in the science dataset and it follows that the flat field and science datasets (up to the .c5h stage) should have been derived using “poa_calfos”. This requires that all source datasets are re-derived from the raw data to the .c5h stage using “poa_calfos” before the super-spectrum is subtracted and the flat produced.

STScI provided us with the appropriate data and procedures to enable us to re-derive these flats. This had to be ported from VMS to UNIX and in the process it was automated so that future changes in “poa_calfos” can be fed through to all the flats by simply running one script.

The result, in all cases, is a new flat that is simply shifted from the version used by the original pipeline “calfos”. However, the magnitude of this shift could only be determined by re-deriving the flats due to uncertainties in the header information regarding the on-board GIMP correction applied by “calfos” when the original flat was derived.

Missing flats

Certain FOS observation modes use flats from similar modes rather than ones specifically derived for the given mode. This happens for a number of reasons even when the data is available to attempt to derive a more appropriate flat. In practice creating these additional flats would involve a lot of extra detective work. Tests show that the gain, in terms of the effects on science data, is modest and could not be considered to be a high priority.

Darks

The dark current correction was another component of the “calfos” pipeline identified for attention from the outset of the POA FOS project. The results of our investigation have not yet been integrated into the publicly released “poa_calfos” pipeline, but the final release will include a change in the way that the dark correction is scaled.

In the standard “calfos” pipeline this scaling is a function of the geomagnetic latitude of HST at the time of an observation. An appropriate function of geomagnetic latitude (the so-called “cosine quarter law”) should reflect approximately the particle flux and the normalisation is obtained from a comparison with the dark datasets. This semi-empirical approach gives an acceptable fit to most of the dark data, but is less convincing at extreme latitudes.

We now have the benefit of data from the entire history of FOS and are better able to identify any epoch dependence which can be expected from the variation of solar activity within the solar cycle. There is a high degree of scatter in the data and some evidence that the dark count rate may differ between dark and bright parts of HST’s orbit (Rosa 1994). This latter point is interesting as calibration observations, such as darks, are more often taken during the bright part of orbits, whilst science observations are preferentially conducted during the dark part. If verified, this would imply a systematic offset between the dark flux measured and the correction required. In order to take these points into account we have once again attempted to use a model that is more physically motivated. Rather than simply using the geomagnetic latitude, the scaling is assumed to be directly proportional to the “Magnetic-shell” parameter which describes more accurately the amount of energetic particles stored in the magnetosphere (see Figure 9). The epoch dependence is modelled as a weak function of the solar cycle. Still under investigation is a physically motivated method of correcting the day/night effect, which might be due to small light leaks.

THE FUTURE

The FOS was chosen as a study case for POA analysis. This was done mostly because we had already been working in close collaboration with STScI Instrument Scientists and had accumulated expertise and deep insight into the specific issues with the FOS calibration. After the release of the refurbished FOS/BLUE data archive and calibration pipeline, with associated reference data and documentation, the POA project at the ST-ECF will make best use of the lessons learned from the FOS/BLUE. Instead of investing our efforts in upgrading the FOS/RED part of the archive, we will concentrate on a much more scientifically versatile and productive instrument, namely STIS. Compared to the total of 24000 FOS data sets (of which about 14000 are true science exposures), STIS has already accumulated about 65000 data sets (of which 30000 are spectra). STIS will remain the only all-purpose spectrograph on HST up until HST’s deorbiting. Therefore it will be scientifically advantageous to put our efforts and POA expertise into STIS. In particular, we can apply results obtained with calibration methods based on physical models of the instrument. The key to STIS re-calibration will be the use of a generic 2D Echelle spectrograph model (Ballester & Rosa 1997), a variant of which is already a permanent part of the VLT/UVES calibration pipeline. We will also be able to reuse many of the tools that we have constructed during the POA-FOS project. Most notably, we have the means to link the science data with the large body of contemporaneous engineering telemetry. This is crucial information not yet integrated into any of the HST data calibration pipelines or data headers.

We will keep the HST user community informed about our progress through the ST-ECF Newsletter, but the best way to check on late-breaking news with POA-upgraded scientific calibration for HST instruments is to go to our website **http://www.stecf.org/poa**

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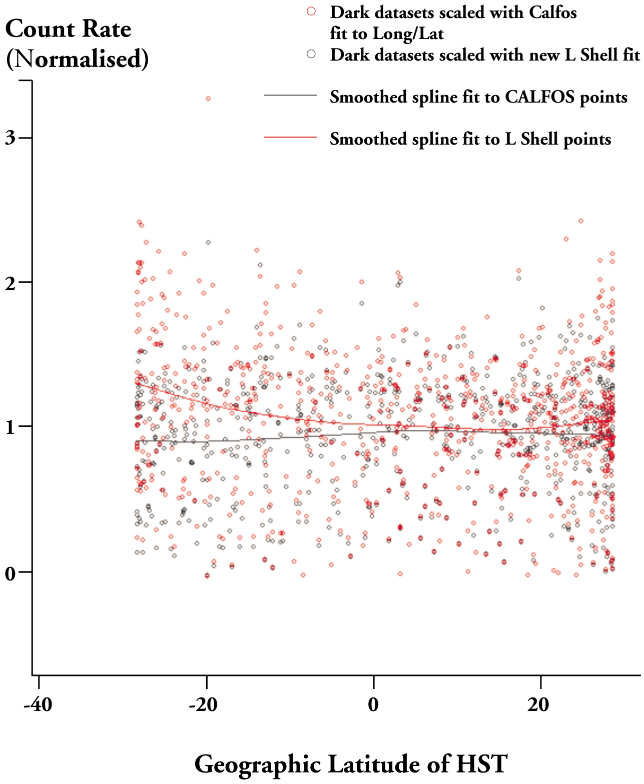


