ST-ECF

July 2006

NEWSLETTER

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HUBBLE NEWS UPDATE

Jeremy Walsh

Hubble has been performing very well over the last few months but a significant problem occurred on 19th June 2006. The Advanced Camera for Surveys (ACS) detected that some voltages within the instrument were outside acceptable ranges and automatically went into safe mode. Whilst this Newsletter was going to press the cause of the suspension had been determined and the instrument operations were resuming. The failure occurred in a +15V power supply that serves the WFC and HRC CCDs. A spare set of electronics, called Side 2, is available and a successful switch from Side 1 was made on 30th June. This failure is similar to the one that occurred in STIS in May 2001, and an equivalent switch to redundant electronics was also made at that time. In addition it was decided to lower the temperature of the ACS/WFC CCDs by about four degrees to improve the noise and hot-pixel characteristics of the detector. Both of these changes will require some additional calibration activities as some detector characteristics, such as the bias, will change.

The Hubble Time Allocation Committee (TAC) meeting for the 15th observing cycle was held at the end of March 2006 and the results were announced in the first week of April. This cycle was very much a reflection of the last one, with the identical instrument complement offered and, at 733, a very similar number of proposals. The over-subscription rate was also similar at 4.5. Europeans were well represented among the panel members and there were three European panel chairs as well as an at-large member who attended the TAC meeting. There were 113 submitted proposals with a European PI and 27 of those were selected, making a 24% return. Cycle 15 was planned with 3200 orbits and European PIs gained 15%. These numbers of course do not reflect the fact that many other proposals with Principal Investigators from the United States or other countries included Co-Investigators from a European country. The vast majority of orbits were allocated to the Advanced Camera for Surveys (ACS), but WFPC2 and NICMOS observations were both competitively sought after. At present Hubble is largely an imaging telescope. Slitless modes are the only forms of spectroscopy currently available and these were allocated around 5% of orbits. Depending on when the next servicing mission occurs, currently expected no earlier than December 2007, the next cycle may be a short one, with the new instruments Wide Field Camera 3 (WFC3) and the Cosmic Origins Spectrograph (COS) becoming available in Cycle 17.

STAFF CHANGES

Jeremy Walsh

Søren Larsen, originally from Denmark and previously an ESO Fellow in Garching, joined the ST-ECF in late 2003 and left in March 2006. He came with a strong background in observational astronomy and his primary interest is the study of extragalactic ‘super’ star clusters. He joined the ST-ECF instrument group supporting slitless spectroscopy with ACS and contributed primarily to calibration of the prisms for the Solar Blind Channel (SBC) and the High Resolution Camera (HRC). He was also active in ground calibration of the WFC3 grisms and his work is included in ACS and WFC3 Instrument Science Reports. He left to take up a tenure track lectureship in the Department of Physics and Astronomy at the University of Utrecht in the Netherlands. Whilst Søren will now be closer to his home country, his Italian wife Giovanna, who is also an astronomer and worked on Adaptive Optics at ESO, will be a lot further from home.

MAGELLANIC GEMSTONES IN THE SOUTHERN SKY [heic0603]

Two new composite images taken with the Advanced Camera for Surveys onboard the NASA/ESA Hubble Space Telescope show a myriad of stars in crystal clear detail. The brilliant open star clusters, NGC 265 and NGC 290, are located about 200,000 light-years away and are roughly 65 light-years across.

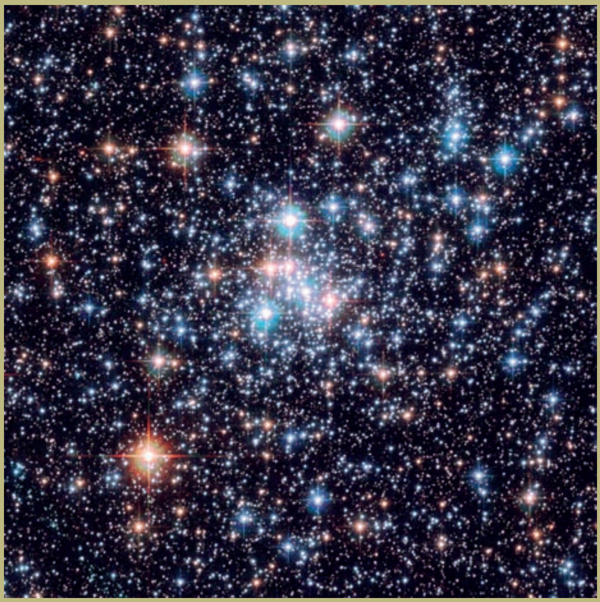
Star clusters can be held together tightly by gravity, as is the case with globular clusters – densely packed crowds of hundreds of thousands of stars. Or they can be more loosely bound, irregularly shaped, groupings of up to several thousands of stars, like the open clusters shown in these images. The stars in these open clusters are all relatively young and were born from the same cloud of interstellar gas. Just as old school-friends drift apart after graduation, the stars in an open cluster will only remain together for a limited time and gradually disperse into space, pulled away by the gravitational tugs of other passing clusters and clouds of gas. Most open clusters dissolve within a few hundred million years, whereas the more tightly bound globular clusters can exist for many billions of years.

