EPA saw clear indications of the acceleration regions and surprising differences in the structures between P/Halley and P/Grigg-Skjellerup. Last but not least IMS recorded good data; however, the data analysis for this instrument is quite cumbersome and complex, due to the comparatively low encounter velocity.

A thorough test of the Halley Multicolour Camera (HMC) onboard GIOTTO on 7 July 1992 could only confirm that the optical path was very effectively blocked. However, on July 12, 1992 a number of tests were performed with the detectors of the MMC, which provided engineering and calibration data on the long-term behaviour of CCD's in space.

The Future of GIOTTO

About one week later than previously planned, on July 21, 1992, another major orbit manoeuvre put the spacecraft into an orbit that will bring it close to Earth (distance about 200,000 km) in July 1999. There are still 4 kg of fuel left onboard for attitude and further orbit correction manoeuvres. This leaves, though with rather hard constraints, the door open for some further activities in 1999. After a final orbit trim manoeuvre on July 23, 1992 at 17:07 UTC the GIOTTO spacecraft was put into hibernation for the third time.

Meanwhile, spacecraft experimenters and telescope observers have started the scientific evaluation of their data, which may still hold surprises. The next space exploration of comets, after cancellation of the American CRAF (Comet Rendezvous Asteroid Flyby) project will be ESA's ROSETTA mission which is supposed to bring a cometary sample back to Earth. It will take place in the next century. Meanwhile, cometary exploration will continue from the ground and we expect that, together with other branches of astronomy, it will profit from ESO's progress in telescope technology.

Acknowledgement

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A Minor Planet with a Tail!

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Minor Planet 1979 VA was discovered by Eleanor Helin at Palomar on November 15, 1979 as a "fast-moving object" of magnitude 11 (IAUC 3422). Further observations were made, and when a reasonably accurate orbit became available, it was found that 1979 VA belonged to the select "Apollo" class of Earth-crossing minor planets. Its perihelion was just inside the Earth orbit, at 0.98 AU, and it had passed within 0.1 AU, or less than 15 million km, of the Earth in late October 1979. The eccentricity was rather large, 0.63, and the orbit was therefore very elongated; the period was somewhat over 4 years.

After more observations had become available in the 1980's, 1979 VA was duly assigned the definitive number 4015, but it has not yet received an official name.

Nothing very exciting about that. But this August, Minor Planet (4015) suddenly became an object of intense interest among solar system astronomers!

The Palomar 1949 Observations

Extrapolating the motion of (4015) backwards in time in the hope of finding earlier recorded images of this object, Ted Bowell of the Lowell Observatory at Flagstaff, Arizona, USA, found that it should be visible on a pair of plates, obtained with the 48-inch Palomar Schmidt telescope for the first Palomar Sky Survey on November 19, 1949. These plates were some of the first obtained with this telescope, red-sensitive no. 9 (45 min; 103a-E + a red plexiglass filtre) and blue-sensitive no. 10 (12 min; unfiltered 103a-O).

The image of (4015) was easy to find, but Bowell and his colleagues were most surprised to discover that it did not look like a normal minor planet trail – it had a tail!

When a hint was passed to Brian Marsden at the Minor Planet Center (Center for Astrophysics, Cambridge, Mass., USA) that the earlier images were "unusual", he immediately recalled that an object on the Nov. 19 Palomar plates had already been catalogued in 1949 as Comet Wilson-Harrington (1949 III). There was also the strange circumstance, however, that this comet was described as having a point-like appearance on plates obtained the following nights.

So here was an object that was a seemingly normal minor planet in 1979 and thereafter, but which looked like a comet on a pair of plates in 1949. How could this be explained? Were the tails perhaps some kind of plate fault, or was this a real effect?

Brian Marsden asked about our opinion and we decided to have a very careful look at the glass copies of the POSS I Atlas plates, stored in the vault at the ESO Headquarters in Garching.

