The ST-ECF After the Launch of HST

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One month after the launch of the Hubble Space Telescope (HST) the excitement is high among us at the Space Telescope European Coordinating Facilitiy (ST-ECF). We were able to follow the launch and the deployment of HST in real-time on the NASA "select" television channel, projected on the big screen in the ESO Auditorium and we are now closely monitoring the activities during the current Orbital Verification (OV) phase (an engineering check-out of HST).

With little surprise to those aware of the complications of the HST, a number of problems in the operation of the telescope have emerged and are under detailed examination. For example, the range of orientation of the high-gain antennae, which provide the high-speed data link to the ground via the relay satellites, is limited to 91 % of the whole sky by a cable harness. The effects of this limitation on the efficiency of the telescope can be made negligible by a proper scheduling of the observations. Considerable efforts are also being devoted to achieve a reliable procedure for pointing the HST. Successful guide-star acquisitions have been obtained, leading to a stable "fine lock", the most precise tracking mode of HST. Nevertheless, these successes are intermixed with failures to acquire guide stars, which have caused considerable disruption in the OV schedule.

On the positive side, all instruments have been turned on and are performing according to specifications or better, the Wide Field Camera has obtained the first images (with still warm CCDs) and the focus of the telescope is improving slowly but steadily. We are trying to keep the interested scientists informed about the progress with the HST by posting information from various sources on our HST bulletin board, which can be accessed from the outside by logging in into the captive account STINFO on the ESOMC1 Vax computer (no password needed). We are also answering questions concerning HST e-mailed to ESOMC1::STDESK (on SPAN) or to STDESK@DGAESO51 (on Bitnet).

Our direct involvement with HST data will grow in a couple of months, when OV will be completed and the engineers will hand over the telescope to scientists, so to speak, for the Science Verification (SV), a phase lasting about five months during which the performances of the instruments will be calibrated on celestial targets. SV is the responsibility of the teams that have developed the instruments and many of us will be closely collaborating with these teams in the effort of understanding the in-orbit performance of the instruments. In order to convey the results of this work to those European astronomers who are directly involved with HST data, we have set up three Special Interest Groups, connected with the Wide Field and Planetary Camera, the Faint Object Camera and the two spectrographs.

After SV the HST will finally start the scientific observations with the first one-year cycle of programmes already allocated to the instrument teams (the so-called Guaranteed Time Observers) and to the General Observers. If you wish to apply for HST observing time during the second cycle, look forward to the Announcement of Opportunity which will be issued by the Space Telescope Science Institute in Baltimore around the end of May 1990, with a proposal deadline no earlier than 15 November 1990.

PROFILE OF A KEY PROGRAMME

A Wide-Angle Objective Prism Survey for Bright Quasars

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Quasars are the most luminous objects in the universe which – not to speak about a growing interest in understanding these luminous active nuclei of galaxies themselves – can be used as light sources that probe the intervening matter at large cosmic distances early in the history of the universe. However, the number of known QSOs, in particular at high redshifts, which are sufficiently bright for detailed follow-up observations is extremely small. So, e.g., although several thousand QSOs are known at present, the only high-redshift QSO sufficiently bright for the short-wavelength camera of the IUE satellite, and as such a prime (accepted) target for the Hubble Space Telescope, was discovered only in 1988 by the Hamburg Quasar Survey with the Calar Alto Schmidt (HS 1700 + 6416, V = 16.1, z = 2.72, Reimers et al., 1989).

One of the reasons for the rareness of such objects is that pure UV excess surveys like the Palomar Green Survey do not find QSOs with $z > 2.2$ and that because of the low surface density of such objects, wide-angle multicolour or objective-prism Schmidt surveys are necessary. A further more practical requirement is the ability to process a larger number of Schmidt plates on a reasonable time scale, i.e. quick search methods are needed.

Bright quasars ($V < 17$) can be used for multiwavelength studies of the quasar phenomenon itself. At sufficiently high redshifts, quasars with absorption lines can be observed at high resolution (~0.2 Å), e.g. with CASPEC, as a tool to study the intervening matter with the aim to learn about large-scale structure, evolution of galaxy halos and galaxies, and chemical evolution of the universe. It has turned out that a spectral resolution of 10^5 may be required to resolve narrow absorption-line systems. Fairly bright QSOs will therefore be required even for the VLT, and here is one of the long-term goals of this Key Programme: to provide a sample of high redshift QSOs for detailed absorption-line studies with the VLT.

