ST-ECF

June 2007

NEWSLETTER 42

Spectral Signal-to-Noise

Re-activating the ACS Solar Blind Channel

Scisoft VII

Space Telescope European Coordinating Facility

HUBBLE STATUS

Jeremy Walsh

It has been an eventful few months for Hubble. Just one day after the deadline for proposals for Cycle 16 closed on 26 January, the first sign of a problem appeared when an increase in pressure was detected by the NICMOS cryocooler. This anomaly turned out not to have anything to do with NICMOS, but to signal a failure in the Side 2 power supply of the Advanced Camera for Surveys (ACS). The ACS Side 1 power supply had already failed in June 2006 and the instrument had been operating on its duplicate electronics set since then. A component had melted when a short developed on one of the power converter boards, thus producing the detected increase in pressure. It took a few days before the extent of the problem could be fully diagnosed but it was clear that both channels of ACS — Wide Field and High Resolution — with CCD detectors would not be operable for Cycle 16. This removed Hubble's prime optical imaging capability, leaving only WFPC2 available.

Since there were about 450 applications to use ACS in the Cycle 16 pool of applications, it was decided to extend the proposal deadline by two weeks to allow the withdrawal of ACS proposals, changes to submitted proposals, or new proposals to use Hubble instruments — now confined to WFPC2, NICMOS, the ACS Solar Blind Channel and the Fine Guidance Sensors. With another two weeks', grace, the number of submitted proposals actually increased, from 747 to 821. Despite the extension of the proposal deadline, the Time Allocation meeting took place as originally planned from 19 to 23 March — an impressive testament to the maturity of the Hubble allocation process.

Cycle 16 showed a typical over-subscription of 5.7:1 by orbits, for an allocated cycle length of 3100 orbits. If the Servicing Mission 4 (SM4) takes place in September 2008, then Cycle 16 could be a few months longer than nominal, and the extra time could be filled by reaching into the highly-rated, but initially unallocated, Cycle 16 proposals. Whilst European astronomers were well represented among the Time Allocation Committee (TAC) and panel members, the allocated orbits fell slightly short of that for previous cycles. The total number of orbits allocated to European PIs was 13.0% (12.6% by primary orbits, since a Snapshot programme was also allocated), and including a Large Proposal (159 orbits).

Following the failure of the ACS Side 1 power supply in June 2006, a supplemental call for proposals had been issued to deal with a potential hiatus in utilisation of Hubble should there be further problems with ACS. Six contingency proposals were selected by members of a Space Telescope Users Committee (STUC) sub-committee in consultation with the Cycle 15 Time Allocation Committee Chair (R. Kudritzki): three using WFPC2 and three for NICMOS were approved. Following the ACS problem these programmes were activated and scheduled by 16 February 2007. As a result there were only about three weeks during which Hubble was severely under-scheduled. These contingency proposals are large GO programmes, but with zero proprietary time; in total 750 orbits were allocated. A huge effort has also gone into reviewing (both from the scientific and technical aspects), and if possible re-scheduling, the Cycle 15 ACS proposals (also some uncompleted Cycle 14 proposals). In many cases part, or even whole, programmes could be transferred to WFPC2. The result of all this replanning is that the efficiency of utilisation of Hubble can be retained during the first half of 2007, until the Cycle 16 proposals are ready to schedule.

The diagnosis of the problem on ACS was a long process and involved a number of on-orbit tests to establish the exact site of the fault. It seems most probable that a power supply board failed with a short-circuit. The Anomaly Review Board report is expected soon. The results are of course very pertinent to whether a repair can be attempted during SM4. The nature of the problem is very similar to that which occurred in STIS in 2004, and the cure — the installation of a new power supply by the astronauts — is also of a very similar nature. The investigations already conducted for a repair of STIS thus turned out to be highly relevant to ACS. The question of whether to repair both instruments will not be an easy one, since the number of astronaut extra-vehicular hours is limited and there may not be enough time to repair both. During SM4 the Cosmic Origins Spectrograph (COS) and the Wide Field Camera 3 (WFC3) will be installed and batteries and gyroscopes need to be replaced. Other factors also have to be considered in the decision to repair ACS: for example the ACS Wide Field Channel has higher sensitivity in the red region of the spectrum than the more UV sensitive CCD of the similar sized UVIS channel of WFC3.

Despite the failure of the ACS power supply, it proved possible to run the Solar Blind Channel (SBC) from a cross-strapped power supply. A series of tests during February showed that this mode was alive and well. The major worry was that the gas release during the short on 27 January might have led to contamination within the instrument. Then UV light could polymerise the contaminants leading to a loss of throughput. A series of tests was scheduled involving filter imaging and prism spectroscopy. It turned out that the calibration proposal developed at the ST-ECF for characterising the SBC red-leak, as part of the ST-ECF support for the ACS slitless modes, could be used to check the UV throughput. The results are described in the article by Harald Kuntschner in this Newsletter. With a quick turn-around, it could be shown that the SBC had suffered no significant loss of UV throughput. Soon after these tests, the SBC began a series of high profile imaging observations of Jupiter in support of the fly-by of the New Horizons mission to Pluto.

HUBBLE'S VIEW OF BARRED SPIRAL GALAXY NGC 1672 [heic 0707]

NGC 1672, visible from the Southern Hemisphere, is seen almost face on and shows regions of intense star formation. The greatest concentrations of star formation are found in the so-called starburst regions near the ends of the galaxy's strong galactic bar. NGC 1672 is a prototypical barred spiral galaxy and differs from normal spiral galaxies in that the spiral arms do not twist all the way into the centre. Instead, they are attached to the two ends of a straight bar of stars enclosing the nucleus.

In the new image from the NASA/ESA Hubble Space Telescope, clusters of hot young blue stars form along the spiral arms, and ionise surrounding clouds of hydrogen gas that glow red. Delicate curtains of dust partially obscure and redden the light of the stars behind them. NGC 1672's symmetric look is emphasised by the four principal arms, edged by eye-catching dust lanes that extend out from the centre.