Our first conclusion was that the "tails" are unlikely to be photographic faults. Although a great variety of artificial dots, lines, etc. is often found on the very sensitive emulsions used in astronomy – the first Palomar Atlas contains many so-called "Kodak stars" – the emulsion structure around the "tail" is uniform on both plates and does not indicate any artificial origin. It is of course true that we were only able to study second-generation copies of the original plates in the plate vault at Caltech in Pasadena, but from our experience with many thousand Schmidt plates over the years, this conclusion still seems quite safe.

The tail is rather weak, especially on the red plate, and we therefore photographically enhanced the two Palomar plates in order to see the structure more clearly. The amplified images are reproduced in Figure 1a and 1b. There is no doubt that on both plates, the "tail" has the normal appearance of a cometary tail. It extends only to one side of the trail, is attached to the trail over the full

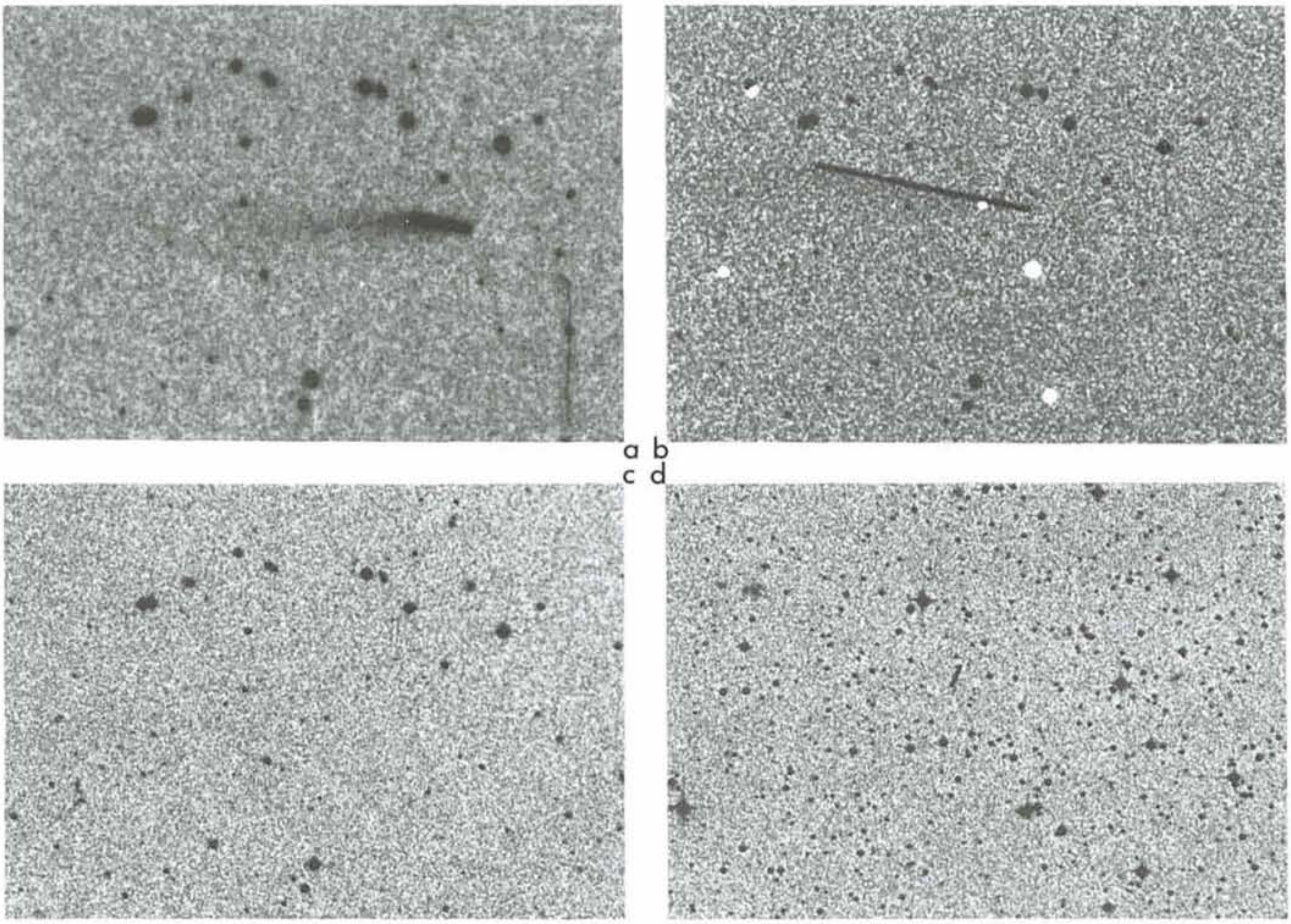

Figure 1: *These photographically enhanced photos show Minor Planet (4015) = Comet Wilson-Harrington on (a) a blue- (12 min) and (b) a red-sensitive (45 min) plate, obtained on November 19,1949, with the 48-inch Schmidt telescope at Palomar. The tail is well visible below and to the left of the trail. The vertical line in the lower right corner of (a) is an emulsion fault. In (c), the same sky field is shown on a recent plate obtained with the same telescope for the POSS II; there is no diffuse object in the field. In (d), a 1979 image of minor planet (4015) from a plate obtained with the 48-inch UK Schmidt telescope demonstrates the sharpness of the short trail (at the centre) – there is absolutely no tail visible. On (a) and (b), the distance from the Earth and the Sun was 34 million km and 172 million km, respectively; on (d) the corresponding distances were 58 million and 178 million km. The object appears brighter in 1949 (a, b) than in 1979 (d), partly because it was closer to the Earth, but most probably also because it was at that time surrounded by a small dust cloud.*

All photos are reproduced at the same scale, approximately 6.5 arcsec/mm; north is up and east is to the left.

The photo was prepared at ESO from the Palomar Observatory Sky Surveys I and II and the ESO/SERC Survey of the Southern Sky (©California Institute of Technology (c) and UK Science and Engineering Research Council (SERC) (d)).

