ST-ECF

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Future of Hubble in Europe

Simulating WFC3 point-spread functions

Hubble Legacy Archive — Data Release One

Space Telescope European Coordinating Facility

GUEST EDITORIAL

Antonella Nota (STScI/ESA) & Bob Fosbury

Hubble celebrated its eighteenth birthday in April with the full expectation that, within a few months, it would be rejuvenated for the fifth time. These eighteen years have seen the Hubble Space Telescope lift itself from an embarrassing technical flop to one of the most successful scientific endeavours in the history of mankind.

The impact of Hubble has been truly remarkable, not only in the transformation of our knowledge of the Universe, but also on our way of doing science. The influence on society as a whole has also been profound, with stunningly beautiful Hubble images becoming recognised throughout the world as cultural icons. The breadth of the scientific discoveries, from our newly found access to the early history of the Universe to the identification of methane in the atmosphere of an extrasolar planet, has far exceeded the dreams of the designers and builders of the observatory. The diversity of the programmes has had the effect of uniting a large community of astronomers into an enthusiastic — and extremely effective — lobby of "Hubble Huggers".

More than 100 astronomers gathered recently in Baltimore to review and analyse the progress made in a "Decade of Dark Energy". The pivotal role that Hubble played in exposing this new challenge to astronomers and theoreticians emerged clearly from the presentations and discussions — together with the part that Hubble is expected to play in the future attempts to solve the riddle.

Throughout the long history of the project, Hubble has helped to forge a great partnership between two major space agencies, NASA and ESA, who have now been collaborating closely over more than two decades to facilitate the scientific success of this unique mission. The agreement between the agencies guarantees access to 15% of Hubble observing time for European astronomers. Europe is also well represented in the observing time allocation process and in most of the important committees and panels that influence the progress of the mission. Almost one hundred European astronomers have, at some time during the operation, been deployed by ESA at STScI to perform support duties and carry out scientific research. ESO and ESA have jointly supported the ST-ECF at the ESO Headquarters in Munich, Germany. In addition to carrying out user and project support, the ST-ECF has provided a channel for much of the Hubble experience to come directly back to Europe.

In October 2008, the next chapter of the Hubble story will unfold when a dedicated crew of astronauts will visit Hubble for the last time during Servicing Mission 4 (SM4) when they will strive to leave Hubble more powerful than ever before and well equipped to survive in the harsh space environment for many years to come.

Veteran astronaut Scott D. Altman will command this final space shuttle mission to Hubble. Navy Reserve Capt. Gregory C. Johnson will serve as pilot. Mission specialists include experienced spacewalkers John M. Grunsfeld and Michael J. Massimino, and first-time space fliers Andrew J. Feustel, Michael T. Good and K. Megan McArthur. Grunsfeld, Massimino and Altman have visited Hubble on previous servicing missions. We should also remember that ESA astronaut Claude Nicollier has flown twice to Hubble during earlier servicing missions.

During the course of five space walks, the astronauts will install two new instruments: the Cosmic Origins Spectrograph (COS) and the Wide Field Camera 3 (WFC3). They will also replace an existing Fine Guidance Sensor with a refurbished one (FGS2RR), that will effectively maintain the precision of the spacecraft pointing in the future and attempt repairs to two instruments currently on board. The Advanced Camera for Surveys (ACS) and the Space Telescope Imaging Spectrograph (STIS) both suffered power supply failures in recent years. The astronauts will also replace all six gyroscopes and install new batteries to extend the healthy life of the spacecraft and they will repair some of the thermal insulation blankets that have degraded due to prolonged exposure to the space environment. Finally, they will also attach a mechanism that will be needed for future automatic docking and so prepare for Hubble's final safe de-orbiting manoeuvres. The complexity of what is actually the fifth servicing mission (there was SM3A in 1999 followed by SM3B in 2002) significantly exceeds what was accomplished during the previous ones. But there is confidence that, once completed, SM4 will return a Hubble that is greatly more capable and robust.

NASA has recently made the best estimates they can of the lifetimes of the critical parts of Hubble and its scientific instruments using all the experience gathered regarding the types and frequency of failures that have occurred in the mission so far. The conclusion is that, following a successful SM4, the spacecraft systems themselves, including the gyros, batteries and FGSs are in good shape and will probably allow operations to continue for a decade. The lifetime of the instruments is most likely to be the limiting factor, which illustrates the importance of repairing ACS and STIS if at all possible.

The wide range of scientific capabilities of Hubble after SM4 was on display during a well-attended conference held in Bologna, Italy in January 2008. This workshop was organised by ESA, NASA and INAF under the chairmanship of Francesco Paresce and in collaboration with STScI and ST-ECF.

WFC3 will offer imaging capabilities from the UV to the IR (200–1700 nm), and will be very suitable for identifying galaxies in the very early Universe ($z \sim 7$–10). The combination of its large field of view and excellent sensitivity in the near-UV (200–400nm) and in the near-IR (850–1700nm) will provide a survey efficiency thirty times greater than ACS in the near-UV, and forty times better that NICMOS in the near-IR. WFC3 is also perfectly suited to studies of star formation and the chemical enrichment history of galaxies, type Ia supernovae, and high-redshift galaxy formation. Low resolution, wide-field slitless spectroscopy with grisms in the near-UV and especially the near-IR will be an effective tool for spectroscopy of faint, small sources.

COS is a slitless spectrograph that will advance UV point-source sensitivity by more than an order of magnitude with respect to previous Hubble spectrographs. In the far-UV, COS will have a resolving power of 20000–24000 in the range 115–178nm, and in the near-UV, a resolving power of 16000–24000 in the range 170–320nm. COS has been designed to study the large scale structure of the Universe by tracing hydrogen Ly-α absorptions, the formation of galaxies, the chemical evolution of galaxies and the interstellar medium.

STScI has just completed the peer-review process of selecting the proposals to populate Hubble's observing schedule after SM4. A total of 958 proposals were received, of which 181 were from ESA member-states (18.9%). Of these a total of 228 were accepted, of which 35 were from ESA member-states (15.4%). There was at least one ESA CoI on 23.3% of the accepted proposals, and those 23.3% accounted for 61% of the allocated orbits.

In Europe, consideration is being given to the problem of how — after the ST-ECF closure at the end of 2010 — to continue some of the essential Hubble functions that the group has been carrying out. One of these is the maintenance and continued post-SM4 population of the European Hubble archive, currently integrated with the ESO facilities. Another is the continued creation of Hubble Legacy Archive data products that are being currently produced within a collaboration between the STScI, the ST-ECF and the CADC. The ST-ECF is also currently supporting the slitless spectroscopy modes offered by the Hubble cameras.

In 1999, NASA asked ESA to take over the European part of the Hubble public outreach activities. This resulted in the setting up at the ST-ECF of the Hubble European Information Centre (HEIC), or 'ESA/Hubble' as it has become known. This group has become so successful and productive that there is a strong desire to maintain the output throughout the Hubble lifetime.

So, what will the future bring? For the scientific community we hope for and expect a renewed and more powerful Hubble. NASA will continue to support scientific operations and provide grants to the US community for at least five years. The twenty year-old agreement between NASA and ESA will expire in 2010, but an extension is planned. Continuing support for Hubble scientific operations will be renegotiated in the near future in order to allow the continued involvement of the European community in this highly successful enterprise. Happy Birthday Hubble! We look forward to many more successful years of exciting discoveries.

