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Space Telescope European Coordinating Facility

ST-ECF Newsletter

This new image of the photogenic bright planetary nebula NGC 6543 was obtained with the Advanced Camera for Surveys (ACS) on the Hubble Space Telescope. It shows a remarkable pattern of concentric shells produced by regular ejections of material from the central star. This object was the first to be shown to be a gaseous body, glowing by fluorescence, rather than the glow of unresolved stars. The line spectrum, dominated by the forbidden lines of [OIII], was seen by William Huggins in 1864 using visual spectroscopy.

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

HST News and Status

Jeremy Walsh

The Space Telescope Imaging Spectrograph (STIS) aboard the Hubble Space Telescope went into safe mode on 2004 August 3. Subsequent investigation revealed that a sudden loss of low voltage power occurred that was consistent with the failure of the Low Voltage Power Supply. STIS suffered a similar loss in May 2001 and it was decided to resume operation with the redundant Side 2 electronics system. Thus both the primary and redundant sets of electronics are now inoperable. Detailed investigations are continuing into the cause of the power loss. The likelihood of a repair seems slight, but must await the verdict of the Failure Review Board. All observations with STIS are suspended forthwith. This removes HST's primary spectrometer for the UV and optical ranges and is a major loss of capability, irreplaceable in the UV. Some very low resolution spectroscopic capability remains with the slitless spectroscopy modes of the Advanced Camera for Surveys (ACS) which has a grism for the near-UV to optical, a prism for the near-UV and two prisms for the far UV (one blocking geocoronal Lyman-α).

The STIS failure occurred very early into Cycle 13, but there is no necessity foreseen to reconvene the Time Allocation process, since a large number of programmes in the pool were well rated. The remaining instruments — ACS, the near-IR imager NICMOS, the WFPC2 and FGS, which is employed for astrometric observations, will be fully occupied with observing programmes until Cycle 14 begins in mid-2005.

Development has continued of the Two-Gyro Science mode which will control pointing and tracking using only two gyroscopes. Currently three gyroscopes are the minimum required for full pointing and tracking. HST at present has four working gyros. The estimate of when two gyro operation will be required is difficult to calculate since it relies on small number statistics. There is a 50% probability of still having three operational gyros in mid-2006. For every day in which there is no gyro failure, this date is pushed further into the future. The consequences of Two-Gyro mode will be poorer tracking, reduced sky accessibility at any given time of the year and longer target acquisition times. Preliminary high-fidelity Hubble attitude control simulations suggest that the two-gyro jitter will about 10mas (RMS), better than initially thought. This prediction will be tested on-orbit in February 2005. More details about the two-gyro mode are to be found in the HST Two-Gyro Handbook which will be available from STScI before this Newsletter goes to press.

The prognosis for another servicing mission to the Hubble Space Telescope still remains unclear. The Committee on Assessment of Options for Extending the Life of the Hubble Space Telescope, convened by the National Academy of Sciences, delivered an interim report on 2004 July 13 in the form of a letter to the NASA Administrator. This letter strongly encouraged NASA to seek a manned servicing mission to HST to install the two planned instruments in Servicing Mission 4. The instruments are the Wide Field Camera 3 (WFC3), an imaging camera to replace WFPC2 that also has a near-infrared imager, and a high spectral resolution UV spectrometer, the Cosmic Origins Spectrograph, COS. Given the demise of STIS, COS would return much needed high resolution UV spectroscopic capability to the community. The National Academy of Sciences Committee also favoured continued exploration of robotic servicing options for HST.

Hubble peers inside a celestial geode

HUBBLE
European Space Agency Information Centre

In this unusual image, the NASA/ESA Hubble Space Telescope captures a rare view of the celestial equivalent of a geode — a gas cavity carved by the stellar wind and intense ultraviolet radiation from a young hot star.

Real geodes are handball-sized, hollow rocks that start out as bubbles in volcanic or sedimentary rock. Only when these inconspicuous round rocks are split in half by a geologist, do we get a chance to appreciate the inside of the rock cavity that is lined with crystals. In the case of Hubble's 35 light-year diameter 'celestial geode' the transparency of its bubble-like cavity of interstellar gas and dust reveals the treasures of its interior.

The object, called N44F, is being inflated by a torrent of fast-moving particles — a stellar wind — from an exceptionally hot star (the bright star just below the centre of the bubble) once buried inside a cold dense cloud. Compared with our Sun (which is losing mass through the solar wind), the central star in N44F is ejecting more than a 100 million times more mass per second and the hurricane of particles moves much faster at 7 million km per hour (as opposed to less than 1.5 million km per hour for our Sun).

ESA/NASA, Yäel Nazé (University of Liège, Belgium) and You-Hua Chu (University of Illinois, Urbana, USA)

The ESO/GOODS Spectroscopy Archive

Harald Kuntschner, Jonas Haase, Alessandro Rettura (ESO), Piero Rosati (ESO) & Eros Vanzella (ESO)

The FORS2 spectrograph at the ESO VLT has been used to obtain spectra of a large sample of faint galaxies in the Chandra Deep Field South (CDFS) in the framework of the Great Observatories Origins Deep Survey (GOODS). In the 2002-3 campaign 399 individual spectra of 303 unique objects (see Figure 1) with magnitude $z_{850} < 25.5$ and red i-z colours were observed and 234 unique redshifts measured. The data reduction of a second set of spectra is underway and promises to yield about another 500 unique redshifts. This survey constitutes an essential contribution to attaining the scientific goals of GOODS, providing the time coordinate needed to delineate the evolution of galaxy masses, morphologies, and star-formation. It has been agreed that, in the spirit of all Legacy Programmes, data obtained with ESO facilities in direct support of the GOODS project will be immediately made public worldwide. High level data products, such as reduced spectra and redshift determinations, will also become public. A more detailed description of the FORS2 survey can be found in the paper "The Great Observatories Origins Deep Survey — VLT/FORS2 Spectroscopy in the GOODS-South Field" by Vanzella et al., submitted to A&A (astro-ph/0406591). In this article, we focus on our efforts to release the raw data and related data products on the web.

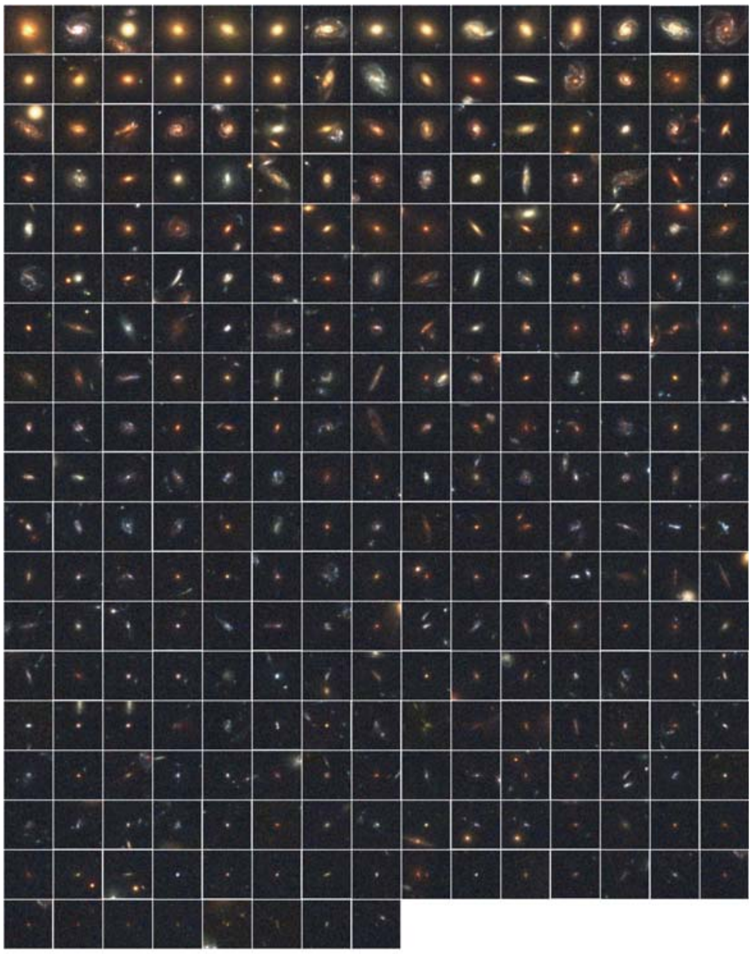

Fig 1: *A colour image montage of FORS2 galaxies in the v1.0 release sorted by decreasing luminosity.*

Rationale

In recent years the usefulness of large astronomical programmes yielding enormous data collections, which contain all the necessary ingredients to settle a number of scientific questions, has been abundantly proven. A well-known example is the thorough, multi-wavelength exploration of "Deep Fields" to the limiting capabilities of existing space and ground based astronomical facilities. A field explored at a particular wavelength to an unprecedented combination of area and depth, inevitably attracts commensurate efforts made at other wavelengths by other telescopes and instruments. In this context a fast public release, easy access to the reduced data products and direct connection to associated data products is of paramount importance. The ESO/GOODS spectroscopy archive is a first, simple implementation of this scheme – it allows access to the spectroscopy and the supporting Hubble Advanced Camera for Survey (ACS) imaging and photometry for each target, while still allowing the user to download the raw data.