***Fig 9:** Count rates from dark datasets corrected with the CALFOS geomagnetic Long/Lat table and the new POA L_Shell formula plotted against L_Shell. The new L_Shell correction can be seen to give an improved correction at higher L_Shell values, the CALFOS correction does not fully remove the dependence on L_Shell. This is also seen for high geomagnetic latitudes.*

Eleven Years in Orbit: Hubble Observes the Popular Horsehead Nebula

HUBBLE
European Space Agency Information Centre

To celebrate its eleventh birthday, the NASA/ESA Hubble Space Telescope released an unsurpassed picture of the famous Horsehead nebula in Orion. This dark nebula is part of the large Orion Complex, birthplace to thousands of stars.

Rising from a sea of dust and gas like a giant sea horse, the Horsehead nebula is one of the most photographed objects in the sky. The American-European Hubble Space Telescope took a close-up look at this heavenly icon, revealing the cloud's intricate structure. This detailed view of the horse's head was released to celebrate the orbiting observatorys eleventh anniversary on 24 April.
Read more on: **http://hubble.esa.int** under "Releases".

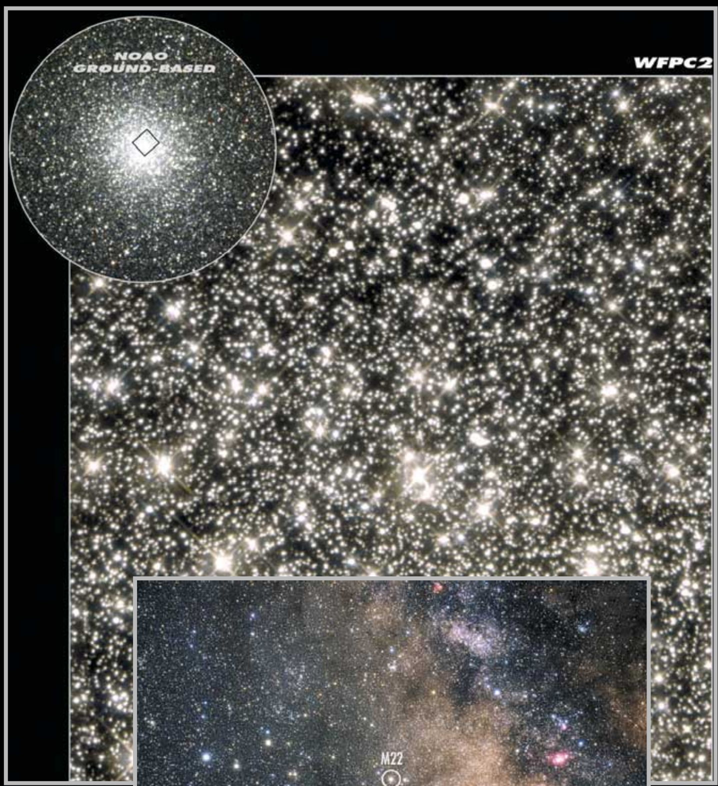
Credit: NASA, NOAO, ESA and The Hubble Heritage Team (STScI/AURA)

Facts
- The Hubble Space Telescope was launched by the shuttle Discovery (STS-31) on 24 April 1990 at 12:33:51 UTC
- Hubble was released by the Shuttle's robotic arm on 26 April at 19:38 UT
- Hubble is a joint American/European collaboration in which the observing time is shared 85%/15%

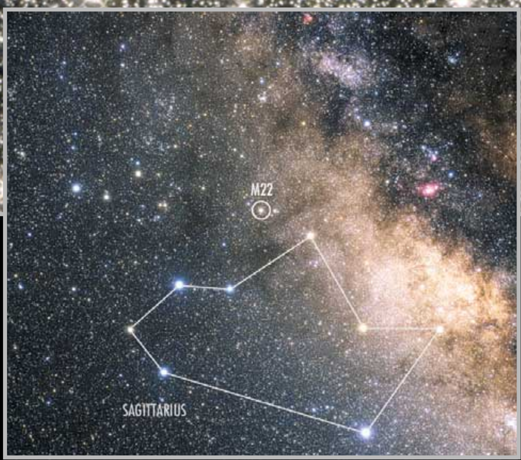
During its first 11 years of operation Hubble has:
- Orbited 60,000 times around the Earth
- Travelled more than 2.6 billion kilometres — more than 17 times the distance to the Sun
- Made more than 400,000 exposures
- Observed 15,000 astronomical targets
- Downloaded approximately 10 Terabytes of data to Earth
- Resulted in 11,000 scientific papers

HUBBLE
European Space Agency Information Centre

Free-floating Planets in M22?



