spectrum. Due to the combined effects of emission and absorption, the line is very asymmetrical with a large, violet shifted wing, indicating a wind velocity of about –350 km/s. Further analysis of the EUV spectra will give information on the rate of mass transfer in this X-ray binary system. Another good example is WRA 977 = 3U1223-62. 20 Å/mm Coudé spectra, taken at ESO, show typical P Cygni profiles. Theoretical calculations for the Hβ line give excellent agreement with the observed line profile (Fig. 4). For details see H. Mauder, M. Ammann and E. Schulz (*Mitteilungen Astr. Ges.* **43**, 227, 1978). It is interesting to note, that the stellar wind in WRA 977 must be remarkably variable: spectra, which were taken in 1979, show little or no emission, only the normal absorption components of the Balmer lines are seen.

Optical Burst in Sco X-1

One of the most exciting new groups among the X-ray sources are the X-ray bursters. A review on these objects was given recently by W. Wamsteker (THE MESSENGER No. 18, p. 31, 1979). Optical bursts have been observed from some of these sources, too (see for instance H. Pedersen, THE MESSENGER No. 18, p. 34, 1979). It is now generally believed that the X-ray bursts – and also the optical bursts – are due to a thermonuclear flash on the surface of a neutron star. In normal X-ray binaries, the matter accreted by the neutron star will undergo nuclear burning similar to the processes in stellar interiors. The hydrogen is transformed to helium, helium to carbon and so on until a distribution of elements similar to the equilibrium process is reached. However, in special cases the temperature and pressure at the surface of the neutron star may be too low for this process to take place. The infalling hydrogen is transformed to helium, but helium burning cannot start. Therefore, more and more helium is accreted, until the temperature and pressure reach the ignition point for helium burning: the helium bomb will explode, leading to the burst. The optical identification of some X-ray bursters showed that these objects are very similar to Sco X-1. The spectra of the X-ray burster MXB 1735-44 and of Sco X-1 are almost identical, even in details. However, no X-ray bursts were detected from Sco X-1 till now, though its X-ray emission is very irregular. In a series of photometric observations, obtained at La Silla with the 1 m telescope with a time resolution of two seconds, an optical burst of Sco X-1 was found on March 13th, 1979, $7^h\,29^m\,49^s$ U.T. (Fig. 5). The short duration of only about ten seconds is typical for burst events. Thus, Sco X-1 may be the connecting link between X-ray bursters and normal, low mass, X-ray binary stars.

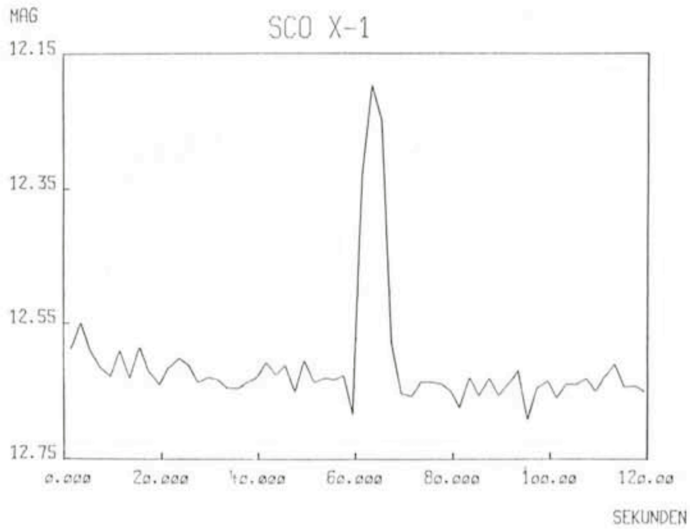

Fig. 5: *Sco X-1 showed a burst event in the optical range on March 13th, 1979, at $7^h\,29^m\,49^s$ U.T. This is an indication that the X-ray bursters are very similar objects.*

Millimetre Observations of Quasars

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During an observing run on La Silla in 1978 I noticed a preprint from Wright & Kleinmann concerning their recent infrared (IR) observations of a very luminous quasar, Q0420-388. It had been discovered at Cerro Tololo on objective prism plates by Osmer and Smith. There were several aspects of this object which interested me: it had a large redshift, z = 3.12, and yet its apparent magnitude was brighter than 17 implying a very large luminosity (3C 273 has an apparent magnitude of 13 and z = 0.158); it was not then known to be a radio source (< .22 Jy at 2.7 GHz); and yet the IR and visual intensity gave a shape to the spectrum which would soon reach a value larger than the radio limit if the spectrum were to be extrapolated to frequencies lower than the IR. In fact, extrapolating the spectrum to 1 mm or 300 GHz yielded a flux density greater than 1 Jy which I thought we could measure.