ACS imaging and photometry

Target selection and mask design for the ESO/GOODS FORS2 campaign was carried out on the basis of the GOODS ACS imaging of the CDFS. For each object the ACS catalogue (version 1.0), prepared using the SExtractor package, provides accurate coordinates and photometric information in the B, V, i and z bands. Additionally, postage stamps (5" x 5") in all bands and a colour composite were also extracted to provide a basic assessment of the target morphology.

Using the archive

The FORS2 spectroscopy archive can be easily accessed via the following link: http://archive.eso.org/wdb/wdb/vo/goods/form. It uses the familiar ST-ECF/ESO archive interface, which has been long established for the ESO/VLT archive searches (see Figure 2).

With few exceptions all the FORS2 objects, including serendipitous objects on the slits, have been cross-matched with the ACS v1.0 catalogue and unique target names created by using the ACS coordinate and the identifier "GDS J", eg, GDS J033206.44-274728.8. While one can simply search by whole or partial object name, the real strength of the archive is the ability to select subsamples matching specific coordinates, redshifts, magnitudes or colours. It is also possible to limit the search by constraining the observational setup such as the FORS2 mask-id and slit geometry. For all targets we provide:

- Basic target and observational information
- A preview of the spectrum with important line features identified if a redshift is measured. An associated quality flag and comment field give further information on the spectra.
- Image cutouts from the ACS imaging in B, V, i and z bands plus a colour composite

Fig 2: *Main search screen for the ESO/GOODS spectroscopy archive.*

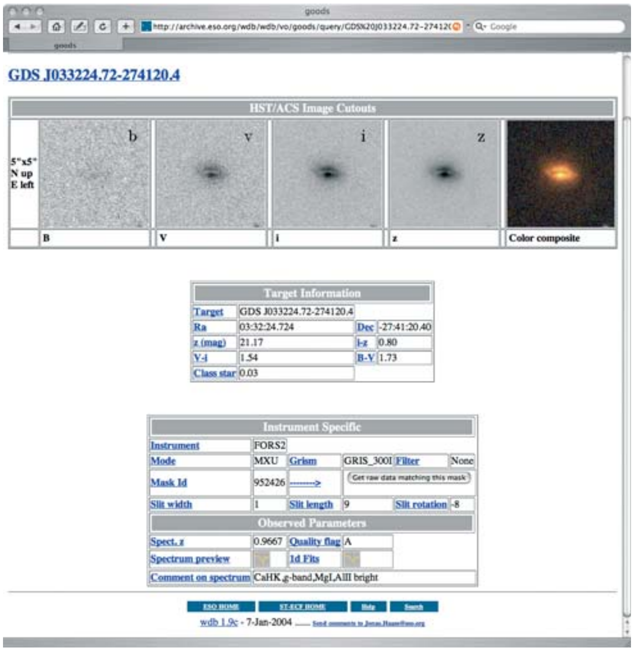

Fig 4: *Main information screen for a single target.*

Typically several objects will match the search criteria and in this case the result is displayed as a table with all the essential data and a quick access to the various preview products (see Figure 3). The main search screen offers an option to sort the output by eg, RA, redshift or mask ID. The columns included in the table-view can be selected in the search form by (un)ticking the checkboxes in front of the fields. It is worth mentioning that a single object can have several database entries since multiple observations of the same target in different masks are possible.

Clicking the INFO link of a row will lead to the full page view of a single object. This view offers a complete presentation of all the available data, including ACS imaging cutouts, links to the spectrum preview and the reduced 1-d spectrum in FITS format (Figure 4). It also offers a link, which will lead to a request page of the ESO/VLT Archive, in which the user can request all the raw data and calibration frames matching this particular reduced spectrum.

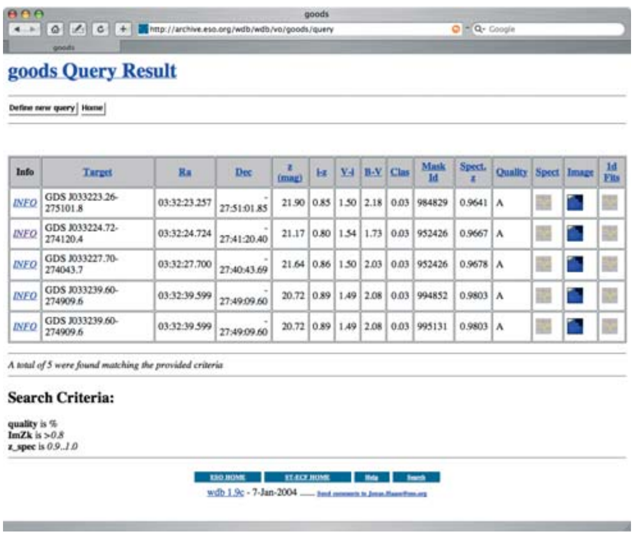

Fig 3: *Result of a search for all objects with redshifts between z=0.9 and 1.0 matching the colour i-z > 0.8.*

Other spectroscopy in the CDFS – A spectroscopy clearing house at ESO

The CDFS has been the focus of many research programmes and thus it is not surprising to find a significant number of redshifts in the literature. In an attempt to provide easy access to the available information, the ESO/GOODS team has committed itself to collecting all the spectroscopic redshifts and spectra publicly available in the CDFS. A first compilation includes spectroscopic data in the GOODS/CDFS region only. The catalogue is the result of cross-matching published spectroscopic surveys and the ACS catalogue (v1.0). Thus, all positions are given in the GOODS coordinate system. Multiple spectroscopic identifications of the same source from different surveys are listed and no attempt is made to compare derived redshifts. Future compilations will include spectroscopic information on the whole (~30'x30') CDFS area. The following link provides a short description of the aims and a link to a web-based search form to query the database:
http://www.eso.org/science/goods/spectroscopy/CDFS_Mastercat

Conclusions

Since the preliminary release at the start of 2004, 211 distinct users outside of the ESO building have accessed the web interface a total of 1792 times and this has led to extensive feedback both from collaborating groups and individual astronomers.

The use of the best modern archive technology speeds up the dissemination of data and minimizes development time on interfaces so that more time can be spent on ensuring data integrity. With the advent of the Virtual Observatory (VO), the data collected in these quick-look releases can also easily be reused and published in a VO context. As an example, the preliminary FORS2 data and a publicly available redshift catalogue of Chandra sources in the CDFS/GOODS region were used in the second Astrophysical Virtual Observatory science demonstration in January 2004, which is described in the May 2004 edition of the ST-ECF Newsletter.

New Insights from the ST-ECF Lamp Project

Florian Kerber, Michael Rosa, G. Nave (NIST - National Institute of Standards and Technology), J. Reader (NIST), C.J. Sansonetti (NIST), Paul Bristow & G. Lercher (Sternwarte Max Valier)

The Space Telescope European Coordinating Facility (ST-ECF) and the National Institute of Standards and Technology (NIST) are collaborating to study Pt/Cr-Ne hollow cathode lamps used onboard the Hubble Space Telescope(HST). The two main components of this study are the production of a comprehensive list of the spectral lines emitted by the lamp and observations of the lamp performance over an extended period to simulate operation in a space mission. Spectra recorded by the NIST 10.7-m grating spectrograph and the vacuum ultraviolet Fourier Transform Spectrometer (FTS) have yielded accurate wavelengths for more than 8000 lines that can be used for calibration purposes in the region 1150 Å to 3200 Å. Typical uncertainty (one standard deviation) is 0.0020 Å for lines measured with the grating spectrograph at wavelengths shorter than 1800 Å and 0.0005 Å for longer wavelength lines measured with the FTS. Observations of the dependence of the lamp spectrum on operating current show that Ne lines dominate the discharge at low current but decline in intensity relative to the metal lines as the current is increased. Accelerated aging tests that mimic the use of the calibration lamps in orbit have been conducted for four lamps. The spectrum emitted was found to be very stable for cumulative operating times as long as 2500 hours. Lamp operating voltage was found to increase as the lamps aged, and it appears that the rate of increase accelerates as the lamp approaches the end of its useful life. Results of this study will be prepared for online dissemination in a form fully compliant with the standards of the Virtual Observatory (VO) initiative of the International Virtual Observatory Alliance (IVOA).