Credit: NASA, ESA, NOAO & K. Sahu (STScI)



Credit: ESA, NASA & Akira Fujii

The Constellation Sagittarius
The constellation Sagittarius (the Archer), home to the globular cluster M22, is one of the best known constellations in the sky. Sagittarius contains a large number of famous nebulae and star clusters due to the presence of some of the richest star fields of the Milky Way. The very centre of the Milky Way lies in the direction of Sagittarius.

Some of the brighter stars in Sagittarius are known as the Teapot, the shape of which is indicated by lines here.

Piercing the heart of a globular star cluster with its needle-sharp vision, the NASA/ESA Hubble Space Telescope has uncovered tantalising clues to what could potentially be a strange and unexpected population of wandering, planet-sized objects.

In results published in NATURE, the international science journal, Kailash Sahu (Space Telescope Science Institute, Baltimore, USA) and an international team of colleagues report six unusual microlensing events inside the globular cluster M22. From 22 February to 15 June, 1999, Sahu and colleagues monitored 83,000 stars. They detected seven microlensing events. One clear event caused by a normal dwarf star in the cluster (about one-tenth the mass of our Sun) and six even

M22
This image shows the globular cluster M22 as seen with the NASA/ESA Hubble Space Telescope's Wide Field and Planetary Camera 2. In the upper left corner is a ground-based view of M22 showing the position of the WFPC2 image.
M22, also known as NGC 6656, is the brightest globular cluster visible from the northern hemisphere and it is an easy naked eye object. The 12 to 14 billion year old cluster is about 8,500 light years distant and about 65 light years across. Its angular diameter is 24 arc minutes or almost the size of the full Moon. The Hubble view measures about 3 light years across.

more interesting, unexpectedly brief events. These microlensing events were unusually brief, indicating that the mass of the intervening object could be as little as 80 times that of Earth. Objects this small have never before been detected by microlensing observations. If these results are confirmed by follow-up Hubble observations, the bodies would be the smallest celestial objects ever seen that are not orbiting any star.

To confirm these extraordinary, but tentative results, Sahu and colleagues next plan to monitor the centre of the globular cluster continuously over a seven-day interval. They expect to detect 10 to 25 short-duration microlensing events, which will be well-sampled enough to yield direct measurements of the true masses of the small bodies.

Read more on: **http://hubble.esa.int** under "Releases".

EUROPEAN * SPACE AGENCY * INFORMATION * CENTRE HUBBLE *
News Release
heic0107

Credit: ESA & Hubble European Space Agency Information Centre

Microlensing in M22
This schematic illustration shows how the NASA/ESA Hubble Space Telescope observes the microlensing events in the globular cluster M22. In the 'film strip' a possible 'free-floating' planet-sized object in M22 passes in front of the red background star and briefly magnifies its light.

Note that the distances and sizes in this artist's rendering are purely chosen for illustration purposes.

Archive news

Alberto Micol on behalf of the ST-ECF Archive Team

ON-THE-FLY CALIBRATION AND REPROCESSING

As the HST data archives have evolved, the approach to the calibration of data has also changed. Instead of doing the calibration soon after the data were acquired it has been found better to store only raw data and perform the calibration when the data are requested from the archive. This "on-the-fly" approach, pioneered by the CADC and ECF, allows more suitable software and calibration reference files to be used and results in a superior product. As the next logical step in this evolution, STScI now provides its archive users with the capability for "On-The-Fly Reprocessing" (OTFR) of HST/STIS and WFPC2 observations. In the near future, NICMOS will also abandon the current "On-The-Fly Calibration" (OTFC) system in favour of OTFR. The ST-ECF and Canadian Astronomy Data Centre (CADC) are currently adopting the same scheme at their respective sites.

What is the difference between OTFC and OTFR?

The old OTFC system applied the most recent calibration software and the best available reference files to the raw data stored in the archive. However, the raw data files, and their headers, were created soon after the time of observation and are not necessarily correct.

The new OTFR system goes further by regenerating the raw files before calibration. Pixel values are obtained from so-called POD files created at Goddard Space Flight Center from the original telemetry stream. Headers are populated by looking up their values in various databases. The subsequent steps are identical to the current OTFC.

Why OTFR? Wasn't OTFC good enough?

The advantage of this new approach is that the most recent, and hence the most reliable, software is used to ensure that the headers of the raw data are always populated with the best possible header keywords. It is well known that almost 100% of the STIS headers have errors and all the other instruments also suffer from incorrect header keyword values. The majority of these errors, introduced mainly by problems with the software that originally created the raw data from the POD files, are cosmetic only, but there are a number of more significant errors such as filter names being wrong in the case of WFPC2 (92 such cases have been noted) and incorrect aperture names in the case of STIS, which could lead to wrongly calibrated products. Instead of repairing the headers before applying the calibration pipeline, as is done in the STScI version of OTFC, the new OTFR will solve the problem directly by fixing the software that creates the raw files from the POD ones, without the need to maintain a cumbersome repair system.

How does this change affect archive users?

