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ST-ECF Newsletter

Space Telescope
European Coordinating Facility

Editorial

From the first issue in March 1985, the Editorial policy for the ST-ECF Newsletter has been directed towards keeping the community informed about the status of the HST project and, in particular, about technical developments which support the scientific use of the Observatory. Scientific results were only reported when they illustrated the application of a newly-developed technique or capability. The aim was to produce a publication which could be found open on the desk of somebody writing an HST observing proposal or reducing data.

We believe that this policy was correct and that the Newsletter fulfilled this function. As an example, one could point to the series of articles on image restoration — first triggered by the spherical aberration problem but later developed into a broadly applicable suite of algorithms with application throughout astronomy and beyond. A related topic, particularly pertinent to the undersampled HST detector arrays, was the question of dithering and the 'data fusion' techniques required to recover the full resolution inherent in the optical point spread function. This led, through an ST-ECF/STScI collaboration, to the 'Drizzling' codes which first came to prominence during the production of the Hubble Deep Field (HDF) images.

We are about to modify this policy and such a decision requires justification. What should be the function of our Newsletter now? It is clear that the requirement for technical information is still there. It is also apparent, however, that a printed Newsletter is not necessarily the best way of satisfying that requirement. The World Wide Web (WWW) — not even dreamt of by most of us in 1985 — provides a capability ideally suited to this function and capable of transmitting information in formats not available on paper. Should the Web be our sole medium for informing our community? In spite of its convenience and flexibility, we think not.

There is a clear need to inform about the HST in general and its evolution towards the Next Generation Space Telescope — a project which has gathered such enormous momentum during the last three of years. In particular, the European involvement in these Observatories has been under active negotiation, the results of which need to be disseminated. Such topics are suited to a paper Newsletter and that is one of our justifications for not succumbing entirely to the attractions of the WWW.

This new version of the ST-ECF Newsletter will appear twice a year, around May and November, and will be more compact than our previous issues. In addition to project news, there will be summaries of technical developments which are presented more fully on the ST-ECF Website. There will be opportunities to present illustrated scientific results but, consistent with our existing policy, these should be related to current technical developments in observation design or data analysis. We are particularly interested in demonstrating the synergetic relationships between space and groundbased optical/NIR astronomy, something that the ST-ECF staff — based within ESO — are particularly well-placed to encourage.

We very much welcome contributions to either the printed or the Web-based incarnations of this Newsletter.

The ESA–NASA agreements on HST and NGST

Piero Benvenuti

The HST is approaching its 9th full year in orbit and, in 2000, it will be visited for the third time by Shuttle astronauts who will replace instruments, perform routine maintenance and re-boost the spacecraft to a higher orbit. With NASA's current intention to extend its operation to the year 2010 and the plan for a launch of its successor, the Next Generation Space Telescope (NGST) in 2007, it is appropriate to review the rôle of HST in the rapidly changing landscape of observational astrophysics. On one side, a '2nd Decade Committee' has been appointed with the charter of suggesting ways to optimise the future scientific utilisation of HST in the context of the new, large groundbased telescopes and the coming of NGST. A progress report about the work of the Committee appears in this issue. On the other side, during the last 18 months ESA and NASA have been discussing the possibilities for an extension, up until the termination of HST operations, of the current Memorandum of Understanding (MoU). The initial MoU foresaw the contribution by ESA of the Solar Arrays, of the Faint Object Camera and of 15 people at the STScI. In exchange, astronomers from the ESA Member States would have access to no less than 15% of HST observing time, averaged over the lifetime of the Observatory.

The original MoU is valid for 11 years following the launch of HST and therefore expires in the year 2001. Being aware of the considerable success of the collaboration, both NASA and ESA agreed that the MoU should be extended to cover the full operational lifetime of the Observatory.

A specific ESA/NASA Working Group was appointed and met on a number of occasions during 1997 and 1998 preparing the groundwork for an agreement which included the extension of the European access to HST observing time throughout its operational life. Initially, a contribution of hardware by ESA in the form of a new scientific instrument or part of it, was considered. Indeed, a proposal based on the STJ — the Superconducting Tunneling Junction detector which is being developed at ESTEC — was submitted, in collaboration with a US group, for competition in the selection of the new instrument to be installed during the last Maintenance & Refurbishment Mission to HST in 2002. After the actual selection in July/August 1997 of the Cosmic Origins Spectrograph (COS), the possibility for a substantial hardware contribution became less practical and the Working Group was obliged to considerer alternative solutions.