A further motivation comes from the finding of J. Surdej and collaborators – cf. the ESO Key Programme on gravitational lenses (Surdej et al., 1989) – that the success rate of finding gravitational lense effects is particularly high in high-luminosity quasars (HLQ) with M_v

<-29. This means, e.g., that all QSOs with $z > 1.7$ and $V < 17$ are candidate objects which can be checked on multiplicity with the superior angular resolution of the NTT.

Bright high-redshift QSOs offer also the possibility to study the quasar EUV with HST. For $z > 2.8$, both He I 584 Å and the Lyα of He II at 304 Å and the corresponding He I and He II absorption "forests" are in principle observable with HST. HS 1700 + 6416 just missed the minimum redshift for He II 304 Å.

Finally, it appears that existing quasar surveys are quite incomplete at the bright end. We recently found with HS 0624 + 6902 ($V = 14.2$, $z = 0.37$) the brightest ever optically discovered QSO (Groote et al. 1989). This particular QSO has a strong "little blue bump" – a well-known excess emission in some QSOs due to Fe II and the Balmer continuum – shifted to $\sim$4000 Å. It therefore would not have been found with pure UV-excess techniques. With the resolution of the ESO Schmidt objective prism the quasar would have been discovered easily through its Mg II emission line at 3840 Å. Further evidence for the incompleteness at the very bright end is the fact that the ratio of bright QSOs ($V < 15$) detected by optical to those by other means (radio, X-ray, IRAS) is 5 : 8, quite untypical for QSOs as a class.

In the last few years, an automated QSO search software for objective-prism plates has been developed at Hamburg Observatory and was successfully applied to plates taken with the Calar Alto Schmidt (the former Hamburg Schmidt, a slightly smaller "twin" of the ESO Schmidt).

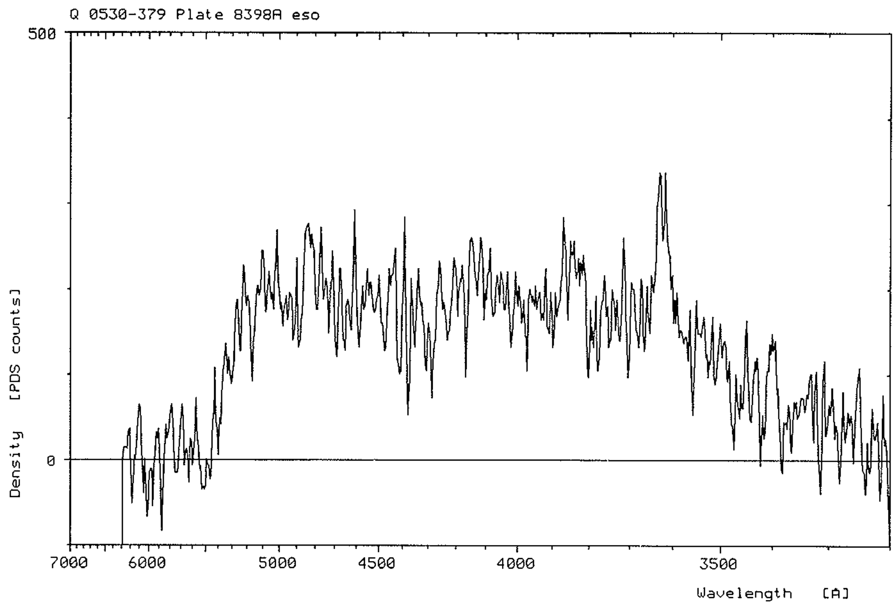
The plates are scanned with a PDS 1010 G in a low-resolution mode with on-line background elimination so that data are compressed to 5% (5 Mbyte) per plate. For details of the procedure I refer to Hagen (1987) and Engels et al. (1988). With a new faster amplifier of the PDS, developed by the Münster group, the scan time for a whole plate plus automated QSO search is only 4 hours. All spectra are stored on optical disks.