In the submillimetre group of Georg Schultz at the Max-Planck Institute the first successful tests of our composite bolometer system were made in 1978. Ernst Kreysa attended to the cryogenics and electronics, and Michael Arnold put the high and low pass filters together to insure that only radiation at 300 GHz could be measured. Recently Peter Gemünd has made further improvements in the transmission characteristics of the filter.

As is well known, the first quasars were discovered through their strong radio emission which led to their being identified with star-like objects with ultraviolet excess and strong emission lines.

This led to two optical methods, 2-colour photography and objective prism spectroscopy, for finding quasars. For comparison the majority of those found optically (~ 90 %) were either very weak radio sources or were not detected (radio quiet).

This result was certainly unexpected, bearing in mind that it was the strong radio emission which led to the discovery of quasars in the first place.

Are the radio-loud and -quiet quasars intrinsically or extrinsically different?

Intrinsic – most of the optically selected quasars may not be strong synchrotron sources in any part of the spectrum or they might be radio quiet due to some frequency selective absorption.

Extrinsic – the distribution and size of relativistic beams may preclude frequent detection.

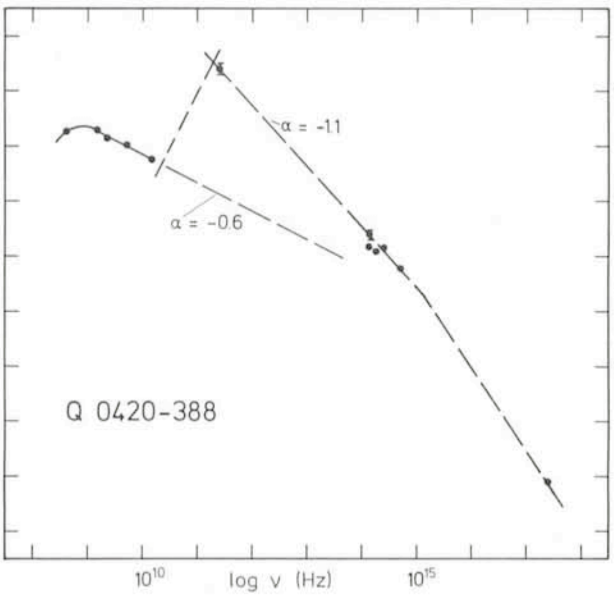

Fig. 1: *The spectrum of the bright quasar, Q0420-388, from the radio to the X-ray region. The error bars are shown where they exceed 10 %. (Fig. courtesy of* Nature).

The quasar Q0420-388, discovered through its strong emission line spectrum, seemed to be a suitable candidate with which to begin a programme of millimetre observations of optically selected quasars. On three nights in September 1979 using the ESO 3.6 m telescope, we detected it. In Juli 1980 on La Silla, we confirmed our detection. In doing so we also confirmed that the spectral index was indeed constant from the optical region to the millimetre range. In the interval between our observations, Q0420-388 was detected in the radio and X-ray regions. The apparent flux density distribution is shown in Figure 1.

With a redshift of $z = 3.12$ the emission from the quasar originated not at a wavelength near 1 mm where we observe it but at a much shorter wavelength below 300 μm. In our galaxy in this wavelength region we find the thermal emission of dust to dominate. Could we be detecting dust in Q0420-388? Theoreticians have predicted the appearance of primeval galaxies as being rich in dust and observers have tried to detect them, so far unsuccessfully. We don't, however, believe that Q0420-388 represents the primeval galaxy type.

One reason is that the thermal emission from dust has a maximum at a shorter wavelength than 300 μm (≤ 100 μm). This component of the spectrum would be independent of the optical/IR spectrum with the consequence that the observed millimetre flux density would have to lie by chance on the extrapolation of the optical/IR spectrum which now extends by at least three orders of magnitude in the opposite direction to the X-ray data with approximately the same spectral index. The continuity of the spectrum could be interpreted as evidence for a single emission mechanism in the absence of support for dust. In a sample of some 40 flat radio spectrum sources we have not found any excess emission which could be attributed to dust. To date no spectrum of a quasar has shown the 2200 Å bump due to interstellar grains when this region of the spectrum has been observed. Furthermore there is no evidence for reddening in the optical spectrum either in the continuum or in the relative line strengths. This may mean that the temperature in quasars is too hot for the heavy elements to form dust.