From the user's point of view OTFR is more a philosophical change to ease maintenance than a real enhancement in the quality of the produced data. Since the interface to the archive will not change, the only noticeable effect is that users will receive more accurate header keywords. In only very few cases (less than 1%) will the improvement in the header keywords affect the calibration and lead to improved science. In all other cases the difference between OTFC and OTFR will remain confined to some "cosmetic" keywords.

OTFR Release Date

The OTFR has already been released at STScI where it runs on a TRU64 UNIX operating system. The ST-ECF and CADC release will run on a Solaris machine. At the time of writing, STScI is preparing a new version of their pipeline software (OPUS V13.2) that will contain the Solaris port of the OTFR system. This release is expected at the beginning of summer 2001. The STScI delivery of the necessary POD files to the ST-ECF and CADC will take place a few months later. Towards the end of 2001 both the ST-ECF and CADC will release the new OTFR for WFPC2, STIS and NICMOS, retaining the usual OTFC for heritage instruments, including the improved calibration software and reference files made available by the Post Operational Archive team (see page 9). Specific archive value-added products will naturally benefit from the enhanced calibration.

A history of recalibration

- **October 1995**: CADC and ST-ECF release OTFC for all HST instruments except the High Speed Photometer.
- **February 1998**: ST-ECF and CADC implement the concept of WFPC2 associations by which groups of exposures with the same roll angle can be co-added and cosmic ray cleaned.
- **June 1998**: CADC and ST-ECF extend OTFC to support the new instruments NICMOS and STIS.
- **December 1999**: STScI releases OTFC for the active instruments, at the time WFPC2, NICMOS and STIS. For heritage instruments STScI offers the products calibrated immediately after observing.
- **July 2000**: the Post Operational Archive team (ST-ECF) produces the first release of the revised calibration software for FOS (POA_CALFOS v1.0). POA_CALFOS offers a correction to image motion problems which have led to significant wavelength scale uncertainties in the FOS data archive. In September 2000 it is offered to archive users.
- **May 2001**: STScI makes the initial release of OTFR for STIS. WFPC2 (June 2001) and NICMOS (August 2001) are supported by OTFR soon afterwards. The heritage instruments do not benefit from this system and again STScI will only offer the original raw and calibrated data in these cases.
- **May 2001**: version 1.1 of POA_CALFOS is released; the final version (1.2) will be released to the community by September 2001.
- **By Autumn 2001** ST-ECF and CADC plan to go public with a Solaris port of OTFR for the supported instruments STIS, WFPC2, NICMOS and ACS. ST-ECF and CADC retain the unique capability of running OTFC on the heritage instruments FOS, FOC, GHRS and WFPC1. WFPC2 associations will transparently make use of the improved OTFR.

POST OPERATIONAL ARCHIVES (POA)

The first two releases of the POA_CALFOS software (July 2000 and May 2001) improved the CALFOS pipeline by enhancing the wavelength calibration of Faint Object Spectrograph observations. In the period since the first release, the ST-ECF archive has offered the POA pipeline to its users as an "on-the-fly" option to the old STSDAS CALFOS pipeline when recalibrating FOS datasets. The default is still the old CALFOS version.

The final release of POA_CALFOS to the public is expected by September 2001.

This new version will be immediately available to the ST-ECF archive users. We would like to stress that the final POA_CALFOS pipeline will become the default version used in the OTFC system. The STSDAS version will still be offered as a selectable option.

To find out more about the specific improvements of this new version, please refer to the main POA article on page 9.

SUPPORTED ARCHIVE DATA DISTRIBUTION MEDIA

The progress of technology and the steady increase in the volume of data to be distributed, in combination with the decay of older devices, all call for a regular update of our supported media list. Until recently we were supporting a number of tapes such as DAT-DDS1 and EXABYTE. The former device has become impossible to obtain and the latter is no longer in demand. We have therefore decided to drop them as low-capacity media. In that range, we are now left with DAT-DDS2 and DVD-R. For high-capacity media, we currently offer DAT-DDS3 (about 12GB per tape), DLT-4000 (about 25GB when compressed) and DLT-7000 (about 50GB compressed).

The ECF archive group would like to have your feedback on these changes. Please tell us what you would like to receive from us and also if there are media you are familiar with which we do not support and which you think we should consider. Feedback should be e-mailed to: **catalog@eso.org.**

The current up-to-date list is always available at **http://archive.eso.org/faq.html#15**

The table below shows the recent changes in the list of supported media.

Medium	*Up to now*	*From now on*
DAT-DDS1	Yes	No
DAT-DDS2	No	Yes
DAT-DDS3	Yes	Yes
EXABYTE	Yes	No
D-R	Yes	Yes
DVD-R	No	Yes
DLT-4000	Yes	Yes
DLT-7000	Yes	Yes

ORGANISATIONAL CHANGES IN SCIENCE ARCHIVE OPERATIONS

The ESO and HST archives have been jointly operated for a number of years. With the fast-growing ESO archive, both in terms of new incoming data and distribution activities, more and more attention and resources were required to keep it in good shape, whilst simultaneously coping with the growth.