Spectral characterization of calibration lamps as used on STIS

As a primary objective, we have observed the spectra of Pt/Cr-Ne lamps to obtain a comprehensive list of emission lines between 1150 Å and 3200 Å, a spectral region corresponding to the Space Telescope Imaging Spectrograph (STIS) echelle modes. This project was initiated in direct support of the ST-ECF's STIS Calibration Enhancement (STIS-CE) effort. Previously, wavelength calibration of all HST spectrographs has been based on the line list produced by Reader et al. (1990) using a Pt-Ne lamp, despite the fact that STIS and the Faint Object Spectrograph (FOS) use a Pt/Cr-Ne lamp. The addition of Cr is especially significant in the near ultraviolet (UV) where up to 90% of the observed lines are Cr. However, published Cr wavelengths are not sufficiently accurate for the calibration of STIS and FOS. We have determined improved wavelengths for about 5000 Cr lines. The combination of our new line lists with the NIST Pt-Ne list of Reader et al. (1990) provides about 11500 lines for calibration purposes in the region 1115 Å to 4332 Å. This forms the basis for the STIS-CE model-based wavelength calibration (Rosa 2000). Results of STIS-CE and its impact on the wavelength calibration and the scientific quality of STIS echelle data will be reported in a future edition of the Newsletter.

The secondary objective of the project is to better understand the performance of hollow cathode lamps and the physical processes involved in their long-term operation; see Kerber et al. (2004) for an overview. Among the issues we have studied is the dependence of the spectrum on lamp current and cumulative operating time. We have performed accelerated aging tests that simulate operation on STIS using newly made space-qualified lamps.

Here we will describe some of the results of these experiments. Our findings also include important lessons for the design and operation of future UV and optical spectrographs in space.

The spectrum of Pt/Cr-Ne hollow cathode lamps

All observations were made at NIST using the 10.7-m normal-incidence spectrograph and a Fourier transform spectrometer (FTS) optimized for the vacuum ultraviolet. For an overview of the project and the experimental work we refer the reader to Kerber et al. (2003) and Sansonetti et al. (2004). The project has clearly met its primary objective with respect to quality and quantity of data. In the far UV we have published a list of more than 1200 lines observed in the range 1132-1827 Å (Sansonetti et al. 2004). Analysis of near UV spectra from the FTS is nearing completion, and the resulting line list is already being used by the STIS-CE project. The full list and a description of the experimental work with the FTS will be published soon. Our work has established accurate wavelengths for more than 8000 lines. The uncertainty is 0.0020 Å (one standard deviation) for lines in the 1150-1800 Å region measured with the grating spectrograph and 0.0005 Å for the 1800-3200 Å region observed with the FTS. Wavelength accuracy for some Pt lines is limited by

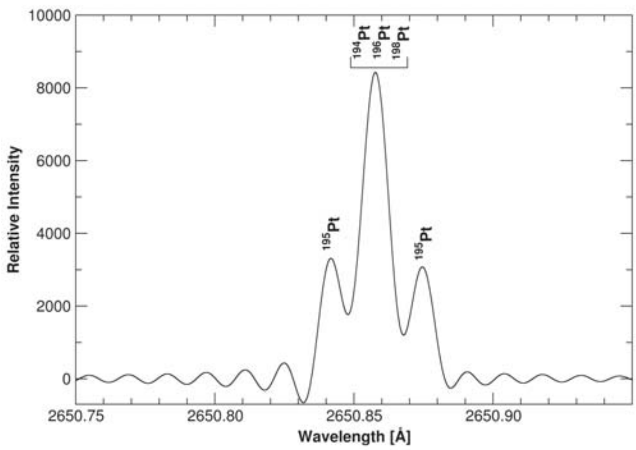

Fig 1: *This short section of the FTS spectrum of a Pt/Cr-Ne lamp near 2650 Å shows an example of hyperfine splitting in Pt. Natural Pt contains four isotopes: ^{194}Pt (33%), ^{195}Pt (34%), ^{196}Pt (35%), and ^{198}Pt (7%). The central line is a blend of the even isotopes while the two satellite lines result from the hyperfine splitting of ^{195}Pt. At the limiting resolving power of the STIS echelle modes (R ~ 100 000), hyperfine structure may be resolved for some lines.*

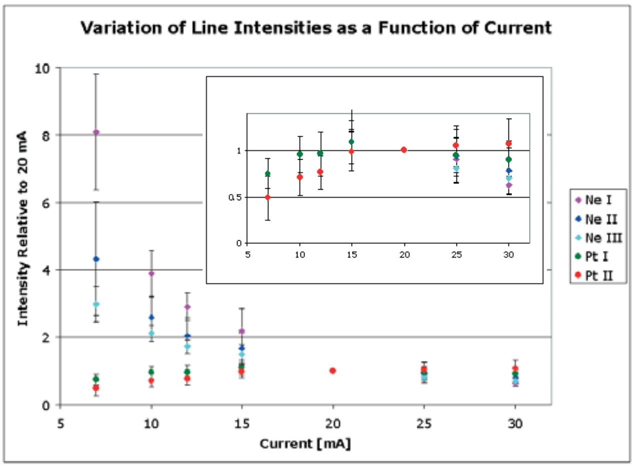

Fig 2: Variation of the line intensities as a function of the operating current of the lamp. The error bars represent uncertainty at the one standard deviation level. Spectra were taken at 7, 10, 12, 15, 20, 25 and 30 mA. Note the pronounced difference in the behaviour of the gas and metal (inset) lines.

asymmetric line shapes due to unresolved hyperfine and isotope structure, see Figure 1.

Dependence of spectral output upon current

In our photographic spectra of the far UV region we recognized that the relative intensity of the Ne lines with respect to the metal lines was significantly enhanced at lower lamp currents (Sansonetti et al. 2004). In the near UV region the linear intensity response of the FTS enabled a more quantitative investigation of the change in the spectrum as a function of operating current. We took spectra at 3.9 mA (low power mode on STIS), 7, 10 (standard current on STIS), 12, 15, 20, 25 and 30 mA. While this is still work in progress, it is safe to say that the operating current does indeed have a profound influence on the ratio of the lines from different elements and ionisation stages.

Analysis of the spectra taken at different currents revealed a very well defined behaviour of the line intensities as a function of current (Figure 2). The intensities of all lines in all spectra were normalized with respect to the intensity of the same line in the 20 mA spectrum. Then, this ratio was averaged for all the lines of a given species observed at a given current. Figure 2 shows the average behaviour of the line intensities as a function of current. 27 lines were used to form this average for Ne I, 202 for Ne II, 55 for Ne III, 378 for Pt I and 552 for Pt II. There is a pronounced distinction between the behaviour of the metal and the gas lines. The gas lines show much higher relative intensities at lower currents, whereas the metal lines (inset) show only a limited variation with current.

A qualitative explanation of this behaviour is that there is less sputtering of metal atoms from the cathode at lower lamp currents. The sputtering of atoms from the cathode is caused by the impact of positive ions accelerated across the cathode fall. The electron density (and corresponding ion density) in the discharge is approximately proportional to lamp current. At higher lamp currents more ions are available in the plasma and there is a corresponding increase in sputtering. Since the density of Ne atoms is independent of current while the density of metal atoms increases with increasing current, the relative intensity of the metal spectrum is enhanced at higher currents. The increasing ionization of the plasma at higher currents also explains the relative enhancement of the spectra of Ne II, Ne III, and Pt II at 20 mA with respect to the corresponding neutral atom spectra. For Cr lines this effect cannot be verified yet since the classification of the Cr lines is still in progress.

To our knowledge, this is the first time the change of the spectrum of a Pt/Cr-Ne lamp has been studied at different currents. These data sets and the well established behaviour of the line intensities could serve as the basis for a more quantitative understanding of the operation of the lamp. In space applications, ozone mapping instruments like the Global Ozone Measuring Experiment (GOME) use similar lamps for wavelength calibration over a wide wavelength range. In order to optimize the lifetime of these lamps they are usually operated at 10 mA, but the strong Ne lines in the visible region make it difficult to observe a rich spectrum with a single exposure. Our findings suggest that operating the lamp at a current of 20 mA would reduce the relative intensity of these lines by a factor of 4, likely alleviating this particular problem.