length, does not extend beyond the trail ends and has the same general direction on the two plates. In other words, the tail really "moves" with the object and it is therefore very unlikely to be a ghost reflection from a bright star in the field. Moreover, a look at the same sky field on the J plate (Figure 1c), recently obtained for the POSS II survey (which is now being reproduced at ESO) shows that there are no nebulae or galaxies in this area which might simulate a comet tail.

It is also important to note that the weakness of the tail on the red plate does not necessarily mean that the tail consists of gas only. Even dust tails which shine by reflected sunlight, and which are generally redder than gas tails, are normally weaker on red than on blue photographic Survey plates because of the different emulsion sensitivity. It is for this reason that comets are much easier to discover on blue-sensitive plates; that is also why very few comets were found on the ESO(R) survey. This does not apply to comet observations with CCDs, since these detectors are more sensitive in the red spectral region.

So we are convinced that minor planet (4015) really had a dust tail in 1949.

Minor Planet/Comet Interrelations

Until now, the object (4015) had fulfilled all requirements for classification as a minor planet; its trail (Figure 1d) was perfectly sharp, without any hint of a coma or a tail. But the 1949 observation proves that it must at least once have had an outburst of some kind, giving it the (temporary) appearance of a perfectly normal comet. So what is it really, a minor planet or a comet?

Possibly both. There has recently been a growing interest in studying the relationship between these two types of solar system objects and various evidence for interrelation has become available during the recent years. For example, minor planet (2060) Chiron, in a 50-year orbit between Saturn and Uranus, developed a large coma in 1988 on its way towards perihelion in 1996. Earlier this year, another minor planet with an even larger comet-like orbit was found and was provisionally designated as 1992 AD (cf. *The Messenger* **67**, p. 34, March 1992). It has in the meantime received the number (5145) and the name Pholus (another Centaur), but contrary to Chiron, Pholus has not shown any activity (yet).

Other minor planets are known to move in highly eccentric comet-like orbits much nearer the Sun. One of them, (3200) Phaeton (discovered by IRAS in 1983 and designated 1983 TB), moves in the same orbit as the Geminid meteor stream. It seems that it is the parent body of the material in this stream. This is strange, because only a comet, and not a solid minor planet, is thought to be able to disperse dust along its orbit.