Galaxies lying behind NGC 1672 give the illusion they are embedded in the foreground galaxy, even though they are really much farther away. They also appear reddened as they shine through NGC 1672's dust. A few bright foreground stars inside our own Milky Way Galaxy appear in the image as bright, diamond-like objects.

NGC 1672 is a member of the family of Seyfert galaxies, named after the astronomer, Carl Keenan Seyfert, who studied a family of galaxies with active nuclei extensively in the 1940s. The energy output of these nuclei can sometimes outshine their host galaxies. The active galaxy family includes the exotically named quasars and blazars. Although each type has distinctive characteristics, they are thought to be all driven by the same engine — supermassive black holes — but are viewed from different angles.

The new Hubble observations, performed with the Advanced Camera for Surveys aboard the observatory, have shed light on the process of starburst activity and on why some galaxies are ablaze with extremely active star formation.

NGC 1672 is more than 60 million light-years away in the direction of the Southern constellation of Dorado. These observations of NGC 1672 were taken with Hubble's Advanced Camera for Surveys in August of 2005. This composite image contains filters that isolate light from the blue, green, and infrared portions of the spectrum, as well as emission from ionised hydrogen.

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

DER_SNR: A SIMPLE & GENERAL SPECTROSCOPIC SIGNAL-TO-NOISE MEASUREMENT ALGORITHM

Felix Stoehr for the STScI/ST-ECF/CADC Spectral Container working group

STScI: Dorothy Fraquelli, Inga Kamp, Tim Kimball, Karen Levay, Tony Rogers, Myron Smith, Randall Thompson & Rick White
ST-ECF: Jonas Haase, Richard Hook, Alberto Micol, Marco Lombardi & Felix Stoehr
CADC: Daniel Durand

How can you characterise the "quality" of a spectrum with one number? Obviously this is far from easy — but can it be done well enough to be useful? This is the challenge that needs to be addressed to help astronomers trawling through large collections of spectral datasets find what they need. A small group from ST-ECF, STScI and CADC have been looking into this problem and have agreed on an algorithm for deriving a signal-to-noise ratio that is described in this article.

INTRODUCTION

The signal-to-noise-ratio (SNR) of a spectrum is a very useful quality indicator and widely used in astronomy. However, in order to estimate the SNR a variety of assumptions about the spectrum and the spectrograph are necessary.

With the advent of large spectral databases covering many varieties of spectrographs — for example in the context of the virtual observatory (VO) — a need for a common algorithm to estimate the SNR arose. This common SNR estimate can be specified in the FITS headers alongside with the existing SNR estimations most data providers compute already.

DER_SNR

We came up with an algorithm that we call DER_SNR — the name is taken from the FITS header keyword name used for the "derived SNR" in the VO Spectral Data Model (http://www.ivoa.net/Documents/latest/SpectrumDM.html).

This algorithm has the following advantages:

- It is simple.
- It is robust.
- The SNR can be (re-)computed from the data alone.
- It does not depend on decisions/assumptions or other user input.

The price to pay for these advantages is that the estimate is less good than when the full instrument and detector knowledge is taken into account. In particular, this SNR estimate silently assumes that the spectrum does have some sort of continuum. Also, as it is by construction a "one-size-fits-all" algorithm, it does not treat different spectra differently, eg, excluding given regions in the spectrum from the computation is not possible. After a series of tests it was decided that the gain in precision of the SNR estimate was not worth the loss of simplicity and ease of use when more complex, but still general schemes were adopted.

The algorithm is:

```
   signal = median(flux(i))
    noise = 1.482602/sqrt(6)*median(abs(2*flux(i)-
            flux(i-2)- flux(i+2)))
  DER_SNR = signal/noise
```

where the median calculations are done over all pixels i that have not been padded with zeros. Routines that calculate DER_SNR in IDL, Python and additional languages in the future can be obtained from: http://www.stecf.org/software/ASTROsoft/DER_SNR.

SIGNAL

The signal of a SNR is usually taken to be the continuum level. Several methods to estimate this level have been proposed and tested: the mean value of the flux, the median value of the flux and a given maximum percentile of the flux, eg, fluxmax2 being the 98% percentile of the sorted flux values. In addition we tested using the full spectrum as well as using only a central region, for example cutting off 10% of the spectrum on either side.

We found the median to be the most robust and simple measurement. For some spectra the mean of the flux was entirely determined by one or a few bad pixels that had extremely large flux values or background such as geocoronal emission. Although it is, in principle possible to account for such values during data reduction it can not be expected to be the case for all instruments and reduction pipelines.

The fluxmax2 signal definition also had the distinct advantage of delivering meaningful values for spectra with no continuum, where the interest only lies in spectral lines and where the rest of the spectrum is close to zero. This is the case for some X-ray spectra or observations of planetary nebulae, for example. For typical spectra with continua, using the fluxmax2 definition would give still a reasonable signal estimate. However, just as the mean method, the fluxmax2 is very sensitive to a few bad high values in the spectrum. Especially for slitless-spectroscopy, it is not uncommon for spectra of extended sources to show large errors (and flux values) at the edges.

Excluding the outer parts of the spectrum and using the fluxmax2 estimator was discussed and tested but finally discarded mainly because different instruments, or even different individual spectra, would need different exclusion regions, which was against the principle that the DER_SNR estimate should to be computable by anyone from the data alone. Also the gain in quality of the estimate was not worth the added complexity of the algorithm.

NOISE

The statistical noise of a spectrum can be estimated numerically under the assumptions that:

1. The noise of two nearby flux values, eg, separated by a given number of pixels, is uncorrelated.
2. That at least for a good part of the spectrum the curvature is comparable to, or larger than, the separation of the nearby pixels so that the signal is similar in nearby pixels.
3. That the noise is approximately Gaussian.

Noise correlations at the level of neighbouring pixels can be introduced by detector crosstalk or the post-processing method, eg, when combining several exposures into one (co-adding, MultiDrizzle). For the spectra we tested, using a separation of two pixels seemed to be a reasonable compromise: whereas we found strong correlations at the one-pixel level, there was nearly no difference when using separations of 2, 3 or 4 pixels. Since using more widely separated pixels makes it more likely that the signal will be different in those pixels (assumption two above), we prefer the closest separation for which noise is uncorrelated.