The aging and failure of Pt/Cr-Ne hollow cathode lamps

An important secondary objective of this project was to investigate the aging of Pt/Cr-Ne hollow cathode lamps and any changes in spectral output or operational characteristics associated with it. To this end we recorded spectra of lamps used to calibrate the Goddard High Resolution Spectrograph (GHRS) and Faint Object Spectrograph (FOS) on the HST. These are the only lamps that have been returned to earth after years of operation in space (Kerber & Wood 2004). Additionally, we conducted dedicated accelerated aging tests in the laboratory at NIST using new lamps. The lamps were operated in a way designed to mimic as closely as possible the use of the lamps onboard HST. An analysis of the HST/STIS archive (Valenti 2002, private communication) shows

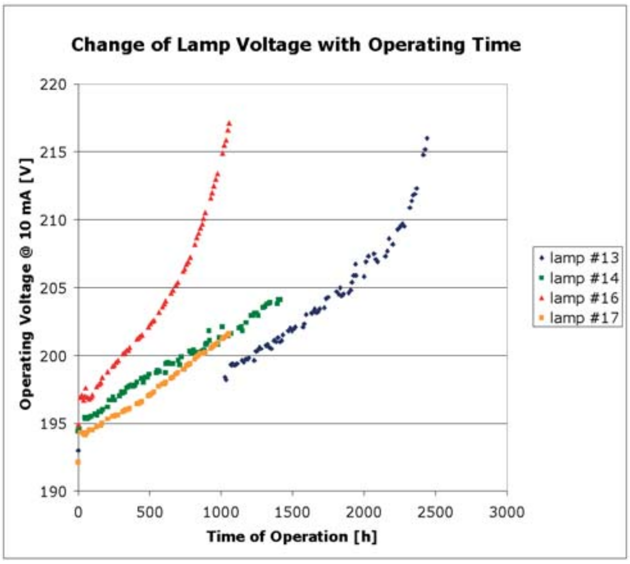

Fig 3: Change of the operating voltage required for a current of 10 mA as a function of accumulated operating time. The lamps were operated in a cycle of 30s on / 30s off in order to simulate operation onboard STIS. The operating voltage increased with usage and, at least in the case of lamp #13, the rate of change also increased. Spectra were taken of lamps #13 and 14 to document any change in the spectral output. Both lamps failed in a similar manner shortly after a set of spectra had been taken. Lamps #16 and 17 are still undergoing aging.

that most of the exposures taken with STIS are short; 91% lasted less than 60 s, with an average exposure time of about 31 s. Therefore we operated our lamps at 10 mA for alternating periods of 30 s on and 30 s off over a span of several months.

Several times during the aging test we photographed the spectrum of the test lamps on the normal-incidence spectrograph and compared them to spectra recorded at the beginning of the test. So far we have completed the aging test for two Pt/Cr-Ne lamps (#13 and #14). One of these (#14) lasted for about 1450 hours and the other (#13) for more than 2500 hours, see Figure 4. Both failed shortly after a set of spectra had been recorded. A preliminary analysis of these spectra shows that the spectral output changed very little over the life of the lamps. Even the absolute intensity of the lines was comparable to that observed initially. As the lamps aged there was a progressive deposition of sputtered cathode material on the inner wall of the lamp envelope. A heavier coating of metal was deposited on the first mica spacer located just behind the front surface of the cathode. After many hours of operation we observed the presence of small metal flakes inside the lamp, indicating that the sputtered metal is not firmly bonded to the mica spacer. Both lamps eventually failed in a similar manner: the discharge no longer concentrated inside the cathode. Instead an anomalous discharge covering the surface of the first mica spacer formed when the lamp was ignited. It is possible that the metal deposited on the spacer forms a conducting layer that leads to failure of the lamp.

The only obvious change observed before failure is an increase in the lamp operating voltage, as shown in Figure 3. This could indicate a change in the Ne gas pressure or in the diameter of the cathode hole. Since the operating voltage seems to be the best diagnostic of lamp aging, and since it can easily be monitored, we suggest that this voltage be part of the housekeeping telemetry of future instruments and that it be used for analysis of the lamp's performance. Currently two lamps (#16 and #17) are still undergoing accelerated aging. Lamp #16 is displaying a strikingly more rapid increase in operating voltage than the other lamps studied. This may be a consequence of the fact that the getter (a barium coating inside the lamp that keeps the fill gas clean by reacting chemically with contaminant gases) in lamp #16 was almost totally depleted when the lamp was received from the manufacturer. After our aging tests are complete, a more detailed account of the results will be given in a separate publication.

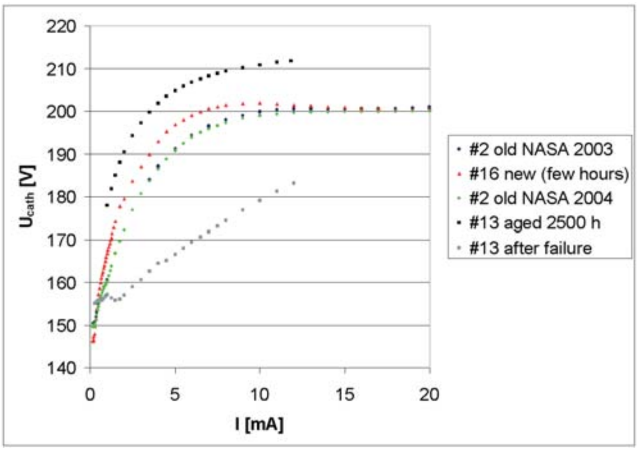

Fig 4: *Voltage-current characteristic of three Pt/Cr-Ne hollow cathode lamps. The three central curves show the general behaviour. Lamp #16 was newly acquired for the experiment and had been used for a few hours when the data were taken. Lamp #2 is a former STIS backup manufactured about 15 years ago. It was provided on loan by the STIS IDT. We measured it twice, once in 2003 and then again in 2004. The curves are virtually identical, illustrating that the passing of time does not lead to change in the electrical characteristics, whereas operating time does. The upper curve represents a lamp (#13), bought in 2002 for aging purposes, after 2500 hours of operation, and the lower curve represents the same lamp after failure.*

The lamp project as a data provider for the Virtual Observatory

The Virtual Observatory (VO) initiative is an effort by the international astronomical community to allow global electronic access to the available astronomical data archives of space and ground-based observatories and sky survey databases. It also aims to enable data analysis techniques through a coordinating entity. In 2002 the existing VO projects formed this coordinating entity, namely the International Virtual Observatory Alliance (IVOA) (www.ivoa.net). After discussions in expert working groups, the IVOA sets standards for data exchange and procedures that will be presented to the International Astronomical Union (IAU) for endorsement. To date there are 15 funded national and international VO projects and each is represented in the IVOA Executive Committee.

Although the VO is still a research and development project, it has already produced the first scientific result that was made possible by combining in a new manner X-ray data, optical data, and catalogues publicly available from data archives (Padovani et al. 2004). See the European Astrophysical Virtual Observatory (AVO) webpage (http://www.euro-vo.org/) to learn how the VO approach and infrastructure enabled this particular scientific study.

The VO is currently working toward better usability of the huge existing archives of astronomical observational data. In order to realize the full potential of the VO, it is vital to support the scientific process in an integrated manner. Both products of theoretical work (eg, stellar model atmospheres) and laboratory measurements must be included in VO data repositories. It is important to note that for VO use presentation of the data itself in the form of an ASCII table is not sufficient. It is essential to also provide ancillary information describing how the data were obtained, reduced, and analyzed. The goal is to characterise data in such a way that an astronomer can assess whether a given data set is suitable for a particular purpose. Such supporting metadata are readily available at the source, and only a limited amount of effort on the part of the data provider is required to make it accessible as part of the data product. However, this kind of information is sorely lacking in many of the current astronomical data archives.

In order to do full justice to the results of this project, the ST-ECF and NIST have decided to become data providers to the VO (Figure 5) and take a pioneering rôle in this field. We plan to provide the relevant data of the Pt/Cr-Ne lamp project in a fully VO compliant manner. In particular, we will make the complete Pt/Cr-Ne line list available as a VOTable including the pertinent metadata in a form ready for use by VO tools. This effort will be fully supported through our websites, making the results and data products available to the global community.