Open star clusters make excellent astronomical laboratories. The stars may have different masses, but all are at about the same distance, move in the same general direction, and have approximately the same age and chemical composition. They can be studied and compared to find out more about stellar evolution, the ages of such clusters, and much more.

The Small Magellanic Cloud, which hosts the two star clusters, is the smaller of the two companion dwarf galaxies of the Milky Way named after the Portuguese seafarer Ferdinand Magellan (1480-1521). It can be seen with the unaided eye as a hazy patch in the constellation Tucana (the Toucan) in the Southern Hemisphere. Both the Small and the Large Magellanic Clouds are rich in gas nebulæ and star clusters. It is most likely that these irregular galaxies have been disrupted through repeated interactions with the Milky Way, resulting in the vigorous star-forming activity seen throughout the clouds. NGC 265 and NGC 290 may very well owe their existence to these close encounters with the Milky Way.

The images were taken in October and November 2004 through F435W, F555W, and F814W filters (shown in blue, green and red, respectively).

European Space Agency & NASA



Two new composite images taken with the Advanced Camera for Surveys onboard the NASA/ESA Hubble Space Telescope show a myriad of stars in crystal clear detail. The brilliant open star clusters, NGC 265 (top) and NGC 290 (bottom), are located about 200,000 light-years away and are roughly 65 light-years across.

THE AstroAsciiData PYTHON MODULE

Martin Kümmel & Jonas Haase

Simple text tables containing numbers and text are extremely common in astronomy and science in general. This article describes some new software, developed in the Python language, which makes manipulating such tables very easy and flexible.

ASCII TABLES IN ASTRONOMY

Tabulated character strings and numbers, often called ASCII tables, are a very widespread data exchange format in astronomy and science in general. They are especially common for small to medium sized (< 10 Mbyte) data volumes and for data formats that do not require a large amount of additional, structured metadata. Typical examples of the use of ASCII tables in astronomy are the stellar spectra distributed via the ESO Spectrophotometric Standard Star pages (http://www.eso.org/observing/standards/spectra/) or the output of the ubiquitous SExtractor program (Bertin & Arnout 1996).

THE PYTHON MODULE AstroAsciiData

Despite the wide distribution and use of ASCII tables, there are no widely-used standard software tools to allow such tables to be accessed, modified and written in a general way. Many scientists and astronomers develop their own methods to deal with ASCII tables. Some use the awk scripting language, others convert tables to FITS format and apply tools for accessing FITS tables and some deploy custom made IDL scripts. Common to all these approaches is their inflexibility and need for customization – for example the preparation of format files for the transformation to FITS or the imposed rigid formatting of the ASCII tables themselves.

This lack of any publicly available suitable software, along with the intensive use of ASCII tables in projects at the ST-ECF such as aXe, aXe2web and the ingestion of the GOODS/ACS v1.1 catalogue into the archive databases (Kümmel et al. 2005; Walsh & Kümmel 2004 & Haase et al. 2005, respectively), was the motivation for the development of a general purpose tool, AstroAsciiData, that would be made widely available in the scientific world.

Python (http://www.python.org) was the natural choice as both the programming language and user environment for the new AstroAsciiData module. Because of its ease of use, power and great flexibility the usage of Python is currently rapidly growing within the scientific community. Python modules such as AstroAsciiData can be used interactively, within small Python scripts and also in large data reduction programs which use IRAF and MIDAS tasks via PyRAF and PyMidas, respectively.

THE REQUIREMENTS

The AstroAsciiData module was developed to meet the following requirements:

- The handling of every kind of ASCII table without any restriction concerning column separator and sign to indicate commented lines
- Maintaining the original data format
- A simple, intuitive usage which keeps the initial threshold of using the module very low
- Complete software releases that include good documentation and webpages from the initial release onwards
- The ability to use the SExtractor catalogue header for the definition of the column names

A SAMPLE SESSION WITH THE AstroAsciiData MODULE

The AstroAsciiData module was released on November 30th, 2005 via the ST-ECF web pages (http://www.stecf.org/software/PYTHONtools/astroasciidata) as version 0.01. This first version of the module already meets all the requirements listed above, with the exception of support for SExtractor catalogue headers.

Figure 1 shows the ASCII table 'example.cat', and Figure 2 is the listing of a typical Python session that uses the AstroAsciiData module to work with the data in this table. The main processing steps, indicated by the red numbers in Figure 2, are as follows:

1. Within Python, the AstroAsciiData module is imported
2. Then the table is loaded
3. The table is viewed inside Python
4. As a first application, the user computes the average from the numbers in the second and third columns
5. Then the user computes and saves the differences between the average and the individual values
6. The modified ASCII table is written to the file 'example_mod.txt'

```
#
# Some objects in the GOODS field
#
unknown 189.2207323 62.2357983 26.87 0.32
galaxy  189.1408929 62.2376331 24.97 0.15
star    189.1409453 62.1696844 25.30 0.12
galaxy  188.9014716 62.2037839 25.95 0.20
```