HUBBLE LEGACY ARCHIVE — DATA RELEASE ONE

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

Brad Whitmore (STScI) and the HLA Teams at STScI and CADC

The Hubble Legacy Archive (HLA) is a continuing effort by the Hubble data archives to deliver high-level science data products through convenient interfaces. The first data release took place in February 2008 and included ACS images and source lists, as well as NICMOS grism spectra extracted at the ST-ECF. This article describes this first data release.

INTRODUCTION

The raw and pipeline reduced data available from the Hubble archives are an invaluable resource for archival research. Using Hubble archival data usually involves downloading the calibrated data, evaluating their quality and performing some measurements on them. This approach is effective for detailed studies of well defined and relatively small lists of targets. For statistical studies of large numbers of objects, or for searches for targets based on information extracted from the data themselves, this process is difficult and inefficient. The Hubble Legacy Archive project, a collaboration between STScI, the ST-ECF and CADC, aims to make high level data products available in a manner that makes them easy to browse and has the overall goal of optimising the scientific output of the archives. High-level data products in this context means that datasets are grouped, co-added, fully calibrated, and the contents are described in a quantitative way that is at minimum useful for browsing and selecting data sets, and generally also useful for immediate scientific investigations. For imaging data this means that astrometrically and photometrically calibrated source lists are also provided. For spectroscopic data, the HLA products are fully calibrated extracted spectra along with complete descriptions of their characteristics, such as signal-to-noise measurements.

DATA RELEASE ONE

The first data release (DR1) was published on February 7, 2008. It is the intention of the three HLA sites to stick to a roughly six-month schedule of data releases. The primary goal of DR1 was to offer Cycle 17 proposers an easy and quick way to look at previous Hubble data before the deadline, and to provide HLA data products for a much larger fraction of the Hubble data than the pre-release of July 2007 (Freudling et al. 2007). The DR1 release includes footprints for ACS, WFPC2, STIS, NICMOS, FOS, and GHRS, and high-level data products for ACS imaging and NICMOS grism spectra. A detailed list of products is shown in Table 1. For data that have not been re-processed specifically for HLA, the standard archive products can be downloaded through the HLA interface.

HLA IMAGING DATA

High level HLA imaging products are being produced at STScI and CADC. The main products are co-added ACS images and associated object source lists. These images are co-added based on visits and filters and additional enhancements include improved astrometry and careful quality assessment for photometry and the presence of artifacts. Object source lists have been extracted with both SExtractor [1] and DAOPHOT [4].

Instrument/Product	Source	HLA Enhanced Products	Standard Products	Download	Interactive Display?
ACS/combined images	STScI	~90%		FITS	✔
ACS/DAOPHOT source lists	STScI	~50%, <~2004		Ascii	✔
ACS/SExtractor source lists	STScI	~10%, Beta product[1]		Ascii	✔
WFPC2/combined images	CADC	Coming Soon, Beta product[1]		FITS	✔
WFPC2/single exposures	STScI		100%	DADS[2]	
NICMOS/GRISM extractions	ST-ECF	~80%, 1-D & 2-D spectra		FITS	
NICMOS images	STScI		100%	DADS[2]	
STIS images and spectra	STScI		100%	FITS	✔
FOS spectra	STScI		100%	Tar	
GHRS spectra	STScI		100%	Tar	

Notes:
1. Beta products are being validated and are not currently recommended for scientific analysis.
2. DADS downloads require a request to the DADS system.

Tab 1: *Data released through the HLA interface at STScI and included in DR1.*

Creating the high-level data products is only one aspect of the HLA. Delivering the data through intuitive interfaces that make it easy to search, evaluate and download the products also contributes greatly to the scientific usefulness of the data. There are three ways to access the data, the HLA web interface from http://hla.stsci.edu, the form based interface available at http://hla.stecf.org (spectra only), and the virtual observatory standard interfaces.

The STScI web interface has three main modes: an image display showing previews (in colour where there are multiple filter images available), an inventory mode where data sets are listed and different sorting and filtering options can be applied and finally a footprint mode where the extent of the Hubble instrument apertures on the sky is plotted on top of an image of the sky from the Digitized Sky Survey. As well as image display facilities, the interface also includes a spectral browser. An example of the footprint mode for the Antennae interacting galaxies (NGC 4038/9) is shown as Figure 1. In addition, access is also given to standard pipeline products through links to the MAST data access points.

The ST-ECF HLA NICMOS grism spectra can also be accessed via the STScI interface and, along with all the other data sets, may be viewed quickly as previews or downloaded as FITS files and accompanying metadata for offline analysis.

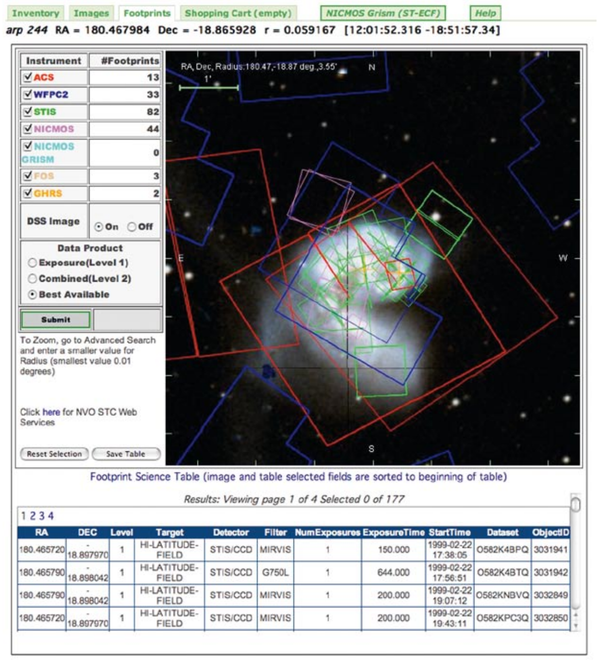

Fig 1: Footprints of Hubble data in the region of the Antennae galaxies visualised by the HLA web interface at STScI.

HLA GRISM SPECTRA

HLA NICMOS grism spectra have been extracted from NICMOS G141 grism images at the ST-ECF. The extracted spectra cover the wavelength range between 1.1 and 1.9 μm and include error estimates, contamination estimates and a wealth of metadata. The extraction procedures have been described in [2] and will be discussed in detail in a forthcoming data paper [3].

A total of 2470 spectra are included in this release. A selection of the spectra is shown on the cover of this Newsletter. All NICMOS G141 images have been processed by our pipeline, and spectra were extracted from about 80% of those data sets. The rest of the images had some defect such as being out of focus, having problems with the background or bad pixels. Whether the spectrum of a particular target is extracted depends, among other things, on the detection of the target on the undispersed image, the relative location and flux levels of other spectra on the grism image, the location of residual image defects and the location of the spectrum relative to the image edges. On average, about five spectra were extracted from each co-added image.

The ST-ECF HLA grism spectra can be searched through the web form http://archive.eso.org/wdb/wdb/hla/product_science/form and constraints on the target (e.g. the target name), the data properties (e.g. effective exposure time), the source properties (e.g. the magnitude) and the data quality (e.g. the signal-to-noise ratio) can be placed. The detailed result pages show the preview of the data as well as all available metadata.