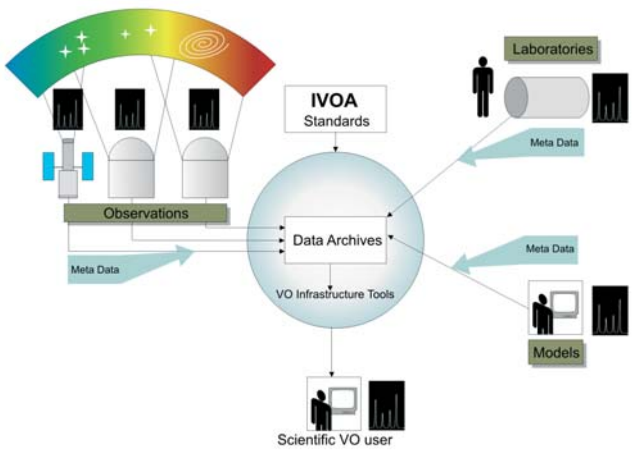

Fig 5: Illustration of the structure of the VO and the relationship of data providers, such as the ST-ECF and NIST, to archives and scientific users.

We are confident that many other data sets exist that are the result of laboratory, theoretical, or modelling work that are highly relevant for astrophysical research (eg, atomic data or stellar model atmospheres). We encourage other scientists to also become data providers to the VO. In this way they can assure that the product of their work can be employed by the astronomical community at large.

Acknowledgments

This project is being funded by the European Space Agency (ESA). The STIS Calibration Enhancement project is conducted within the framework of the extension of the Memorandum of Understanding between NASA and ESA covering the HST.

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Hubble studies generations of star formation in neighbouring galaxy

The NASA/ESA Hubble Space Telescope captures the iridescent tapestry of star birth in a neighbouring galaxy in this panoramic view of glowing gas, dark dust clouds, and young, hot stars. The star-forming region, catalogued as N11B, lies in the Large Magellanic Cloud (LMC), located only 160,000 light-years from Earth. With its high resolution, the Hubble Space Telescope is able to view details of star formation in the LMC as easily as ground-based telescopes are able to observe stellar formation within our own Milky Way galaxy.

NASA/ESA and the Hubble Heritage Team (AURA/STScI)/HEIC

Our neighbourhood galaxy, the Large Magellanic Cloud (LMC), lies in the Constellation of Dorado and is sprinkled with a number of regions harbouring recent and ongoing star formation. One of these star-forming regions, N11B, is shown in this Hubble image. It is a subregion within a larger area of star formation called N11. N11 is the second largest star-forming region in LMC. It is only surpassed in the size and activity by 'the king of stellar nurseries', the Tarantula nebula (or 30 Doradus), located at the opposite side of LMC.

The image illustrates a perfect case of so-called sequential star formation in a nearby galaxy — new starbirth triggered by old massive stars. The sequence begins with a cluster of stars outside the top of the Hubble image which led to the birth of the collection of blue- and white-coloured stars near the left of this new Hubble image. These stars are among the most massive stars known anywhere in the Universe. The region around the hot stars is relatively clear of gas, because the stellar winds and radiation from the stars have pushed the gas away. When this gas collides with and compresses surrounding dense clouds, the clouds can collapse under their own gravity and start to form new stars. This chain of consecutive star birth episodes has been seen in more distant galaxies, but it is shown very clearly in this Hubble image.

The First NEON Archive Observing School

Harald Kuntschner & Michel Dennefeld (IAP)

This ten-day summer school was held during the period 14th to 23rd July 2004 at the ESO Headquarters in Garching. It was intended to give PhD students the opportunity to gain practical experience in observational astrophysics via archival research, data-reduction and data analysis and the use of Virtual Observatory tools. This summer school was the first of a new series organized by the Network of European Observatories in the North (NEON, http://www.iap.fr/eas/neonNew.html) which now includes the Asiago Observatory (Italy), the Calar Alto Observatory (Germany — Spain), the Haute Provence Observatory (France), the La Palma observatories (ING and NOT, UK — Netherlands — Spain and Nordic Countries), the European Southern Observatory (ESO), and the Space Telescope European Coordination Facility (ST-ECF).

Twenty students from eleven different European countries attended introductory lectures in observational astronomy as well as targeted talks on the instrumentation of 8-m class telescopes, the data-flow of a modern observatory and the new Virtual Observatory tools that are becoming available. Furthermore, the students were asked to carry out small research projects in groups of four, under the guidance of an experienced observer, which went through all the steps of a standard observing programme. In these research projects particular emphasis was given to the use of archival, multi-wavelength data from the ground and space. More information on this year's summer school programme and the presentations of the students' science projects can be found on the web (http://www.eso.org/gen-fac/meetings/neon-2004/).

Future summer schools of this kind, including ones organized directly at the participating observatories, are being planned and will be announced via the usual channels.

Fig 1: *Participants in the first NEON Archive Observing School at ESO, Garching.*

The ESA/ESO/NASA Photoshop FITS Liberator

Lars Lindberg Christensen

For many years astronomical images from the world's telescopes were reserved for an elite of astronomers and technical staff. Now anyone with a desktop computer running Adobe® Photoshop® software can try their hand at crafting astronomical images as beautiful as those from the Hubble Space Telescope. This free software Photoshop plug-in makes a treasure trove of archival astronomical and spectra from the NASA/ESA Hubble Space Telescope, the European Southern Observatory's Very Large Telescope, the European Space Agency's XMM-Newton X-ray observatory, NASA's Spitzer Space Telescope, NASA's Chandra X-ray Observatory and many other famous telescopes accessible to home astronomy enthusiasts.

If there is anything that unites astronomy, it is the worldwide use of a single file format — nearly all the images produced by telescopes on the ground and in space are stored as FITS files. Unfortunately this file format has been accessible to very few people other than professional scientists using highly specialised image-processing tools.

Now a new and unique tool — the ESA/ESO/NASA Photoshop FITS Liberator – developed by imaging scientists at the European Space Agency, the European Southern Observatory and NASA makes the immense wealth of astronomical images and spectra stored in data archives around the world accessible to the layman. The only thing required is access to either Adobe Photoshop® or Adobe Photoshop Elements®, both leading image software packages.

For the professional creators of astronomical colour images, the plug-in revolutionises the workflow of the making of colour images from raw data and gives a huge boost to the image quality by giving access to the full 16 bit (65536 colours) range of the observations. In addition the plug-in may be used as a powerful educational tool when teaching about light, colour and digital images. A set of fairly comprehensible educational material is available from the web pages. This includes a teacher's guide, descriptions of how the Hubble images are made, a guide on how to make your own colour images, educational data sets and much more. On the web pages there is also a gallery with colour images made by enthusiastic users, user guides and more.

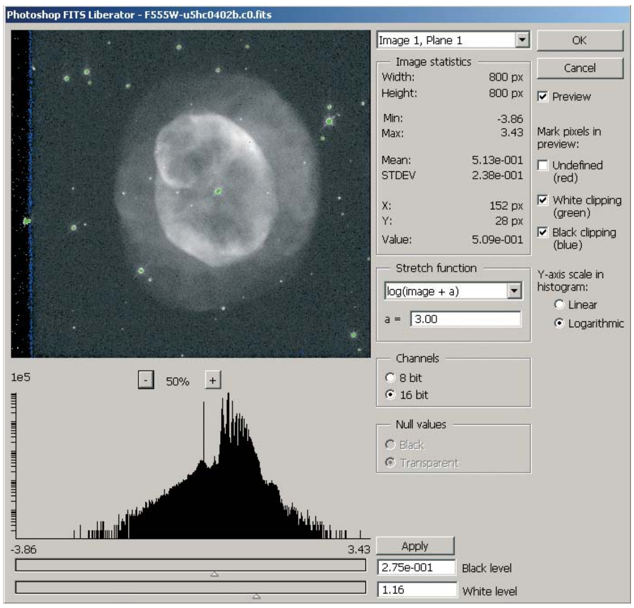

Image credit: ESA, ESO and NASA

***Fig 1:** This screenshot shows the ESA/ESO/NASA Photoshop FITS Liberator in action. The plug-in has a number of interactive features that makes it easy for the imaging professional to produce attractive colour images of stars and galaxies. The largest part of the plug-in shows a preview pane. Below the preview a histogram shows the distribution of greyscale intensities.*

The ESA/ESO/NASA Photoshop FITS Liberator is freely available for download from:
http://www.spacetelescope.org/projects/fits_liberator

Acknowledgements

The team that produced the ESA/ESO/NASA Photoshop FITS Liberator consists of:
- Project Leader: Lars Lindberg Christensen (lars@eso.org)
- Development Leader: Lars Holm Nielsen
- Graphical Interface Programming: Kasper K. Nielsen
- I/O programming: Teis Johansen
- Technical, scientific support and testing: Robert Hurt, Zolt Levay, Bob Fosbury and Richard Hook.