Fig 1: *Example of a small ASCII table ('example.cat') that is used as an example below.*

```
>>> import asciidata                          (1)
>>> example = asciidata.open('example.txt')   (2)
>>> print str(example)                        (3)
#
# Some objects in the GOODS field
#
unknown 189.2207323 62.2357983 26.87 0.32
galaxy  189.1408929 62.2376331 24.97 0.15
star    189.1409453 62.1696844 25.30 0.12
galaxy  188.9014716 62.2037839 25.95 0.20
>>> sum1=0.0                                  (4)
>>> sum2=0.0
>>> for index in range(example.nrows):
...    sum1 += example[1][index]
...    sum2 += example[2][index]
...
>>> ave1 = sum1/example.nrows
>>> ave2 = sum2/example.nrows
>>> print ave1, ave2
189.101010525 62.211724925
>>> for index in range(example.nrows):        (5)
...    example['diff1'][index] =
example[1][index] - ave1
...    example['diff2'][index] =
example[2][index] - ave2
...
>>> print str(example)
#
# Some objects in the GOODS field
#
unknown 189.2207323 62.2357983 26.87 0.32
        1.197218e-01 2.407338e-02
galaxy  189.1408929 62.2376331 24.97 0.15
        3.988237e-02 2.590817e-02
star    189.1409453 62.1696844 25.30 0.12
        3.993477e-02 -4.204052e-02
galaxy  188.9014716 62.2037839 25.95 0.20
       -1.995389e-01 -7.941025e-03
>>> example.writeto('example_mod.txt')        (6)
```

Fig 2: *Listing of a typical Python session that uses the AstroAsciiData module to work with the data in the example table shown in Figure 1.*

The listing in Figure 2 illustrates the straightforward usage of the module for these basic processing steps. Even without a manual, this example already provides ample insight into how to apply the module classes and functions.

STATUS AND OUTLOOK

The AstroAsciiData module is available for download from its associated web page (URL given above). It is also included in the Scisoft VI astronomical software collection. This new version became public in April 2006 (www.eso.org/scisoft) and is described on page 12 of this Newsletter. The responses from users confirm that the AstroAsciiData module indeed has closed a hole in the range of scientific software and is very useful in many applications spread over different science areas.

The AstroAsciiData module is part of the AstroLib project (http://www.scipy.org/AstroLib) that coordinates the development of astronomical utility libraries built for Python, analogous to the ASTRON library for IDL.

We welcome feedback from users in the form of comments, suggestions and even development requests and these form an important source of input to the further development of the AstroAsciiData module. The next version is currently being finalized for a release in summer 2006.

The new version will include:

- Full support for the SExtractor catalogue format
- Transformation to the FITS format
- Column sorting capability

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CREATING A LEGACY ARCHIVE FOR HUBBLE

Jeremy Walsh & Richard Hook

A large proportion of all the data that Hubble will ever acquire is already publicly available through the archives and accessible through the web. The fraction of science coming from such archived data, rather than from newly acquired data, is rising rapidly. The current challenge is to ensure that this huge legacy of the mission remains scientifically useful and accessible long into the future. In order to understand the many issues involved in producing a "Hubble Legacy Archive", a meeting was held in Garching on 4/5th May 2006 and this article reviews the ideas presented and discussions held.

INTRODUCTION

In the past year the idea of transforming the archive of Hubble data from a repository of individual observations to an archive of science-ready higher-level data products, accessible through the Virtual Observatory, has taken root. This shift may be seen as a reaction to a variety of pressures. Firstly, Hubble is approaching the last phase of its life and the priceless treasure of observations should be readied for scientific preservation. Scientific preservation should be contrasted with mere conservation, which saves the raw bits but does not facilitate scientific use of the datasets. Secondly, technical expertise peaks towards the end-of-life (or decommissioning) of an instrument and, as the instrument team personnel move to other projects, that knowledge quickly dissipates. Beyond this point the intellectual legacy of that expertise only resides in documentation and the instrument reduction pipelines. This phase has obviously already been completed for instruments that have been decommissioned, such as the ESA Faint Object Camera (FOC), Faint Object Spectrograph (FOS), and Goddard High Resolution Spectrograph (GHRS). A good example is the FOS post-operational archive that has been produced at the ST-ECF (see http://www.stecf.org/poa/FOS/). Finally, the Virtual Observatory is now becoming a reality and the Hubble archive needs to be readied for searches of comprehensive metadata and easy and fast access to high level data products. Up to now the archive has been a repository in which searches are strictly on a data set level. This has been enhanced by the introduction of associations for imaging data (WFPC2 and ACS) in which combined images of a region of sky are produced, characterized, and made available for rapid access. At present the Hubble archive could not fulfil a request that asks for all images of radio quiet quasars for example. Of course such a search is possible by generating coordinates of the quasars, querying the archive for these pointings, retrieving the processed data and cutting out the images – a time-consuming and error-prone process.

ONE CONCEPT – THREE CONTRIBUTORS

In order to discuss and coordinate plans for the migration to a Legacy Archive from the present archive of data sets, a meeting was held at the ST-ECF in early May 2006. Participants included a team from STScI composed of those already preparing HLA concept studies, members of the Canadian Astronomy Data Centre, members of the ST-ECF, and representatives of non-Hubble archive centres such as ESO and ESAC.