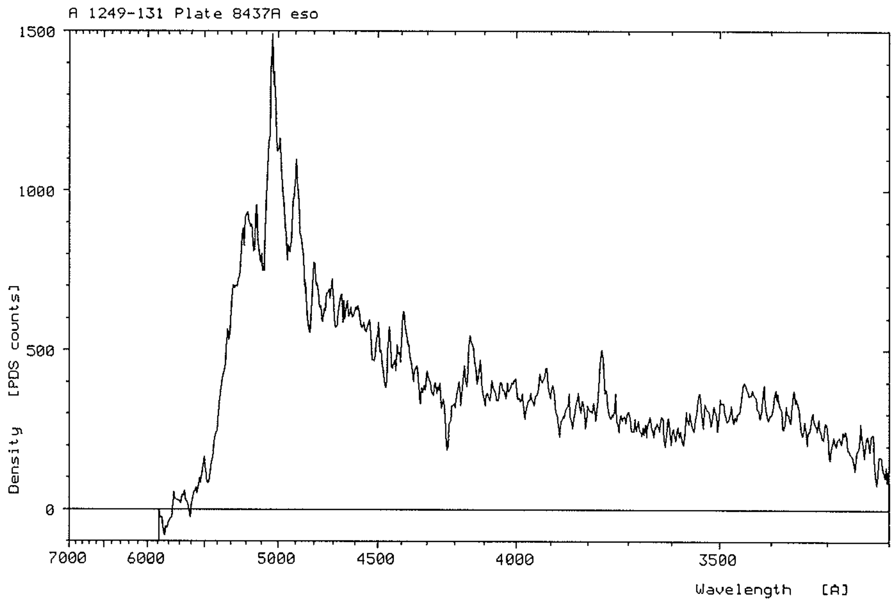
The software has been applied to and tested with the Calar Alto Schmidt plates, in particular an 8 square-degree field where we have identified 23 new QSOs to $V \approx 18.8$ by slit spectroscopy of all candidates. Altogether, several hundred new bright QSOs have been identified on the Northern Sky.

Since the ESO Sky Atlas is essentially complete, the time appears ripe to use the ESO Schmidt equipped with its prism (480 Å/mm) for a large-scale spectral survey on the Southern Sky in combination with automated techniques. The limit will be around $B \approx 18$. On 200 fields ($\approx$ 5000 squ. degr.) – except a few test fields we aim at fields not covered by the the multicolour QSO Search Key Programme (Barbieri et al., 1989) or other surveys – we expect 50 QSOs with $V < 16$ (including about 20 for absorption line studies) and 400 QSOs with $V < 17$ (including 100 HLQs for a gravitational lense search). Hopefully 2 or 3 QSOs with $z > 2.8$ suitable for HST He I and He II line studies are among them. A side product will be large numbers of AGN ($Z < 0.08$) and emission-line galaxies, since contrary to other automated surveys, we start object selection on prism plates before star-galaxy separation. A further side product will be many new white dwarfs and hot subdwarfs. At the resolution of the ESO prism, WDs can be easily separated from subdwarfs, and rare classes like DBs (white dwarfs with only He lines) or magnetic white dwarfs may be recognized already on the prism plates.

The first high-quality prism plates for 12 fields have just arrived, and we look forward to see new exciting candidate objects.

Collaborators in this Key Programme are the gravitational lense group headed by Sjur Refsdal, Hamburg, the Liège quasar and gravitational lense group (J. Surdej and collaborators), both with interest in finding further bright lensed objects, J. Wampler (ESO) who would like to see new interesting QSOs sufficiently bright for high resolution spectroscopy of QSO absorption lines, and finally the stellar groups at Kiel and München for bright WDs and O subdwarfs as by-products.





ESO objective-prism spectra of a QSO (upper, z = 0.29) and an AGN (z = 0.01). Note that at the resolution of the ESO prism, O III and H_β are separated.

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PROFILE OF A KEY PROGRAMME

A Photometric and Spectroscopic Study of Supernovae of All Types

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Supernovae are unpredictable events. For this reason, despite the fact that their interest spreads over numerous different fields, from stellar evolution to the interstellar medium and to cosmology, they have been observed, generally, with medium/small telescopes, whose schedules are flexible enough to ensure prompt observation of new objects. Therefore, the observations have been limited to the first months after outburst, and even in this period hardly on a regular basis.