GETTING MAD

For a Gaussian-distributed variable x, the median absolute difference (MAD) of values of the distribution and the median can be converted into the standard deviation of the Gaussian (ie, the desired noise measurement) via

$$\begin{aligned} m &= median(x(i)) \\ \sigma &= 1.482602\, median(|m - x(i)|) \end{aligned}$$

where the median calculations are done over all pixels i. The factor of 1.482602 that converts the MAD to a standard deviation can be derived by integrating a Gaussian probability distribution. The median value of the flux is not fixed within the spectrum but is a local quantity and is thus not easy to determine. Using the trick of going to higher orders of the median absolute difference, this problem can be circumvented:

$$\begin{aligned} 2nd\ order: \quad \sigma &= f_2\, median\,(|x(i) - x(i+2)|) \\ 3rd\ order: \quad \sigma &= f_3\, median\,(|-x(i-2) + 2x(i) - x(i+2)|) \\ 4th\ order: \quad \sigma &= f_4\, median\,(|-x(i-2) + 3x(i) - 3x(i+2) + x(i+4)|) \end{aligned}$$

Again, median calculations are done over all pixels i. The f factors stem from error propagation and compensate for the fact that the Poisson noise for higher orders decreases just because more pixels are taken into account for one measurement.

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

Figure 1 shows how the noise estimate decreases when going to higher orders for about 36,000 NICMOS grism spectra. The noise computed with the second order, ie, the simplest noise estimation using the MAD is 120% larger, the third order about 50% larger than the noise estimate using the 10th order. Clearly, going from second to third order results in the largest gain of quality. In doing so, linear effects in the spectrum, eg, a tilt, will not show up as high noise values.

As a compromise between simplicity and accuracy, taking into account the roughness of the signal estimation, it was decided to use the third order MAD for the noise estimation.

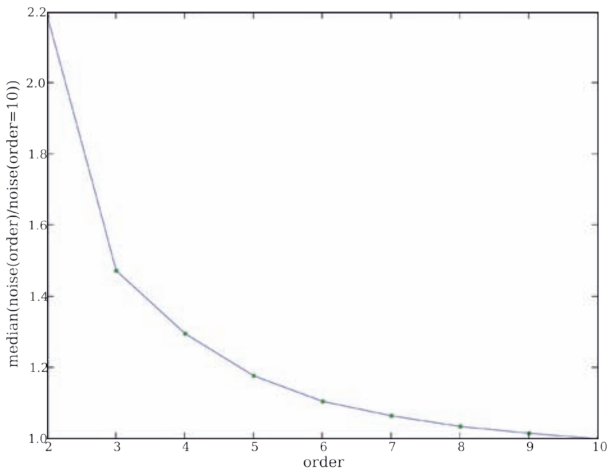

Fig 1: *Ratio between the noise value of a given order and that of order 10. The curve shows the median values for all 36000 NICMOS grism spectra. For a typical spectrum, when taking out linear effects from the noise measurement (ie, going from 2nd order to 3rd order), the noise estimate decreases from about 120% to 50% that of the estimate of the 10th order.*

In some cases where the background is not well defined, background subtraction can lead to negative flux values and thus negative SNR values may result. This is unphysical. Negative SNR values therefore indicate that the data should be inspected carefully before being used.

STATUS AND OUTLOOK

As a first step, this DER_SNR computation will be applied to the datasets from IUE, GALEX, HUT, WUPPE, EUVE, FUSE, BEFS, TUES, HPOL and from all the spectrographs on Hubble (FOS, GHRS, NICMOS and STIS). We hope that, especially given that it is so easy to compute, other missions will follow and indicate the value of DER_SNR in their FITS headers together with the already existing instrument-specific SNR estimates.

STAFF UPDATE

FELIX STOEHR

The ST-ECF archive group returned to full strength at the start of 2007 with the arrival of Felix Stoehr. Felix is German and no stranger to Garching as he did his PhD with Simon White at the Max-Planck-Institute for Astrophysics before moving to IAP in Paris for a couple of post-docs with Patrick Petitjean, Avishai Dekel and Elisabeth Flam. Changing subject, he became an oceanographer for two years before — back from starfish to stars — he joined the ESO/ST-ECF on January 1st as a Software Engineer. His research interests are galaxy formation, large scale structure and the Antarctic circumpolar current but his main interest is certainly software development. Felix is already involved with many aspects of both the running of the classical Hubble archive at the ST-ECF and work for the Hubble Legacy Archive project.

CARINA NEBULA: STAR BIRTH IN THE EXTREME [heic 0707]

Hubble's view of the Carina Nebula shows star birth in a new level of detail. The fantasy-like landscape of the nebula is sculpted by the action of outflowing winds and scorching ultraviolet radiation from the monster stars that inhabit this inferno. In the process, these stars are shredding the surrounding material that is the last vestige of the giant cloud from which the stars were born.

This immense nebula contains a dozen or more brilliant stars that are estimated to be at least 50 to 100 times the mass of our Sun. The most opulent is the star eta Carinae, seen at far left. Eta Carinae is in the final stages of its brief eruptive lifespan, as shown by two billowing lobes of gas and dust that presage its upcoming explosion as a titanic supernova.

The immense nebula is an estimated 7,500 light-years away in the southern constellation of Carina the Keel (of the old southern constellation Argo Navis, the ship of Jason and the Argonauts, from Greek mythology).

This image is a mosaic of the Carina Nebula assembled from 48 frames taken with Hubble Space Telescope's Advanced Camera for Surveys. The Hubble images were taken in the light of ionised hydrogen. Colour information was added with data taken at the Cerro Tololo Inter-American Observatory in Chile. Red corresponds to sulfur, green to hydrogen, and blue to oxygen emission.

NASA, ESA, N. Smith (University of California, Berkeley), and The Hubble Heritage Team (STScI/AURA)

RE-ACTIVATION OF THE ACS SOLAR BLIND CHANNEL

Harald Kuntschner, Martin Kümmel, Jeremy Walsh & Marco Sirianni (STScI)

In January 2007 the main Hubble camera — the Advanced Camera for Surveys — suffered a major problem which stopped all three of its imaging channels from operating. Although the two main imagers (WFC and HRC) could not be recovered, the third — the Solar Blind Channel (SBC), designed for imaging and spectroscopy of ultraviolet light, could be brought back. But would the failure affect its performance?

