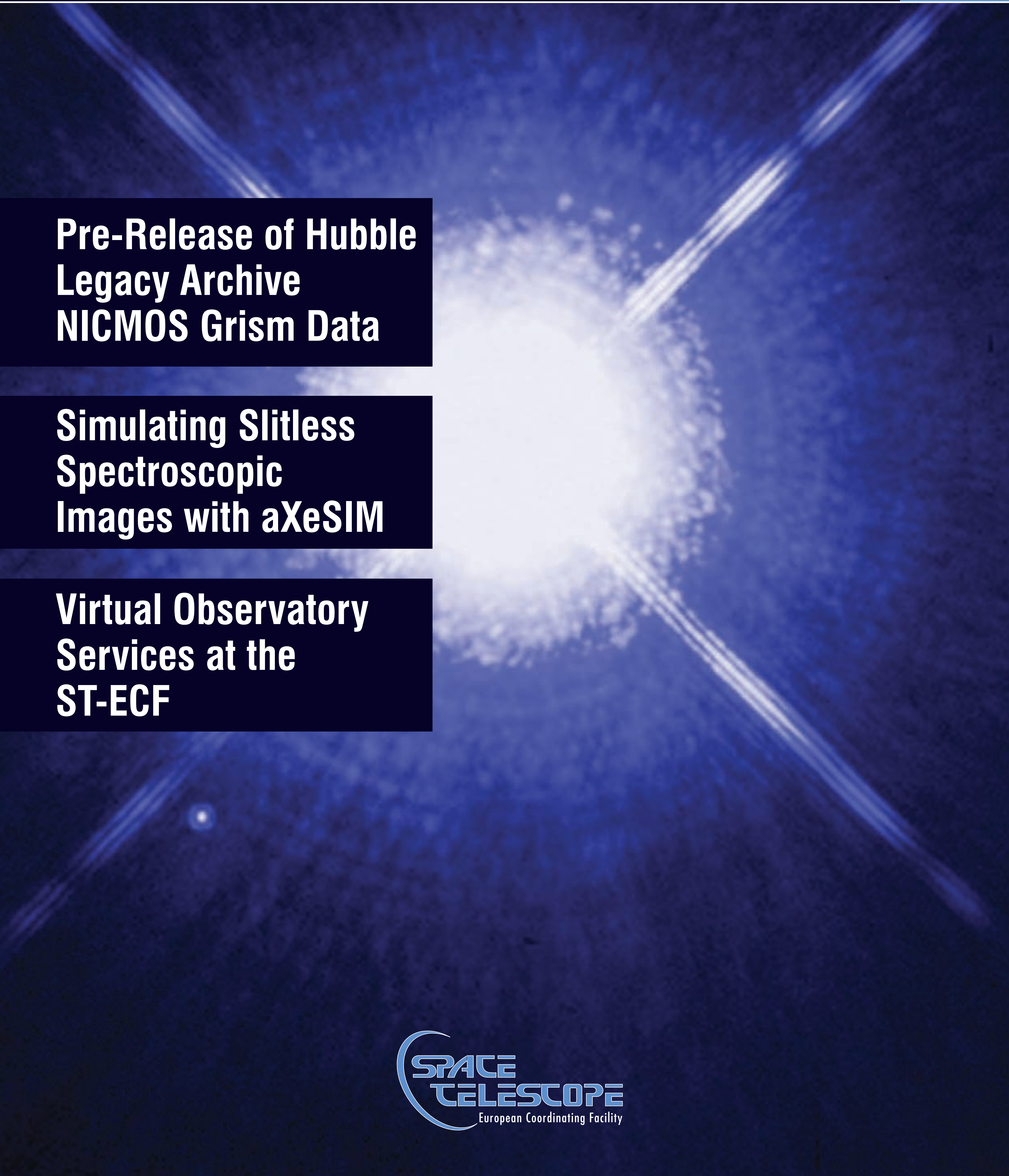
ST-ECF

NEWSLETTER

December 2007

43



Pre-Release of Hubble Legacy Archive NICMOS Grism Data

Simulating Slitless Spectroscopic Images with aXeSIM

Virtual Observatory Services at the ST-ECF

Space Telescope European Coordinating Facility

HUBBLE NEWS UPDATE

Jeremy Walsh

Gyroscopes form an important part of the Hubble pointing control system but they have a finite life and another failure had been anticipated for some time. After a long period of stable gyro status Gyro #2 failed on 31st August 2007 and Hubble entered zero-gyro sun-point safe mode. Gyro #6, which had been turned off to preserve its lifetime, was reactivated and within two days observations had resumed. In the currently used two-gyro mode, #1 and #6 are powered up and used for pointing and tracking, whilst #4 is switched off. Even if another two gyros fail before the next servicing mission, a one-gyro mode is under development and will be tested on Hubble early next year. Two days after the gyro failure, and shortly after the transition to operations from safe mode, the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) also entered safe mode. However, it appears that the two events were not related and the NICMOS safing was most probably caused by a 'single event upset', a feature that is perhaps related to a bitflip induced by radiation. NICMOS was quickly returned to normal operations.

Planning for the next servicing mission, SM4, and Hubble's last, is well underway and will bring Hubble to its best instrumented state ever. There will be two new instruments: the Cosmic Origins Spectrograph (COS) for deep UV single object spectroscopy; and Wide Field Camera 3 (WFC3) for UV-visual and near-infrared imaging. COS is an axial instrument and WFC3 replaces Wide Field Planetary Camera 2 in the radial bay. WFC3 includes spectroscopic modes that are supported by the ST-ECF; the article by Kümmel et al. on page eight describes an image simulation tool for slitless spectroscopy.

The two instruments that suffered low voltage power supply failures are planned to be repaired in SM4. A panel will be unscrewed from the Space Telescope Imaging Spectrograph (STIS), and after removal of some boards, a new power supply will be mounted. The repair for the Advanced Camera for Surveys (ACS) will be executed in a similar manner. Even though ACS only failed in January 2007, the preparation for the repair of STIS, which failed in 2004, has allowed the planning for the repair of ACS to be achieved in a short time. Other items for the servicing mission astronauts are replacement of batteries, installation of a new set of six gyros and installation of a replacement for the Fine Guidance Sensor unit #2, which has shown signs of wear. These replacements and repairs should enable at least five years of Hubble science with the widest Hubble instrument complement yet. The SM4 launch date is planned for August 2008.

In preparation for SM4, the call for proposals for Cycle 17 was released on 3rd December 2007 and the proposal deadline is 7th March 2008. The Time Allocation Committee (TAC) will meet in May 2008 and proposers will be notified shortly afterwards.

ERRATUM

Felix Stoehr

In the last ST-ECF Newsletter (number 42, July 2007) a small mistake slipped into a formula on page five in the article on spectral signal-to-noise. The indices k in the expression for the scaling factors should run from 0 to n-1, instead of from 1 to n. The correct formula is:

$$f_n = 1.482602 \frac{1}{\sqrt{\sum_{k=0}^{n-1} \binom{n}{k}^2}}$$

The rest of the article and the other formulæ, as well as the code to download, were all correct. We thank Jens Decker from Bruker Daltonik GmbH for spotting and reporting this error and apologise for any inconvenience this may have caused.

SCIENCE WITH THE NEW

HUBBLE SPACE TELESCOPE

AFTER SERVICING MISSION 4

A workshop to discuss the unprecedented scientific capabilities of the HST after Servicing Mission 4 presently scheduled for early August 2008.

29–31 JANUARY, 2008

Bologna, Italy
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THE HUBBLE LEGACY ARCHIVE – ST-ECF PRE-RELEASE OF NICMOS GRISM DATA

Wolfram Freudling, Jonas Haase, Richard Hook, Martin Kümmel, Harald Kuntschner, Marco Lombardi, Alberto Micol, Felix Stoehr & Jeremy Walsh

The Hubble Legacy Archive (HLA) is an international project to extract calibrated science data from the Hubble archive and make them accessible via user-friendly and Virtual Observatory compatible interfaces. It is a collaboration between the Space Telescope Science Institute (STScI), the Canadian Astronomy Data Centre (CADC) and the ST-ECF. The participating institutes released small subsets of the high level science data products on 30th July 2007 and this article describes one component of this “pre-release”: NICMOS grism data prepared by the ST-ECF.

INTRODUCTION

Hubble data retrieved from one of the archives have, in most cases, been calibrated by the instrument pipelines. These remove basic instrument signatures, but the data normally need substantial further processing before they can be used scientifically. The Hubble Legacy Archive is designed to optimize the long-term scientific use of Hubble data by building high-level science-ready data products on top of the pipeline-reduced products. The goal of the HLA is to produce such enhanced data products and provide access to them through easy-to-use and intuitive, fully VO-compliant interfaces.