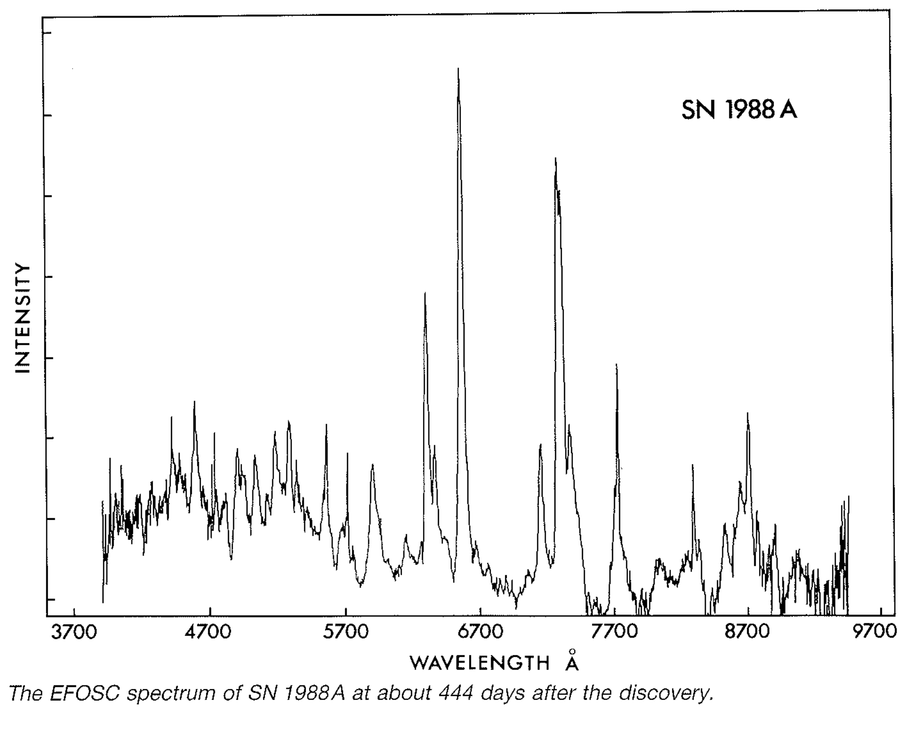
The recent experience with SN 1987A has demonstrated the large interest in this field of research including the ESO community, and also that it is possible to carry out successfully, even within a large structure like ESO, a programme needing regular observing for periods of years. Thanks to the use of appropriate equipment and to a dense temporal coverage approved by the OPC, astronomers at ESO have been able to announce a number of firsts, such as the discovery of molecules and dust formation, the temporal mapping of the ^{56}Co (+^{57}Co) decay (both from the bolometric light curve and the measurement of the CoII 10.52 μ line), the first order computation of elemental abundances in the envelope and the spectral characteristics of the just resolved shell around SN 1987A. There has also been much success in theoretical modelling of the expanding envelope.

Successful observations of a sample of SNe with modern detectors at large telescopes during a pilot programme started at ESO have also demonstrated that it is possible to follow photometrically and spectroscopically the evolution of SNe, other than the exceptionally close SN 1987A, for years (Fig. 1) and, at least in some fortunate cases, even for decades (Turatto et al. 1989).

In this framework, our Key Programme, dedicated to the study of the photometric and spectroscopic evolution of SNe of different types, has been proposed and approved at ESO. The general aim of the programme is to accumulate regularly spaced photometry, particularly for constructing bolometric light curves, and spectroscopy of SNe from their earliest announcement. At the same time, late-time spectra of already known SNe will be secured. It will be possible to store in a large unique database a great deal of material for a selected sample of supernovae. Emphasis will be put on observing a few objects in detail rather than many sparsely.

The regular allotment of telescope time over a span of years, awarded to the Key Programme, will allow us to address different questions.

From a quick inspection of the Asiago Supernova Catalogue (Barbon et al. 1989), it appears that the average rate of discovery in the last years is of about 20 SNe per year. Of these, about 6 are closer than 40 Mpc (H = 50 km/s Mpc) and reachable from La Silla. Whatever their type, all these SNe stay above the detection limit of EFOSC (or EMMI) for longer than 1 year in spectroscopy and 2 years in photometry. We will be able, therefore, to cover all phases of the optical evolution for several SNe of various types.



The EFOSC spectrum of SN 1988A at about 444 days after the discovery.