Meanwhile, European scientists were becoming increasingly interested in NASA's energetic initiatives on the NGST. In response to this, ESA appointed an 'ad hoc' Task Group, chaired by J-P. Swings, to assess the potential areas for a European collaboration on NGST. The Group recognised the high level of European interest, both scientific and technological, in the project and suggested a number of actions to be undertaken in order to prepare for a future ESA/NASA collaboration. In particular, the Group recommended the initiation of three studies on NGST to be carried out in Europe, one on a multi-object/integral-field spectrograph for the prime IR wavelength band (1 to 5µm), one on the concept of an 8-metre class lightweight deployable telescope and its instrument suite and one on the characteristics of a distant (~ 3 AU) orbit for NGST. Following an assessment of other recent orbital studies, it was decided to redirect the third study to the extension of the NGST capability into the optical waveband.

At this point it was natural for the MoU Working Group to propose a merging of the HST and NGST negotiations into a single agreement. It should be noted here that, beyond the obvious interest of merging the financial resources on these large projects, both NASA and ESA have stressed the importance of the sharing of intellectual developments which, following the very positive HST experience, is considered an essential element for the scientific success of NGST.

By July 1998 a new HST/NGST Agreement was ready to be presented to the ESA and NASA executives who judged the document an acceptable basis for both the extension of the HST collaboration and the future definition of a similar NGST MoU.

In summary, the new agreement says that ESA will contribute the following elements:

❏ Hardware parts, electronics and engineering support for the new Solar Arrays which NASA is assembling for the 2000 Maintenance & Refurbishment mission.

❏ Continuation of the support of HST operations with the fifteen ESA staff at the STScI.

❏ Participation in the production of the Guide Star Catalogue II (GSCII): the new Catalogue is needed for the automatic detection of dangerously bright stars for the Advanced Camera (ACS). This collaboration started at the beginning of 1998 at the ST-ECF and will be completed by the end of 1999. It involves the processing of some 3000 digital scans of Schmidt plates. For this purpose two additional staff were recruited at the ST-ECF and a consultancy contract was signed with the Observatory of Turin (see ESO Messenger, 93, September 1998, p25).

❏ Improvement in the calibration of the Archive data of the HST Instruments which have completed their operational lives (FOS, GHRS and later FOC, etc.). This task will be performed at the ST-ECF in coordination with the STScI. Eventually the responsibility for this Post-Operation Instrument Archive will be transferred to the ST-ECF for all users. Additional resources will be recruited for this specific task.

❏ HST Outreach: ESA will set up a service to distribute in Europe the outreach material (PR and educational) which is currently produced at the STScI. ESA will also produce its own outreach products in coordination with the Office for Public Outreach of the STScI.

❏ Contribute to the scientific operation of HST and definition of NGST by supporting the European participation in the different scientific and technical committees (eg, Discipline Panels, Telescope Allocation Committee, etc.)

❏ Collaboration in the NSGT project, from feasibility studies to two years of science operations up to a level of approximately M$200 (FY 96 value). After the first two years, although the details of science operation will not be known until the beginnning of Phase B, ESA plans to provide a level of support to NGST equivalent to HST, eg, sustaining engineering, operational and science support, archive support and public outreach.

In exchange NASA will:

❏ Provide access, through peer review based on scientific merit, to no less than 15% of the observing time of both HST and NGST, for the duration of each of those missions.

❏ Give access to NGST observing time, in the same way as for HST, for the first two years of operation. The extension of this initial period will be discussed and negotiated after the launch and science verification of NGST.

On the ESA side, the agreement has been approved by the Astronomy Working Group and by the Space Science Advisory Committee and it was finally approved, together with its budgetary implications, by the Science Programme Committee during its meeting this November.

The ESA/NASA Working Group will meet again in December with a slightly modified charter by which it will continue to monitor the implementation of the agreement and prepare the elements for the specific NGST MoU.

European astronomers can now look forward to continuing a very successful collaboration with their US colleagues in the very front line of space astronomy.

European involvement in the Next Generation Space Telescope

Peter Jakobsen (ESTEC) & Robert Fosbury

The concept of a Next Generation Space Telescope with an aperture greater than 4m and a primary wavelength coverage from 1 to 5 microns, originated with the 'HST and Beyond' committee, chaired by Alan Dressler, whose report was published in 1996. Feasibility studies in the US of NGST concepts up to 8m in aperture rapidly built momentum and are described in the 1997 report: 'NGST — Visiting a time when galaxies were young' edited by Peter Stockman of the STScI. Present planning foresees a launch for NGST around 2007.

Following a formal invitation by NASA to cooperate in studies related to its Origins programme, ESA formed an NGST Task Group chaired by J-P Swings. This group recommended in mid-1997 that studies be initiated in Europe to examine specifically:

❏ independent concepts for an 8m class telescope and payload suite;

❏ a multi-object and integral field spectrograph covering in the 1-5µm region and

❏ technical aspects of employing distant orbits.