The primary current VO interface uses the "Simple Spectrum Access Protocol" (SSAP) for access to the NICMOS grism spectra at http://www.stecf.org/hla-vo. That site serves the spectra in VOTable V1.1 format, and can be accessed by any compliant VO tool. It has been tested with the ESO VirGO tool (http://archive.eso.org/cms/tools-documentation/visual-archive-browser), which can be used to browse the footprints overlayed on DSS images, select spectra and download them or send them directly to VO compliant spectral analysis tools such as SPLAT-VO (http://star-www.dur.ac.uk/~pdraper/splat/splat.html) or VOSpec (http://esavo.esa.int/vospec/). A screen shot of the VirGO tool is shown in Figure 2. Future HLA releases will also support access to the imaging data via VO services.

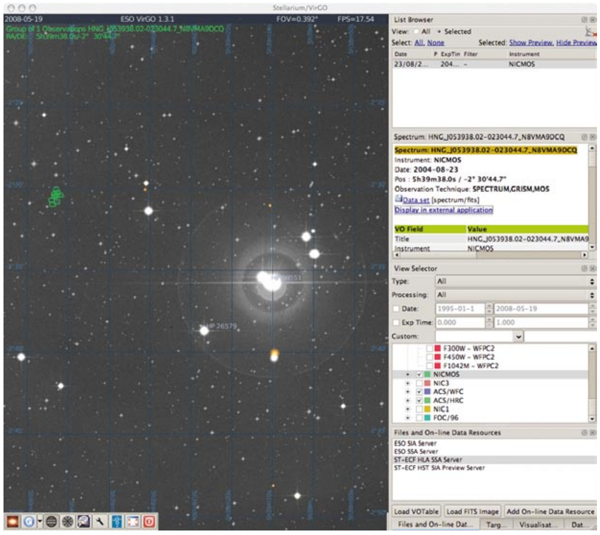

Fig 2: The ESO VirGO archive browsing tool in action. The region around the multiple star σ Ori is shown and the footprints of some NICMOS grism extracted spectra are shown in green at the left.

SUMMARY AND OUTLOOK

The Hubble Legacy Archive provides a new way to access Hubble data. High level data products, which can be used directly for science, are made available through interfaces that encourage browsing and exploration. This will make projects feasible that cannot readily be carried out with the classical Hubble archives. The first data release was in February 2008 and DR2, which will include most WFPC2 in fully processed form as well as some mosaic products and further enhancements to interfaces, is expected later in 2008.

In future the HLA will also include spectra extracted from a uniform set of ACS slitless data and the ST-ECF HLA team is currently working at tuning the spectral extraction HLA pipeline for optimal results with ACS. The first ACS spectral release will be from the G800L grism data, covering a wavelength range from 550-1050 nm.

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[1] Bertin E. & Arnouts S. 1996, A&AS, 117, 393

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[4] Stetson, P. 1987, PASP, 99, 191

THE WFC3 SLITLESS SPECTROSCOPY SIMULATOR AXESIMWEB

Martin Kümmel, Harald Kuntschner, Jeremy Walsh & Diego Sforna (ESO)

Planning slitless spectroscopic observations is tricky and without a good tool it is almost impossible to optimise the observing strategy. To help out astronomers who intend to use the powerful slitless spectroscopy modes of the new Wide Field Camera 3, due to be installed on Hubble in the autumn, the ST-ECF has created a simulator, aXeSIM, that is now also available through a simple web interface.

INTRODUCTION

As part of its support of the WFC3 slitless spectroscopic modes, the ST-ECF has developed **aXeSIM**, a software package to simulate slitless spectroscopic images that was described in the last edition of the Newsletter [1].

In addition to distributing the **aXeSIM** software, we have also installed the web application **aXeSIMweb** [2] on the ST-ECF web server. This allows the creation of simulated WFC3 slitless spectroscopic images by running **aXeSIM** as a background application without the need for any local software installation.

aXeSIMweb is intended for users who only occasionally want to run a slitless simulation. It does not offer all of the simulation options available in **aXeSIM**, but it does have several advantages. There is no need to install software, the newest versions of software and calibration files are always used and the user's computer is not loaded with potentially computational intensive simulations.

USING AXESIMWEB

Starting a simulation is as simple as going to the web page http://www.stecf.org/instruments/aXeSIMweb and following the instructions there. Figure 1 shows the interface to **aXeSIMweb** where the user enters the simulation parameters. The email address of the user (field 1) is used to send a notification when the simulations have finished.

There are two ways of specifying the input objects to be used in the simulation. When simulating a single source, the object parameters are entered directly into the parameter fields 2b, but when there are several sources, the user has to prepare a simple text file where each row contains the parameters of each single source (see [2] for format details). This text file is then uploaded using the parameter field 2a.

The other parameters control the selection of the grism mode (field 3), the passband for the spectral information (field 4) and the parameters for the noise model (fields 5 and 6). **aXeSIMweb** can also compute the direct image that is associated to the grism image, and its input parameters are specified in fields 7-9.

After submitting the simulation, the user input is checked for consistency. For example, the exposure times must be positive and there must be overlap between the redshifted spectral template and the filter

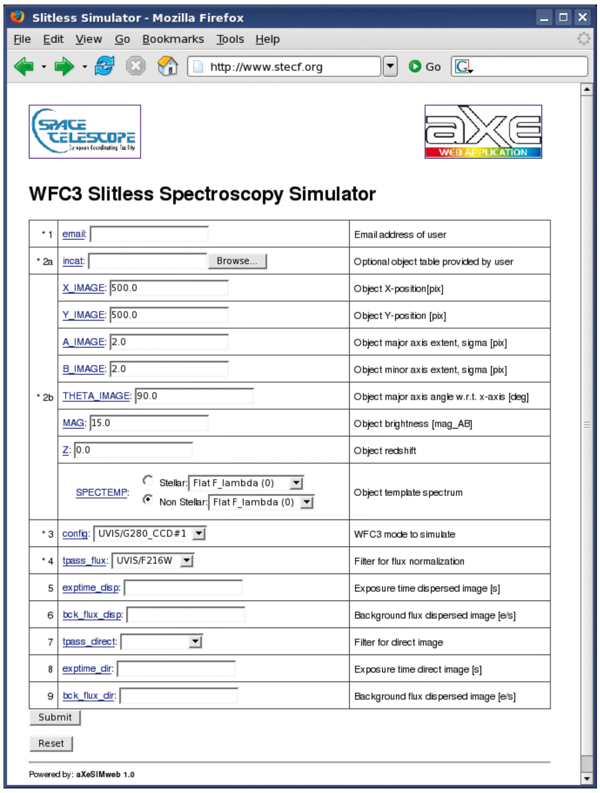

***Fig 1:** Interface to the aXeSIMweb web application. (http://www.stecf.org/instruments/aXeSIMweb/cgi/aXeSIMform?instrument=WFC3). The email address (for notification purpose) is the only parameter that must be provided in order to submit a first, tentative simulation, which then can be refined in subsequent runs.*

pass band. In the next step, a summary of the simulation is presented and the computation is started once the user has confirmed that the inputs are correct. Typical computation times are 15s per object for the NIR grisms and 180s per objects for the UVIS grism.

All simulation results are transferred to a web page and the appropriate URL is sent to the user as part of a notification email. Figure 2 shows an example of such a results web page. From this web page the FITS images, preview images in JPEG format and further information on the simulation details can be downloaded by following the embedded links.