On 27 January 2007, Hubble went into "safe mode" due to the failure of the Side 2 electronics of the Advanced Camera for Surveys (ACS). Subsequent investigations soon revealed that the ACS Wide Field Channel (WFC) and High Resolution Channel (HRC) will remain inoperable,but the ACS Solar Blind Channel (SBC) could again be reactivated using the ACS Side 1 electronics.

The SBC channel was reactivated on 20 February 2007, but before deciding on resuming science operations, it was very important to assess possible contamination of the ACS optics and SBC detector window as a result of the out-gassing event after the Side 2 failure. In this article we briefly report on the ST-ECF contribution to this investigation.

As the first observations with the SBC, images and slitless spectroscopic data were obtained for selected standard stars. Immediately after the data were available on the ground, we analysed the new SBC observations of the flux standard star WD1657+343 (Programme 11056, observations from 21 February 2007 and 1 March 2007) with the aXe software package (http://www.stecf.org/instruments/ACSgrism/axe/, developed at the ST-ECF). The results were compared with observations of the same object taken one and a half years ago (Programme 10391, observations from 8 August 2005). For this analysis the SBC observations with the PR110L grism, covering wavelengths in the range 1150-1700 Å were used.

The top panel of Figure 1 shows the fully calibrated spectrum of WD1657+343 as extracted from the pre ACS-failure observations in black. The spectrum is the average of seven individual observations, which were distributed over the field of view of the SBC channel. The average spectrum of the new observations is shown in red and, as with the previous observations, seven different spatial positions were observed. The programme was carried out twice so that a total of 14 individual observations were averaged.

The lower panel of Figure 1 shows the ratio of the two averaged flux standard star spectra in black while the red dashed lines indicate the 1-σ error range. The errors are evaluated as the RMS between the individual observations of a given epoch divided by the square root of the number of observations minus one.

Throughout the wavelength interval covered by the PR110L grism, we do not detect any significant deterioration of the SBC sensitivity. Our measurement accuracy is about 1% from 1300-1700 Å, while it degrades to 3% accuracy at around Lyα and up to 10% for the bluest wavelengths covered. Additional investigations of flat field images and images of photometric standard stars also indicate only minimal contamination, and it was decided to resume normal science observations with the SBC. One of the first science programmes conducted with SBC supported the flyby of the New Horizons spacecraft past Jupiter (see http://www.nasa.gov/mission_pages/hubble/news/jupiter_flyby.html).

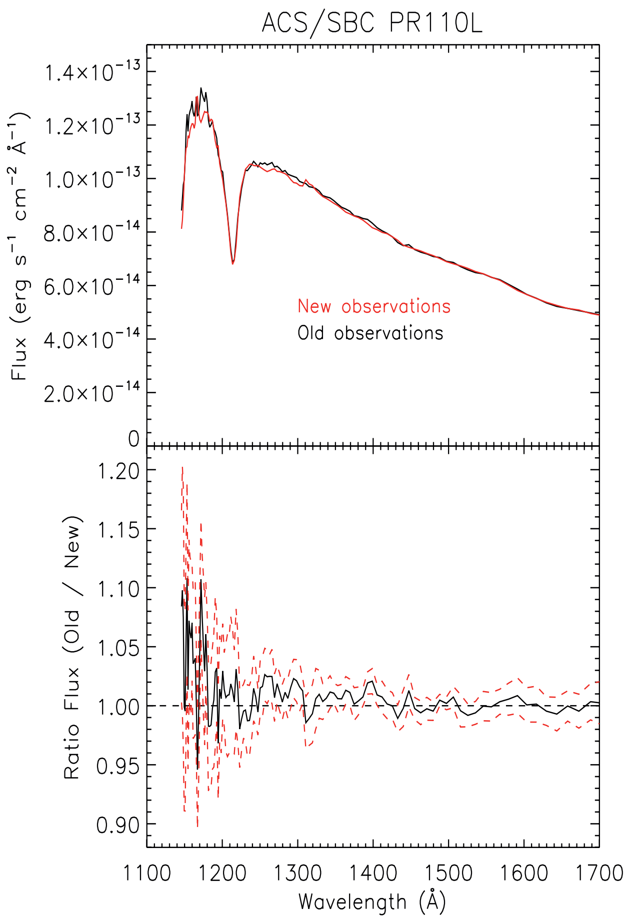

Fig 1: *Top panel: Comparison of ACS/SBC PR110L observations of the flux standard star WD1657+343 before (black line) and after (red line) the failure of the Side 2 electronics in January 2007. Bottom panel: The ratio of the two epochs is shown with 1-* σ *error ranges indicated by red dashed lines.*

SCISOFT VII — WITH VO SUPPORT

Richard Hook on behalf of the Scisoft Team

The Scisoft bundle is a collection of astronomical software intended mostly for ESO users, but which is also distributed to other interested parties. It includes most of the packages needed by working observational astronomers with an emphasis on those widely used for handling optical and infrared data sets. Scisoft is installed on almost all the scientific computers running Linux at ESO Garching and widely at the ESO sites in Chile. More complete details can be found on the Scisoft web pages at www.eso.org/scisoft.

We are pleased to announce the availability of Scisoft VII (June 2007). This new version of the collection includes many updates and additional packages and also incorporates some new features. For the first time we have a collection of Virtual Observatory (VO) tools as well as extended support for longer wavelength data handling from sub-millimetre facilities such as APEX.

A list of the items included in the new version, and where there are changes from the previous one, is given in the adjacent tables. Scisoft VII was built on, and intended to be used on, Fedora Core 6 Linux, but is likely to run on many similar modern Linux systems. We no longer maintain a version of Scisoft for other architectures such as Solaris or HPUX, but a similar version for Mac OSX, produced independently of ESO, is also available through a link on the Scisoft web page.