SPACE TELESCOPE SCIENCE INSTITUTE (STSCI)

Rick White and Helmut Jenkner introduced the background to the reasons for considering an enhanced version of the current Hubble archive. Archive developments at STScI have been aimed primarily at improving science return for Principal Investigator (PI) programmes. However, with the increasing size of the archive and consequently rising emphasis on archive-based research (currently 40% of publications resulting from Hubble are archival, viz. where none of the authors was in the original list of proposers), the move away from a PI data archive has already occurred. Central to the STScI concept is to have separate storage for archive products, with the primary aim to serve processed data within seconds rather than the hours to days of current large archive requests. The core archive processes would be left unchanged. The enhancement introduces the possibility of providing a view of the Hubble data presented like a sky atlas rather than an observation list.

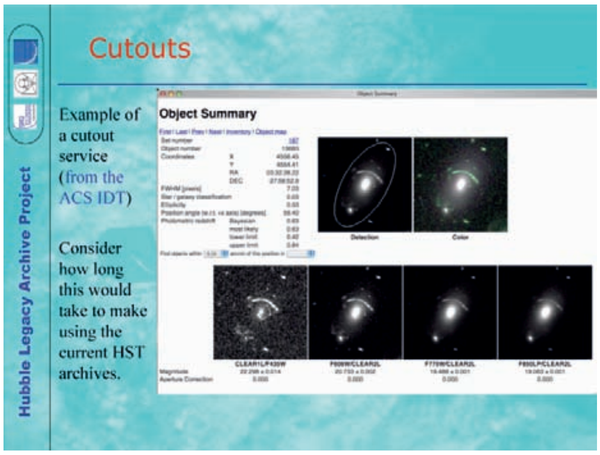

Fig 1: Slide taken from the presentation of Anton Koekemoer at the meeting. It illustrates the potential of a powerful image cutout service and is based on a custom facility developed by the Hubble ACS IDT.

The products to be served are to be enhanced by various additions, such as improved astrometry (with the aim of 0.2" absolute accuracy using GSC2) and object catalogues for images and image cutouts. These plans were outlined by Anton Koekemoer, who presented the many studies currently in progress at STScI. A footprint service would allow users to specify a point or area of sky and find out what Hubble data is available, retrieving observation information or a set of images. For objects multiply observed, time series products could be generated and tools provided for locating moving targets and the images on which they are recorded. Such archives of High Level Science Products (HLSPs) have already begun to be made available for some Hubble projects, such as the Hubble Deep Fields North and South, GOODS, and the Hubble Ultra Deep Field (HUDF). The Legacy concept seeks to generate similar products applied to data not necessarily originally designed with a survey or broader science goal in mind. The emphasis of the STScI archive enhancements is very much on imaging but links from the high level products to Hubble spectra could also be made. The developments are in a trial phase ('sandbox') but the aim is to develop the system end-to-end as a Service Oriented Architecture (SOA), described by Warren Miller. Given the evolution in computer hardware and software, these enhancements are feasible and not expensive options.

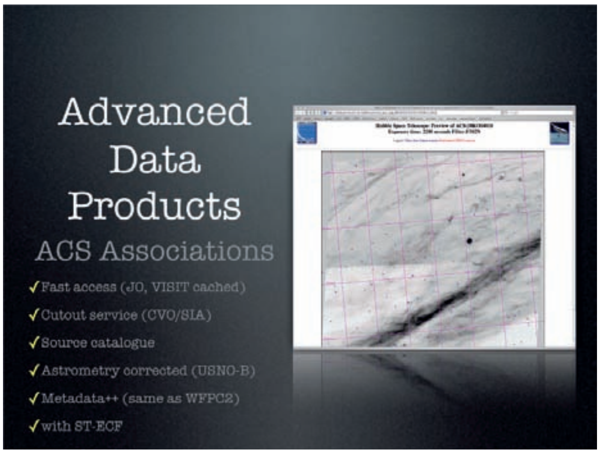

Fig 2: *Slide taken from the presentation of Daniel Durand at the meeting. It shows the features of the ACS Associations project that is currently underway.*

CANADIAN ASTRONOMY DATA CENTRE (CADC)

Daniel Durand and David Schade sketched out the Hubble activities that form a part of CADC's extensive archives of data from many telescopes. CADC participated in many early Hubble data product enhancement activities such as the production of preview images and spectra, On-The-Fly Calibration (OTFC), and most recently image associations. Combined images of a contiguous area of sky formed from images of a single proposal or across proposals were built. In the WFPC2 V2 associations (due for release in summer 2006), the combined images are cached and hence can be quickly delivered by archive request or through standard VO protocols. A cut-out service is also available and SExtractor catalogues are generated. For ACS, the WFPC2 V2 association concept is further enhanced by the use of the MultiDrizzle task to produce combined mosaiced images. For both instruments, registration is improved through cross-matching object catalogues and by applying absolute astrometric corrections based on matches with USNO catalogue objects. In addition the associations have metadata containing VO compliant information on space, time, bandpass, and image observables (such as limiting magnitudes). Access to these products is available through the Canadian VO project and also applicable to other archives through the Common Archive Observation Model, described by Séverin Gaudet.