In January 1998, ESA solicited 'Letters of Interest' from scientists and industry willing to participate in the first two of these studies. Following receipt of these in mid-February, ESA issued 'Invitations to Tender' for the studies. An International Workshop, 'The Next Generation Space Telescope: Science Drivers and Technological Challenges', was held in Liège from 15–18 June this year and acted as a forum for European astronomers and industry. Some 195 individuals participated in this meeting, the proceedings of which have been published by ESA (ESA-SP-429).

Current Developments

The negotiations between ESA and NASA for the replacement of the existing HST Memorandum of Understanding, due to expire in 2001, have drawn to a successful conclusion (see the article by Piero Benvenuti in this issue) and also cover ESA's foreseen participation in the NGST project. Briefly put, the agreement assumes that ESA will contribute to the NGST project at the level of a so-called 'Flexi-Mission' in the parlance of the Horizon 2000+ long-term science plan (around M$200 FY 1996 value) in return for a guaranteed minimum of 15% of NGST observing time for ESA member state astronomers. The envisaged ESA/NASA NGST collaboration conforms closely to the highly successful HST model, ie, assumes that a key component of ESA's hardware contribution will be in the form of a scientific instrument, augmented by possible contributions to the spacecraft and operations.

In addition to ESA, Canada has also expressed interest in participating in the NGST project at the level of approximately M$50.

Who's Who on NGST at ESA

ESA NGST Project

Study Manager: J. Cornelisse
Study Scientist: P. Jakobsen

ESA NGST Study Science Team Members

External: S. Arribas (Tenerife), E. van Dishoeck (Leiden), A. Ferrara (Arcetri), J. Hjorth (Copenhagen), M. McCaughrean (Potsdam), P. Schneider (Garching)

Study Consortia: O. LeFèvre (Marseille), R. Davies (Durham)

ESA: P. Jakobsen (ESTEC P Chair), R. Fosbury (ST-ECF), C. Burrows (STScI), S. Volonté (HQ)

NASA: J. Mather (NASA/GSFC), P. Stockman (STScI)

ESA Members of NASA Ad Hoc Science Working Group

R. Fosbury, P. Jakobsen, P. Schneider, E. van Dishoeck

ESA Members of NASA NGST Standing Review Board

M. Verdant (ESTEC), R. Genzel (MPI)

Two of the three technical assessment studies recommended by the ESA NGST Task Group are now well underway. The contract for the study of a Multi-Object/Integral Field Spectrograph has been awarded to consortium led by Laboratoire d'Astronomie Spatiale (Marseilles) with Dornier Satellitensysteme (Ottobrunn) as industrial partner. The Telescope & Complete Payload Suite study was awarded to the same Dornier/LAS consortium augmented by Alcatel Space (Cannes) on the industrial side and the UK Astronomy Technology Centre (Edinburgh) on the science side. These two studies are due to be completed in June and September of this year respectively.

Concerning the third recommendation of the Task Group, subsequent assessments in both NASA and ESA have sufficed to demonstrate that deep orbits are not really attractive for NGST for reasons of power, communications and launch weight compared to the baseline L2 orbit. The funding for this has, therefore, been allocated instead to the study of an NGST Optical Camera/Spectrograph working in the visible spectrum. The invitation to tender for this activity was released on October 7 with responses due on November 27.

Lastly, the possibility of ESA initiating a fourth industrial study of the NGST data handling system is being explored.

What comes next?

The results of the various technical studies listed above will form the basis from which ESA's potential contributions to NGST will be distilled. In order to assist in this process, an ESA NGST Study Science Team (SST) has been formed (see box). This group met for the first time at ESTEC on October 29. Several of these team members also belong to the US NGST Ad-Hoc Science Working Group (ASWG) which is currently engaged in constructing the Design Reference Mission to act as a quantitative scientific benchmark for the NGST engineering studies (see STScI Newsletter, April 1998, Vol.15, No. 2, p14).

The narrowing down of the options for ESA's hardware contributions to NGST — especially as concerns the choice of scientific instrument — will clearly not be easy, not least since the ambitious NGST schedule demands that this task be completed in mid-1999.

In addition to its in-house activities, NASA is presently sponsoring a total of six external studies spanning a variety of potential NGST instruments. These studies are scheduled to be completed on a similar timescale to the ESA and Canadian studies, after which a Joint Science Review Board will be set up to recommend the final instrumental capabilities required for NGST.