Scisoft VII can be either downloaded from the ESO ftp site (ftp://ftp.eso.org/scisoft/scisoft7/linux/fedora6/) or the entire collection may be requested on DVD through the ST-ECF online shop at http://www.spacetelescope.org/hubbleshop/. We also continue to support a mirror of the Scisoft collection in China (http://scisoft.lamost.org/). Note that only requests from China, to be delivered in China, are accepted by the Chinese mirror site.

Scisoft is a collaboration between many people. I would particularly like to thank Mathias André, and Jean-Christophe Malapert for their help with the preparation of the release. I would also like to thank Markus Dolensky for proposing the addition of VO content and Mark Allen (CDS, Strasbourg) for selecting the VO tools we include. We are grateful to Chenzhou Cui of the National Astronomical Observatory, Chinese Academy of Sciences for his continued support of the Chinese mirror. Finally a special word of thanks to Peter Stetson (HIA, Canada) for allowing us to include DAOPhot and related tools in the collection.

DATA ANALYSIS SYSTEMS

IRAF 2.12.2a-EXPORT

- ctio – Utilities from CTIO
- crutil 1.6 – Cosmic ray utilities from NOAO
- gemini 1.9 – Utilities from the Gemini Telescopes
- gmisc – Miscellaneous utilities for Gemini – Updated in Scisoft 7
- mxtools (Dec2001) – Utilities from NOAO including QDPHOT
- guiapps – Graphical applications for IRAF
- xdimsum (Jan2003) – Enhanced IR data reduction and mosaicing software
- ifocas (Apr2001) – Enhanced object detection and classification software
- dimsum 3.0 (Aug2002) – IR data reduction and mosaicing software
- color – Utilities for creating colour images
- fitsutil – FITS utilities
- mscred 4.8 (May 2004) – Mosaic camera CCD reduction tasks from NOAO
- esowfi 1.3 (Mar2001)
- eis 1.8 (May2002) – ESO Imaging Survey IRAF tasks (EIS Drizzle etc)
- rvsao 2.5.0 – Spectral Radial Velocity package from CfA
- nmisc 020618 – IRAF miscellany
- xccdred – CCD reduction for multi-port chips
- stecf 1.5 – Utilities from ST-ECF, including polarimetry reduction and spectral restoration packages
- stsdas/tables 3.6 – HST data analysis and tables systems - Updated in Scisoft 7
- ECL – Enhanced CL – New in Scisoft 7

Eclipse 5.0 – Includes ISAAC, CONICA, WFI, Lua and ADONIS add-ons – Updated in Scisoft 7
ESO-MIDAS 07FebPl1.0 – Updated in Scisoft 7
PyMidas 1.0.5

IDL 6.3 – Interactive Data Language from RSI. Commercial package, requires license – Note: NOT included in EXPORT version – Updated in Scisoft 7

- Astron (Jul2004) – Goddard Astron IDL astronomical procedure library
- StarFinder – IDL adaptive optics photometry software
- JHUAPL Library (Aug2004) – IDL procedure collection from Johns Hopkins
- ATV – an interactive display tool for IDL

Gildas (Feb2007a) – Radio astronomy applications from IRAM – Note: NOT included in EXPORT version – Updated in Scisoft 7
Difmap 2.4i – Interactive program for radio synthesis imaging from Caltech – Updated in Scisoft 7
Miriad 3.1 – New in Scisoft 7
Karma 1.7 – New in Scisoft 7

IMAGE DISPLAY SERVERS

x11iraf 1.3.1 – May 2000 version, including xgterm
SAOImage 1.35.1 – The original, needs 8bit Xserver – Updated in Scisoft 7
DS9 4.0b11 – Latest display server from SAO. – Updated in Scisoft 7
XPA 2.1.7b2 – Messaging system from SAO. Used by DS9. – Updated in Scisoft 7
Skycat 3.0.1 – ESO image display tool with catalogue and image server access
fv 4.4 – Interactive FITS viewer – Updated in Scisoft 7
QFitsView – FITS file viewer. – New in Scisoft 7
Gaia – Graphical Astronomy and Image Analysis Tool. – New in Scisoft 7

GRAPHICS SOFTWARE

SM 2.4.26 (Dec2002) – SuperMongo – Note: NOT included in EX-**PORT** version
PGPLOT 5.2 – Graphics library
gnuplot 4.2 – Command-line driven interactive function plotting utility – Updated in Scisoft 7
Grace 5.1.9 – 2D WYSIWYG plotting tool
ggobi 2.1.4 – Data visualisation in 3D – Updated in Scisoft 7
Matplotlib 0.90.0 – Python 2D plotting library – Updated in Scisoft 7

SCRIPTING LANGUAGES

Python 2.4 – General purpose, object orientated, extensible scripting language.

- Numeric 24.2
- Scientific 2.4.9
- RV 1.1
- Imaging (PIL) 1.1.4
- Pmw 1.2
- pCFITSIO 0.99.2
- _sre readline _locale thread gdbm zlib fcntl pwd grp errno select mmap _socket termios _tkinter
- asciidata 0.01
- binascii
- ipython 0.6.6
- pygtk 2.10.4
- scipy 0.3.2
- ppgplot 1.3
- biggles 1.6.4
- psyco 1.4
- pygame 1.7.1
- cStringIO & cPickle

STScI_Python 2.4 – STScI Python packages, including: – Updated in Scisoft 7

- PyRAF 1.3.0 – Python replacement for IRAF cl
- numarray 1.5.2 – Enhanced Python numerical package from STScI
- pyfits 1.0.1 – Python FITS package from STScI
- PyDrizzle 5.7.0 – Drizzling software
- MultiDrizzle 2.7.2 – Automatic image combination drizzling software
- NumPy 1.0.1 – Python package for scientific computing – New in Scisoft 7

Java 1.5.0.11 – Java runtime environment and JDK – New in Scisoft 7
DPUSER – Interactive language – New in Scisoft 7