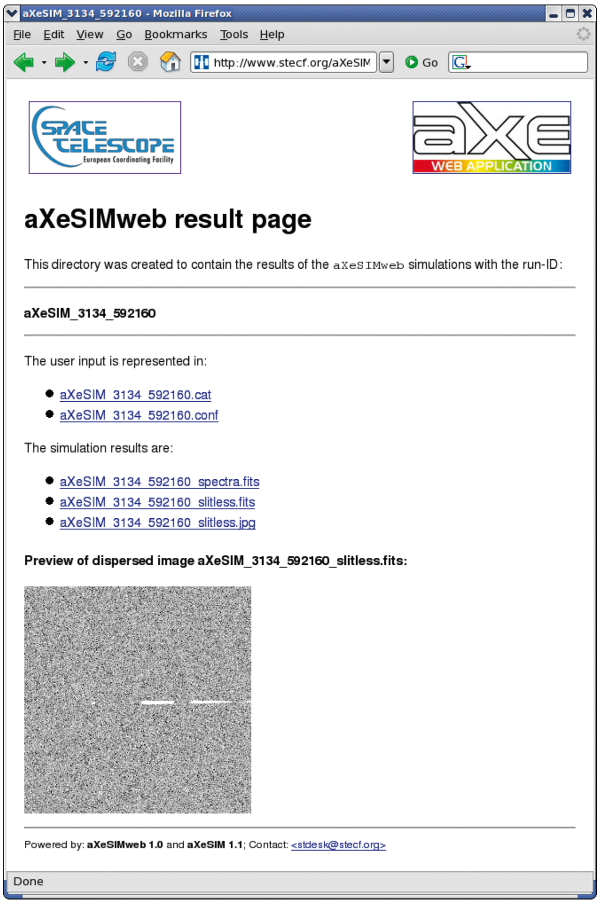

Fig 2: *Web page showing the results of an **aXeSIMweb** simulation. The dynamic ranges of the previews are set to allow easy assessment of the success of the simulation rather than to display the spectral details of the simulated objects.*

SPECTRAL TEMPLATES

aXeSIMweb offers a set of 32 templates to characterise the spectral properties of the objects to be simulated.

The stellar templates were taken from the Kurucz 93 stellar atmospheres atlas [3]. From the available range in temperature and log(g), we have picked 25 spectra as templates. These stellar template spectra were selected to give a uniform sampling of all spectral types for dwarfs and a selection for giants, while keeping the number of templates low. Table 1 lists the stellar templates offered in **aXeSIMweb** with the temperatures, log(g) values and the stellar types which they represent.

Figure 3 displays the seven non-stellar template spectra in relative f_λ plotted against wavelength. These templates contain one QSO [4] and several galaxy templates from the literature [5][6]. As a starburst template we used the model #4 from [5] and extended it into the near infrared by assuming a simple power law $f_\nu \propto \nu^{-1/3}$.

All template spectra are available for download from the **aXeSIMweb** templates pages [7] in order to provide transparency and repeatability for users.

Spectral type	T[K]	log(g)
O5 V	45000	5.0
O6 V	40000	4.5
O8 V	35000	4.0
B0 V	30000	4.0
B0 III	29000	3.5
B3 V	19000	4.0
B5 V	15000	4.0
B5 III	15000	3.5
B8 V	12000	4.0
A0 V	9500	4.0
A5 V	8250	4.5
F0 V	7250	4.5
F5 V	6500	4.5
G0 V	6000	4.5
G0 III	5750	3.0
G5 V	5750	4.5
G5 III	5250	2.5
K0 V	5250	4.5
K0 III	4750	2.0
K5 V	4250	4.5
K5 III	4000	1.5
M0 V	3750	4.5
M0 III	3750	1.5
M2 V	3500	4.5
M5 V	3500	5.0

Tab 1: *Stellar templates available in **aXeSIMweb**.*

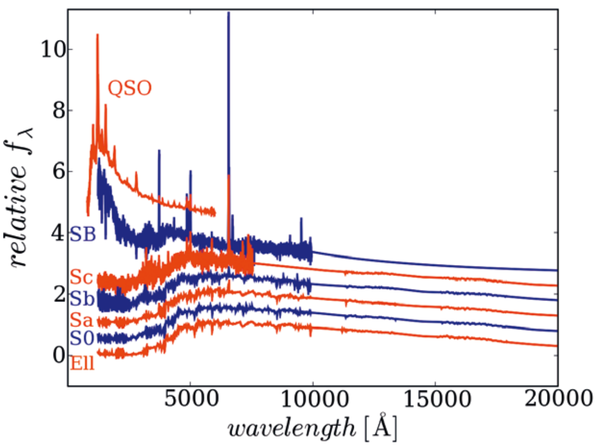

Fig 3: *Non-stellar templates provided by **aXeSIMweb**. The six galaxy templates, ranging from elliptical (**Ell**) to starburst (**SB**), are complemented by a QSO spectrum.*

AXESIMWEB AND THE EXPOSURE TIME CALCULATOR

The primary aim of **aXeSIMweb** is to provide the user with the tools to easily explore the two-dimensional aspects of slitless spectroscopy, and especially to assess the contamination of sources for a particular observational setting (pointing and roll angle).

aXeSIMweb was developed independently of the STScI Exposure Time Calculator (ETC). While every effort has been made to ensure that the simulator provides similar estimates of detected counts to the ETC, differences are bound to result. The STScI ETC [8] is to be taken as the official tool and should always be used to determine exposure times for the purposes of critical time justification in proposal preparation Phases I and II.

OUTLOOK

The first release of **aXeSIMweb** was in December 2007, at the time of the HST *Call for Proposals* for Cycle 17. Equipped with configuration and calibration files derived from Thermal Vacuum 2 data, it was extensively used by astronomers who prepared Phase I proposals for WFC3 slitless spectroscopy (deadline: March 7th 2008).

The Thermal Vacuum 3 tests, which were conducted during the period February-April 2008 with the flight detectors in both channels, provided new sensitivity files for all grism modes. An updated version of **aXeSIMweb**, including the new sensitivity files and some minor software changes, will be published in due time for the Cycle 17 Phase II proposal deadline.

REFERENCES AND LINKS

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[2] The web application aXeSIMweb: http://www.stecf.org/instruments/aXeSIMweb

[3] Kurucz 93 atlas in the Calibration Database System (CDBS): http://www.stsci.edu/hst/observatory/cdbs/k93models.html