The enhancements to the data include improvement of astrometry and flux calibration, the creation of co–added images including composites and colour images, and the extraction of footprints, source lists, and spectra from the data.

Slitless spectra, as collected by NICMOS, STIS, ACS and in future WFC3, are a vastly underused resource of Hubble and form the primary focus of the ST-ECF HLA work at present. The main advantage of slitless spectroscopy is that spectra can in principle be obtained from all objects within the field of view of an instrument. However, only a relatively small fraction of all spectra has ever been extracted. The ST-ECF HLA project aims to remedy this situation by providing extracted spectra from these instruments.

The main reason for the small number of extracted sources is that extracting one-dimensional spectra from such data is a complex process. A fraction of the slitless data in the Hubble archive has been collected to obtain spectra of specific objects, but spectra of objects other than the primary target have in most cases not been extracted or analysed. As an example the ACS grism has been used for deep spectroscopy of high redshift supernovæ (Riess et al. 2004) where the object of interest is just one of many spectra in the field. The goal of the ST-ECF HLA project is to extract spectra of as many objects as possible that have been observed with Hubble slitless spectroscopy modes, within the limits of available resources, and to serve these spectra through an archive together with an associated description of the spectra, such as how much one spectrum is contaminated by those of nearby objects.

HLA PRE-RELEASE

The first official data release (DR1) of the HLA is planned for early 2008. To give future users of HLA a feeling for the data that will be included in the HLA, a small fraction of all data, accessible through preliminary interfaces, was released on 30th July 2007. The imaging data for this pre-release can be accessed at http://hla.stsci.edu, and the ST-ECF HLA NICMOS spectral data at http://hla.stecf.org. The pre-release of imaging data consists of ACS images. Both data and colour composites can be directly accessed through a web browser and in addition, footprints and object catalogues are also available. In total, about 25% of the ACS images are included the pre-release.

The spectral data products prepared at the ST-ECF and included in the pre-release are one-dimensional spectra extracted from the slitless spectra taken with the NICMOS camera and the G141 grism. Previews and the FITS files of the spectral cutouts, the co-added undispersed direct images, and the extracted one-dimensional spectra are available through a query form (see Figure 1) that resembles the ST-ECF archive query form. In addition to this access mode, Data Release 1 in 2008 will also make the spectra available through a VO-compliant SSAP server (see article by Felix Stoehr on page 12).

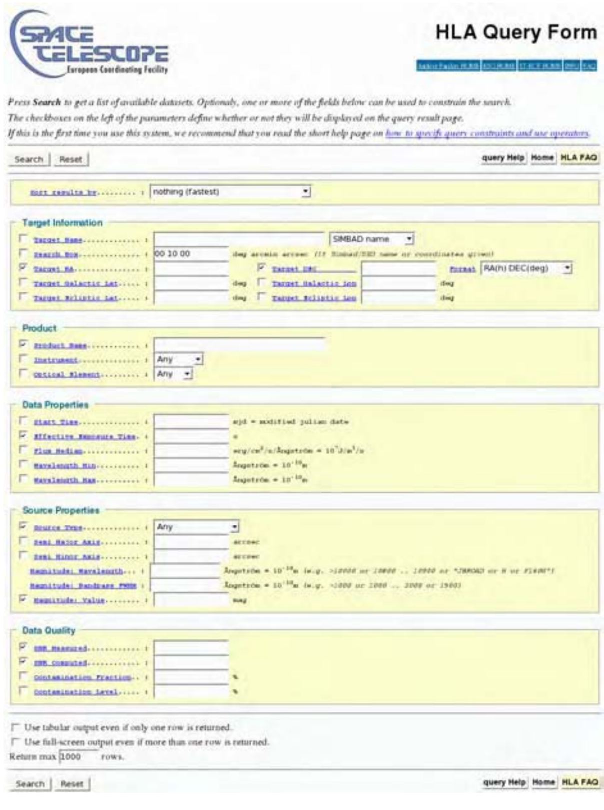

Fig. 1: *Query form for HLA NICMOS grism data.*

NICMOS G141 SPECTRA

THE DATA

G141 is the most used of the three grisms in the NICMOS camera and we have chosen to start the slitless spectroscopy HLA project with this data set. Available data include both pointed observations of specific targets, and the NICMOS parallel observations programme. The latter was a survey in cycles 7, 11, 12 and 13, where NICMOS was used in parallel with the primary instrument. In order to extract the spectra we grouped the NICMOS dispersed G141 images and NICMOS direct images of the fields into sets of overlapping images that use the same guide stars and for which all grism images have similar orientation on the sky. In total 962 such NICMOS G141 "associations" were created from the 9262 grism members (up to June 2007). The pointings are almost randomly distributed on the sky and are shown in Figure 2.

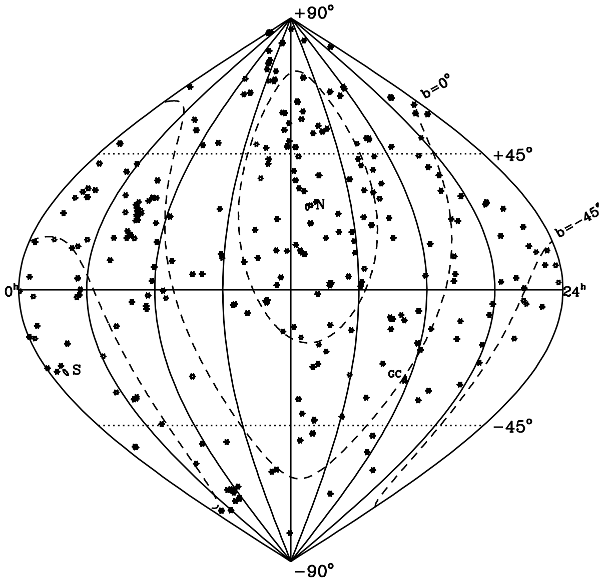

Fig. 2: *Distribution of NICMOS grism images on the sky.*

IMAGE PRE-PROCESSING

The standard pipeline in STSDAS does not treat slitless spectral data differently from direct images and does not extract the spectra. To obtain the highest quality spectrum extraction, the raw images have to be processed through a number of steps that go beyond the usual pipeline reduction.

The most important of these pre-processing steps are:

1. **CALNICA**. The STSDAS programme CALNICA (Bushouse 1997) produces calibrated images from the raw data. The processing steps include bias correction, dark current subtraction, and computation of the count rate for each pixel using all readouts. We re-run CALNICA on all grism images with parameter sets optimised for grism data.
2. **Bad Pixels**. Specially developed algorithms were used to recognize and flag bad pixels and cosmic rays on the grism images.
3. **Pedestal**. NICMOS images suffer from random DC offsets in the bias level, which might be different in each of the four quadrants. The value of this offset was estimated and subtracted from each image by analyzing the build-up of charge from the multiple readouts.
4. **Astrometry**. The coordinate system in the image header of pipeline reduced NICMOS images is accurate to about one arcsecond. We derived more accurate pointing information by identifying catalogued point sources with accurate coordinates in the undispersed images. The improved astrometry will be used for Data Release 1, but was not yet implemented for the pre-release.

EXTRACTION OF NICMOS SPECTRA

In order to automatically reduce the NICMOS slitless data, the end-to-end Pipeline for the Hubble Legacy Archive Grism data (PHLAG, see Kümmel et al. 2007) has been developed. Inputs to PHLAG are dispersed data and matching direct images that have had only the basic calibrations applied. As output, PHLAG delivers fully calibrated, VO-compatible spectra ingested in the HLA archive.

The pipeline consists of several reduction steps and uses already-existing software whenever possible:

1. **Data preparation**. The data are prepared for the pipeline reduction. The direct images are grouped according to the filter. Lists of pairs, comprised of one direct image and one slitless image with small positional offsets, are created.
2. **Image combination**. The direct images are combined using MultiDrizzle (Koekemoer et al. 2006) in combination with other software.
3. **Object detection**. The object detection software SExtractor (Bertin & Arnouts 1996) is run on the deepest direct image.
4. **Spectral extraction**. The extractions of 1 and 2-D spectra are performed using a NICMOS-optimised version of the aXe software package (Pirzkal et al. 2003, Kümmel et al. 2006).
5. **Metadata**. The spectra are prepared for ingestion into the database. The metadata are collected or derived from the spectra.
6. **Data ingestion**. All products are inserted into the data base tables of the archive.