There was discussion about the scientific utility of pre-prepared catalogues. The CADC catalogues were tested on users and were found to be useful, particularly in regard to characterization of an image (eg, finding images with seeing better than some threshold, or that are sensitive to some limiting magnitude). SExtractor has become a routine tool and many astronomers are familiar with its output and behaviour. Most of the general catalogue parameters satisfy a large fraction of needs. However, it is clear that multi-wavelength catalogues require a lot more consideration, taking into account differences in spatial resolution, detection limits, and background levels in different wavelength regimes.

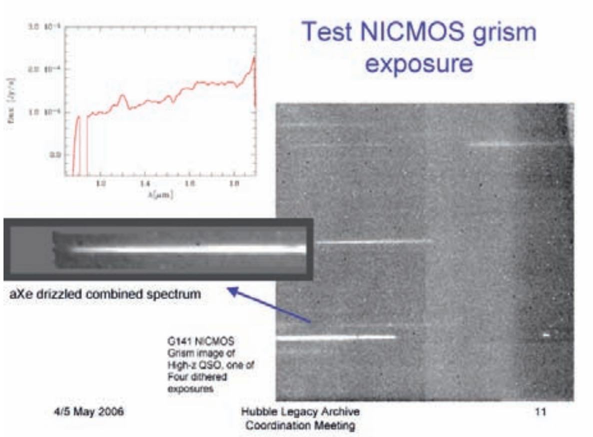

Fig 3: *Slide taken from the presentation of Richard Hook at the meeting. It shows how grism spectra from NICMOS are combined and extracted using aXe.*

SPACE TELESCOPE-EUROPEAN COORDINATING FACILITY

Bob Fosbury and Richard Hook presented the ST-ECF activities. The ST-ECF provides the full European copy of the Hubble archive and, over the years, the ST-ECF has been instrumental in the development of many value added services. These range from archive user interfaces such as Starcat and wdb, to on-the-fly calibration and enhanced data products such as the WFPC2 associations. The latter was originally a pure ST-ECF product but is now a joint project with CADC. Other core activities of the ST-ECF are instrument support projects such as FOS wavelength recalibration and provision of the 'final' archive, support for slitless spectroscopy with NICMOS and ACS, and model based calibration for STIS dispersion solutions.

The limited resources of the ST-ECF constrain how much work can be done on the Legacy Archive. Given the experience with slitless spectroscopy, a well-scaled pilot project is to provide extracted spectra for NICMOS. This was seen as a useful product, one that is not provided by the routine reduction pipeline processing and would have a number of science applications. An archive of extracted slitless spectra would very definitely be an enhanced product suitable for immediate VO exploitation. Wolfram Freudling and Martin Kümmel provided more details of the plans for the pilot project, which will concentrate on the most used NICMOS grism, G141. Since there is a non-repeatability in the NICMOS filter wheel, this translates into an error in the wavelength zero point and in the position and orientation of the spectrum. Enhancements of the aXe spectral extraction, originally developed for ACS but purposely kept rather general, were described for correcting for these effects in the datasets. This project was seen as a pilot to understand all the steps from producing high-level products (the extracted spectra) to providing them in a well-described archive that could connect to the VO.

RELATED DEVELOPMENTS

Hubble archive developments form just a small part of a very active area in which Hubble data volume is now dwarfed by that produced by many ground-based imaging surveys. ESO is actively producing Advanced Data Products (ADPs) for imaging data, and Piero Rosati presented the plans for ingesting these products into the VO. The GOODS ISAAC field is an example of a photometrically and astrometrically calibrated dataset produced by the ESO ADP group. ESO, in collaboration with the ST-ECF, also issued 1204 optical spectra of 934 targets in the GOODS CDF-S field and the lessons learned from the presentation and packaging of the data were described by Harald Kuntschner. This experience will be valuable for other releases of archive data such as the ST-ECF HLA slitless spectra pilot study, particularly in regard to preparation of metadata. Christophe Arviset from the European Space Astronomy Centre (ESAC) presented an overview of the ESA mission archives where, irrespective of the instrument – IR, X-ray, gamma-ray – the archive layer is very similar and offers easy access to raw data, pipeline data (already processed for all but also on-the-fly reprocessed for XMM-Newton) and Highly Processed Data Products (HPDP for ISO). Furthermore, through a flexible architecture, as soon as they become public, the scientific products are also published to the VO.

All these archive developments seek to keep abreast of hardware developments, such as increasing processor speed and ever lower cost of data storage. STScI would require a different system on which to operate their fast access science archive, distinct from DADS, which is used to process current requests. ESO has developed a new archive system called NGAS (Next Generation Archive System) that was described by Andreas Wicenec. This is based on magnetic disks as storage and the software employs Python and C. STScI is investigating the Storage Resource Broker from the San Diego Supercomputing Center for handling data and requests. The ST-ECF Hubble archive is being migrated to NGAS and was described by Alberto Micol.