If in the beginning, an archive operation team was sufficient to handle what was mostly HST data, the level of responsibility is now such that the small team has become a new group in the Data Management and Operations Division of ESO. The new group is called Operations Technical Support (OTS) and is composed of four technical teams with responsibilities ranging from administration of replicated database servers through management of the observations database content and archive data operations to computer systems administration. HST archive operations continue to be performed by the same people within the enlarged group.

ASTROVIRTEL NEWS

ASTROVIRTEL is a programme which is funded by the European Commission to support the exploitation of astronomical archives. It began in summer 2000 and work on the first yearly cycle is still in progress. The investigators of the five selected proposals have both visited the ST-ECF and participated in teleconferences. Such communication has been very useful to both the investigators and the ASTROVIRTEL team. It has allowed both sides to monitor the development of the necessary software tools and also to assess progress with the retrieval of relevant data from the different archive centres. The first publication from the ASTROVIRTEL activities, "An upper mass limit for the progenitor of the Type II-P supernova SN1999gi" by Smartt and collaborators has been submitted to ApJ letters, and is available on astro-ph (**Http://xxx.lanl.gov/abs/astro-ph/0105453**).

At the time of writing, the second ASTROVIRTEL call for proposals deadline has just passed and evaluations will be made by the TAC panel in July. We hope to start inviting the successful proposers for their first visit by the beginning of September. During such visits each individual programme will be discussed in detail, the requirements will be set, and a course of action will be defined.
The ASTROVIRTEL programme will eventually merge with the newly approved Astrophysical Virtual Observatory (AVO) that is described in more detail by Piero Benvenuti in his article on page 4 in this Newsletter.

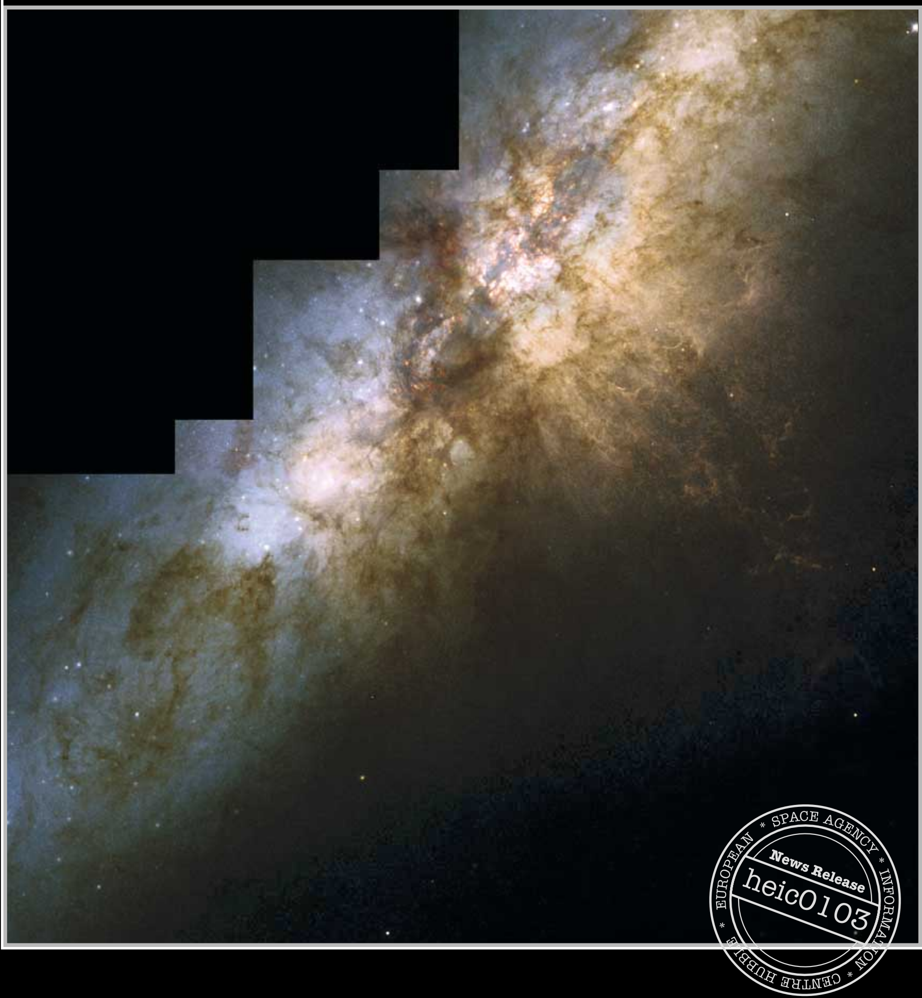
HUBBLE
European Space Agency Information Centre

Hubble Zooms In on Bar of Favourite Spring Spiral Galaxy

Astronomers have long suspected that the bar systems that dominate the appearance of some spiral galaxies provide an efficient mechanism for fuelling star births at their centres. New results from the NASA/ESA Hubble Space Telescope provide evidence that this is indeed the case.

Read more on ***http://hubble.esa.int*** *under "Releases".*

Credit: ESA, NASA & Almudena Alonso-Herrero (University of Hertfordshire, United Kingdom)



Credit: NASA, ESA, R. de Grijs (Institute of Astronomy, Cambridge, UK)

Hubble Spies Huge Clusters of Stars Formed by Ancient Encounter

Beautiful, detailed Hubble images of the centre of the prototypical starburst galaxy M82 point to a violent past. An ancient burst of star formation that gave birth to more than 100 super star clusters is linked to a violent encounter with the galaxy's large neighbour, M81.