CALIBRATION OF NICMOS SPECTRA

The extracted NICMOS spectra are based on a completely new set of calibration data that was derived from the full set of NICMOS calibrations collected over the whole history of the instrument. These observations were analysed using the same software that was used to extract the science data.

1. **Flat field Cube**. A key ingredient for extracting spectra is a wavelength-dependent flat field cube that is used to correct for the flat field at each pixel for any wavelength over the

entire range of the grism. The flat field cube used was produced from both the broad and narrowband NICMOS image flat fields.

2. **Wavelength Calibration**. In-orbit wavelength calibration for G141 spectra was established by observations of spectra of planetary nebulæ (PNe). Two compact PNe were used – Hubble 12 and Vy2-2. Figure 3 shows the 1D spectrum of Hb12 extracted with PHLAG with the identified emission lines indicated. First order polynomial fits were made to the variations of the pixel position with wavelength.

3. **Flux Calibration**. The flux calibration was derived separately for data acquired before and after the installation of the NICMOS cryocooler (NCS), from the combined observations of three different flux standard stars (GD153, G191B2B and P330E). The average flux calibrations agree to about 3% between the three standard stars. However, variations as a function of position within the field of view show a scatter of about 8%. Overall the absolute flux calibration for individual extracted spectra should be accurate to better than 10%.

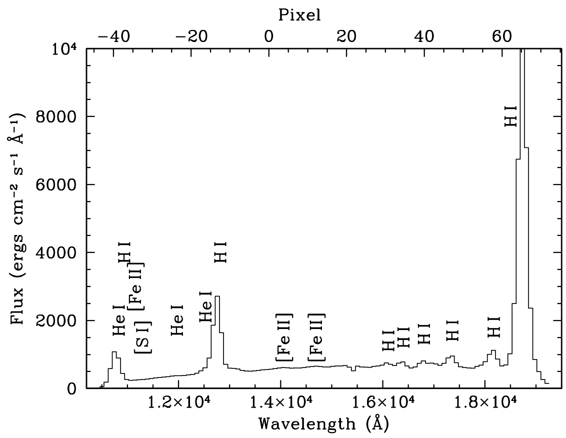

Fig. 3: *NICMOS G141 spectrum of the planetary nebula Hb12 showing the emission line identifications. The upper axis shows the offset in pixels from the position of the direct image.*

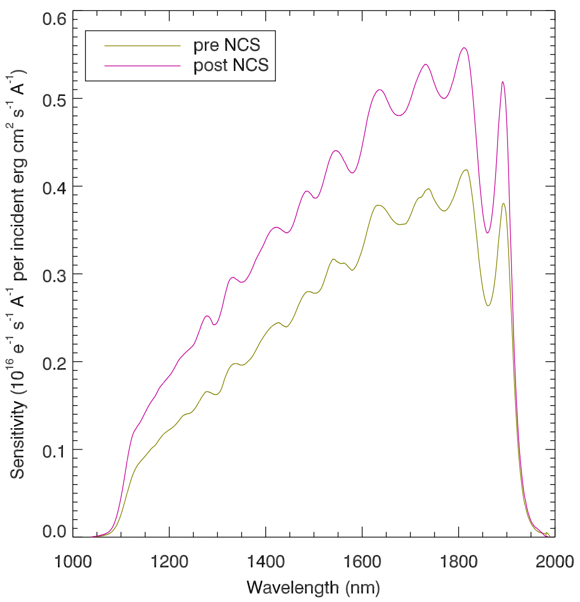

Fig. 4: *NICMOS sensitivity curves against wavelength for the G141 grism are shown for the periods before and after the installation of the NICMOS cryocooler (NCS).*

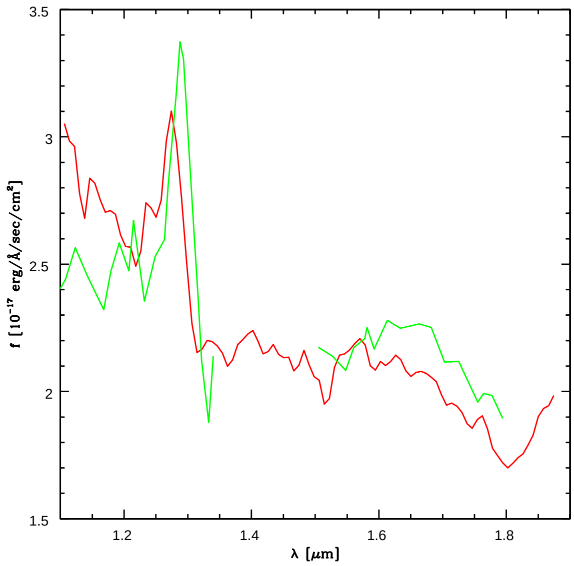

Fig. 5: *Comparison of an HLA NICMOS spectrum with a Gemini spectrum of the same source. The green curve is the heavily-smoothed spectrum of SDSS J083643.85+005453.3 from Stern et al. (2003), the red curve is HNG J083643.82+005453.4 (N6LE01ULQ).*

SPECTRA IN THE PRE-RELEASE

The ST-ECF NICMOS HLA pre-release contains about 10% of the G141 spectra. These are the spectra of mostly unresolved objects with the highest signal-to-noise ratio. Some examples of extracted spectra are given in Figures 5 and 6.

Figure 5 compares the spectrum of two high redshift QSOs to spectra from Gemini (Stern et al. 2003) and the NICMOS grism extraction of the same object. The shape of the line and continuum around the CIII line at 1.3μm is well reproduced.

In Figure 6, we compare HLA NICMOS spectra of the brown dwarf ASR 24 with the spectra extracted from the same data set by Greissl et al. (2007). ASR 24 has been observed three times with NICMOS G141 with three different roll angles. The HLA hence contains three separate spectra of this source, namely HNG J032911.32+311717.5 (N8VM06BEQ), HNG J032911.32+311717.5 (N8VM09G5Q) and HNG J032911.32+311717.6 (N8VM16S3Q). The file naming scheme concatenates the standard HLA NICMOS grism prefix and the position on the sky and the original data association name is also given in brackets. Greissl et al. (2007) did not derive a flux scale for this data and the spectrum has therefore been scaled to match the HLA extraction. It can be seen that the absolute and relative flux calibrations of the three HLA extractions agree to within 10%.

OUTLOOK

The HLA NICMOS grism project provides a database of H-band IR spectra, most of which have never been extracted from the grism data. The absolute and relative flux calibration of the spectra are currently better than 10%. The astrometric accuracy of the final data release will be about 0.2 arcseconds although this is not achieved in the pre-release. The first full data release in 2008 will include a much larger fraction of the grism spectra, further improved calibration, and distribution through completely new interfaces.

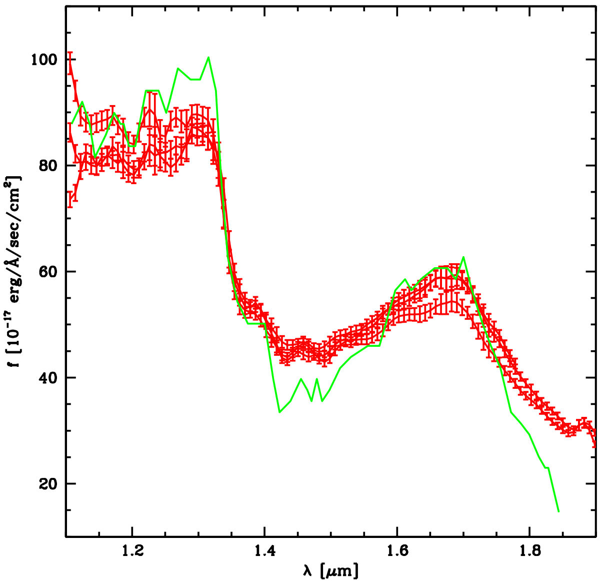

Fig. 6: Comparison of HLA spectra of brown dwarf ASR 24 (red curves and error bars) with the spectrum published by Greissl et al. (2007) (green curve). The green curve has been scaled to match the mean flux level of the HLA data.

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HUBBLE SEES THE GRACEFUL DANCE OF TWO INTERACTING GALAXIES [heic 0717]

Two galaxies, containing a vast number of stars, swing past each other in a graceful performance choreographed by gravity. The pair of galaxies, known collectively as Arp 87, is one of hundreds of interacting and merging galaxies known in our nearby Universe. Arp 87 was catalogued by astronomer Halton Arp in the 1960s. Arp's Atlas of Peculiar Galaxies is a compilation of astronomical photographs using the Palomar 200-inch Hale and the 48-inch Samuel Oschin telescopes. The resolution in the Hubble image shows exquisite detail and fine structure that was not observable when Arp 87 was first catalogued. Arp 87 is in the constellation Leo, the Lion, approximately 300 million light-years away from Earth. These observations were taken in February 2007 with the Wide Field Planetary Camera 2. Light from isolated blue, green, red, and infrared ranges was combined to form this colour image.