SCIENTIFIC LIBRARIES

GSL 1.9 – The GNU Scientific Library – Updated in Scisoft 7
DISLIN 9.1 – Scientific Data Plotting software – Updated in Scisoft 7
CFITSIO 3.0.30 – FITS File Subroutine Library – Updated in Scisoft 7
LAPACK Release 3.1.1 – Linear Algebra Subroutine Library – Updated in Scisoft 7
Atlas 3.6.1 – Another Linear Algebra Library
FFTW 3.1.2 – Fast Fourier Transform library – Updated in Scisoft 7
plotutils 2.5 – GNU plotting utilities – Updated in Scisoft 7
JPype 0.5.2.2 – Java to Python integration – New in Scisoft 7

MISCELLANEOUS UTILITIES

wcstools 3.6.8 – World Coordinate System software tools and library from Doug Mink at SAO – Updated in Scisoft 7
Terapix Software Tools – A Selection: SExtractor 2.5.0, SWarp 2.16, & WeightWatcher 1.7 – Updated in Scisoft 7
Tiny Tim 6.3 (Jun2004) – HST point-spread function simulation software
Xephem 3.7.2 – Planetarium and ephemeris software – Updated in Scisoft 7
dss & dss2 – Digitized Sky Survey image extraction software
Cloudy 06.01 – Plasma simulation and spectral synthesis code (no patches applied)
HyperZ 1.1 – Photometric Redshift Code
Hipparcos Transit Tools – Two small Fortran applications (td2uv and td2gf) for processing transit data
Latex style files – A collection of style files for astronomical journals
DAOPhot – Stellar Photometry and related package from Peter Stetson at DAO/HIA, see agreement for redistribution or access to the source code – New in Scisoft 7

VO TOOLS

Aladin 4.0 – Aladin Sky Atlas – New in Scisoft 7
VOspec 2.5 – tool for handling Virtual Observatory compliant Spectra – New in Scisoft 7
VOplot 1.4 – New in Scisoft 7
Plastic 2006.3.rc3 – PLatform for AStronomical Tool InterConnection – New in Scisoft 7
Specview 2.12.2 – New in Scisoft 7
Splat 3.7-0 – Spectral Analysis Tool – New in Scisoft 7
Stilts 1.3 – Starlink Tables Infrastructure Library Tool Set – New in Scisoft 7

Communicating Astronomy with the Public 2007

Communicating Astronomy to a Global Audience

http://www.communicatingastronomy.org/cap2007/

Eugenides Foundation / Planetarium

Athens, Greece 8-11 October 2007

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Specific goals

- To prepare for the International Year of Astronomy 2009
- To make public astronomical knowledge global and accessible to everyone, adapting communication methods to cross national, political, social and cultural borders and impairment limitations
- To promote international collaboration
- To evaluate current tools and methods and prepare for future developments

Key topics

- Case Studies and hands-on demonstrations
- Communication in the YouTube/MySpace/vodcasting mediascape
- Audiovisual, multimedia & online tools
- Social impact and evaluation of astronomy communication
- Education and communication tools for the visually impaired
- Prospects of IAU Commission 55: Communicating Astronomy with the Public

International Astronomical Union Commission 55

National Observatory of Athens

Eugenides Foundation Planetarium

HUBBLECAST: A VIDEO PODCAST FROM ST-ECF

Lars Lindberg Christensen & Raquel Yumi Shida (IAU/ST-ECF)

Video podcasting, or vodcasting, is one of the trendiest areas in the burgeoning domain of Video on Demand (VOD) products. The instant 24-7 availability of video material for immediate download and consumption has an irresistible appeal, especially for younger people. Here the budding video podcaster is offered some advice by the producers of ESA's Hubblecast: a vodcast that quickly made it to the top of the playing lists after its launch in March 2007. Vodcasting is a very direct way to sneak a bit of science into the minds of young people by following the newest and hottest trends in mass media technology.

Audio podcasts and video podcasts, or vodcasts, are these days quickly filling the hard drives of youngsters worldwide. For the producer they offer a direct link to the consumer, for much less effort than a conventional radio and television show where demands on the quality of the final product are more stringent. In March 2007 ESA's Hubble Education and Outreach group at the ST-ECF started surfing the podcast wave by producing the Hubblecast — a video podcast with the latest news and images from the Hubble Space Telescope (see the link below). Podcasts and Vodcasts are relatively simple to produce, despite the daunting number of steps in the workflow, which is divided into three principal stages: preproduction, production and postproduction. This article highlights the major steps along the way to producing a vodcast.

PREPRODUCTION

Before actually producing anything at all it is worthwhile considering where the potential video podcast may fit into the overall podcast mediascape. Identify the specialty or niche that will make the podcast stand out. It might be the graphical "look", the style of the host or hosts, the level of the content or perhaps just the choice of topics included. Although aspirations in this initial brainstorming phase may be high, be realistic and make sure that the concept is feasible in terms of production time and costs. A steady stream of fresh and interesting episodes is one of the most difficult things to achieve in podcasting.

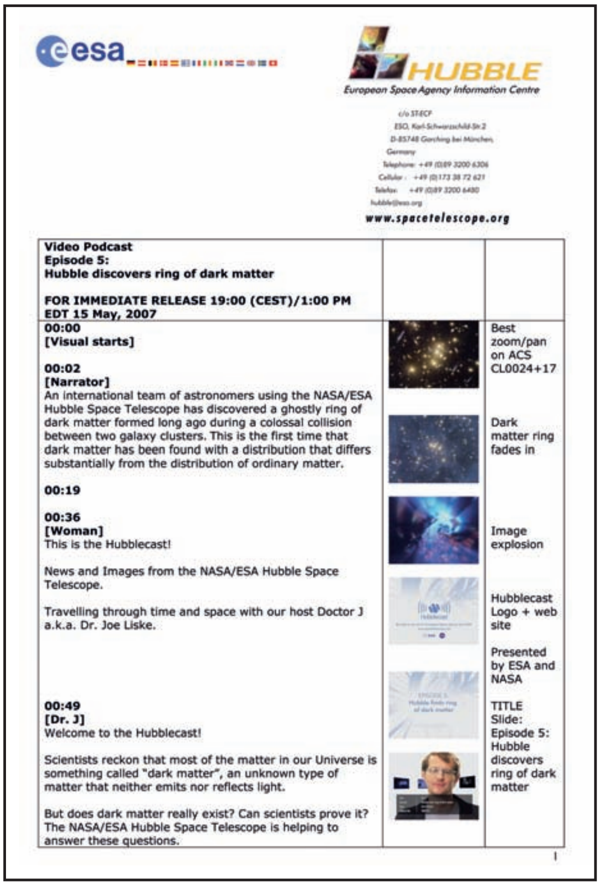
Script writing is one of the most important steps in the planning, or preproduction phase, as it will define all the subsequent steps. Podcasting is a very "light" medium and it is essential to extract the most important facts and make them as attractive as possible. The visual side must be incorporated in the script together with the narration and text for the host. Effective planning for the visuals means fewer problems downstream at the editing stage. Specially produced video segments and sound effects (as much as the production budget allows for) can make the programmes more attractive and give each episode a unique character.