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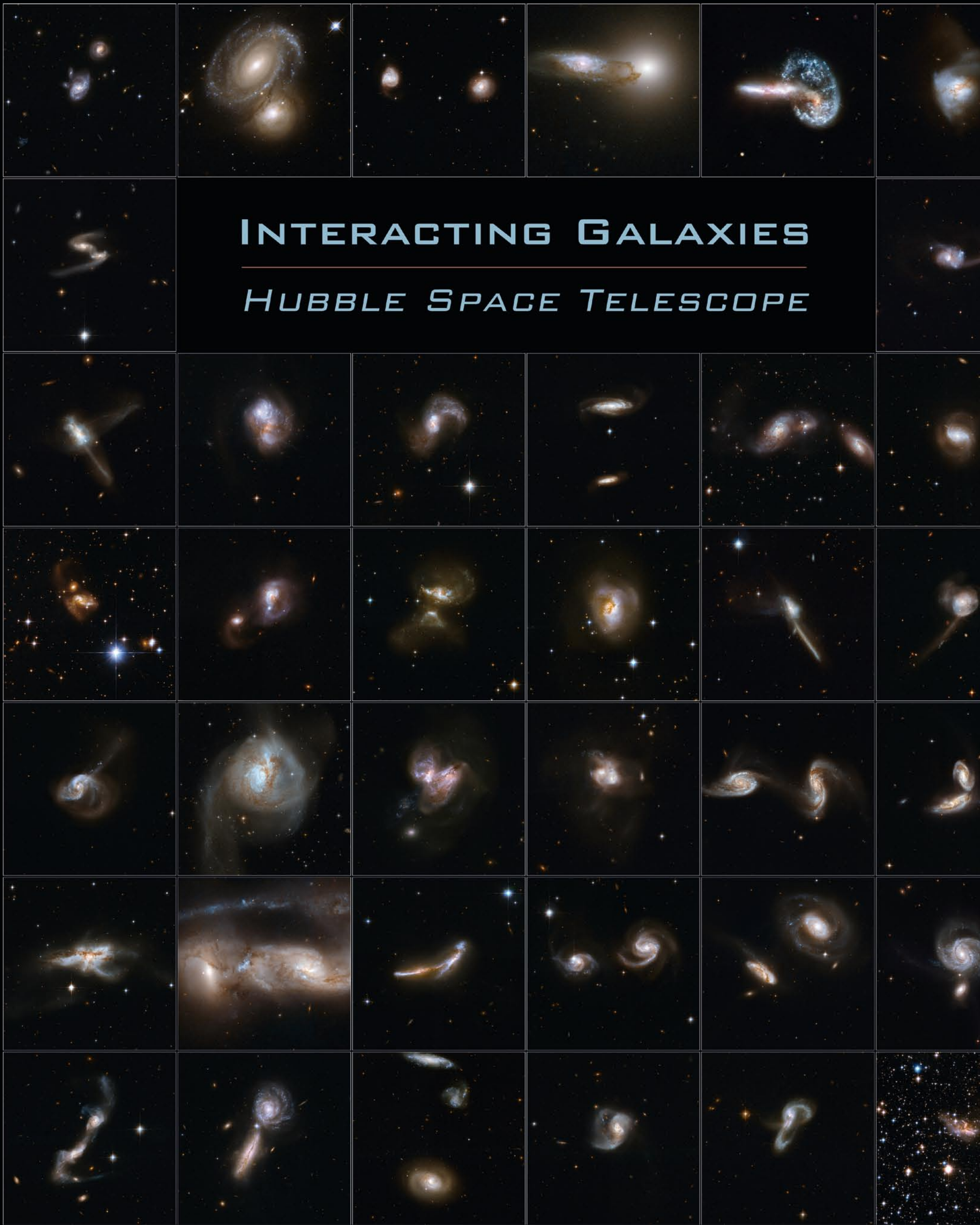
[7] The aXeSIMweb templates page: http://www.stecf.org/instruments/aXeSIMweb/templates.php

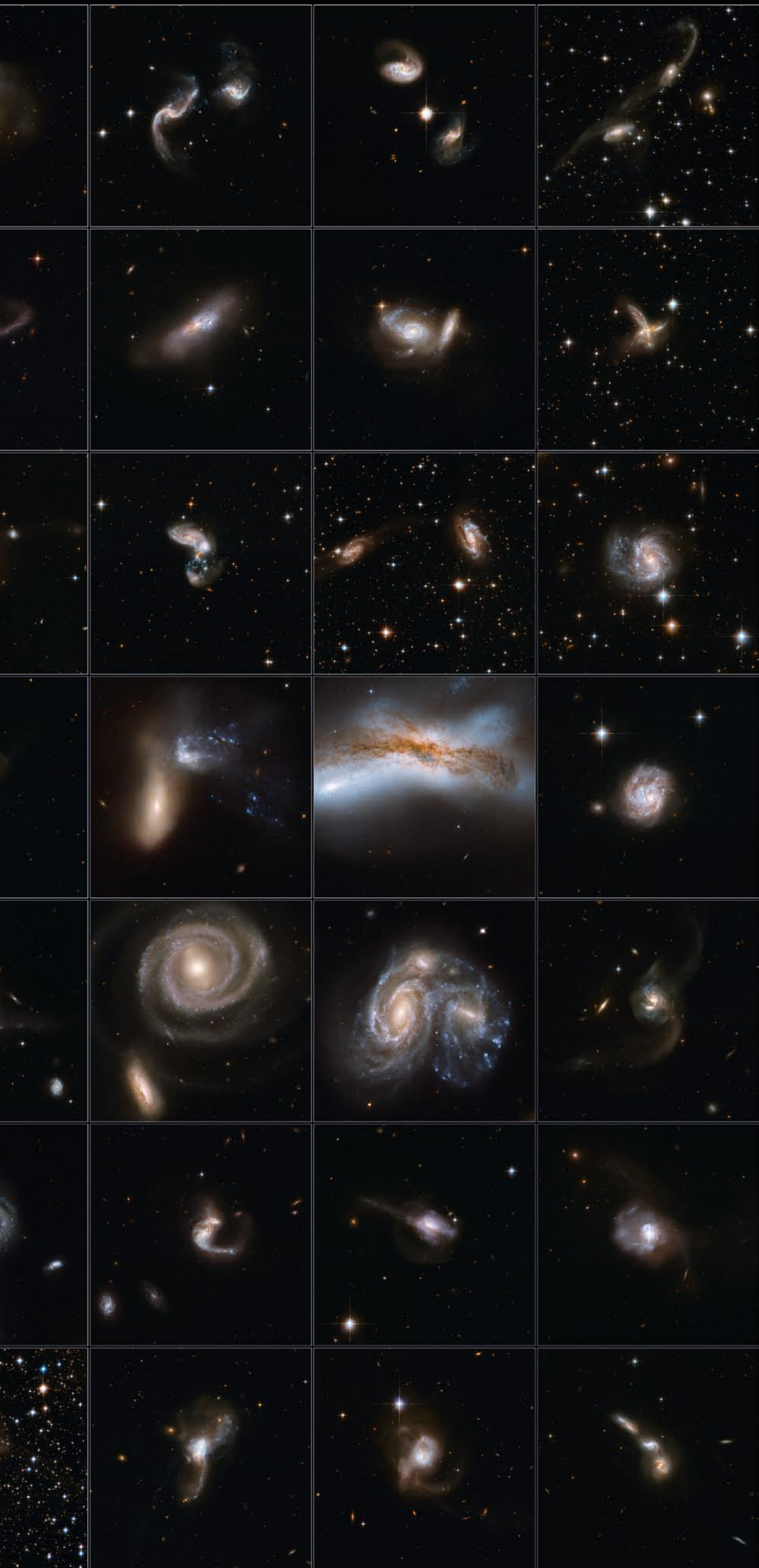
[8] The STScI exposure time calculator (ETC) for WFC3: http://www.stsci.edu/hst/wfc3/tools/etcs/

THE ANTENNAE GALAXIES MOVE CLOSER [heic 0812]

New research on the Antennae Galaxies using the Advanced Camera for Surveys onboard the NASA/ESA Hubble Space Telescope shows that this benchmark pair of interacting galaxies is in fact much closer than previously thought — 45 million light-years instead of 65 million light-years.

NASA, ESA & Ivo Saviane (European Southern Observatory)/Robert Gendler


INTERACTING GALAXIES
HUBBLE SPACE TELESCOPE



GALAXIES GONE WILD!