Fig 4: *Some of the participants relax in the Garching beer garden after the meeting. From lower-left, clockwise: part of Bob Hanisch, Alberto Micol, Christophe Arviset, Anton Koekemoer, part of Rick White, Séverin Gaudet, David Schade, Daniel Durand, most of Warren Miller and the hands and watch of Helmut Jenkner.*

DISCUSSIONS

The bulk of the meeting was taken up with discussions on finding a common framework that all could agree as a Hubble Legacy Archive (HLA). This covered topics such as science oversight of the process and products, importance of metadata and provision to VO standards, what to deliver and how (single HLA archive versus distributed distribution) leading to topics for collaboration. The need for close links with the VO protocols is obvious and was emphasized by Bob Hanisch, who successfully pulled together the strands of opinion on what the HLA should become. For none of the partners is the HLA a major new project with distinct funding, but rather an extension and focusing of current efforts in several areas. The overriding aim should be to both optimize the scientific return in the short term and capture the telescope and instrument expertise for posterity. The primary intention is to provide a range of high level data products, but if requirements change in response to community input it should be flexible and 'agile'.

All agreed that visibility and oversight through the relevant committees and peer reviewed publications were essential for the well-being of the effort. Web portals and other services would be developed to provide access to the high level products. All understood that HLA would be in partnership with VO, would use VO protocols and tools (eg, SkyNode protocols for catalogues); but obviously could provide valuable input into the VO in areas where Hubble archive developments lead.

The meeting concluded with a draft agreement on the way forward. The ST-ECF will concentrate on the NICMOS slitless spectra pilot study into 2007. CADC and ST-ECF will publish the WFCP2 V2 associations in summer 2006 and ACS associations towards the end of the year. STScI will define and prototype infrastructure for serving high level products and populate this with some ACS, and perhaps WFPC2, calibrated images by the autumn of 2006. CADC, STScI, and also ST-ECF, will collaborate on providing catalogues, image cut-outs and footprints.

A Declaration of Intent was agreed during the meeting: *"The STScI, CADC and ST-ECF are working together to optimize the scientific return from the Hubble archive by producing high-level data products and efficient data discovery and access services. The goal is to capture expertise in Hubble and assure the maximum utility of Hubble data for long term use in the community."* This declaration will be followed up by a tripartite agreement under an umbrella of continuing coordination and collaboration.

ACKNOWLEDGMENTS

We would like to thank all the participants for their contributions to a very stimulating meeting and for making their presentations and beer garden snaps available. We also much appreciated feedback on draft versions of this article from many people.

THE NEW ST-ECF WEB

Martin Kümmel, Harald Kuntschner & Lars Lindberg Christensen

Web page design and technology changes very rapidly. As a consequence, web pages have to be re-designed from time to time to provide an up-to-date look and feel and tempt users to explore their content. In the spring of 2006 there was an increasing feeling that the ST-ECF web pages were overdue for such an update.

After deciding on a new design, closely modelled on that already in use for the ST-ECF outreach pages (www.spacetelescope.org), and migrating the content of the old pages into the new design, the new ST-ECF web pages went public on June 12th 2006. Figure 1 shows the new front-page.

During the migration we have taken the opportunity to also re-build the structure of web page content to offer better access to information on the ST-ECF and Hubble, including instrument science, the Hubble archive and related software tools.

Pages which were outdated or obsolete were not transfered into the new ST-ECF pages. If you find you are missing web pages that you need or find other mistakes please let us know by sending an email to stdesk@stecf.org.

Fig 1: *New front page (www.stecf.org) for the ST-ECF web site.*

NASA, ESA, M. Robberto (Space Telescope Science Institute/ESA) and the Hubble Space Telescope Orion Treasury Project Team

HUBBLE PANORAMIC VIEW OF ORION NEBULA REVEALS THOUSANDS OF STARS [heic0601]

In one of the most detailed astronomical images ever produced, the Hubble Space Telescope is offering an unprecedented look at the Orion Nebula. This turbulent star-formation region is one of astronomy's most dramatic and photogenic celestial objects.

The crisp image reveals a tapestry of star formation, from the dense pillars of gas and dust that may be the homes of fledgling stars to the hot, young, massive stars that have emerged from their gas-and-dust cocoons and are shaping the nebula with their powerful ultraviolet light.

In a mosaic containing a billion pixels, Hubble's Advanced Camera for Surveys (ACS) uncovered 3,000 stars of various sizes. Some of them have never been seen in visible light. Some are merely 1/100 the brightness of stars seen previously in the nebula.

Among the stars Hubble spotted are possible young brown dwarfs, the first time these objects have been seen in the Orion Nebula in visible light.

The Hubble Space Telescope also spied for the first time a small population of possible binary brown dwarfs. Comparing the characteristics of newborn stars and brown dwarfs in their natal environment provides unique information about how they form.

The Orion Nebula is a perfect laboratory to study how stars are born because it is 1,500 light-years away, a relatively short distance within our 100,000 light-year wide galaxy. Astronomers have a clear view into this crowded stellar maternity ward because massive stars in the centre of the nebula have blown out most of the dust and gas in which they formed, carving a cavity in the dark cloud.

A detailed look at one of the lesser known regions of the otherwise well-known Orion Nebula. A small blue reflection nebula.

SCISOFT VI

Richard Hook on behalf of the Scisoft Team

Scisoft is a large collection of public astronomical software tools. It is widely used at ESO and also made available outside. It is very convenient to have a "bundle" of such software, already tested and installed, rather than have to start from scratch. A new version is now available and the changes and contents are described here.