FITS is an abbreviation for Flexible Image Transport System and has been a standard since 1982 and is recognized by the International Astronomical Union.

The ESA/ESO/NASA Photoshop FITS Liberator uses NASA's CFITSIO library. Adobe and Photoshop are either registered trademarks or trademarks of Adobe Systems Incorporated in the United States and/or other countries.

We kindly ask users to acknowledge the use of this plug-in in publicly accessible products (web, articles, books etc.) with the following statement: *"This image was created with the help of the ESA/ESO/NASA Photoshop FITS Liberator"*.

Requirements

- Windows PCs
- Macintosh (OS X 10.2+)
- Photoshop CS (recommended)
- Photoshop 7.0 (only 15 bit colour, and only partial functionality for more than 8 bit colour)
- Photoshop Elements 2 (only 8 bit colour) (Elements 1.0 NOT supported)

A Framework for a Virtual Repository of Outreach Products

Lars Lindberg Christensen

The coordinated exploitation of archive data through the Virtual Observatory will have a major effect on the way astronomers work. The exploding volume of incoming data and the emergence of technologies and tools to mine the archives will inevitably also have a knockdown effect and result in significant changes for outreach and education as well. There is undoubtedly a great potential for exploiting 'VO-data' (meaning data in the VO era) and facilities in the fields of education and outreach, but there is equally no doubt that this task is difficult and will need a coordinated worldwide effort.

Here we discuss some recent developments in this direction and outline a proposal for a framework for a virtual repository of outreach products (pretty pictures, videos and other digital material). This repository should allow the future exploitation of all kinds of outreach material in 'digital universes' by systematically linking resource archives worldwide.

Virtual Observatory

For scientists the Virtual Observatory (VO) will in the future link the archival data holdings of space and ground-based astronomical observatories, multi-wavelength catalogues and related computational resources. The VO will provide new opportunities for scientific discovery by enabling a new mode of research through the application of new database and data-handling tools that will become available during this decade.

Together with advanced instrumentation techniques, a huge new array of astronomical data sets will soon be available at all wavelengths from the radio to the X-ray and gamma-ray regions. These very large datasets will have to be archived and made accessible to scientists in a systematic and uniform manner to realise the full potential of the new observing facilities. It is difficult to illustrate the upcoming 'data explosion', but even now, if a scientist wants to download and analyse just one third of the Sloan Digital Sky Survey images, it would take him about a year with a very good 200 KB/second network connection.

The Virtual Observatory initiative is currently building a global collaboration of the astronomical communities in Europe, North and South America, Asia, and Australia under the auspices of the International Virtual Observatory Alliance (IVOA).

Astrophysical Virtual Observatory

A major European component of the Virtual Observatory is the Astrophysical Virtual Observatory (http://www.euro-vo.org) that started in November 2001 as a three-year Phase A project, funded by the European Commission (FP5) and six organizations (ESO, ESA, AstroGrid, CNRS (CDS, TERAPIX), University Louis Pasteur and the Jodrell Bank Observatory) with a total of 5 MEuro. A Science Working Group was established in 2002 to provide scientific advice to the AVO Project and to promote the implementation of selected science cases through demonstrations. In 2004 the first science result – a systematic search of the archives, culminating in the finding of numerous obscured Type 2 Active Galactic Nuclei — was released as a consequence of these efforts.

There is no doubt that the Virtual Observatory will become a powerful tool, not only for scientific research, but potentially also as a means to promote a better understanding of the Universe in society and to provide for the educational needs of current and future generations. There is however a huge leap from the 'dirty' data in the archive to the 'clean' and refined data needed in an educational situation.

An educational VO

For a real "educational VO" the primary aim may be defined as: *"Excite, inform and educate the public about space science and astronomy through access to real data, and serve as a catalyst for scientific and technological literacy."*

As we will see this is very difficult to achieve in practice. However, there are many reasons for trying to use real data, especially in education. Firstly the data are free. In addition real data and real science give students a sense of adventure and discovery. In some cases there is a real feeling of breaking new ground and the chance to make genuine discoveries. Finally astronomy projects that draw on real data can be a catalyst for learning about information technology.

Some small, but significant steps in the direction of opening the data archives to laymen, educators, and students have been achieved with our "ESA/ESO/NASA Photoshop FITS Liberator" (http://www.spacetelescope.org/projects/fits_liberator and the article opposite) and "FITS for Education" projects. For many years astronomical images from the world's telescopes were only easily manipulated and displayed by astronomers and technical staff with access to collections of powerful, but often hard to use, software tools. With this free plug-in anyone can work with images and spectra from the NASA/ESA Hubble Space Telescope, the European Southern Observatory's Very Large Telescope, the European Space Agency's XMM-Newton X-ray observatory, NASA's Spitzer Space Telescope and many other major facilities.

Fig 1: *International Virtual Observatory Alliance partners.*

But for a real "educational VO" the goal might even be the creation of advanced "Digital Universes" that tap into science archives around the world and gives access to all data at the click of a mouse. A beguiling vision: but is it realistic?

The obstacles

In many ways this vision is not realistic, at least not within the foreseeable future. Education implies clarity and simplicity in presenting and using new ideas and principles, and so demands products at the highest level of 'refinement'. Raw data are inherently 'dirty' and full of the complications that make the extraction of real science a challenge on all levels even to experienced scientists. These complications can often obscure the educational point. The VO interfaces that are currently under development are for experts only, requiring extensive training even for astronomers.

With time, data issues will become more and more complicated. Today there are ever more data, more wavelength regions, more telescopes, more detectors and more calibrations to follow. On top of this, VO concepts are very abstract and difficult to explain in an educational situation. Teachers themselves have often not had the right training in dealing with data or using advanced astronomical image processing tools such as IRAF and MIDAS, and may not have the right connections with scientists who could help.

A framework for a virtual outreach and education repository

If a real educational VO is not a realistic proposition for the next five or ten years, then we must turn instead to some smaller and more realistic goals. It is in a way paradoxical to discuss access to real data when there already today are vast quantities of 'clean' outreach and educational material available on the web. The problem is that they are not linked systematically, and it is therefore next to impossible for educators, laymen and the like to search these resources in a simple manner.

Here we describe a realistic first step towards an "educational VO". The framework outlined here will link outreach products and resources worldwide, ultimately allowing the creation of various 'digital universes' by professional companies or other organisations.

Today, most public outreach resources, most notably images, do not adhere to any specific standards for archiving. Imagine if the wonderful collections of press release materials from ground and space-based missions could include common information (known as metadata), such as their positions in the sky, object names etc. An elaborate and standardised system could be envisaged whereby the world's archives of more refined outreach and education products such as 'pretty pictures' and videos could be tied together and made accessible.

This would make it possible for outreach offices as well as third-party companies to build automated tools that could interface

Fig 2: *The vision of a Digital Universe. Wearing Virtual Reality helmet and gloves we fly through a database of star positions and images of objects placed in the correct positions. Occasionally we stop to query for information about interesting objects we find along the journey. Credit: NOVA/NCSA.*

with image databases on the internet and allow exploration of this treasure. Anything from simple searches using existing, and very powerful, internet search engines up to interfaces to fully three-dimensional 'digital universe' settings is conceivable as an outcome of such a framework. One could imagine using outreach images in live planetarium shows, in comparative multi-wavelength views, as a teaching aid and in many other places. Finally, and most important of all — so long as future PR images are compatible with some yet to be agreed upon standard, the treasury of 'mouse-click accessible' images will grow from day to day.

This is a challenging, but manageable, task. It demands consensus and collaboration among the entire outreach and education community — from the people creating the 'pretty pictures' (image processing specialists), via the data providers (the outreach archives) to the different end-users such as educators and 'visualisers', who use the resources to visualise 'digital universes'.

The aim of such a system could be stated: *"To allow outreach resources to be 'catalogued' in a virtual repository and accessed by educators, press, students and public through specialized visual tools combined with search engines."*

An imaginary example of the outcome of such a system is shown in Figure 2.

All parties will gain by such a system. By working together and defining a common set of systems and formats more people will see and use the resources from each group. This should be enough in itself to get the ball rolling.