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

SIMULATING SLITLESS SPECTROSCOPIC IMAGES WITH AXESIM

Martin Kümmel, Harald Kuntschner & Jeremy Walsh

The ST-ECF has worked for many years on methods for extracting spectra from slitless Hubble data sets. This support will continue for the Wide Field Camera 3 that will be installed on Hubble during the SM4 servicing mission in summer 2008. However, before such data can be acquired proposals need to be prepared and being able to simulate datasets before they are acquired is vital for observers, allowing them to assess the feasibility of observations and estimate appropriate exposures times. The ST-ECF has developed a slitless spectroscopy simulator that is available as both an application and as a web-based tool.

INTRODUCTION

During Servicing Mission 4 the Wide Field Camera 3 (WFC3) is going to be installed on Hubble. Besides imaging, WFC3 offers slitless spectroscopy on both the ultraviolet/optical (UVIS) and infrared (IR) channels. The UVIS channel is equipped with the G280 grism, which has a resolving power R~70 in the wavelength range 200-400 nm. The IR channel includes the grisms G102 and G141 with resolving powers R~210 in the range 800-1150 nm and R~130 in the range 1100-1700 nm, respectively.

The ST-ECF is responsible for supporting the WFC3 slitless spectroscopic modes. As part of this support, we have developed aXeSIM, a dedicated software package to simulate WFC3 slitless spectroscopic images. While the WFC3 slitless support was certainly the prime target for aXeSIM, it is equally applicable to other instruments on Hubble featuring slitless spectroscopy such as ACS and NICMOS.

aXeSIM can help WFC3 users during their Phase I and II proposal preparation. In particular it allows observers to:

- gain a two-dimensional impression of the layout of a target field and assess potential problems arising from crowding or spectral overlap;
- explore in two dimensions the sensitivity and resolution offered by the various slitless modes;
- determine the optimal pointing and roll angle for a specific target field;
- become familiar with the characteristics and reduction of slitless spectroscopic images.

In order to mimic observational data very closely, aXeSIM also can optionally produce a matching direct image (through a user-selected filter) for each slitless image.

THE INPUT TO AXESIM

To simulate slitless spectroscopic images, aXeSIM needs two things as input. Firstly a complete characterisation of the slitless mode including trace information, wavelength solutions and information about sensitivity. Secondly a description of the objects to be simulated is needed. This information includes the object position, the object shape and its spectral characteristics.

For the characterisation of slitless modes, aXeSIM uses the same configuration and calibration files that are used by the spectral extraction package aXe (developed and maintained at the ST-ECF, see the aXe webpage: http://www.stecf.org/software/slitless_software/axe/ and Kümmel et al. 2006) when extracting the spectra. This closes the loop between aXeSIM simulations and the subsequent extraction of the simulated spectra with aXe, since identical files are used in both.

The user has several possibilities to describe the simulation objects. In the most basic form, each object is represented in one row of a simple text table like that produced by SExtractor. The object position is given by its pixel coordinates on the detector, the object shape is Gaussian (defined by major axis size, minor axis size and position angle), and the object "spectrum" is flat in f_λ (described with an AB-magnitude value at a certain wavelength).

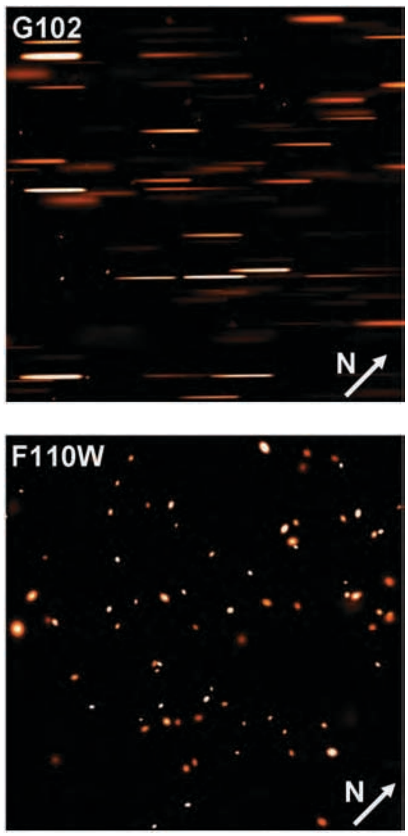

Fig 1: *NICMOS HUDF field simulated for the WFC3 G102 grism and in the F110W filter shown in the upper and lower images, respectively. The field is 133"x133", which is the FOV of the WFC IR channel. Both images are noise free.*

In order to simulate more realistic objects, the user can also:

- provide 2D image templates to define “real” object shapes;
- build more complex spectral energy distributions using several AB-magnitudes at different wavelengths;
- specify a high resolution spectrum for each object. In this case the spectrum is redshifted and normalized in flux to user-provided z and brightness in a chosen filter passband.

aXeSIM allows the different options for defining an object to be mixed. So it is possible to simulate one target object with a high resolution spectrum and two-dimensional image template together with ‘background objects’ described in the basic form.

The aXeSIM limitation that an object spectrum cannot vary over its area can be circumvented by decomposing an object into several components and providing a different spectrum for each component. As an example an aXeSIM user could build a spiral galaxy by declaring one object for the bulge, one for the spiral arms and several objects for HII regions, providing different object shapes and spectra for each component. In principle, it is even possible to simulate a larger object by declaring each pixel to be an individual object with its own spectrum.

THE OUTPUT OF AXESIM

The basic result of an aXeSIM simulation is a dispersed image in units of [e/s]. In addition options in aXeSIM allow for:

- the generation of a corresponding direct image if a total filter passband is provided;
- the addition of a sky background;
- the addition of noise (readout and Poisson noise from sky background and sources);
- the adjustment of the image size;
- a default spectral extraction on the simulated image with the identical source list and configuration file used for the simulation.

The direct image and slitless image pairs produced by aXeSIM mimic very closely the data coming from the real instrument. It is straightforward to run SExtractor on the direct image and then the aXe extraction software (Kümmel et al. 2006) on the slitless image for sophisticated investigations beyond the default aXeSIM extraction.

EXAMPLES

As examples we present two typical applications of aXeSIM for the WFC3/IR grisms G102 and G141. The configuration and calibration files for this instrument mode were derived from data taken during Thermal Vacuum 2 Testing (July/August 2007) and are available from the ST-ECF webpage (http://www.stecf.org/instrument/WFC3grism).

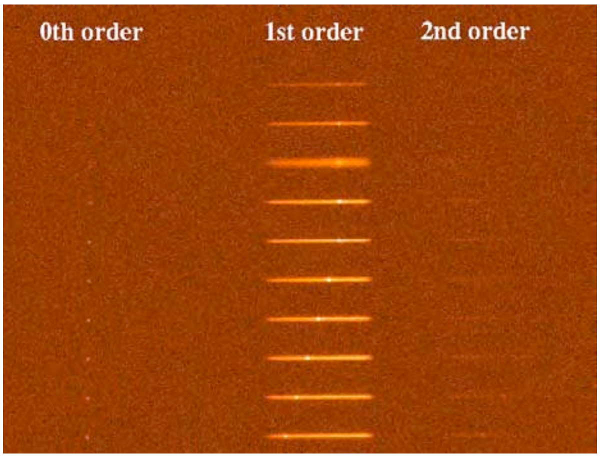

Fig 2: *Simulated slitless image for a starburst galaxy with ten different realisations of redshift, magnitude and size. Here we show an image cutout of roughly 750 x 600 pixels. See text for details.*

1. The NICMOS Hubble Ultra Deep Field

To illustrate the capabilities of aXeSIM we have simulated a WFC3/G102 noise-free observation of the NICMOS Hubble Ultra Deep Field (HUDF). The 144” x 144” size of this field is a perfect match to the 133” x 133” field of view of the WFC3 IR channel. The original source list, published in Thompson et al., was used to derive the source positions and source shapes in the WFC3. The AB-magnitudes from the source list were taken to describe the object spectral energy distribution. In the sensitivity range of the G102 grism (see above), a spectrum is defined by the magnitudes in the filters ACS/F775, ACS/F850LP and NICMOS/F110W. In this example simulation a magnitude cut of F160W < 23.0 mag was applied to limit the number of objects to $\sim$100, thus keeping the computation time low ($\sim$1h).