A second reason lies in the extremely high luminosity exhibited by Q0420-388, $> 10^{15}$ L_0, several orders of magnitude greater than that predicted for primeval galaxies or observed in other dusty galaxies (SgrA, NGC 253). The luminosity at 1 mm is also relatively greater than that expected for dust.

Another reason may be that the millimetre and IR data may show evidence for variability on a time scale too short for a thermal source. This needs to be carefully checked and confirmed.

At the end of 1979 we had reached the stage of asking why we had detected Q0420-388. Was it unique? Was it because it was very luminous or very young as implied by the large redshift? We had chosen, for our July 1980 run, two samples to test the luminosity question: quasars with ultraviolet excess and brighter than $17^m.5$; and quasars with strong emission lines also brighter than $17^m.5$. The redshifts for the first group were ~ 0.5 and for the second group ~ 1.5-2 making the second group, for the same apparent magnitude, the more luminous. It was among quasars of this latter group that we had the higher detection rate ~ 90 % versus ~ 20 %. Yet, even in the first group, the quasars detected appear to have higher than average redshifts, i.e. appear to be the most luminous.

We sought to test this result even more strenuously with a biased sample of quasars with $z > 3.0$ irrespective of apparent magnitude. This is a heterogenous sample representing about 25 % of all the radio and optically selected quasars known with $z > 3.0$.

We have 3-sigma detections for all 8 objects which we had time to observe. The spectra are shown in Figure 2. The faintest object has $B \sim 20^m.5$, $z = 3.17$, and the most distant object has $z = 3.49$, $B \sim 19^m$.

We conclude that the radio-quiet quasar phenomenon is an intrinsic property of quasars. The phenomenon appears to be a function of luminosity but may easily be a function of another

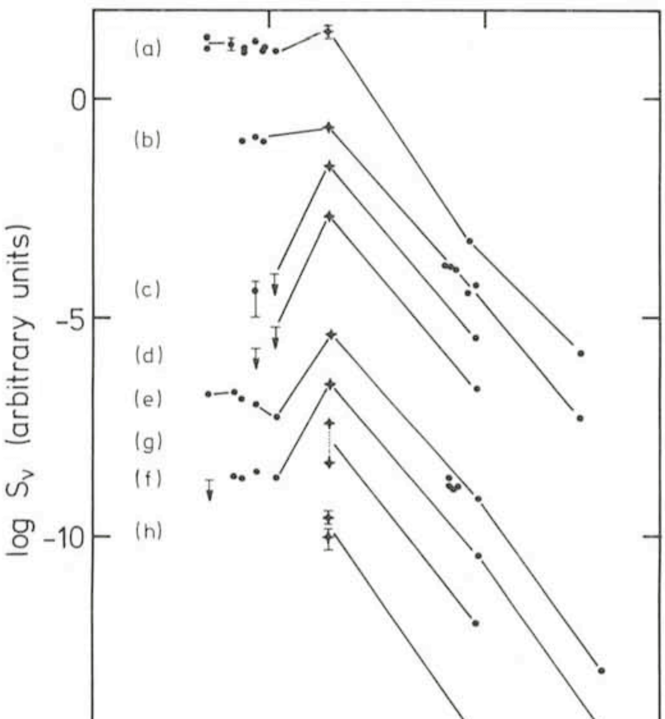

Fig. 2: *The spectra of 8 quasars with z > 3.0. (a) PKS 0537-286, (b) PKS 2126-15, (c) 0130-403, (d) 0324-407, (e) 0420-388, (f) 2204-408, (g) 2227-394, (h) 2228-405. The measurements at 1 mm are denoted by "✦".*

parameter, such as age/evolution, gas content (mass loss or accretion rate), etc., which is not easily separable from luminosity.

We are grateful to ESO for their support of unorthodox photometry in the far infrared and to the DFG-SFB project 131, Radioastronomy, for financial support.

Discovery and Rediscovery of Comets and Minor Planets with the ESO 1 m Schmidt Telescope

H.-E. Schuster, ESO – La Silla

After a successful night with the ESO Schmidt, having taken plates for the ESO Atlas or for the scheduled non-Atlas programmes, follows the indispensable check and quality control of the plates. Focus behaviour all over the large field, image quality, evenness of development, limiting magnitude, emulsion faults are some of the quality factors to be checked. This is done usually by visual inspection, the plate being put on a light table and inspected through a zoom microscope allowing a magnification of 10 to 40 times. The whole plate is scanned from corner to corner.