Read more on ***http://hubble.esa.int*** *under "Releases".*

Photo Release heic0101

EUROPEAN * SPACE AGENCY * INFORMATION * CENTRE HUBBLE *

Credit: NASA, ESA and the Hubble Heritage Team (STScI / AURA)

Ants in space?
— Tantalising detail in ant-shaped nebula illuminates last moments of Sun-like stars

Observed from ground-based telescopes, the so-called 'ant nebula' (Menzel 3, or Mz3) resembles the head and thorax of a common garden ant. This dramatic NASA/ESA Hubble Space Telescope image, showing 10 times more detail, reveals the ant's 'body' as a pair of fiery lobes protruding from a dying, Sun-like star.

Read more on **http://hubble.esa.int** *under "Releases".*

HUBBLE
European Space Agency Information Centre

The ST-ECF Users Committee

The ST-ECF has a Users Committee which was established by the parent organisations (ESA and ESO) to monitor its activities and assess how effectively it supports the European HST community. The Committee, which meets at least once per year, is appointed by ESO and its members normally serve for three years. It prepares a report which is presented at an annual ESA/ESO review where ESO and ESA management discuss modifications to the direction of ST-ECF activities as well as new initiatives and possible redistribution or reassessment of resources. Important questions relating to the work of the ECF and HST support in Europe may be raised with the committee. The current membership and contact information is available at: **http://www.stecf.org/UC**

Piero Benvenuti

SCISOFT

A COLLECTION OF ASTRONOMICAL SOFTWARE

Richard Hook

There are active astronomers, visitors and students at all four ESO sites who need a wide variety of software to work efficiently. Much of this scientific software has been developed in the community and is not normally used in non-astronomical establishments. Examples are software to reduce, display, analyse and visualise astronomical data. If there is no coordination, there is a strong tendency for such software to be installed at the different sites only when requests come from users and there is no simple way, or enough human resources, to make updates or ensure compatibility between sites. As a result it was common for visitors to ESO sites to be unsure what software they could expect to be available and in the case of offline data manipulation at the telescope such uncertainty could lead to inconvenience and possibly inefficient use of observing time.

To try to avoid these problems the Scisoft project was established at the beginning of 2000. It is a joint effort between the author from the ST-ECF, the ESO scientific community represented by an advisory board with delegates from each ESO site, and the ESO IT group, which is part of the Technology Division. Recently, the Data Management and Operations Division has also become an active member by supporting external distribution.

Scisoft maintains a uniform, documented and tested collection of astronomical software for the three main ESO computer platforms — Solaris, HP-UX and Linux and makes regular distributions internally on CD-ROM. This collection is the standard one for users and visitors at all four ESO sites. It is also distributed from Garching to Chile using mirroring so that updates propagate automatically. The items included on the three platforms are close to identical. At each release the policy is to have only one version of each package, the most recent available. Installing a single collection takes far less effort than locating and installing many individual items and testing them and hence leads to a major reduction in the total effort required for scientific software support throughout ESO.

The content of the collection is driven by the needs of ESO users which are expressed by representatives of all four ESO sites at a board meeting before each new release. At present the collection contains IRAF with many layered packages, including the latest version of STSDAS for HST data, ESO-MIDAS, Eclipse (for ISAAC and other data), IDL (although a license must be bought to allow full operation, not just the demo mode), Tiny Tim for HST PSFs, Difmap, Terapix tools including SExtractor, image display programs such as Skycat, ds9, SAOimage, ximtool etc, and many other things. A full list is available at **http://www.eso.org/scisoft.** The contents are biased towards the needs of the ESO optical and near-IR communities so, for example, there is no X-ray software included, but there is a lot of software for HST data. Scisoft releases occur at approximately six-monthly intervals and there have so far been two, in June and November 2000. The next one will appear in July 2001 as this Newsletter goes to press.

Originally this collection was just intended for internal ESO use, but in spring 2001 it was decided to also allow external distribution without support. Although now available to external users, it is intended that the Scisoft collection will remain focused on the ESO internal needs and will develop accordingly. Nevertheless, we are interested in hearing comments from the external community. The external ("EXPORT") version lacks some of the items in the internal version because of copyright questions, but is otherwise close to identical.

Anyone wishing to request a copy is encouraged to send their postal address and the name of the version they would like to receive (Linux, Solaris or HPUX) to *scisoft_request@eso.org* and we will post them a CD.

ST-ECF Instrument Science Report Series

Jeremy Walsh

The role of the ST-ECF to provide general support of HST European users has been evolving to providing project support for HST and NGST activities. These rather well-defined activities, such as the Post-Operational Archive for FOS and the support for the spectrometric modes of ACS, have a variety of "instrument science" outputs in addition to user support and calibration software. In order to ensure dissemination of the expertise gained in these projects, we have begun an instrument report series, similar to those series for individual HST instruments distributed by STScI. Another distinct project within the ECF is involvement in NGST and the European instrument studies; the report series will also include results of this work. The first few reports are now available on the ECF Web pages and a very brief overview of their contents follows.