[heic 0810]

Interacting galaxies are found throughout the Universe, sometimes as dramatic collisions that trigger bursts of star formation, on other occasions as stealthy mergers that result in new galaxies. A series of 59 new images of colliding galaxies has been released from the several terabytes of archived raw images from the NASA/ESA Hubble Space Telescope to mark the 18th anniversary of the telescope's launch. This is the largest collection of Hubble images ever released to the public simultaneously.

Galaxy mergers, which were more common in the early Universe than they are today, are thought to be one of the main driving forces for cosmic evolution, turning on quasars, sparking frenetic star births and explosive stellar deaths. Even apparently isolated galaxies will show signs in their internal structure that they have experienced one or more mergers in their past. Each of the various merging galaxies in this series of images is a snapshot of a different instant in the long interaction process.

Cutting-edge observations and sophisticated computer models demonstrate that galaxy collisions are far more common than previously thought. Interactions are slow stately affairs, despite the typically high relative speeds of the interacting galaxies, taking hundreds of millions of years to complete. The interactions usually follow the same progression, and are driven by the tidal pull of gravity. Actual collisions between stars are rare as so much of a galaxy is simply empty space, but as the gravitational webs linking the stars in each galaxy begin to mesh, strong tidal effects disrupt and distort the old patterns leading to new structures, and finally to a new stable configuration.

NASA, ESA, the Hubble Heritage Team (STScI/AURA)-ESA/Hubble Collaboration and A. Evans (University of Virginia, Charlottesville/NRAO/Stony Brook University), K. Noll (STScI), and J. Westphal (Caltech)

WHY SHOULD WE BOTHER TO COMMUNICATE ASTRONOMY?

Will Gater (ESA/Hubble & BBC Sky At Night), reprinted from CAPjournal #2, 2008

I once attended a lecture on science communication by a prominent BBC radio producer. At the end of the lecture questions were taken by the producer on the ways in which science is communicated in the media and a lively discussion quickly arose. After covering the in and outs of target audiences, pitching articles and news pieces at the right level, the debate settled. Finally one postgraduate promptly raised his hand and proceeded to ask the producer something along the lines of: “Why should we even bother with science communication?” He then continued, emotively and quite genuinely, to argue that to try and explain his complex work would simplify it and, ultimately, belittle it. As he went on the room became quieter and quieter.

At the end of the lecture, as I picked up my pen and paper to leave, I tried to understand where my colleague was coming from. As someone who has a passion for communicating science and astronomy to other people I began to question whether I had really taken for granted that mine was a job that needed to be done. Maybe it was because the question was posed without a hint of jest and with complete genuineness that I was jolted. Did my postgraduate colleague have a point — surely not? Was he just being narrow-minded, not seeing the bigger picture and if so how many other scientists shared such a hard-line view? As science communicators these are questions we need to be able to respond to with clarity and strength.

One of the observations which arose in my mind from the lecture hall experience was that here was a young man just starting out in his research career in some field of astronomy; someone of similar age to myself who had grown up in a much more media-orientated world than today’s more experienced researchers. A world where research grants, project funds and big name backing are all linked by the potent ability to communicate, enthuse and convey your own innate passion for your work to someone else. Yet before even starting his career he had already perceived the communication of his work as something that can have a detrimental effect, not a positive one. How so?

It is no secret that many scientists today feel that communicating their work is not the most important item on their agenda. But nevertheless many appreciate its value. Some scientists commendably approach outreach with a passion, whilst others take the view of the postgraduate in the lecture hall. Now this may ultimately depend on the individual’s communication abilities but everyone, communicators and scientists alike, can always improve their skills. It is the perception within the scientific community of outreach as damaging that we have to shed. If we are to reduce or even reverse this attitude then we must continue to ensure that as science communicators we produce the best work we can.

Our work should maintain credibility at all costs. We should strive to be factually correct whilst conveying the theory, message and science. We should inform not hype, simplify but not patronise and explain without confusion or ambiguity. It is quite a difficult but — crucially — not an impossible task. These issues have already been widely discussed so I will not explore them much further here. We need simply to make sure that credibility is ingrained in our work so that the interface between scientists and the media is as smooth as possible and is as beneficial to the researcher as it is to us communicators.

The central question is still why we should communicate not how. The discoveries of science and astronomy need to be communicated. Astronomy represents one of the oldest, most captivating sciences there is. Today many laypeople yearn, as they have always done, to understand more about the Universe they live in. As astronomers and scientists we too covet every new major discovery almost with a veneration for progress that has lasted for centuries; it is our job to disseminate this vital information. I doubt that many people, academic and lay alike, would disagree.

We should communicate astronomy because it is important. It is important to many people, on a multitude of levels. Take the images from the various space agencies around the world. Millions of people have marvelled at the exquisite detail of the spirals in distant galaxies thanks to the Hubble Space Telescope, or the view of a Saturnian moon they had never even heard of thanks to Cassini. Whilst these images may not be heavily laden with scientific prose, they are incredibly important keys to communicating the science. If even a small percentage of the millions who see the pictures from space take an interest in what the image actually shows then thousands will be educated in the astronomical workings of the Universe. What would have happened if Vivaldi had decided to show only a few friends the sheet-music to The Four Seasons before filing it away? With good communication our lives, our culture and, most importantly for us, our work is so much richer. Astronomy is a stimulating, mystifying, often baffling and immense subject that brings pleasure and intrigue to young and old, experienced and inexperienced all over the world. Not to communicate the wonders of the Universe would be an outrage.

Culturally, the advancement of astronomy has gone hand in hand with the expansion of some of the most vibrant and diverse cultures the world has ever seen. Similarly, those countries which have embraced science throughout history (especially astronomy and space sciences) have also witnessed a growth in the skills of their populace, employment opportunities arise and numerous economic benefits. Without outreach and education few laypeople would know anything about the workings of the Universe, let alone the workings of a research scientist! If we were to stop communicating astronomy how could we ever hope to inspire and bring forward the next generation of astronomers?

In everyday life we communicate because we must do so to survive. It is a central foundation of our human existence; it has been so since our ancestors wandered the dusty plains of Africa. Today, many millennia later, there is absolutely no difference. Astronomy (and science in general) must communicate to survive. If astronomy is to evolve and progress in the burgeoning manner that it has done since it began, then we must not only bother to communicate we must also excel at it.

TINY TIM PSF SIMULATOR — NOW WITH WFC3 SUPPORT

Richard Hook, Felix Stoehr & John Krist (JPL)

When a point-source of light such as a star shines into Hubble and creates an image it forms a slightly extended complex shape because of the wave nature of light and small imperfections of the both the telescope and camera optics and the detector. Knowledge of this point-spread function (PSF) is very useful for predicting how observations will turn out and for many other applications. The ST-ECF has extended John Krist's Tiny Tim Hubble PSF simulation software to include preliminary support for the new WFC3 camera and also created a web interface for running the simulations.

INTRODUCTION

Tiny Tim [1][3][4] was written by one of us (JK) soon after Hubble was launched and has become the most widely used PSF simulator for all the cameras on the observatory. Over the years it has been extended to handle new instruments as they are installed and to incorporate many instrumental effects as they have been discovered. Simulated PSFs are useful for many applications including observation planning, modelling and image deconvolution. Tiny Tim is written in standard C and is very easy to install and run. With modern computers preparing a PSF typically only takes a few seconds.