Figure 1 shows the slitless G102 image at the top and the corresponding direct image (in F110W) at the bottom. The dispersed image displays the mutual overlap of spectra that is typical of slitless spectroscopy. The sharp spots in the dispersed image are the zeroth order spectra, which are around 300 pixels to the left of the first orders, and for bright objects the second orders are also visible, offset by 300 pixels to the right.

Using aXeSIM with different orientations for the dispersion direction, it would be possible to identify the roll angle that results in the least possible overlap for a selected primary target object or set of objects.

2. Starburst galaxies

For the second example we have simulated galaxies using a starburst template spectrum (Hα emission equivalent width of 100Å) and redshifts between 0.8 and 1.3. The G141 grism covers the region of Hα emission for those redshifts. Figure 2 shows the simulated slitless image featuring ten different simulation setups. The exposure time was set to 2000s, which corresponds to a typical one orbit integration. Counting from the bottom the first five simulations show a starburst galaxy with H $= 20.0$ and redshifts of 0.8, 0.9, 1.0, 1.1 and 1.2. These examples represent typical observations that have been previously obtained with the NICMOS slitless mode (McCarthy et al. 1999).

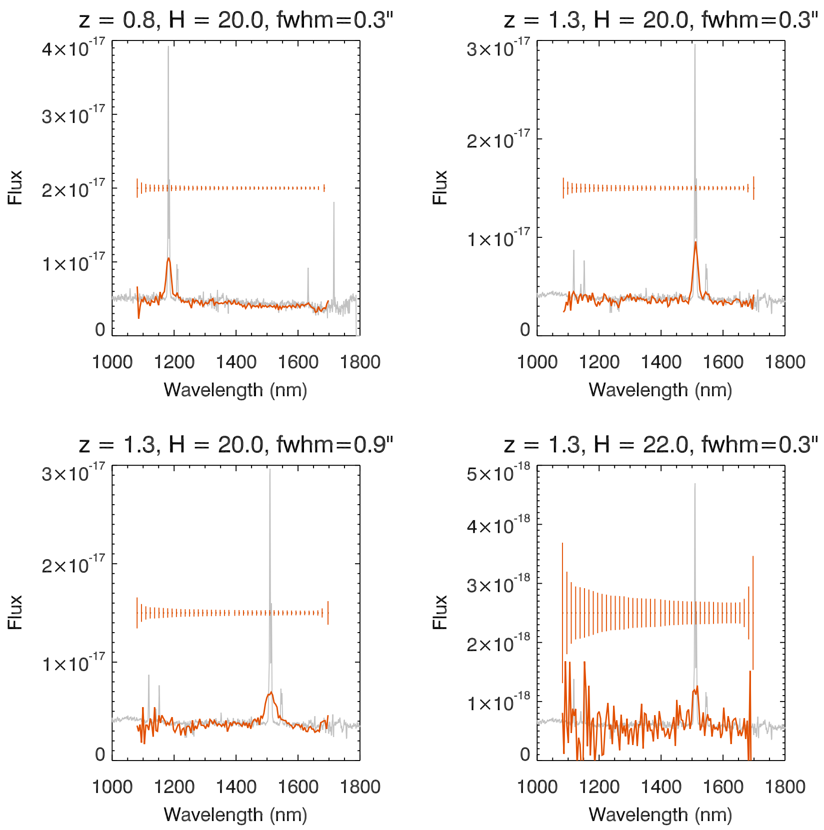

Fig 3: *Comparison of the input template (grey spectrum) and the spectra extracted from our simulations (red line). The redshift, target magnitude and target size (FWHM) is given in the title of each panel. Typical error bars for the simulated spectra are shown in the middle of each panel.*

To define the object shape we have broadened the WFC3/IR point spread function by convolution with a Gaussian with σ=1 pixel in order to produce an object with FWHM = 0.3", and used the resulting two-dimensional stamp image as an image template. In Figure 2 one can clearly see the zeroth and first orders, while there is only a faint trace of the second order. The Hα emission line moves to the right with increasing redshift. For the next three simulated spectra we used H = 20.0 and a constant redshift of 1.3, but image templates with varying size (point source, FWHM = 0.3" and FWHM = 0.9"). The top two spectra show targets of H = 21.0 and H = 22.0 at a redshift of 1.3 and a target size of 0.3".

In Figure 3 we show a comparison between the input template spectrum and our extracted one-dimensional simulated spectrum for four selected cases. The prominent emission feature seen in all four panels is Hα. For slitless spectroscopy, the effective spectral resolution is not only determined by the grism, but also by the target size. This is demonstrated in the lower left panel where we have increased the target size by a factor of three resulting in a much broader appearance of the Hα emission line. Targets as faint as H = 22.0 at our nominal target size of 0.3" can be detected in a single 2000 s exposure. Fainter objects are still detectable, however in these cases a more detailed treatment of non-statistical noise sources (eg, flat-field errors and bad pixels) becomes important.

WORKING WITH AXESIM

aXeSIM can be downloaded from http://www.stecf.org/software/slitless_software/axesim/. It is distributed as a PyRAF/IRAF package and operates from within any recent version of PyRAF. aXeSIM consists of several tasks, but in most usage scenarios (as in all examples presented here) it will only be necessary to execute a single command, the high level task called simdata.

In addition, aXeSIM for WFC3 is available via a web interface at http://www.stecf.org/instruments/aXeSIMweb/. Without any registration or administrational overhead, the user can select a WFC3 slitless mode, choose or adjust additional parameters and start the simulation. Once ready, the simulation images and data can then be downloaded directly from the web. The web interface targets new, less experienced or occasional users and offers a subset of all options existing in aXeSIM.

aXeSIM will also be distributed as part of the STSDAS version 3.8 release, which is projected to be in January 2008.

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Astrophysikalisches Institut Potsdam | Germany

Practical Workshop

on IFU observations and data reduction

19 - 24 May 2008

eas.iap.fr/ifu.html

opticon.3d-school.aip.de

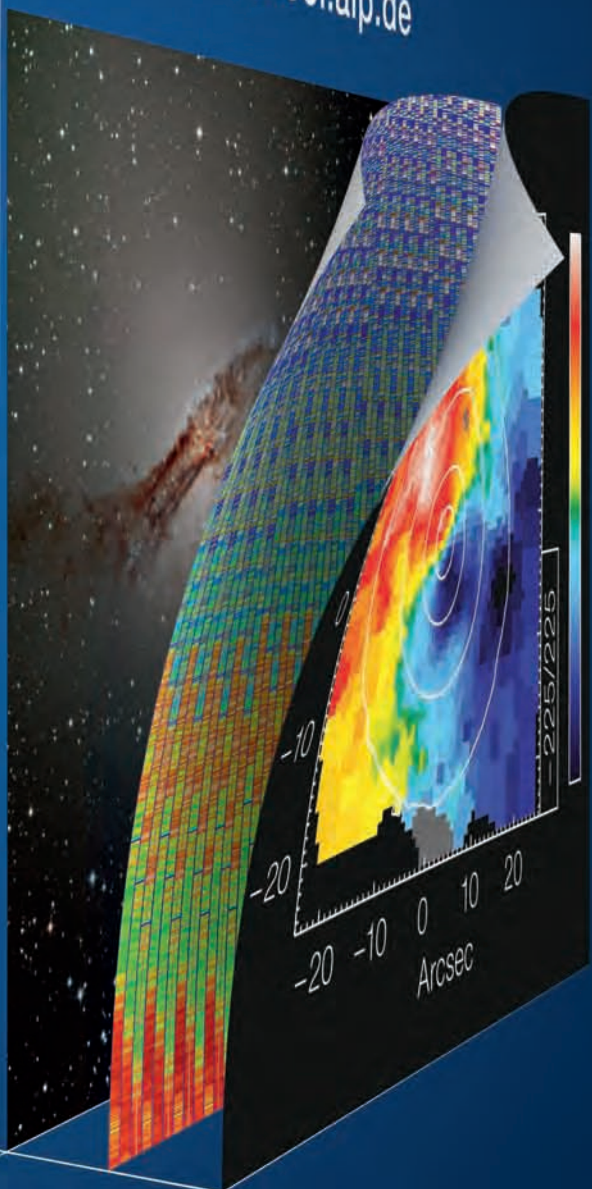
The Network of European Observatories in the North (NEON) is pleased to announce a workshop on Integral Field Unit observations and data reduction. The workshop is sponsored by the European Community, Marie Curie actions and by OPTICON.