Scisoft is a collection of astronomical software intended mostly for ESO users but 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. It is installed on all the standard 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 VI (April 2006). This new version of the collection includes many updates and additional packages and also incorporates some new features. 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 VI was built on, and intended to be used on, Fedora Core 3 Linux, but is likely to run on similar modern Linux systems. We no longer maintain a version of Scisoft for older architectures such as Solaris or HPUX, but a similar version for Mac OSX, produced independently of ESO, is also available.

Scisoft VI can be either downloaded from the ESO ftp site (ftp://ftp.eso.org/scisoft/scisoft6/linux/fedora3/) or the entire collection may be requested on DVD through the ST-ECF on-line shop at http://www.spacetelescope.org/hubbleshop/webshop/ . We also now have 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.

The next release of Scisoft will be Scisoft VII at the end of 2006. This version will include a selection of virtual observatory tools as well as many other new features and updates to the latest versions of the current contents.

Scisoft is a collaboration between many people. I would particularly like to thank Alexis Huxley, formerly with Terma at ESO, for his very diligent and thorough help with the technical aspects of the release; Chenzhou Cui of the National Astronomical Observatory, Chinese Academy of Sciences, for his help and enthusiasm for the Chinese mirror and, as always, Lars Lindberg Christensen for helping with copying the DVDs and setting up the web shop.

Data Analysis Systems	Notes
IRAF 2.12.2a-EXPORT	UPDATED
+ ctio	Utilities from CTIO
+ crutil 1.6	Cosmic ray utilities from NOAO
+ gemini 1.7 (Oct2004)	Utilities from the Gemini Telescopes – UPDATED
+ gmisc	Miscellaneous utilities for Gemini – UPDATED
+ mxtools (Dec2001)	Utilities from NOAO including QDPHOT
+ guiapps	Graphical applications for IRAF
+ xdimsum (Jan2003)	Enhanced IR data reduction and mosaicing software – UPDATED
+ ifocas (Apr2001)	Enhanced object detection and classification software
+ dimsum 2 (Oct1999)	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 – UPDATED
+ esowfi 1.3	March 2001 Version
+ eis 1.8 (May2002)	ESO Imaging Survey IRAF tasks (EIS Drizzle etc)
+ rvsao 2.3.2	Spectral Radial Velocity package from CfA – UPDATED
+ nmisc 020618	IRAF miscellany – UPDATED
+ xccdred	CCD reduction for multi-port chips

Image Display Servers	Notes
x11iraf 1.3.1	May 2000 version, including ximtool and xgterm – UPDATED
SAOImage 1.26	The original, needs 8bit Xserver
DS9 4.0b7	Latest display server from SAO. Works with 24bit X servers – UPDATED
XPA 2.1.6	XPA 2.1.6
Skycat 2.7.4	ESO image display tool with catalogue and image server access – UPDATED
fv 4.1.4	Interactive fits viewer – UPDATED

Graphics Software	Notes
SM 2_4_26 (Dec2002)	SuperMongo – Note: NOT included in EXPORT version – UPDATED
PGPLOT 5.2	Graphics library
gnuplot 4.0	Command-line driven interactive function plotting utility – UPDATED
Grace 5.1.9	2D WYSIWYG plotting tool
ggobi 1.0-4-beta	Data visualisation in 3D – UPDATED
xgobi (Apr2002)	Multivariant data visualisation

Scripting Languages	Notes
Python 2.4	General purpose, object orientated, extensible scripting language. Includes Numeric 23.8, Scientific 2.4.9, RV 1.1, Gnuplot 1.7, 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, new, asciidata 0.01, binascii, matplotlib 0.70.1, ipython 0.6.6, pygtk 2.4.1, scipy 0.3.2, ppgplot 1.3, biggles 1.6.4, psyco 1.4, pygame 1.7.1, cStringIO, & cPickle packages – UPDATED
STScI_Python 2.2	STScI Python packages, including the following – UPDATED
PyRAF 1.2	Python replacement for IRAF cl – UPDATED
numarray 1.4.1	Enhanced Python numerical package from STScI – UPDATED
pyfits 1.0	Python FITS package from STScI – UPDATED
PyDrizzle 5.6.0	Drizzling software – UPDATED
MultiDrizzle 2.7.0	Automatic image combination drizzling software – UPDATED

Scientific Libraries	Notes
GSL 1.6	The GNU Scientific Library – UPDATED
DISLIN 8.2	Scientific Data Plotting software – UPDATED
CFITSIO 2510	FITS File Subroutine Library – UPDATED
LAPACK Release 3.0	Linear Algebra Subroutine Library
Atlas 3.6.1	Another Linear Algebra Library – NEW
FFTW 3.0.1	Fast Fourier Transform library – NEW
plotutils 2.4.1	GNU plotting utilities – NEW

Miscellaneous Utilities	Notes
wcstools 3.5.7	World Coordinate System software tools and library from Doug Mink at SAO – UPDATED
Terapix Software Tools	A Selection: SExtractor 2.3.2 – UPDATED, SWarp 2.15 – UPDATED, & WeightWatcher 1.7 – UPDATED
Tiny Tim 6.3 (Jun2004)	HST point-spread function simulation software – UPDATED
Xephem 3.6.3	Planetarium and ephemeris software – UPDATED
dss & dss2	Digitized Sky Survey image extraction software
Cloudy 06.01	Plasma simulation and spectral synthesis code (no patches applied) – UPDATED
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 – UPDATED

NASA, ESA and the Hubble Heritage Team (STScI/AURA). Acknowledgment: J. Gallagher (University of Wisconsin), M. Mountain (STScI) and P. Puxley (NSF).