The first ECF ACS Instrument Science Report (ISR) on spectroscopy covers the simulations of direct and grism image pairs with the SLIM software and is entitled "ACS Grism Simulations using SLIM 1.0". As well as describing the Python based simulation software, a simulation of ACS WFC grism spectroscopy of the HDF-N is included and examples of the detectable spectra of AGN at a variety of redshifts. Since the support for the ACS grism and prisms modes is in close conjunction with STScI, the ST-ECF ACS ISRs also appear in the STScI ACS ISR series. Thus this report, ST-ECF ISR ACS 2001-02, is also STScI ISR ACS 2001-03.

The second spectroscopy report in the ACS series is entitled "The Effective Resolution of the ACS WFC and HRC Grism" and shows how the size of extended objects (and the orientation of elliptical ones) affects the spectral resolution of the resulting slitless spectra. Simulations of planetary nebulae are used to illustrate the effects on extracted spectra. This ISR is also 2001-02 in the STScI ACS series.

An earlier report on polarisation properties of the ACS polarisers in combination with the different filters was also produced at the ECF but it is not strictly within the ACS spectrometry project. However, it is included in the ECF series (ISR ACS 2001-01).

The first report in the ST-ECF NGST ISR series has also been issued (ST-ECF ISR NGST 2001-01, by Cristiani et al). In the NGST Design Reference Mission there is demand for extension of the IR imaging camera to optical wavelengths. In this case photometric redshifts of faint targets in the redshift range 5-9 would considerably enhance the scientific yield of NGST. The report investigates, through simulations, the effect of long wavelength leaks on the accuracy of optical filter photometric redshifts.

The Post Operational Archive (POA) group are also preparing ISRs on FOS recalibration which will appear in the near future. Stay tuned.

ISRs currently available:

■ *Cristiani, S., Arnouts, S., Fosbury, R. A. E., 2001, "Parasitic Light in NGST instruments: the accuracy of photometric redshifts and the effect of filter leaks in the visible and near-IR camera", ST-ECF ISR NGST 2001-01 (astro-ph/0106298)*

■ *Pasquali, A., Pirzkal, N., Walsh, J. R., Hook, R, N., Freudling, W., Albrecht, R., Fosbury R.A.E., 2001, "The Effective Resolution of the ACS WFC and HRC Grism", ST-ECF ISR ACS 2001-03*

■ *Pirzkal, N., Pasquali, A., Walsh, J. R., Hook, R. N., Freudling, W., Albrecht, R., Fosbury, R.A.E., 2001, "ACS Grism Simulations using SLIM 1.0", ST-ECF ISR ACS 2001-02*

■ *Walsh, J. R., 2001. "Polarization Properties of ACS". ST-ECF ISR ACS 2001-01.*

Massive Infant Stars Rock Their Cradle (Photo Release heic0104).

Extremely intense radiation from newly born, ultra-bright stars has blown a glowing spherical bubble in the nebula N83B. A new NASA/ESA Hubble Space Telescope image has helped to decipher the complex interplay of gas and radiation in a star-forming region of a nearby galaxy. The image graphically illustrates just how these massive stars sculpt their environment by generating powerful winds that alter the shape of the parent gaseous nebula. These processes are also seen in our own Milky Way in regions like the Orion Nebula.

Read more on ***http://hubble.esa.int*** *under "Releases".*

Credit: ESA, NASA & Mohammad Heydari-Malayeri (Observatoire de Paris, France)

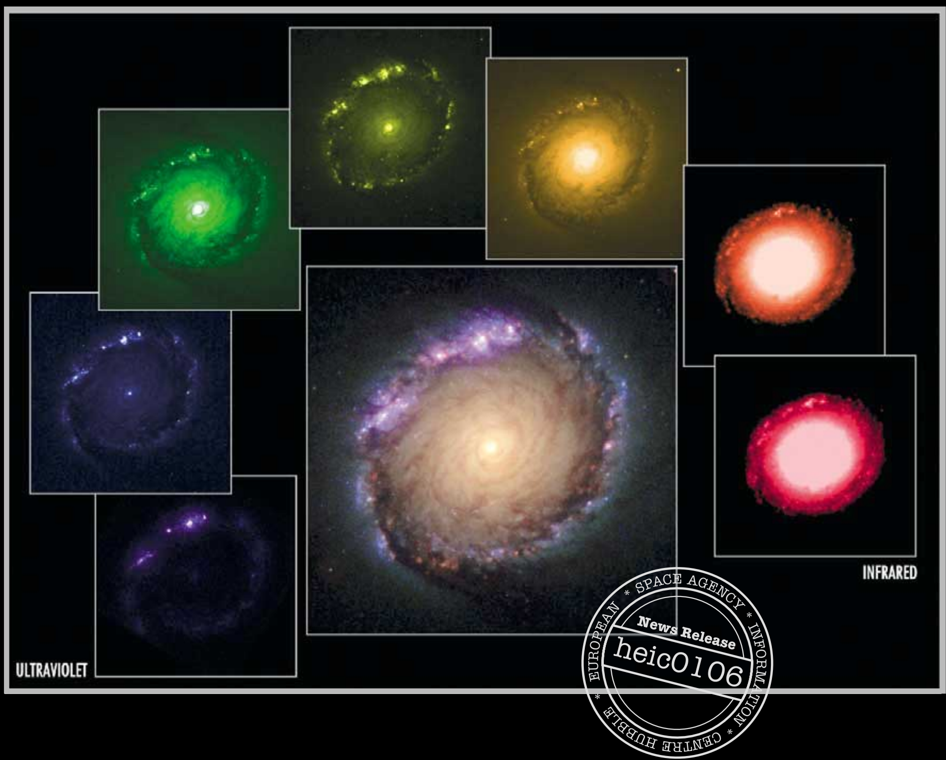
HUBBLE
European Space Agency Information Centre