The aim of this workshop is to provide the opportunity for potential IFU users to obtain practical experience in observational techniques, data reduction and analysis. Various types of IFU set-ups will be represented (e.g., fibre instruments, lens arrays, slicers) and participants will have the opportunity to work in small groups on data from instruments of their choice, under the direction of experienced tutors.

The mornings will be devoted to general lectures on various technical aspects, as well as some scientific highlights from actual observations. The afternoons are reserved for practical work. The presence of experts in the field will offer a unique opportunity to share experience obtained with various IFU instruments.

The workshop is open to PhD students or PostDocs, and also to more senior astronomers, who would like to gain first-hand experience with IFU data and techniques. For PhD students who are nationals of a member state or associated state of the EU, a contribution to their expenses will be provided. Other requests for cost reimbursement will be considered on a case-by-case basis.

The application deadline is 24th February 2008.



AIP

VIRTUAL OBSERVATORY SERVICES AT THE ST-ECF

Felix Stoehr

The Virtual Observatory is now an operating reality and an important way of delivering science content to the world. In this article the current VO access points at the ST-ECF and the services they provide are briefly introduced.

THE VIRTUAL OBSERVATORY IN A NUTSHELL

The Virtual Observatory (VO) is a global effort to enable new astronomical research by allowing global electronic access to the available astronomical data archives and computing resources.

Perhaps the most important aspect of this effort is the standardisation of the description of scientific data (normally called the metadata) and the definition of protocols that define how services can be queried and how data and metadata can be accessed in an easy way. Standards and protocols are defined by the International Virtual Observatory Alliance (IVOA) and these can be obtained from their web page (http://www.ivoa.net/Documents).

In a VO environment, software tools can simultaneously query a number of astronomical databases and treat the returned standardised answers in order to, for example, display the astronomical images or spectra on the computer screen of the user. The simplest of these queries is to ask for all objects in a given region on the sky that the databases contain. Such a query is called a "cone search". However, more complex query constraints, such as requiring that the resulting data also lie within a certain wavelength range, are possible.

THE VIRTUAL OBSERVATORY AT THE ST-ECF

The ST-ECF is already distributing scientific data through the VO by offering the spectral data from the Faint Object Spectrograph (FOS) using the Simple Spectrum Access Protocol (SSAP – http://archive.eso.org/bin/fos_ssap.pl) as well as previews of all images taken with Hubble's cameras through the Simple Image Access Protocol (SIA – http://archive.eso.org/archive/hst/siap1.0/preview).

Apart from the publication of the Hubble Legacy Archive NICMOS grism spectra (see Freudling et al. on page four), and their access through the standard archive interface http://archive.eso.org/wdb/wdb/hla/product_science/form, we also provide VO SSAP access at: http://www.stecf.org/hla-vo.

To implement these services we have used the DALserver Toolkit (http://webtest.aoc.nrao.edu/ivoa-dal/dalserver.html) from Doug Tody and the footprint library (http://wiki.eurovotech.org/twiki/bin/view/VO-Tech/FootprintLibrary) from Jean-Christophe Malapert. These run on a Tomcat Apache server.

The VO services at the ST-ECF are complementary to those available at the Multi Mission Archive of the Space Telescope Science Institute (MAST, http://archive.stsci.edu/ssap/search.php?id=HST & http://archive.stsci.edu/siap/search.php?id=HST).

The figure shows footprints of the equivalent slits of NICMOS grism spectra in the new ESO archive browser VirGO. In order to produce this output, VirGO had directly queried the ST-ECF HLA SSA server. A number of metadata entries are shown on the right-hand side and clicking on "Data set" allows the direct download of the data from the ESO/Hubble archive. The spectrum can be loaded into a VO display tool such as VOSpec (http://esavo.esa.int/vospec) as shown in the inset.

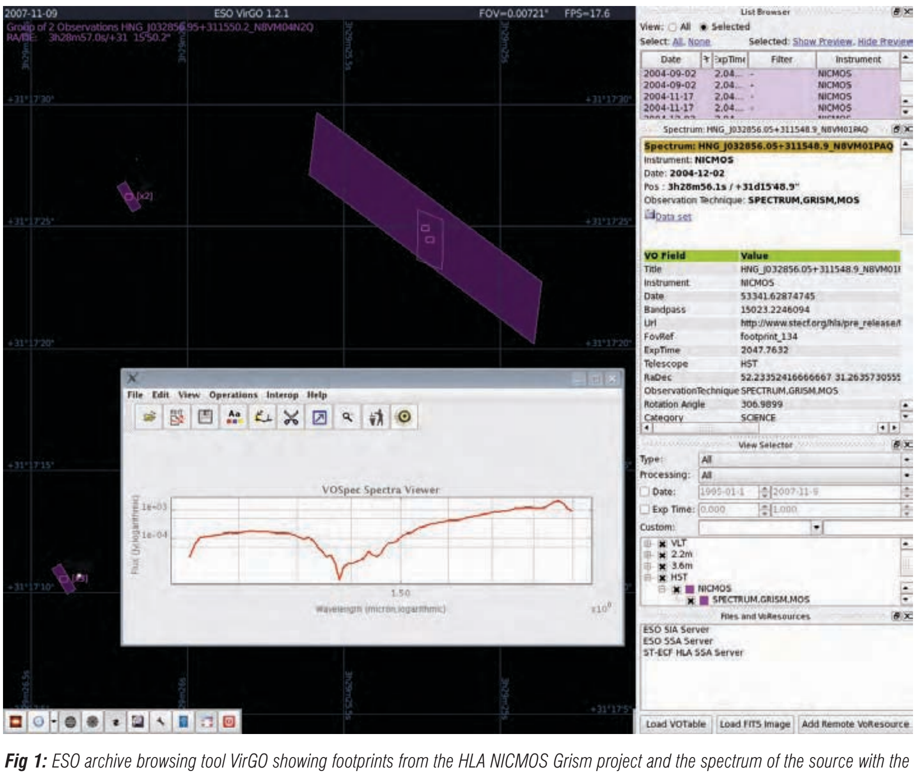
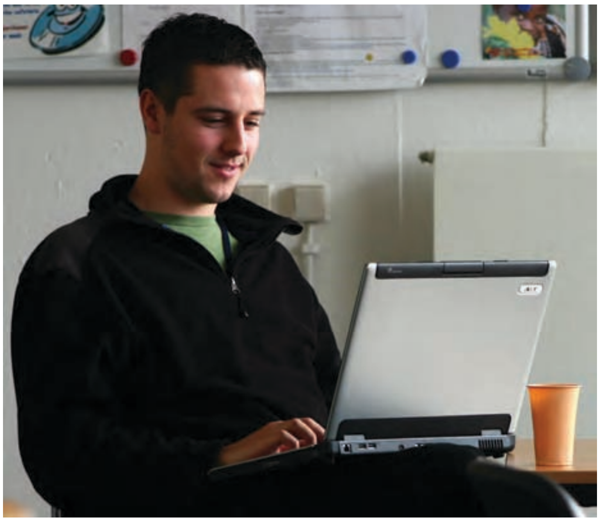


Fig 1: *ESO archive browsing tool VirGO showing footprints from the HLA NICMOS Grism project and the spectrum of the source with the largest footprint in a VOSpec window.*

INSIDE THE ESA/HUBBLE INTERNSHIP PROGRAMME

Will Gater (ESA/Hubble)



When I was young I had a huge poster of the 'Pillars of Creation' proudly displayed on my bedroom wall. It stayed there for many years and was the ultimate interior decoration for an astronomy obsessed twelve year old. Now, well over a decade later, it's somewhat surreal for me to be working in the office where the European pictures and news from the NASA/ESA Hubble Space Telescope are made.

My placement at the Hubble Europe Information Centre (HEIC) is part of the internship programme run by the ESA/Hubble office in Garching near Munich, Germany. The programme welcomes a variety of applicants whether they are undergraduates, graduates or even post-graduate students. Interns can choose one of two streams to embark upon when joining the centre that should give a, quite literally, hands-on approach to the work of the ESA/Hubble press office. Interns can either work in graphic design or in science communication/journalism.
Science communication interns work closely with the head of communication Lars Lindberg Christensen in producing news and photo releases, website material, promotional press material and articles which are published by the groups working under the umbrella of the HEIC. This means that one day you might be writing the next news release of a new Hubble discovery and the next editing material for an International Astronomical Union (IAU) publication. The work of the science communication intern is indeed varied and if you are interested in learning a breadth of writing, editing and production skills it is an excellent introduction.

Potential science communication interns interested in learning how to write material for new media projects would be well placed in the ESA/Hubble group. The office is responsible for producing the Hubblecast, an international renowned video-podcast that regularly attracts many thousands of downloads a month, currently on its tenth episode. Interns may be required to script and aid in the making of this dynamic production. Writing for a range of different productions and publications means that a science communication intern gets excellent experience in learning how to communicate to differing audiences and levels.