HAPPY SWEET SIXTEEN, HUBBLE SPACE TELESCOPE [heic0604]

Throughout the central region of Messier 82, young stars are being born 10 times faster than they are inside in our Milky Way Galaxy. These numerous hot new stars emit not only radiation but also particles called a stellar wind. Stellar winds streaming from these hot new stars also have combined to form a fierce galactic superwind. This superwind compresses enough gas to make millions more stars and blasts out towering plumes of hot ionised hydrogen gas, above and below the disk of the galaxy (seen in red in the image).

In M82 young stars are crammed into tiny but massive star clusters which themselves then congregate by the dozen to make the bright patches or "starburst clumps" seen in the central parts of M82. The individual clusters in the clumps can only be distinguished in the ultra-sharp Hubble images. Most of the pale objects sprinkled around the main body of M82 that look like fuzzy stars are actually star clusters about 20 light-years across and containing up to a million stars.

The rapid rate of star formation in this galaxy will eventually be self-limiting. When star formation becomes too vigorous, it will destroy the material needed to make more stars and the starburst will subside, probably in a few tens of millions of years.

Located 12 million light-years away, M82 appears high in the northern spring sky in the direction of the constellation Ursa Major. It is also called the "Cigar Galaxy" because of the elongated elliptical shape produced by the tilt of its starry disk relative to our line of sight.

The observation was made in March 2006 with the Advanced Camera for Surveys' Wide Field Channel. Astronomers assembled this 6-image composite mosaic by combining exposures taken with four coloured filters that capture starlight from visible and infrared wavelengths as well as the light from the glowing hydrogen filaments.

The central "inner-city" portion of the galaxy shows the combined light of countless stars and reveals numerous star-forming clumps, dark red clouds of gas and dust obscuring the light from the galaxy's core, and an overall field of fainter red (cooler) and blue (hotter) stars.

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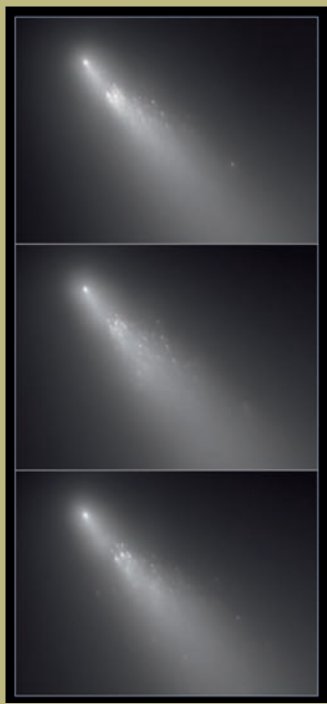
HUBBLE PROVIDES SPECTACULAR VIEW OF ONGOING COMET BREAKUP

[heic0605]

The NASA/ESA Hubble Space Telescope has provided astronomers with extraordinary views of comet 73P/Schwassmann-Wachmann 3 as it disintegrated before our eyes. Recent Hubble images have uncovered many more fragments than have been reported by ground-based observers. These observations provide an unprecedented opportunity to study the demise of a comet nucleus.



Images from a three-day observation with Hubble showing the break-up of the Fragment B of Comet 73P/Schwassmann-Wachmann 3.

NASA, ESA, H. Weaver (APL/JHU), M. Mutchler and Z. Levay (STScI)

***Cover image** [heic0602a]: The central region of the nearby spiral galaxy Messier 101. This Hubble image reveals one of the best known examples of 'grand design spirals', and its supergiant star-forming regions, in unprecedented detail. The image is one of the largest mosaic images of a spiral galaxy ever prepared from Hubble data. It was assembled from archived Hubble images taken with the Advanced Camera for Surveys and the Wide Field and Planetary Camera 2 over nearly 10 years: in March 1994, September 1994, June 1999, November 2002 and January 2003. The Hubble exposures have been superimposed onto ground-based images. These are visible at the edge of the full mosaic image but do not appear in this subset. The ground-based data were taken at the Canada-France-Hawaii Telescope in Hawaii, and at the 0.9-meter telescope at Kitt Peak National Observatory, part of the National Optical Astronomy Observatory in Arizona. Exposures taken through a blue filter are shown in blue, through a green filter in green and through a red filter in red.*

***Image credit:** European Space Agency & NASA*

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***Image processing:** Davide de Martin (www.skyfactory.org)*

***CFHT image:** Canada-France-Hawaii Telescope/J.-C. Cuillandre/Coelum*

***NOAO image:** George Jacoby, Bruce Bohannan, Mark Hanna/NOAO/AURA/NSF*