During this inspection, every now and then, just by pure chance, a comet or a minor planet is detected. As these objects have a noticeable differential movement against the field stars, they show up as long trails on the plates. The lengths of the trails depend on the "speed" of the objects and on the exposure time of the plate. Sometimes, trails of this kind call special attention because their fuzzy structure or even haziness on one edge indicate that the object may be a comet. From at least three different exposures a preliminary orbit can be calculated and a first ephemeris, and, what is important, the second and the third plates definitely confirm the reality of the object. And finally the repeated plates show if one has not been trapped on the first one (the detection plate) just by a reflection or an emulsion fault. In this stage it is normally also possible to decide whether the object is really "new" or if it is a known one just coming back in our neighbourhood.

In reality, the inspection of plates for comets and minor planets is not as easy as it may look here. There is first a certain effect of getting tired after having inspected some plates and there is also the danger of becoming less attentive and missing an object, especially as they are not always very spectacular. If the motion is slow and the exposure short, the trails may be very short and look like slightly elongated star images.

The aspect of a comet may be even more ambiguous. When far away from the sun, they do not show any noticeable activity or only a very low one. In consequence their trails may look like "normal" minor planet trails. Sometimes, a certain fuzziness promising a comet is faked only by seeing conditions or emulsion behaviour.

If one is sure about the reality of the object, a notice, normally by telex, is given to the IAU (International Astronomical Union) office in Cambridge (Mass.). From there the discovery is made known to other observers and institutes, for confirmation or for further studies of the new member of our solar system. As soon as a reliable set of coordinates has been established, people dedicated to such work will set up the orbital elements (a sort of passport for the object) and calculate an ephemeris for further observations. Of special interest are comets when their orbital and other parameters indicate that they may become bright and spectacular when passing near the earth in favourable observing conditions.

Special classes of minor planets not belonging to the large bulk of so-called main belt asteroids, are exciting for astronomers. Having orbits of high inclination with respect to the ecliptic plane, or being extremely "quick" (that means near the earth), they may cross the earth's orbit and are of high interest for specialized observers. In both cases, as well for comets as for special minor planets, it is very useful to detect them as early as possible, long before their close approach to the earth. Only then observations, and maybe even space missions, can be planned carefully and efficiently and a campaign can be started.

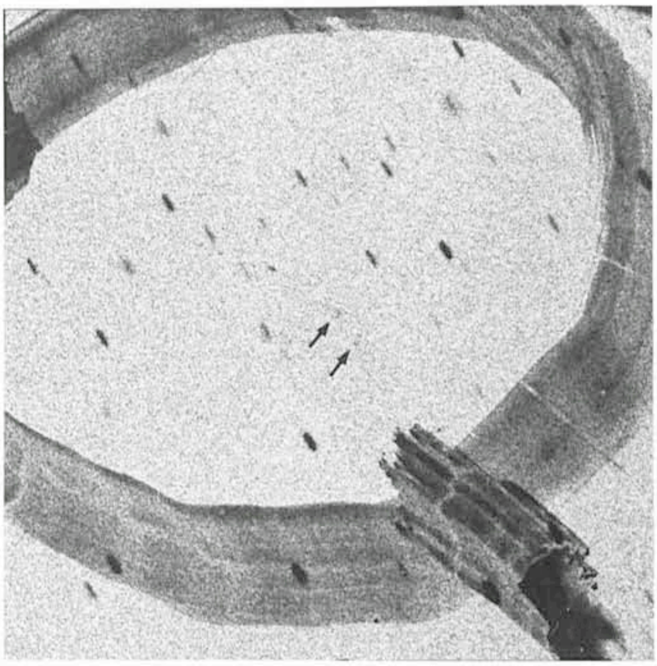

Fig. 1: *Recovery plate of comet P/Brooks, taken by H.-E. Schuster on 12 June 1980. Double exposure, 20 minutes each, on IIa-O emulsion, filter GG385. The arrows show the two images of the comet.*

The MESSENGER has frequently reported during the last years about comets and special minor planets detected on La Silla with the 1 m Schmidt telescope. Also reports on further studies and results have been given. So it is not intended to repeat these notes here.

What has to be stressed is the following: All the minor planets and comets found on La Silla with the Schmidt telescope are an accidental by-product of other programmes. No systematic long-time "hunting" has been done.

A more systematic and planned enterprise is the so-called recovery of known comets and minor planets. Here the time and the coordinates are known with some accuracy, when and where on the sky a periodic comet or a minor planet will show up again. It is of course not so spectacular and exciting to