Students who engage in the graphic design programme are similarly presented with a range of challenges which may encompass website design and interface work, production of video or audio material such as the Hubblecast as well as image processing of Hubble images.

So what does the day of the science journalism/communication intern involve? Well work begins at about 9 am in the press office. After checking the morning emails (the most important method of communicating across the office and between scientists) work begins. As mentioned the work is varied, so for instance today I have been working on a news release of a Hubble result as well as some editing and research for an IAU website. Once a month a few members of the team (including Lars and lead graphic designer Martin Kornmesser) travel to a studio to film the Hubblecast. Sometimes an intern may be asked to join the team in the studio to make last minute suggestions and script alterations. This requires on the spot ideas and quick thinking and is a great experience in a new and exciting facet of science communication.

Science journalism interns may also participate in teleconferences (telecons) with Hubble scientists. Telecons are a valuable tool to the science communicator as they are a quick and effective way to gather lots of information from the scientist as well as ask questions which can improve and refine your work, such as a news release. Learning how to interview a scientist – asking the right questions and getting what you need from them – not only saves you time but the scientists too and will undoubtedly improve your interview technique.

If you are interested in gaining invaluable experience in science communication and want to work with a team of professional communicators then the ESA/Hubble internship is a great way to go forward. Be prepared to learn new skills and material and be prepared to work hard! One of the best things about working in the ESA/Hubble office is how genuinely involved in the projects you become. If you are ready and prepared for these aspects then an ESA/Hubble internship is for you!

For more information about the individual internships and their requirements you can visit – http://www.spacetelescope.org/jobs/.

EXTREME STAR CLUSTER BURSTS INTO LIFE IN HUBBLE IMAGE [heic 0715]

NGC 3603 is a prominent star-forming region located in the Carina spiral arm of the Milky Way, about 20,000 light-years away from our Solar System. This image from the NASA/ESA Hubble Space Telescope shows a young star cluster surrounded by a vast region of dust and gas. Most of the bright stars in the image are hot blue stars whose ultraviolet radiation and violent winds have blown out an enormous cavity in the gas and dust enveloping the cluster.

The Hubble image provides a snapshot in time of many stars with differing masses but similar ages inside the young cluster. This allows for detailed analysis of several types of stars at varying stages in their lives. Astronomers can then compare clusters of different ages with one another and determine which properties (such as temperature and brightness) change as the stars get older.

According to astronomer Dr. Jesús Maíz Apellániz from Instituto de Astrofísica de Andalucía, Spain, who is leading the Hubble investigation, the massive star cluster in NGC 3603 appears to gather the most massive stars at its core. He and his team have discovered that the distribution of different types of stars at the centre of this very dense cluster is similar to that of other young star clusters in the Milky Way.

The team has also found that the three brightest stars in the centre are apparently misleading us into believing that they are more massive objects than theoretical limits allow. These heavyweight stars may actually consist of two or maybe more individual massive stars whose light has blended together. Even with the resolution of Hubble it is not possible to separate the individual stars in each of the three systems. This finding agrees with a recent discovery by Dr. Anthony Moffat from the Université de Montréal, Canada, who used ESO's Very Large Telescope and Hubble's infrared NICMOS camera to measure the movements of the individual stars in two of the three systems. Dr. Moffat measured the largest individual mass to be roughly 115 solar masses, which is within the acceptable limits for conventional theory.

The swirling nebula of NGC 3603 contains around 400,000 solar masses of gas. Lurking within this vast cloud are a few Bok globules (seen at the top right corner of the image), named after Bart Bok who first observed them in the 1940s. These are dark clouds of dense dust and gas with masses of about ten to fifty times larger than that of the Sun. They resemble insect cocoons and are undergoing gravitational collapse on their way to form new stars. Bok globules appear to be some of the coldest objects in the Universe.

NGC 3603 was first discovered by Sir John Herschel in 1834. It is known to harbour a blue supergiant star called Sher 25 that can be spotted above and left of the densest part of the cluster. This star is believed to be near the point of exploding as a supernova and is often denoted as the Milky Way counterpart of the predecessor of the now famous supernova SN 1987A.

NASA, ESA and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration

The 7th NEON Observing School

La Palma Observatories, La Palma, Spain, 23 June – 5 July, 2008

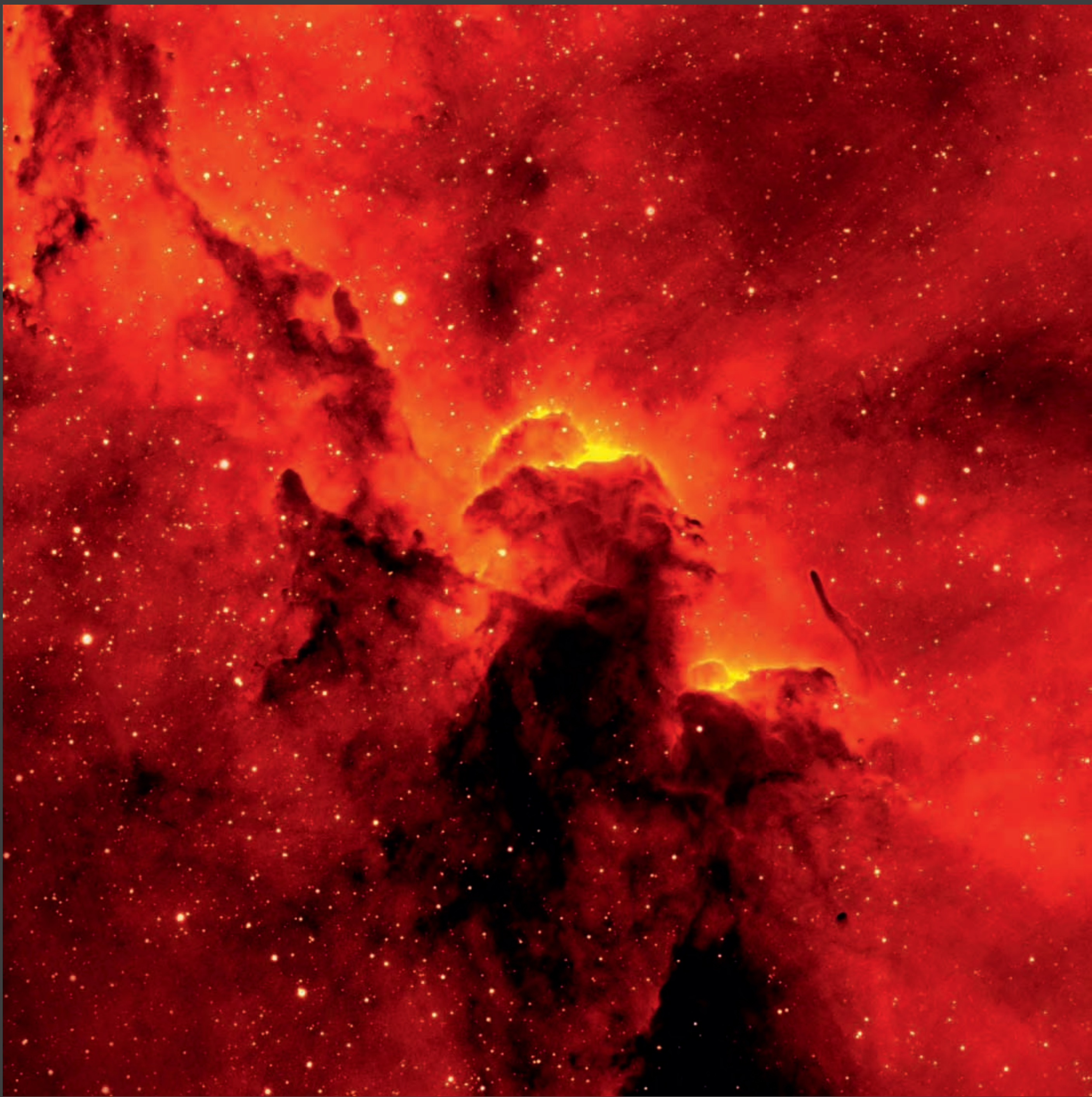


Image: IC 1396B Nebula by the 2.5-m Isaac Newton Telescope. Nick Wright (UCL) and the IPHAS collaboration.

The Network of European Observatories in the North (NEON) is pleased to announce the 7th NEON Observing School. The school is sponsored by the European Community, Marie Curie Actions and supported by OPTICON and the European Astronomical Society (EAS).