The process of labeling ESA's instrument contribution within the recommended suite will clearly have to be an iterative one starting with the formulation of a technically and scientifically cogent recommendation by the ESA Study Science Team, followed by approval of ESA's standing scientific advisory committees (Astronomy Working Group, Space Science Advisory Committee) and ending with Science Programme Committee (SPC) approval based upon detailed negotiations with NASA at the project and headquarter levels. Only time will tell how arduous and contentious this process will turn out to be.

Once the ESA (and Canadian) contributions to NGST have been agreed upon, more detailed joint Phase A studies of the mission will take place. Final SPC approval of ESA's participation in NGST will be sought in 2001.

In order to assure equal access to NGST for all ESA member states, the working assumption is that the successful HST model will be followed, ie, Europe's participation in NGST will be solely ESA-sponsored with all hardware components acquired with ESA funds through competitive bids to industry.

What this means for European astronomers

As a result of rather intensive activities and negotiations over the last few years, European astronomers are now in a position to continue to exploit the HST observatory throughout its lifetime in orbit. Provided that the project progresses on schedule and the anticipated funding does become available through ESA, similar access to NGST will follow. As is obvious from the tremendous benefits accrued from HST during the last nine years, these advantages are many-faceted and go well beyond the guaranteed minimum fraction of observing time. The excellent relationships with our US colleagues and the high level of European participation in all levels of the project activity have become accepted features of modern astronomical life on this continent. Moreover, given the heavy investment in large groundbased telescopes by Europe, the prospect of not having access to a future large space telescope is almost scientifically unthinkable.

The second decade of HST operations

Robert Brown (STScI)

At the request of NASA, the Space Telescope Science Institute (STScI) is developing a strategic plan to optimise the scientific return from Hubble Space Telescope during its second decade, and especially during the period after the final servicing mission in 2002/3. For this purpose, STScI has formed a committee drawn from the broad astronomical community to study the issues, formulate a plan, and write a report of its analysis and recommendations. The 'HST Second Decade study' will be completed in 1999.

The study is prompted by NASA's recent decision to extend the HST mission until 2010 with low-cost operations. This means that HST will operate in parallel with its successor, the Next Generation Space Telescope (NGST), planned for launch in 2007.

What should be the vision for HST science in that future environment? What policies should guide the allocation of resources such as observing time? What forethought can be provided regarding the opportunities, constraints, and issues that will be important for HST's future contributions to science?

With respect to opportunities, the committee is asking: What developments will set the scientific agenda in the period 2002–2010? What questions will be most important for HST to address? What synergies could — and should — develop between HST and NGST or other space or ground-based observatories?

The constraints will consist of the instrument and spacecraft capabilities in place after the final servicing mission. The low-cost operations now being developed for HST may impose others.

Issues before the committee include: the desirable precursor and/or coordinated programs with NGST and other observatories; the optimum mix of large and small observing programs and the possible implications for community grant support; the uniqueness of HST's capabilities, particularly in the near infrared; the options with respect to proprietary data rights; and the relative emphasis to be placed on archival research.

The first meeting of the committee was held in Baltimore on the 7th and 8th of July 1998. The principal topics presented were:

- ❏ A synopsis of the project so far including an historical perspective on HST science and a review of the proposal and time allocation process.
- ❏ A review of the evolution of the instrument complement and the power and thermal constraints expected in the future.
- ❏ Mission maintenance strategies and the evolution towards low-cost operations.
- ❏ A discussion of the HST uniqueness space, a review of archival research and a discussion of the science opportunities for the second decade.
- ❏ The concept of a WFC3 baseline CCD imager covering from 0.2–1.0μm resulting in a proposal by the committee to stretch the wavelength coverage to 1.9μm if an additional source of funding can be found.

The second meeting is being held at ST-ECF/ESO in Garching on the 17th and 18th of November as this Newsletter goes to press. The main agenda items are an assessment of the impact of low-cost operations on HST science productivity and an analysis of 'science program demographics', ie, the mix of large and small programs, the 'Key Projects' and the public surveys like the Hubble Deep Fields.

The third meeting will be held at STScI early in 1999, after NASA has made its final decisions on the NICMOS cryocooler and the capabilities of the final-generation scientific instruments. The final report will be published in the form of a booklet.

The Study maintains a dual-purpose WWW site:
`http://sso.stsci.edu/second_decade/`
One purpose is to support the Second Decade Committee and its contributors with working papers, proceedings, documentation, action items, etc. Equally important, the site's second role is to provide the community with access to the study, both to learn of our goals and progress, and to contribute opinions and new ideas. For example, the *contact group* page enables email to any or all committee members with the click of a mouse. The *background documents* page offers electronic versions of the FOSI, HST & Beyond, NGST, and New Science Strategy for Space Astronomy and Astrophysics book reports, and the *status reports* page offers our AAS newsletter article and the viewgraphs used to brief various committees.