In view of the forthcoming installation of a new camera, the Wide Field Camera 3 (WFC3), during the next Hubble servicing mission, later in 2008, it was clearly desirable to have WFC3 included in Tiny Tim before the phase II proposal period in the summer of 2008. After discussions with the WFC3 team at STScI we agreed that the ST-ECF would take on this job and build on their experience with the initial NICMOS implementation back in 1997.

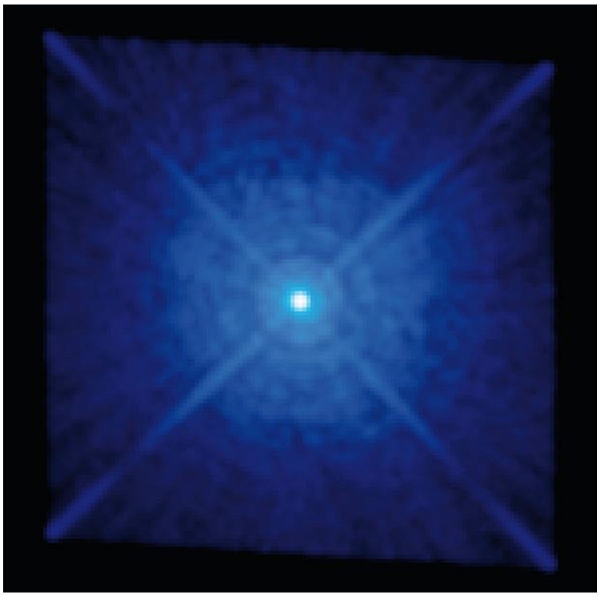


Fig 1: *WFC3/UVIS monochromatic (300 nm) PSF created with Tiny Tim. A logarithmic stretch has been used to reveal both the inner and outer structure. The geometric distortion of the camera has been included. This image covers 5x5 arc-seconds and shows the skew geometric distortion of the UVIS channel.*

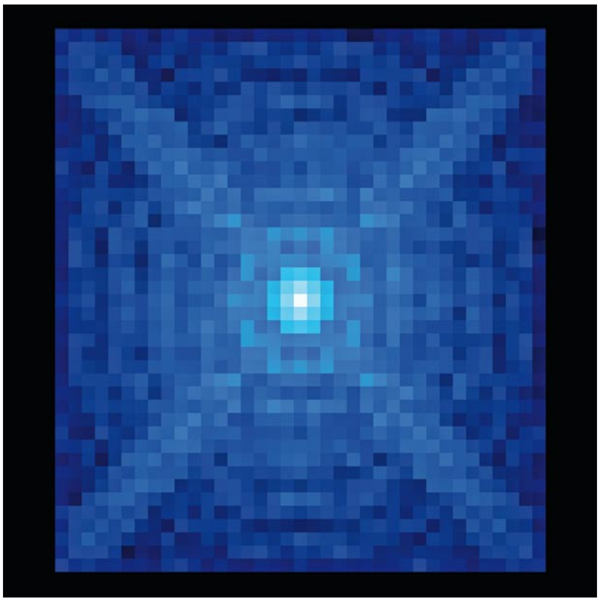


Fig 2: *WFC3/IR monochromatic (1.5 μm) PSF created with Tiny Tim. A logarithmic stretch has been used to reveal both the inner and outer structure. The geometric distortion of the camera has been included. This also image covers 5x5 arc-seconds and shows the difference in scales in X and Y, and the relatively large pixels, of the IR channel.*

ADDING WFC3

Including a new camera in Tiny Tim involves some code changes but the bulk of the work is to get all the required information. For the WFC3/UVIS channel we have re-used much of the code originally for ACS, in particular that for implementing space and wavelength dependent charge diffusion and geometric distortion. In the case of the IR channel some of the code for NICMOS was convenient. We have included the WFC3 filter curves, the field dependent aberrations derived from optical models of the instrument, preliminary estimates of charge-diffusion in the UVIS CCD chips (at two wavelengths, from thermal vacuum testing), geometric distortions from the optical models as well as information about the geometry of the cold mask stop in the IR channel. We are very grateful to George Hartig, Colin Cox, John MacKenty and Howard Bushouse at STScI and Eliot Malumuth at Goddard Space Flight Center for providing information and support. Although we are confident that all the major effects are included, and there appears to be qualitative agreement with ground-based thermal vacuum testing data, we will not know how well this very preliminary version matches reality until appropriate data is acquired in orbit. This new preliminary version is called Tiny Tim 7.0.

TINY TIM ON THE WEB

Although it is easy to download and install Tiny Tim and run it locally we felt that many would prefer the convenience of a web interface for preparing PSFs. The aim was to have an interface through which the user specifies the PSF parameters using dynamic forms. The PSF is then prepared on the server, using the standard Tiny Tim software, and then plots, and many options for downloading the resultant images are made available. Figure 3 shows the web form itself, after it is complete and ready to run, and Figure 4 the resulting displays and download options available after the simulation has been completed.

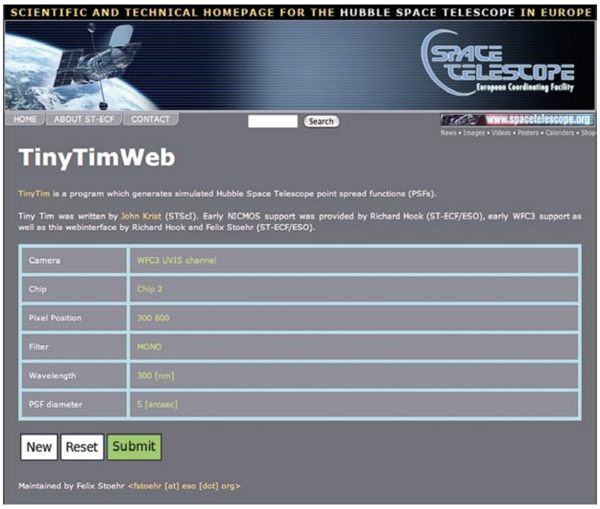


Fig 3: *Web form for running Tiny Tim on the ST-ECF web server. This screen-shot shows the appearance of the page after the pull down menu has been used to specify the input parameters, in this case those for the WFC3/UVIS 300nm monochromatic PSF shown in Figure 1, and before Tiny Tim has created the PSF.*

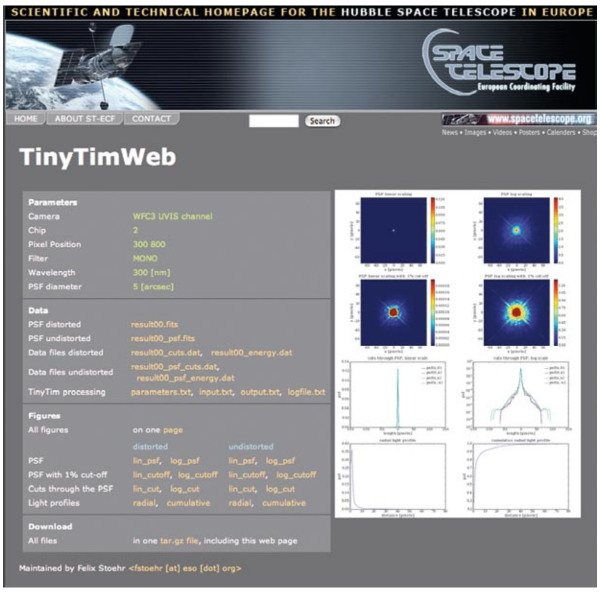


Fig 4: *Results web page after the run of Tiny Tim described in Figure 3. Many files are available for download and several different displays of the PSF are shown.*

FUTURE PLANS

Tiny Tim 7.0, with the initial WFC3 support, will be made available in early June 2008 from the usual STScI Tiny Tim web site [1] as well as through the ST-ECF web pages [2]. It must be stressed that this version is based on early estimates for aberrations, geometrical distortions and charge diffusion effects in the UVIS channel and is certainly far from complete. As a result, the PSFs created may differ significantly from those found once the camera is in orbit. We hope to include better estimates as they become available and also try to incorporate the "unknown unknowns" that surface as the camera is used for science.