The purpose of the summer school is to provide the opportunity for young researchers to gain practical experience in observational techniques, data reduction and analysis. Students will carry out research projects directly at the telescope by conducting observing runs in small groups under the supervision of experienced astronomers. These practical exercises will be complemented by lectures on observational techniques.

The school is principally open to astronomy PhD students and postdocs who are nationals of a Member State or an Associate State of the European Union. Applications from other European countries will also be considered.

The application deadline is 31 March 2008

For details, see:

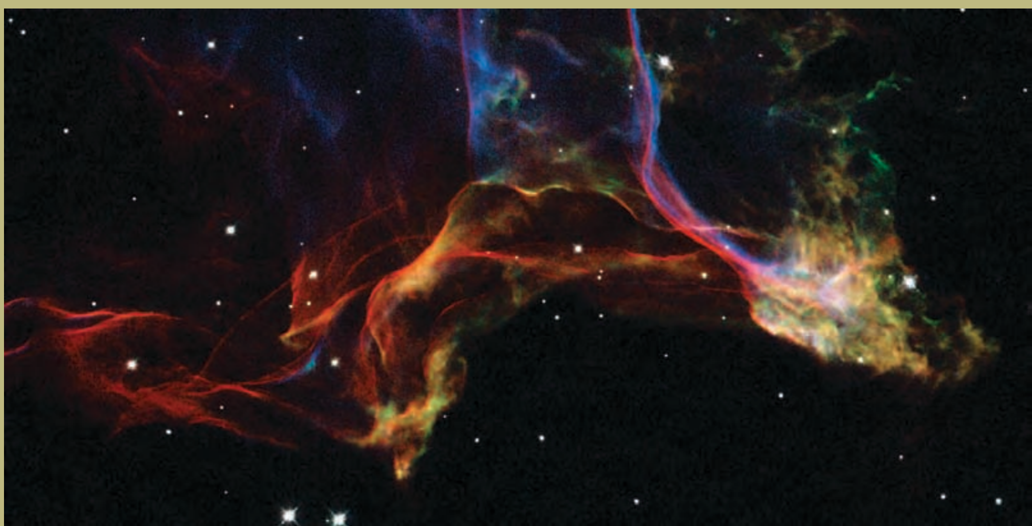
www.eso.org/neon-2008

www.iap.fr/eas/neonNew.html

UNCOVERING THE VEIL NEBULA [heic 0712]

The NASA/ESA Hubble Space Telescope has photographed three magnificent sections of the Veil Nebula – the shattered remains of a supernova that exploded some 5-10,000 years ago. The Hubble images provide beautiful views of the delicate, wispy structure resulting from this cosmic explosion.

The three images reveal magnificent sections of one of the most spectacular supernova remnants in the sky – the Veil Nebula. The entire shell spans about 3 degrees, corresponding to about 6 full Moons. The small regions captured in the Hubble images provide stunning close-ups of the Veil. Fascinating smoke-like wisps of gas are all that remain visible of what was once a Milky Way star.



The 3rd NEON Archive Observing School

ESO Headquarters, Garching near Munich, 27 August – 6 September, 2008

Image: Montage of the NGC 1313 Galaxy over the ESO HQ in Garching.

The Network of European Observatories in the North (NEON) is pleased to announce the third NEON Archive Observing School. The school is sponsored by the European Community, Marie Curie Actions and supported by OPTICON and the European Astronomical Society (EAS).

The purpose of the summer school is to provide the opportunity for young researchers to gain practical experience in observational techniques, data reduction and analysis and the use of virtual observatory tools. Students will carry out small research projects with archival data, centered on selected astrophysical topics, in small groups under the supervision of experienced astronomers. These practical exercises will be complemented by lectures on general observational techniques and archival research for both ground and space based astronomy.

The school is principally open to astronomy PhD students and postdocs who are nationals of a Member State or an Associate State of the European Union. Applications from other European countries will also be considered.

The application deadline is 31 March 2008

For details, see:

www.eso.org/neon-2008

www.iap.fr/eas/neonNew.html

STELLAR FIREWORKS ARE ABLAZE IN GALAXY NGC 4449 [heic 0711]

Nearly 12.5 million light-years away in the dwarf galaxy NGC 4449 a veritable stellar "fireworks" is on display - here shown in exquisite detail through the eyes of the Hubble Space Telescope.

Hundreds of thousands of vibrant blue and red stars are visible in this image of galaxy NGC 4449 taken by the NASA/ESA Hubble Space Telescope. Hot bluish white clusters of massive stars are scattered throughout the galaxy, interspersed with numerous dustier reddish regions of current star formation. Massive dark clouds of gas and dust are silhouetted against the flaming starlight.

NGC 4449 has been forming stars since several billion years ago, but currently it is experiencing a star formation event at a much higher rate than in the past. This unusual explosive and intense star formation activity qualifies as a starburst. At the current rate, the gas supply that feeds the stellar production would only last for another billion years or so.

Starbursts usually occur in the central regions of galaxies, but NGC 4449 has a more widespread star formation activity, since the very youngest stars are observed both in the nucleus and in streams surrounding the galaxy.

A "global" starburst like NGC 4449 resembles primordial star forming galaxies which grew by merging with and accreting smaller stellar systems. Since NGC 4449 is close enough to be observed in great detail, it is the ideal laboratory for the investigation of what may have occurred during galactic formation and evolution in the early Universe.

It is likely that the current widespread starburst was triggered by interaction or merging with a smaller companion. NGC 4449 belongs to a group of galaxies in the constellation Canes Venatici, the Hunting Dogs. Astronomers think that NGC 4449's star formation has been influenced by interactions with several of its neighbours.

This image was taken in November 2005 by an international science team led by Alessandra Aloisi of European Space Agency (ESA)/the Space Telescope Science Institute (STScI) in Baltimore. Other team members include Francesca Annibali (STScI), Claus Leitherer (STScI), Jennifer Mack (STScI), Marco Sirianni (ESA/STScI), Monica Tosi (INAF-OAB), and Roeland van der Marel (STScI).

Hubble's Advanced Camera for Surveys observed the NGC 4449 in blue, visible, infrared, and Hydrogen-alpha light.

NASA, ESA, A. Aloisi (ESA/STScI) and The Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration

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CAPJOURNAL – A NEW FREE PEER-REVIEWED JOURNAL FOR ASTRONOMY COMMUNICATORS, ONLINE AND IN PRINT

Public communication of astronomy provides an important link between the scientific astronomical community and society, giving visibility to scientific success stories and supporting both formal and informal science education. While the principal task of an astronomer is to further our knowledge of the Universe, disseminating this new information to a wider audience than the scientific community is becoming increasingly important. This is the main task of public astronomy communication – to bring astronomy to society.

The next few years will be extremely important for astronomy communication and education. The International Year of Astronomy 2009 will serve as a unique platform to inform the public about the latest discoveries in astronomy as well as to emphasize the essential role of astronomy in science education. However, as the astronomy outreach community expands globally, it becomes increasingly important to establish a community of science communication experts.

The IAU DIVISION XII Commission 55 Communicating Astronomy with the Public Journal Working Group prepared a study assessing the feasibility of the Communicating Astronomy with the Public Journal (CAPjournal). The conclusions were unequivocal. The present situation of public astronomy communication shows a clear need for a publication addressing the specific needs of the public astronomy communication community.

The main objectives of the journal are:

- documenting and absorbing knowledge ("Teach and Train");
- providing a basis for discussions;
- stimulating further progress;
- establishing priorities in the field;
- furthering careers (through documentation of the excellence of the individual);
- and helping to avoid the duplication of effort.

Public communication of astronomy is a burgeoning field of science communication. We would like to see the astronomy outreach community deeply involved in this journal's evolution and production. Please feel free to send us your articles and reviews on communicating astronomy, as well as suitable books/websites/products for review in the pages of CAPjournal. Submission guidelines are available at: http://www.capjournal.org/submission.php. Relevant advertisements are also more than welcome. We are eager to get your feedback, so please feel free to e-mail us at editor@capjournal.org.

Cover Image [heic0516]: This Hubble Space Telescope image shows Sirius A, the brightest star in our night-time sky, along with its faint, tiny stellar companion, Sirius B. The companion, the first white dwarf star to be recognised, is about ten thousand times fainter than Sirius A itself and appears as the small dot to the lower-left of centre. The cross-shaped diffraction spikes and concentric rings around Sirius A, and the small ring around Sirius B, are artifacts produced within the telescope's imaging system. This image was acquired with the Wide Field Planetary Camera 2 on Hubble and has been used to measure the position of the faint companion to high precision.