Comments and input from the community on all aspects of the study are welcomed in the strongest terms.

HST Second Decade committee membership

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The Committee chairman in action in Garching.

Cycle 7 public parallel observations with NICMOS and STIS

With the installation of the solid-state 'tape recorder' during the second servicing mission at the beginning of 1997, the capability of HST to use more than one instrument simultaneously was greatly enhanced. Such 'parallel' observational opportunities are particularly valuable with the imaging capabilities of WFPC 2, NICMOS and STIS and the slitless spectroscopy offered by the latter two. Most of the parallel opportunities during Cycle 7 were used in a 'public' program producing non-proprietary data and designed with the advice of a Working Group appointed by the STScI (see STScI Newsletter, July 1997, Vol. 14, No. 3, p5). STScI staff put a great deal of effort into improving the parallel scheduling capabilities from the simple 'unscripted' procedure started in June 1997 to the more sophisticated planning which has been operating in 1998.

The following two articles summarise work on the NICMOS grism spectroscopy parallels to search for emission line galaxies at high Galactic latitude and on the STIS CCD imaging parallels for measurements of weak gravitational lensing or 'Cosmic Shear'.

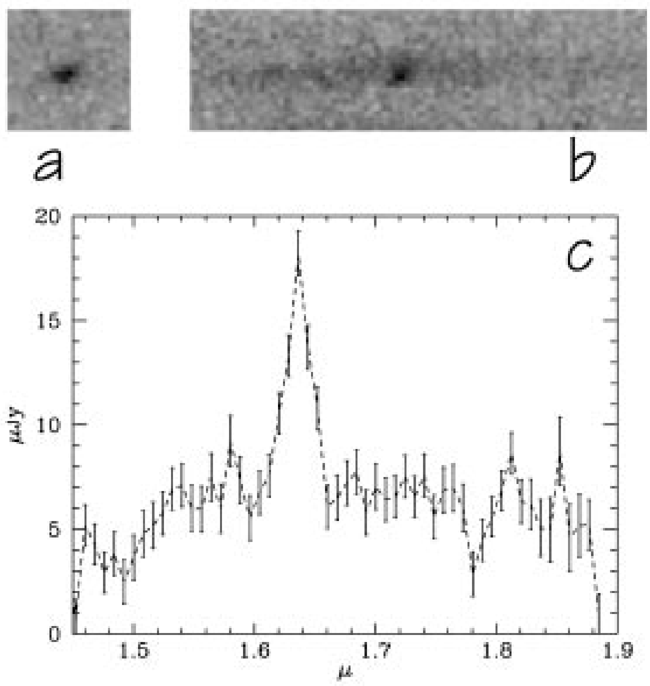
NICMOS grism searches at high latitude

The current NICMOS parallel program consists of two parts, imaging and grism spectroscopy. The imaging program uses the filters F160W and F110W while the spectroscopic program obtains pairs of observations using the same wide-band filters followed by exposures on the identical field with the grisms G096 and G141. The data can be obtained, with no proprietary restrictions, from the ST-ECF archive (at `http://ecf.hq.eso.org/parallel/`) or from the STScI archive.

The spectroscopic program is unique because slitless spectroscopy in the infrared can only be carried out from space. Bright atmospheric OH lines would increase the background to unusable levels in groundbased observations.

The problem with focusing NICMOS Camera 3 for parallel observations has little impact on the spectra of slightly extended objects such as distant galaxies.

The typical mode of operation of the NICMOS grisms is to first take the direct image of a field followed by a longer exposure with one of the grisms. Several such pairs of direct and grism images are usually taken, shifting the position of the mapped fields in between exposures by a few pixels. In parallel programs, such shifts are either carried out when the primary observation requires a repositioning of the field, or by using the NICMOS internal field offset mirror (FOM) to dither the position of the NICMOS fields only.