For the sake of simplicity such a system might be termed a "Virtual Repository". Here repository is used in the meaning of a 'place' where the outreach and education resources are 'collected', and 'virtual' in the sense that no physical movement of data should take place. Instead a framework is put in place whereby the data can be accessed seamlessly in a similar style to that envisaged for the Virtual Observatory.

The components of the "Virtual Repository"

The first component of the "Virtual Repository" is a central coordinating organisation to endorse the necessary formats for metadata and protocol. This rôle would sit most effectively with a programme group within the International Astronomical Union Division XII Working Group "Communicating Astronomy". Such a programme group was created following the Global Hands-On Universe meeting in St. Petersburg in 2004: http://www.communicatingastronomy.org/repository/.

The second component should be a well-defined list of *metadata descriptors* that would always accompany products such as images and videos. A draft for such a list is given to the right. It is currently under discussion and, once agreed, will be submitted for final endorsement by the IAU.

The third component is a dynamic *provider metadata* list that should reside with the central coordinating organisation. This list contains the 'addresses' of data providers ('pretty picture' archives etc.) with 'contact details' etc. Some natural things to have in this list would be the data provider address, the archive query format and metadata conversion rules as well as the provider type (EPO group, school, robotic telescope).

Any interested group with data to share should in principle be allowed to sign up to the provider list so that resources can be disseminated as widely as possible.

The fourth component would be *a protocol for outreach-related queries*. One could envisage an Outreach and Education Mark-up Language (OEML) similar to the Robotic Telescope Mark-up Language (RTML) (see Pennypacker et al. 2002), or a VO-style Data Access Layer.

With our development of the upcoming FITS Liberator version 2.0 we are taking a step in the direction of the second item on this list by adding agreed-upon metadata to the jpeg and tiff 'pretty pictures' that are stored in outreach archives around the globe.

Summary

The basic framework outlined above needs a collaborative endorsement of the fundamental elements at each level in the list. For the first item this is a central coordinating organisation, for the second a fixed list of metadata descriptors for outreach and education resources such as images and videos. For item three an agreed dynamic provider metadata list containing 'addresses' of the archives of images and videos is required and finally a protocol for outreach-related queries whereby the data providers can be reached is needed for the last item to be realised.

If this basic framework were successfully put in place it would open the door to the 'Digital Universe'. Search engines could be built that would enable laymen and educators to search globally for pictures of individual galaxies and stars. Visualisers such as the Redshift and Starry Night planetarium software or full-immersion 'real' planetarium dome systems such as Evans & Sutherland's Digistar 3 could place the outreach images in the right context in the sky and link to textual information. And this would just be the beginning.

Metadata keywords

FILE:

1. Product type ("image") [image/video/text]
2. File format ("tiff") [tiff/jpeg/avi/mpeg-2/]
3. Original dimensions (=NAXIS1/2) ("2100 x 2304 pixels")

ID:

4. IDs (e.g. "heic0412a, opo0420b")
5. Data provider ("41: Hubble European Space Agency Information Centre")
6. Observatory ("1: Hubble Space Telescope")
7. Instrument ("WFPC2")
8. Dataset names (VO compliant if possible): („ivo://ESO.HST/U2JZ0607B, ivo://ESO.HST/U2JZ0603B, ivo://ESO.HST/ U2JZ0607B, ivo://ESO.HST/U2JZ0605B") [ivo://AuthorityID/ResourceKey]
9. Image release date ("02.01.1995")
10. Author ("Lars Lindberg Christensen")
11. Credit ("ESA & NASA")

PROCESSING:

12. White level (z1)
13. Black level (z2)
14. Stretch function
15. Scale factor
16. Offset

INFO:

17. Quality ("2")
18. Further information link ("http://hubblesite.org/newscenter/newsdesk/archive/releases/1995/45/image/a")
19. Comment ("This spectacular colour panorama of the center the Orion nebula is one of the largest pictures ever assembled from individual images taken with the Hubble Space Telescope. The picture, seamlessly composited from a mosaic of 15 separate fields, covers an area of sky about five percent of the area covered by the full Moon.")

ASTRO:

20. Wavelength range ("502-658 nm")
21. Corner coordinates (ra, dec, Epoch 2000) "(04 12 12, -05 04 32) (04 12 04, -05 04 32) (04 12 10, -05 07 32) (04 12 04, -05 07 32)"
22. Creation type ("real") [real/simulated/artwork]
23. Target name ("M 42")
24. Other Number of exposures ("4")
25. Exposure times in seconds ("320, 300, 700, 900")
26. Object class/subclass ("nebula")("emission")

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The Release of aXe 1.4

Martin Kümmel, Jeremy Walsh, Søren Larsen & Richard Hook

Slitless spectroscopy is one of the observing modes offered by the Advanced Camera for Surveys (ACS) on the Hubble Space Telescope (HST). The ST-ECF is responsible for the support of the spectroscopic modes of ACS, and a key component of this support is the development of the aXe software package.

aXe is a spectroscopic data extraction software package which was designed to handle large format spectroscopic slitless images such as those from the ACS. aXe is distributed by STScI as part of the STSDAS software package and version 1.3 has been described in earlier Newsletter articles (see Pirzkal et al. 2001, or the aXe manual http://www.stecf.org/software/aXe/Manual_1.30.pdf). In this article we introduce the new aXe version 1.4, which is to be released together with STSDAS version 3.3 around mid-November 2004.

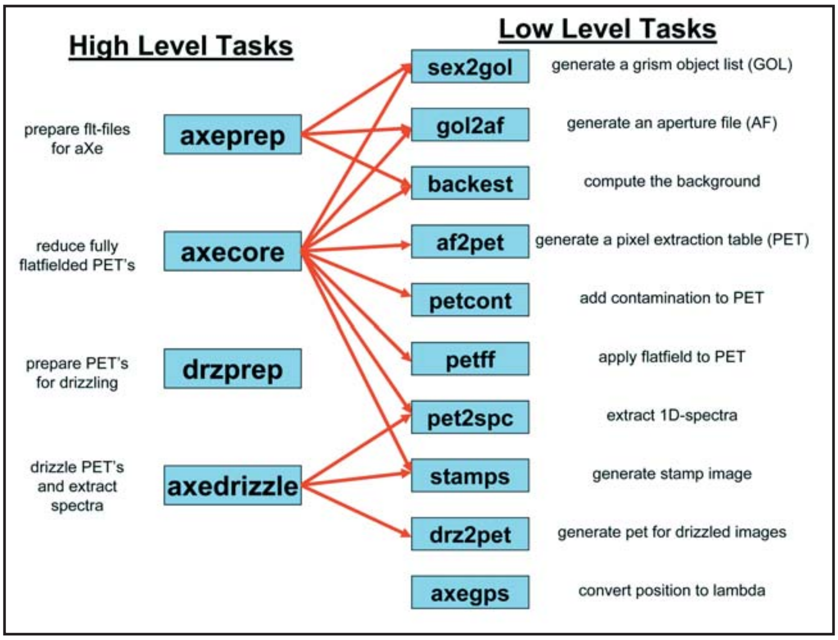

Fig 1: *Overview of all aXe 1.4 tasks. The arrows indicate the interactions between the High Level and Low Level Tasks.*

Version 1.4 of aXe differs from earlier aXe releases in several ways. Users who are familiar with previous versions of aXe should find considerable simplification for routine spectral extraction compared with aXe 1.3. However, there are also considerable enhancements for dealing with multiple slitless images which give aXe 1.4 a new "look and feel". We trust that the benefits of the new features in aXe by far outweigh the inconvenience of having to learn new tasks. In the following sections we present and explain the new features and philosophies that come along with aXe 1.4.

Python/PyRAF

Some of the aXe tasks are now written in Python, an interpreted, interactive, object-oriented programming language (see http://www.python.org). The main reason for this change was the implemention of the aXedrizzle technique (see below and Kümmel et al. 2004a). In Python, IRAF commands can be called directly through their PyRAF interfaces. It is therefore easy to use the standard IRAF implementation of drizzle within aXedrizzle. The convenient access to the standard aXe tasks also allowed the implementation of the task axeprep, which extends aXe to allow some preparatory steps for which users had been required to write their own scripts in previous versions of aXe.

aXe 1.4 is closely tied to PyRAF, the new command language for running IRAF tasks (see http://www.stsci.edu/resources/software_hardware/pyraf). From version 1.4 on all future aXe releases will include PyRAF frontends. This makes it straightforward to integrate aXe tasks into python/PyRAF scripts. aXe tasks no longer have to be applied in external shell scripts, but can become an integral part of any data reduction scheme implemented in IRAF/PyRAF.