Hubble Unveils A Galaxy in Living Colour

An extensive, multi-wavelength study with the Hubble Space Telescope has shown the many faces of the galaxy NGC 1512. Hubble's unique vantage point high above the atmosphere allows scientists to see objects over a broad range of wavelengths from the ultraviolet to the infrared.

In this view of the centre of the magnificent barred spiral galaxy NGC 1512, the NASA/ESA Hubble Space Telescope's broad spectral vision reveals the galaxy at all wavelengths from ultraviolet through to infrared. The colours (which indicate differences in light intensity) map where newly born star clusters exist in both 'dusty' and 'clean' regions of the galaxy.

Read more on ***http://hubble.esa.int*** *under "Releases".*



Credit: NASA, ESA, Dan Maoz (Tel-Aviv University, Israel, and Columbia University, USA)

PRELIMINARY ANNOUNCEMENT

ESO-CERN-ESA
Symposium on Astronomy, Cosmology and Fundamental Physics

Garching, Germany
March 4-7, 2002

The connections between Astronomy, Cosmology and Fundamental Physics are well known and become closer every day. Recent exciting developments in these fields include the structures in the cosmic background radiation, evidence for an accelerating Universe, searches for dark matter candidates, evidence for neutrino oscillations, space experiments on fundamental physics and discoveries of extrasolar planets. ESO, CERN and ESA are thus involved in scientific endeavours and technologies that overlap considerably.

This joint Symposium is the first to be co-organized and co-sponsored by all three organizations. Topics will include scientific areas of interest to the communities of the three organizations: astronomy from ground and space, cosmology and astro-particle physics and fundamental physics in a wider context. It is meant to give a broad overview and to highlight the contributions of the three organisations, their plans and the synergies between them. The programme will consist largely of invited reviews and discussion, although there will also be some shorter contributed papers and posters.

Scientific Organising Committee:
R. Battiston (Univ. of Perugia), R. Bender (Univ. of Munich), A. de Rujula (CERN), L. DiLella (CERN), C. Fabjan (CERN), A. Gimenez (ESA), M. Jacob (CERN), F. Pacini (Arcetri), A. Renzini (ESO), P. Shaver (ESO; chair), M. Spiro (Saclay), B. Taylor (ESA), P. van der Kruit (Univ. of Groningen), S. Vitale (Univ. of Trento), S. Volonte (ESA), M. Ward (Univ. of Leicester)

More details and a registration form will be posted at:
http://www.eso.org/gen-fac/meetings/symp2002
or contact symp2002@eso.org for further information

Symposium secretaries — Christina Stoffer and Britt Sjöberg
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HST Cycle 11 Call for Proposals

Proposals for the 11th Cycle of HST observations are due on 7 September. This Cycle sees an increase in HST's capabilities:

– Deep, high spatial resolution and wide field (to 200"x200") imaging becomes possible with the *Advanced Camera for Surveys* (ACS). This camera has a powerful slitless spectroscopy mode for which the ST-ECF is providing software and support.

– The near-infrared imager, the *Near Infrared Camera and Multi-Object Spectrograph* (NICMOS), which exhausted its solid nitrogen cryogen in 1999, will be "re-awakened" with a mechanical cryocooler.

In addition
– the workhorse imager, *Wide Field Planetary Camera 2* (WFPC2) and
– the multi-purpose *Space Telescope Imaging Spectrograph* (STIS), will both continue to be available in Cycle 11

There is also an expansion in proposal types.
See **http://www.stecf.org/observing/** for links.

The ST-ECF HST archive is available to all at:
http://archive.eso.org

Support for extensive archive projects is growing through the ASTROVIRTEL programme (see **http://www.stecf.org/astrovirtel/**).

ST-ECF Support for ACS Spectrometry Modes

Among the capabilities of ACS, the major new instrument to be installed in the next HST servicing mission, will be slitless spectrometry using grisms in the optical range and prisms in the UV-blue range. The capability for low (R~100) resolution spectra over the ACS Wide Field Channel (WFC) of 200" square will be the most popular mode.
Whilst the imaging modes of ACS will be fully supported by STScI, the ECF is providing support for the spectral modes of ACS. Full details can be found on the ECF ACS Web page **http://www.stecf.org/instruments/acs/** and in the article starting on page 5.

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- or use www.stecf.org/newsletter

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