A typical example of an emission line galaxy with Hα at a redshift of about 1.5. Panel (a) shows the image with filter F160W, which is similar to an H filter. Panel (b) shows the spectrum with the emission line. The images in panels (a) and (b) have been processed with the STScI NICMOS pipeline program calnica. *Subsequently, the background was removed and artifacts such as the 'pedestal', a difference in the bias level in the four quadrants, and other bias residuals were removed with the ST-ECF package of IRAF scripts* nictools. *The individual dithered images were then shifted and co-added on a grid twice as fine as the original pixel size using again tasks in* nictools. *Finally, the spectrum was extracted using the ST-ECF tool* NICMOSlook. *The final calibrated spectrum is shown in panel (c).*

Search for Emission Line Galaxies

A large body of evidence suggests that the star formation rates in normal galaxies were significantly higher at large redshift. Both theoretical and observational work suggest that the peak star formation activity occurred at redshifts between 1 and 2 (eg, Cowie et al. 1995, Nature 377, 603; Lilly et al. 1996, ApJ 460, L1; Fall et al. 1996, ApJ 464, L46; Steidel et al. 1996, ApJ 462, L17; Madau et al. 1996, MNRAS 283, 1388). Line flux limited samples of galaxies are the ideal tool to directly investigate the star formation history of galaxies. The G141 grism covers the wavelengths between 0.9 and 1.9μm which is the appropriate range to search for the Hα line in galaxies at redshifts between 0.5 and 2. The G096 grism data could detect [O II] line emission in galaxies in the same redshift range. In order to search for such star forming galaxies, we are carrying out a search for high redshift emission lines using data from both the GO parallel proposal by McCarthy et al. (PID 7499) and the public parallel program.

A total of about 3000 NICMOS G141 grism images were processed and a total of 18 emission line objects have been found so far. The figure shows a typical example of an emission line and the corresponding direct image. In all cases, only a single line was detected. The most likely identification of this emission line is Hα, in which case the redshift of the galaxies is between about 0.7 and 1.8. The space density of Hα emission line objects is then similar to the one found of Lyman break galaxies at z ~ 3 by Steidel et al. (1996, AJ 112, 352). This interpretation should be confirmed with follow-up spectroscopy from the ground, which requires large telescopes such as ESO's VLT. Our line-flux limited sample of high redshift galaxies will be used to investigate the star formation history of the Universe in this important redshift range in unprecedented detail.

This program is being carried out in a collaboration including Wolfram Freudling, Norbert Pirzkal, Anna Pasquali, Guido de Marchi, Rodrigo Ibata and Bob Fosbury at the ST-ECF and Patrick McCarthy, Ray Weymann and Lin Yan at the Carnegie Observatories.

Measuring Cosmic Shear with STIS images

Cosmic shear, the distortion of distant galaxies by intervening gravitating matter, can constrain the power spectrum of the cosmic density fluctuations without any assumption about the relative distribution of dark and luminous matter. Measurements on small and large angular scales should not only yield the amplitude of density fluctuations and the matter content of the Universe, but also test structure formation in the non-linear regime. The analysis of STIS parallel data offers a unique opportunity to measure cosmic shear on arcminute scales. The unprecedented sensitivity and angular resolution of STIS in imaging mode, and the small anisotropy of its point spread function (psf) should allow the measurement of cosmic shear on these very small scales, even with a modest number of fields.

Introduction

Light bundles are gravitationally distorted when propagating through density inhomogeneities. Consequently, the shapes of galaxy images carry information about the weighted projected tidal field of the intervening mass. Since galaxies are intrinsically elliptical with random orientation, this tidal field cannot be extracted from individual images but only by analysing the coherent distortion of the ellipticities of a sample of galaxies along a given line of sight.

The relation of the statistics of the tidal field and projected surface mass density along random lines of sight to the properties of the large scale structure has been derived by a number of authors: see Schneider et al. 1998, MNRAS 296, 873; 1998, A&A 333, 767 and references therein.

The measurement of cosmic shear requires deep imaging to overcome the noise due to the intrinsic ellipticities of galaxies. High image quality is required as each uncorrected anisotropy induced in the galaxy shapes by imaging and data reduction artefacts can mimic cosmic shear. Many lines of sight are needed in order to sample the statistics of the large scale structure.

The STIS-parallel program meets all these requirements in that it serves as a deep, high quality imaging survey of hundreds of random lines of sight. High Galactic latitude fields are used for the cosmic shear analysis, and low latitude ones for monitoring the stellar psf over the whole field as a function of time, telescope jitter and of the angle between the main target and the HST orbital direction. The latter is to account for the relativistic differential velocity aberration since the telescope guides on the primary target and not the the parallel one. The analysis of the stellar fields demonstrates that the psf anisotropies are small and that the variation over the field is well described by a second order polynomial. We are currently investigating whether the psf anisotropy can also be derived from small, 'starlike' objects in those fields where very few stars are present.

The small size of the anisotropy — below 1% for stars and thus even smaller for the extended galaxies — implies that, for a first analysis of the significance and size of the cosmic shear, no psf anisotropy correction is necessary at all since the expected rms shear due to the large scale structure on a one arcminute scale is a few percent.