High level tasks

In previous releases all aXe tasks worked on only a single spectrum image. The task sex2gol for example creates a Grism Object list for one grism image. Then the task gol2af generates an Aperture File for that grism image, af2pet produces a Pixel Extraction Table for that grism image, and so on.

aXe 1.4 introduces a new class of High Level Tasks. The High Level Tasks work on image lists, and are designed to perform a reduction step on an entire data set. To work on the individual images the High Level Tasks often employ the old Low Level Tasks of aXe. Each High Level Task combines several reduction steps, eg the whole aXe 1.3 reduction is now executed within the High Level Task axecore. This strategy keeps the number of tasks which the user actually has to use and understand low. Although the capabilities of the aXe software have been greatly extended in aXe 1.4, only four High Level Tasks are required to perform a full reduction of a set of ACS grism images with aXe 1.4.

Figure 1 gives an overview of the High Level and Low Level tasks in aXe 1.4. The interaction between the tasks is indicated with arrows.

aXedrizzle

The drizzling of grism spectra is probably the most significant addition in aXe 1.4. This is the first implementation of the drizzle code to combine spectral data, but the overall methodology can in principle also be applied in other reduction packages for spectral data.

The main advantages of aXedrizzle have already been discussed in a previous Newsletter article (see Kümmel et al. 2004a and Kümmel et al. 2004b). Figure 2 gives a schematic overview of aXedrizzle:

• The first order beams in the flatfielded and wavelength calibrated PET's are converted to stamp images (Figure 2b)
• For each stamp image, transformation coefficients are derived to drizzle the stamp image to an ideal long slit spectrum with the dispersion parallel to the x-axis and the cross-dispersion with constant pixel scale parallel to the y-axis (Figure 2c)
• The single stamp images of each object are drizzled onto a single deep, combined 2D spectral image (Figure 2d)
• The 1D spectra are extracted from the deep 2D spectral image using "classical" aXe tools

In a pilot study, the aXedrizzle reduction scheme was used for the reduction of the Hubble Ultra Deep Field (HUDF) HRC Parallels data. The results can be seen on the preview webpages at http://www.stecf.org/UDF/HRCpreview.html.

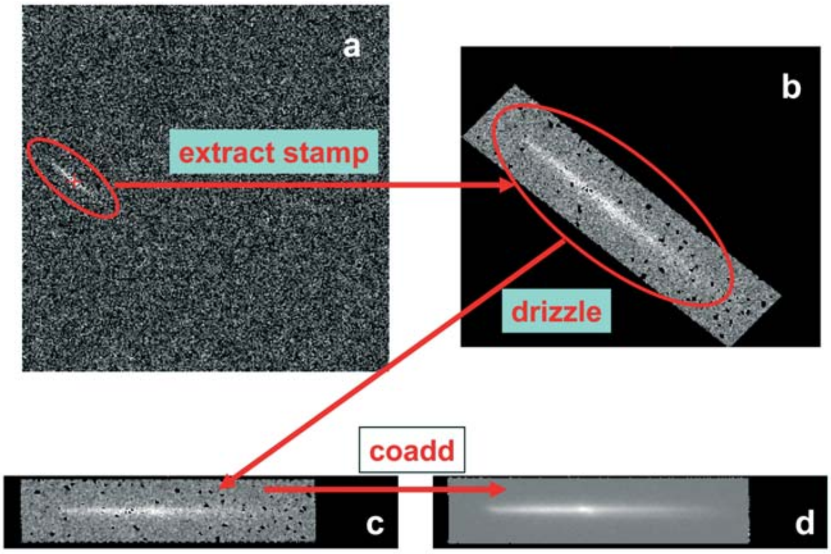

Fig 2: *aXedrizzle: the object marked in panel a is extracted as a stamp image (b). The stamp image is drizzled to an image with constant dispersion and constant pixel scale in the cross dispersion direction (c). The deep 2D drizzled image (d) is then used to extract the 1D spectrum.*

Background subtraction

Another new feature introduced with aXe 1.4 is the option of using a global background subtraction, based on a scaled master sky frame. The homogeneous background of a typical high-latitude HST grism exposure makes the background subtraction directly from the pipeline processed science images (ie, _flt.fits files) feasible.

Scaling and subtraction of the master sky is done with the aXe task axeprep (see Figure 1). Before scaling the master sky to the level of each science frame, the object spectra are masked out on both the science and the master sky image.

The experience with the application of this technique to the HUDF HRC Parallels data and within the Grism ACS Program for Extragalactic Science (GRAPES), PI Sangeeta Malhotra (see http://www-int.stsci.edu/~san/Grapes/, and Pirzkal et al. 2004 for more details) are very encouraging. New master sky images as well as the latest information concerning background subtraction are posted on the aXe webpages at:
http://www.stecf.org/software/aXe/index.html.

Release and future development

aXe 1.4 is released within STSDAS version 3.3 in the subpackage 'hst_calib.acs.axe'. The current release date for STSDAS 3.3 is around mid-November 2004.

As a relatively young software project which is still under active development, the changes and improvements of the code are quite fast and favour release cycles which are independent from STSDAS. To give users the possibility to always work with the newest aXe we also distribute aXe through the aXe webpages at http://www.stecf.org/software/aXe/index.html. On this webpage we always offer the latest aXe release for download. The aXe version posted there is loaded and used as a local package within PyRAF.

Future releases of aXe will target the use of prismatic dispersion relations on a rather short timescale (by December 2004). Although the hooks to reduce prism data are already there, present aXe versions cannot yet adequately handle them. Moreover, we will implement the optimum extraction method (Horne, 1985) and a more refined scheme for source contamination correction in the near future.

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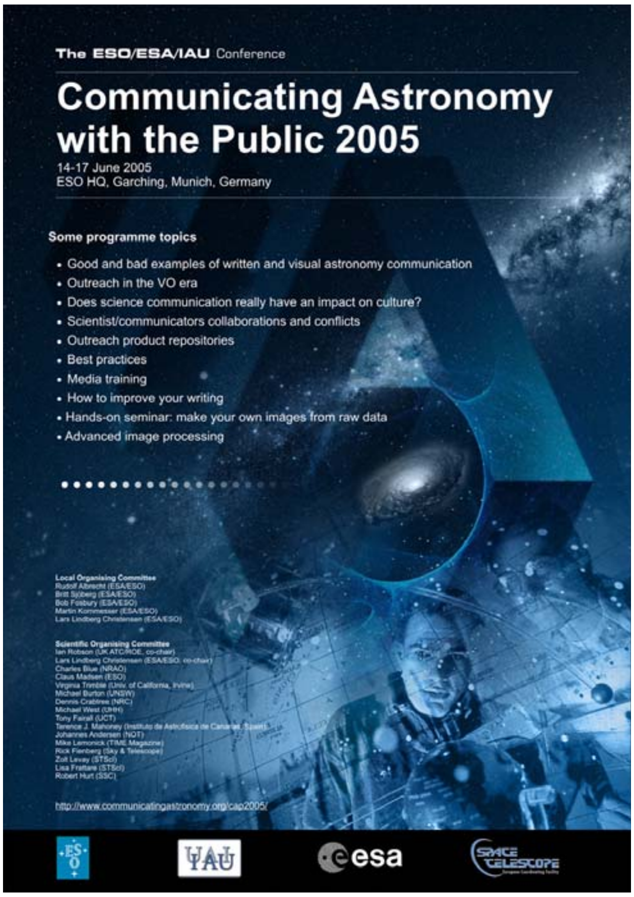

The ESO/ESA/IAU Conference
Communicating Astronomy with the Public 2005
14-17 June 2005
ESO HQ, Garching, Munich, Germany

http://www.communicatingastronomy.org/cap2005/

In recent years many of the scientific institutions in Europe have stepped up their communication efforts. It is slowly becoming normal to have communication offices at universities, within a faculty and at scientific institutions in general. This has been the standard in the US for many years, where even the smallest universities have communication offices.

This conference aims to bring together the “producers” of astronomical information (research scientists), “public information officers” (connected with large observatories and space missions), and “mediators” (science reporters and writers, staff members from museums, planetariums). A list of topics can be found on the web site but the key topics of the meeting will be
1) “Good and bad examples of astronomy communication” and
2) “Outreach in the Virtual Observatory era”.

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