REFERENCES & LINKS

[1] The Tiny Tim site at STScI:
http://www.stsci.edu/software/tinytim/tinytim.html

[2] Web access at the ST-ECF:
http://www.stecf.org/instruments/TinyTim/tinytimweb

[3] The Tiny Tim Users Guide:
http://www.stsci.edu/software/tinytim/tinytim.pdf

[4] Krist, J. 1995, "Simulation of HST PSFs using Tiny Tim", Astronomical Data Analysis Software and Systems IV, ASP Conference Series, R.A. Shaw, H.E. Payne, and J.J.E. Hayes, eds., 77, 349.

BLACK HOLE FOUND IN ENIGMATIC OMEGA CENTAURI [heic 0809]

A new discovery has resolved some of the mystery surrounding Omega Centauri, the largest and brightest globular cluster in the sky. Images obtained with the Advanced Camera for Surveys onboard the NASA/ESA Hubble Space Telescope and data obtained by the GMOS spectrograph on the Gemini South telescope in Chile show that Omega Centauri appears to harbour an elusive intermediate-mass black hole in its centre. *"This result shows that there is a continuous range of masses for black holes, from supermassive, to intermediate-mass, to small stellar mass types"*, explained astronomer Eva Noyola of the Max-Planck Institute for Extraterrestrial Physics in Garching, Germany, and leader of the team that made the discovery.

Omega Centauri is visible from Earth with the naked eye and is one of the favourite celestial objects for stargazers from the southern hemisphere. Although the cluster is 17 000 light-years away, located just above the plane of the Milky Way, it appears almost as large as the full Moon when the cluster is seen from a dark rural area. Exactly how Omega Centauri should be classified has always been a contentious topic. It was first listed in Ptolemy's catalogue nearly two thousand years ago as a single star. Edmond Halley reported it as a nebula in 1677. In the 1830s the English astronomer John Herschel was the first to recognise it as a globular cluster. Now, more than a century later, this new result suggests Omega Centauri is not a globular cluster at all, but a dwarf galaxy stripped of its outer stars.

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

HUBBLE FINDS FIRST ORGANIC MOLECULE ON EXTRASOLAR PLANET [heic 0807]

The tell-tale signature of the molecule methane in the atmosphere of the Jupiter-sized extrasolar planet HD 189733b has been found with the Hubble Space Telescope. Under the right circumstances methane can play a key role in prebiotic chemistry — the chemical reactions considered necessary to form life as we know it. Although methane has been detected on most of the planets in our Solar System, this is the first time any organic molecule has been detected on a world orbiting another star.

This discovery proves that Hubble and upcoming space missions, such as the NASA/ESA/CSA James Webb Space Telescope, can detect organic molecules on planets around other stars by using spectroscopy, which splits light into its components to reveal the "fingerprints" of various chemicals.

"This is a crucial stepping stone to eventually characterising prebiotic molecules on planets where life could exist", said Mark Swain of NASA's Jet Propulsion Laboratory (JPL), Pasadena, USA, who led the team that made the discovery. Swain is lead author of a paper in the 20 March issue of Nature.

The discovery comes after extensive observations made in May 2007 with Hubble's Near Infrared Camera and Multi-Object Spectrometer (NICMOS). It also confirms the existence of water molecules in the planet's atmosphere, a discovery made originally by NASA's Spitzer Space Telescope in 2007. *"With this observation there is no question whether there is water or not — water is present"*, said Swain.

The planet, HD 189733b, now known to have methane and water vapour is located 63 light-years away in the constellation Vulpecula, the little fox. HD 189733b, a "hot Jupiter"-type extrasolar planet, is so close to its parent star that it takes just over two days to complete an orbit. "Hot Jupiters" are the size of Jupiter but orbit closer to their stars than the tiny innermost planet Mercury in our Solar System. HD 189733b's atmosphere swelters at 900 degrees C, about the same temperature as the melting point of silver.

Fig 1: *A wide star field image of the region around HD 189733b. The star HD 189733 is located in the centre, just to the left of the planetary nebula Messier 27. The field-of-view is approximately 2.1 x 1.5 degrees.*

ESA, NASA and G. Tinetti (University College London, UK & ESA)

CONTENTS

STAFF CHANGES

Bob Fosbury

After working as an ESO staff member at the ST-ECF for fifteen years, Wolfram Freudling is moving on to lead a new Science Data Products group in the ESO Operations Directorate. During his tenure at the ST-ECF, Wolfram has applied his considerable scientific and technical skills both to Hubble instruments, notably NICMOS, and to the early work on understanding the performance of the multi-shutter array being used as the entrance aperture of the JWST spectrograph. Most recently, he has been leading the team producing calibrated grism spectra from NICMOS as part of the Hubble Legacy Archive (HLA) collaboration with STScI and CADC and the subsequent continuation of the project to prepare for the processing of ACS grism data.

At the same time the ST-ECF is being joined by Piero Rosati who will work on the grism products from ACS for the HLA, as well as associated science projects. As a member of the ACS Science Team, Piero has considerable experience with both the camera and observing with Hubble and is leading research in many areas of observational cosmology.

Cover Image: The plots on the cover show a selection of the NICMOS grism spectra included in the ST-ECF Hubble Legacy Archive Data Release One described in this Newsletter. Each one is a fully wavelength and flux calibrated near-IR spectrum covering the wavelength range 1.1–1.9 microns. Because of the strong emission and absorption of the Earth's atmosphere at these wavelengths the spectra are of far higher quality than can be obtained from the ground, even with larger telescopes. This collection of 2470 spectra features many different kinds of astronomical objects — normal stars, very red objects, brown dwarfs and emission line objects such as planetary nebulae.

ST-ECF

Head
Robert A.E. Fosbury
+49-89-320 06 235
Robert.Fosbury@stecf.org

Advanced Data Products
Jeremy R. Walsh
+49-89-320 06 248
Jeremy.Walsh@stecf.org

Public Outreach
(Hubble European Space Agency Information Centre):
Lars Lindberg Christensen
+49-89-320 06 306
lars@stecf.org

The Space Telescope-European Coordination Facility
Karl-Schwarzschild-Str.2
D-85748 Garching bei München, Germany

Websites
http://www.stecf.org
http://www.spacetelescope.org

Telephone
+49-89-320 06 291

Telefax
+49-89-320 06 703

Hot-line (email)
stdesk@stecf.org

Email
<user>@stecf.org

ST-ECF Newsletter

Editor
Richard Hook, Richard.Hook@stecf.org

Editorial assistant
Britt Sjöberg, Britt.Sjoeberg@stecf.org

Layout & Illustrations
Martin Kornmesser
Nuno Marques

Production Coordination
Lars Lindberg Christensen

Printed by
TypeSet, München

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ST-ECF