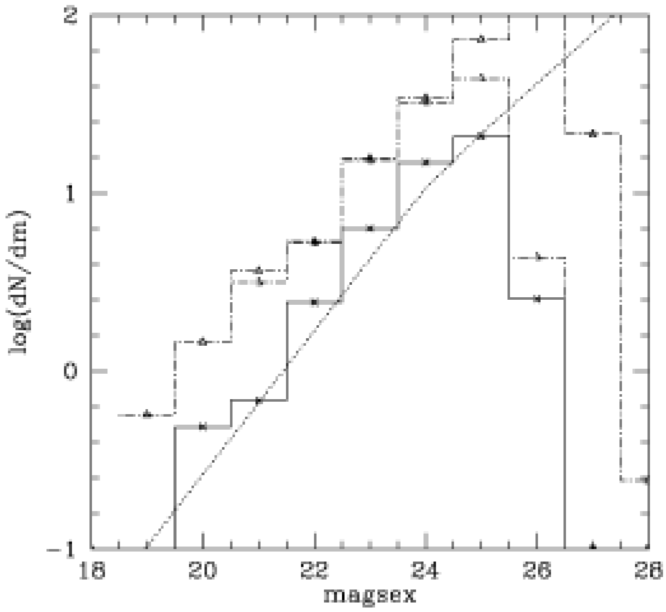
For details concerning the data processing pipeline, its testing, the source extraction and shape estimating software used and the selection criteria for galaxies and stars we refer to Seitz et al. 1998, (in proc. 14th IAP meeting 'Wide Field Surveys in Cosmology'.

Results and conclusions

To date, seventeen high Galactic latitude fields have been analysed, each with about 1600 to 2000 seconds of total exposure time. The number of suitable pipelined fields in the archive has meanwhile increased by a factor of about ten. Typically between 25 and 40 galaxies per field are used for the shear analysis. The galaxy number counts are shown in the figure. The significance of the measured shear is tested by performing an identical analysis on a dataset which has the orientation of the galaxy images randomized. The results are then expressed with respect to the cumulative probability distribution for obtaining a squared shear in a given field smaller than the observed squared shear. Eleven of the seventeen fields show a measured value above the median of the distribution expected from randomly oriented galaxies, a result which already is inconsistent with a COBE-normalized SCDM Universe.

The study of the 170 fields now available is considered as a pilot project which, with future parallel STIS imaging, will be extended to a cosmic shear measurement along about 1000 lines of sight. These should enable the rms-shear to be measured with an accuracy of about 10%, thus determining the normalization of the power spectrum for any given cosmological model. In addition, by comparison with numerical simulations, the shear probability distribution will constrain the basic cosmological parameters through measurement of the higher-order statistics.

This program is being carried out in a collaboration between Stella Seitz, Peter Schneider, Thomas Erben and Simon White at the Max Planck Institute for Astrophysics in Garching and Lara Collodel, Alberto Micol, Norbert Pirzkal, Wolfram Freudling and Bob Fosbury at the ST-ECF.



The number counts of the galaxies in the 17 fields analysed so far. The typical exposure time per field is 1600 seconds. The transformation between the STIS 50CCD and Johnson V magnitudes is very approximate and needs to be calibrated for typical galaxies. The upper dot-dash histogram gives the counts (per magnitude and per square arcminute – the STIS field is 51×51 arcsec²) obtained from the SExtractor software, where an object is defined as having 5 connected pixels 1.5σ above the sky noise and so includes stellar objects. The lower dot-dash histogram results from the use of a size cut at 3 pixels 'diameter'. The solid histogram shows those galaxies which satisfy the detailed selection criteria (described in the Seitz et al. 1998 paper referenced above) for the shear analysis. The dotted curve shows the V-band counts from Smail et al. (1995, ApJ 449, L105).

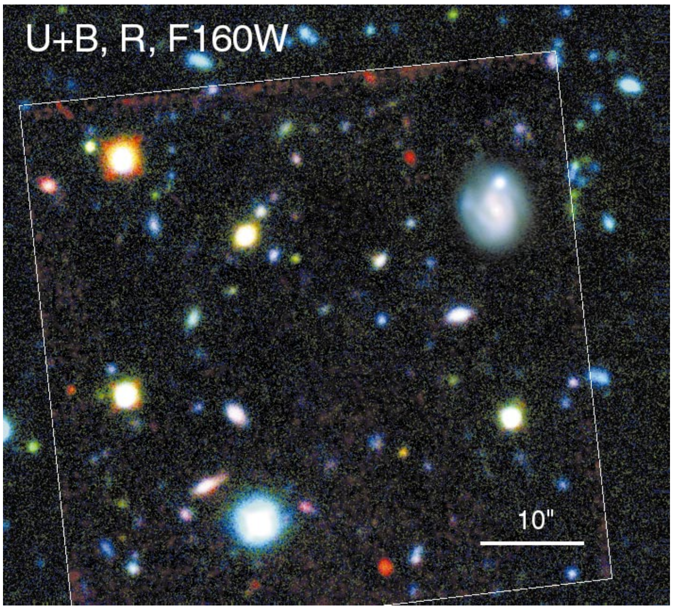
The Hubble Deep Field - South HST and ESO data