Video podcasts step-by-step

Preproduction
1. Selecting a style
2. Script writing
3. Casting a host

Production
4. Filming
5. Audio recording
6. Green screening/keying
7. Scientist interviews
8. Music

Post-production
9. Video editing
10. . Encoding
11. . Distribution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Video Podcast **Episode 5:** **Hubble discovers ring of dark matter** **FOR IMMEDIATE RELEASE 19:00 (CEST)/1:00 PM EDT 15 May, 2007**		
00:00 **[Visual starts]** **00:02** **[Narrator]** An international team of astronomers using the NASA/ESA Hubble Space Telescope has discovered a ghostly ring of dark matter formed long ago during a colossal collision between two galaxy clusters. This is the first time that dark matter has been found with a distribution that differs substantially from the distribution of ordinary matter. **00:19** **00:36** **[Woman]** This is the Hubblecast! News and Images from the NASA/ESA Hubble Space Telescope. Travelling through time and space with our host Doctor J a.k.a. Dr. Joe Liske. **00:49** **[Dr. J]** Welcome to the Hubblecast! Scientists reckon that most of the matter in our Universe is something called "dark matter", an unknown type of matter that neither emits nor reflects light. But does dark matter really exist? Can scientists prove it? The NASA/ESA Hubble Space Telescope is helping to answer these questions.		Best zoom/pan on ACS CL0024+17 Dark matter ring fades in Image explosion Hubblecast Logo + web site Presented by ESA and NASA TITLE Slide: Episode 5: Hubble discovers ring of dark matter

1

Fig 1*: Example of a script for a video podcast (here Hubblecast Episode 5).*

The choice of presenter, or host, is also important. A likeable person who comes across well on-screen is essential, but it is naturally even better if he or she is a real scientist and is good at memorising lines from a script. The host for the Hubblecast was selected from several very good candidates by a panel consisting of several scientists in a casting session reminiscent of reality television. Despite the undoubted ability of many of the candidates, there could only be one host, and the ESO astronomer Dr. Joe Liske had the best combination of talents. His on-screen alias is "Dr. J" and he now receives fan mail on a daily basis via his MySpace page.

Fig 2: Narrator Bob Fosbury with the Hubblecast host Dr. J in front of the greenscreen that is used to create a combination of real footage and computer graphics.

PRODUCTION

Once the script is in hand, the audio and video have to be produced. The video footage is generally the most important part of the production, but the right audio can give an incredible "lift" to the visual side.

The raw video footage can consist of real footage recorded with a camcorder and digitised, or of animations, or a combination of both. Real footage is recorded with a camcorder either in-house or with the assistance of a small hired camera team, depending on the budget. Naturally, the better the real footage is, the more "cinema-like" the final result.

3D animations are a good and — potentially — inexpensive way to enhance a video podcast and an excellent tool for explaining scientific concepts. The combination of animations and real footage using bluescreening, or keying, techniques may be an interesting option if you intend to show human interaction with scientific phenomena. The technical setup is a bit more complicated as it requires a studio with a blue or green screen, whose function is simply to create a uniform "monochromatic" background that can easily be deleted digitally and replaced with other images or animations.

Free sound tracks and effects from the web, as well as copyrighted "pay-per-use" stock music are available for the sound. However, it may be interesting to collaborate with artists who can compose music and sound effects that will better fit the specific needs of the project. The narration should be done by a native speaker if at all possible. It can be distracting if the narrator has too marked an accent. However, if scientists are interviewed then an accent is a natural part of his or her distinctive personality.

POSTPRODUCTION

The postproduction stage follows the recording of the audio and video. Video editing consists of organising the footage, previewing the clips, trimming the clips to remove unwanted parts, adding clips to the timeline, adding the audio, adjusting, colour-correcting, making transitions, adding supers and titles, all while working in close conjunction with the script. Adobe Premiere is an example of a suitable simple editing tool.

The final important step is the release and promotion of the videos. The primary distribution of the Hubblecast is made via the web, on http://www.spacetelescope.org/videos/hubblecast.html, the iTunes Store and several other podcast repositories. This requires an XML file (for RSS feeds) that contains the relevant technical information for each episode and the submission of links to some of the most popular feed repositories on the internet.

The video footage is delivered in Mpeg-4 format, using the very efficient H.264 codec. This is the format played by video iPods. However, since a video podcast is essentially just a piece of video footage and can be played on any soft- or hardware player, it is advisable to make popular video formats such as QuickTime, or Mpeg-1 available as well. Broadcast formats in addition make it easy to include parts of video podcasts in news shows. If time allows, YouTube and MySpace can be excellent channels for promoting and distributing a video podcast. Download numbers from these pages can be substantial.

IMPACT ASSESSMENT

At the time of writing, five episodes of Hubblecast have been released and have been downloaded more than 35,000 times in total by thousands of astronomy enthusiasts. In addition, many other sites such as YouTube, MySpace, esa.int, Veoh, dailymotion, gofish etc. also offer the Hubblecast and deliver thousands of "views" or downloads to the always podcast-hungry audience. The Hubblecast is — at least for the time being — ranked among the 10 most-viewed podcasts in the science category in iTunes. We plan to keep up with the steady stream of exciting vistas of space seen through the eyes of Hubble and present the latest science to the younger generation so long as this segment of young viewers enjoys our work. Who knows what the next trend will be? Podcasts in HD? Or a new, more exciting medium that allows interaction between the scientists and the public? Only time can tell…

Further information and links for downloads are available at:
http://www.spacetelescope.org/videos/hubblecast.html

Fig 3: The final product. Dr. J, Dr. Joe Liske from ESO, interacting with a globular cluster.