Several comets in well-known orbits have been found to disappear from view, probably because their source of volatiles is exhausted. One of the most well-documented cases is that of Biela's comet, first discovered in 1826. It was seen to split into two pieces in 1846, it faded in 1852 and was not seen at all at its predicted return in 1866. When no more ice is available on the surface of the nucleus of a comet, or if the Sun's heat can no longer penetrate through the insulating surface to the reservoirs of ice that may still be present inside the nucleus, no coma and tail will develop. The comet will have become "inactive" and its small nucleus will only shine by reflected sunlight. This implies that it will be very faint and its image, if observable at all, will from then on be indistinguishable from that of a minor planet. This type of object is appropriately referred to as a "dead" or "dormant" comet.

It is widely believed that at least some of the minor planets, now in comet-like orbits in the inner solar system, are in fact dead comets. It may well be that we actually witnessed the death throes of comet 1949 III, and that its inactive nucleus was "re-discovered" in 1979 as minor planet 1979 VA. It is the first direct observation of this kind and it will surely stimulate much activity in this interesting research field.

Minor planet (4015) again passed through its perihelion in late August 1992. There is little doubt that it will be extensively observed during the coming months. Unfortunately, it will be located in the northern sky and will not be easily accessible from La Silla. Initial observations (IAUC 5585 and 5586, August 14, 1992) have not revealed any signs of activity whatsoever.

A Very Low Resolution Spectrophotometric Nova Survey

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The Aims of the Survey

A very low resolution spectrophotometric survey of classical novae at minimum is of great interest for a more thorough understanding of these objects. As it was stressed in a previous account (Bianchini et al., 1991), up to now only Williams (1983) studied a number of spectra of old novae. There is therefore a strong need of a systematic study of the post-outburst spectra of a large number of these objects, in order to be able to derive statistical conclusions.

With very low resolution spectroscopy we can cover a wide wavelength range for many novae at minimum, obtaining a statistically meaningful sample, and detect the following features:
- the slope of the continuum;
- the ratios of the intensities of different emission lines of H, He I and He II, all meaningful to understand the accretion mechanisms;
- the presence of a nebular spectrum if this still exists;
- sometimes the spectrum of the secondary;
- the possible discovery of peculiar variabilities (see Bianchini et al., 1991).

Since we are engaged also in the systematic study of novae at minimum in other wavelength ranges, especially UV and X (Bianchini et al. 1991, Orio et al. 1992), this survey in the optical range becomes an important tool when the level of the continua is correlated with that in UV and IR or certain details of the optical spectra are used to understand the mechanisms of X-ray emission (the typical example is the He II λ4686 line, which has been shown by Patterson and Raymond (1984) to be the result of reprocessed soft X-ray emission for high accretion rates). Moreover, many objects were poorly studied at maximum and their classification is uncertain. Using the ESO 1.5-m telescope, we are able to distinguish between the spectrum of an old nova and that of a symbiotic star or a red variable up to $M_V = 20$; a proposed classification as dwarf nova (with long cycle length) instead of classical nova can be rejected on the basis of a strong λ4686 He II emission line, which is typical only of classical novae or magnetic CV's and is an indicator of accretion rates $m > 10^{16}$ g s^{-1} (Patterson and Raymond 1984).

A systematic study of classical novae at minimum is therefore extremely important to understand the physical mechanisms powering novae and the nature of the different systems.

First Results

The spectral atlas we are building consists already of 50 different objects, all observed in the range λ3000-9000 Å. In three observing runs at the ESO 1.5-m telescope (February 1991, December 1991, July 1992) we have been able to study 31 novae using a CCD detector and the Boller & Chivens spectrograph. In addition there are spectra of 23 objects taken by Duerbeck in the years 1986–1988 with the same telescope and B & C spectrograph; the majority was observed with the somewhat ageing image dissector scanner (IDS) instead with a CCD, resulting in a poorer S/N and a lower spectral resolution. However, these observations are useful in order to establish secular trends in the data – e.g. declining continuum fluxes and decreasing strengths of He II emission. Such findings are useful to find indications for a secular decrease in the accretion rate, which is postulated hy the hibernation hypothesis (Prialnik and Shara 1986, Shara et al. 1986). Accord-