Richard Hook

During October 1998 the HST observed a second deep field as a sequel to the original, hugely successful, WFPC 2 HDF which was released back in January 1996. The new field is in the south (δ = -60°), contains a z = 2.2 quasar and involves STIS, NICMOS and WFPC 2. The use of 3 instruments in parallel has resulted in a much larger and richer data set including UV spectroscopy of the quasar, very deep STIS imaging of the quasar field, IR imaging with NICMOS at F110W, F160W and F222M of an adjacent field as well as direct WFPC2 imaging of comparable depth to the original field. There were also flanking field observations with WFPC 2 and moderately deep (9 orbit) imaging of the NICMOS field using STIS CCD in unfiltered mode.

The reduced data products—coadded images, catalogues and extracted spectra—were made public on 23 Nov. and are available via both the ST-ECF and STScI Web pages. The raw data are also available from both sites in the usual way.

In addition to the HST data, the HDF-S fields have been extensively observed from ESO Chile. VLT Test Camera images of the HDF-S NICMOS field, obtained during Science Verification, are available to interested astronomers worldwide at `http://www.eso.org/paranal/sv/` and are also on the VLT-SV CD-ROM. More recently, deep imaging in both the optical and near-infrared has been obtained using the SUSI-2 and SOFI cameras on the ESO 3.5m NTT as part of the *EIS Deep* project. Some of these data will become public in December 1998. More information is available at `http://www.eso.org/science/eis/`



Colour composite of the NICMOS field made from the ESO VLT Test Camera images in U plus B (blue), R, (green) and the 1997 NICMOS F160W test exposure (red). The box shows the boundary of this NICMOS field (slightly different from the final one). See ESO Messenger No. 93, September 1998 for more details.

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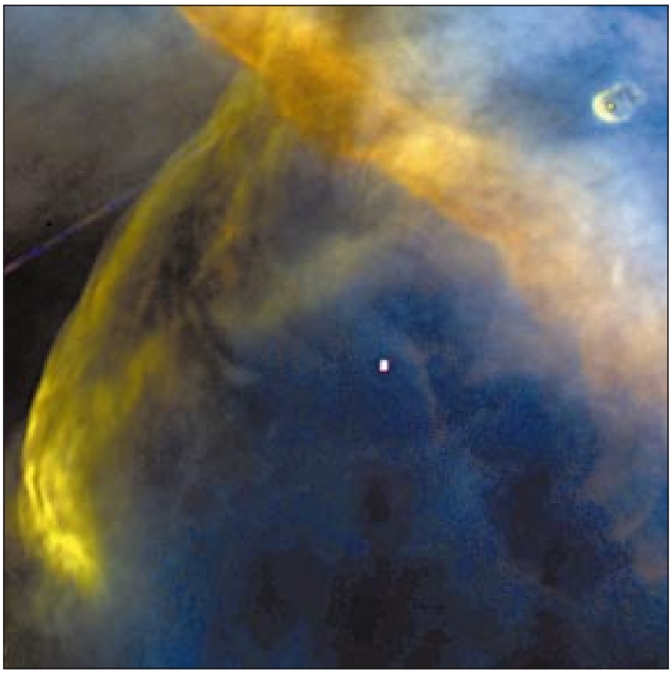
Web-Newsletter articles shortly to become available from the ST-ECF Website (http://ecf.hq.eso.org/)

Cover picture



The front cover shows the central section of a large mosaic derived from fifteen images of the Orion nebula region in each of four filters (F502N, F547M, F656N and F658N)and combined by Jeremy Walsh using the drizzle code developed originally for the Hubble Deep Field by Fruchter & Hook (1997, Fruchter, A.S. & Hook, R.N., 1997, "A novel image reconstruction method applied to deep Hubble Space Telescope Images", Invited paper, in Applications of Digital Image Processing XX, ed. A. Tescher, Proc. S.P.I.E. vol. 3164, 120). The Web-based article describes how it was done and illustrates the result with a large JPEG image. The frame above shows a small section lightly filtered with an unsharp mask.

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Please note that we are revising and updating our mailing list. A customised sheet, giving our knowledge of your current address, is included with this issue. Please return it to us with (or without) corrections if you wish to continue receiving the Newsletter.

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