Credits: European Space Agency, NASA, G. Piotto (University of Padua, Italy) and A. Sarajedini (University of Florida, USA). Acknowledgement: Davide de Martin (ESA/Hubble)

HUBBLE FINDS MULTIPLE STELLAR "BABY BOOMS" IN A GLOBULAR CLUSTER [heic0708]

Astronomers were surprised when Hubble spied three generations of cluster stars. The discovery is very different from the standard picture of a globular cluster. For decades, astronomers thought that cluster stars formed at the same time, in the same place, and from the same material, and have co-evolved for billions of years.

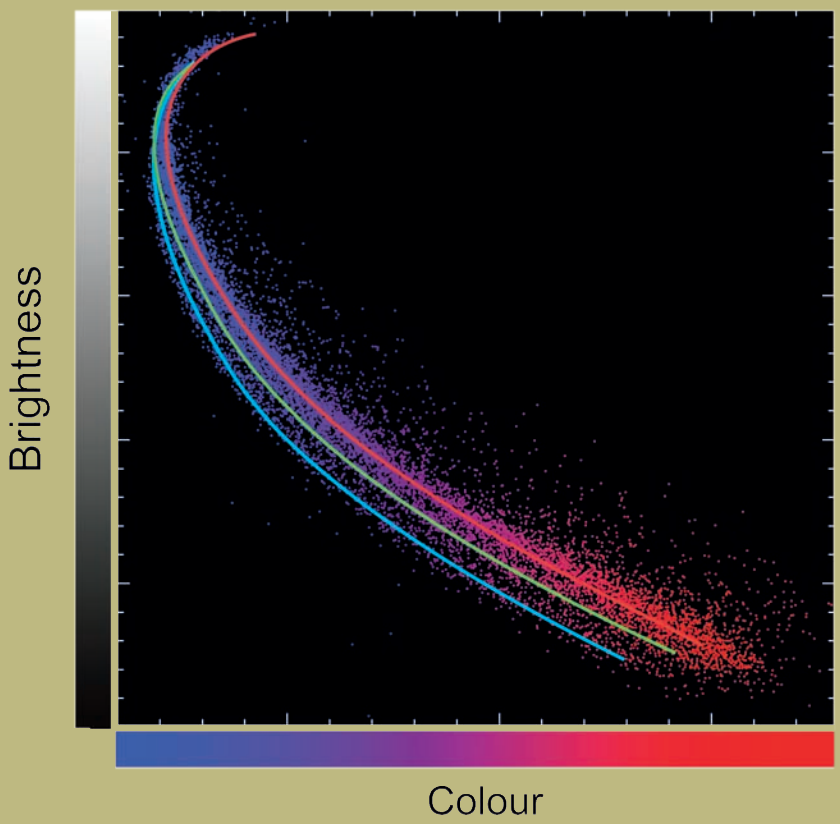
Globular clusters are among the earliest settlers of our Milky Way galaxy, born during our galaxy's formation. They are compact swarms of typically hundreds of thousands of stars held together by gravity.

All the stars in NGC 2808 were born within 200 million years very early in the life of the 12.5-billion-year-old massive cluster. Of the roughly 150 known globular clusters in our Milky Way Galaxy, NGC 2808 is one of the most massive, containing more than 1 million stars.

The sharp resolution of Hubble's Advanced Camera for Surveys measured the brightness and colours of the cluster stars to find the three stellar populations.

The Hubble images were taken in May 2005 and in August and November 2006.

The three generations of stars in NGC 2808. Each point in this graph represents one star in NGC 2808. The vertical axis represents the brightness (as measured through Hubble's near-infrared F814W filter) of the stars (the brightest stars near the top). The horizontal axis represents the colours of the stars, with bluer stars to the left and redder to the right (blue magnitude minus near-infrared magnitude). The three coloured curved lines, red, green and blue, represent the three different stellar generations that are present in the globular cluster.



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DARK MATTER RING IN GALAXY CLUSTER [heic0709a]

This Hubble Space Telescope composite image shows a ghostly "ring" of dark matter in the galaxy cluster ZwCl0024+1652.

The ring-like structure is evident in the blue map of the cluster's dark matter distribution. The map is superimposed on a Hubble image of the cluster. The ring is one of the strongest pieces of evidence to date for the existence of dark matter, a substance of unknown nature that pervades the Universe.

NASA, ESA, M.J. Jee and H. Ford (Johns Hopkins University)

The map was derived from Hubble observations of how the gravity of the cluster ZwCl0024+1652 distorts the light of more distant galaxies, an optical illusion called gravitational lensing. Although astronomers cannot see dark matter, they can infer its existence by mapping the distorted shapes of the background galaxies. The mapping also shows how dark matter is distributed in the cluster.

Astronomers suggest that the dark matter ring was produced from a collision between two gigantic clusters.

Dark matter makes up the bulk of the Universe's material and is believed to make up the underlying structure of the cosmos.

The Hubble observations were taken in November 2004 by the Advanced Camera for Surveys (ACS). Thanks to the exquisite resolution of the ACS, astronomers saw the detailed cobweb tracery of gravitational lensing in the cluster.

Cover Image *[heic0702]: This image depicts bright blue, newly formed stars that are blowing a cavity in the centre of a fascinating star-forming region known as N90. The high energy radiation blazing out from the hot young stars in N90 is eroding the outer portions of the nebula from the inside, as the diffuse outer reaches of the nebula prevent the energetic outflows from streaming away from the cluster directly. Because N90 is located far from the central body of the Small Magellanic Cloud, numerous background galaxies in this picture can be seen, delivering a grand backdrop for the stellar newcomers. The dust in the region gives these distant galaxies a reddish-brown tint. Image credit: NASA, ESA and the Hubble Heritage Team STScI/AURA)-ESA/Hubble Collaboration*