

The comets of 2002 (Part 2)

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A report of the Comet Section (Director: J. D. Shanklin)

This is the second part of the thirteenth report in the annual series which gives for each comet: the discovery details, orbital data and general information, magnitude parameters and BAA Comet Section observations. The year was somewhat unusual with several bright comets. Further details of the analysis techniques used in this report are given in an earlier paper.¹ Ephemerides for the comets described in this report can be generated from the JPL *Small-Body Database Browser*.²

Editor's note

Part 1 of this paper, covering comets with discovery letter designations, tables of observers, and tables of orbital data and magnitude parameters, appeared in the 2014 October *Journal*.²¹ Numbering of figures, tables and references in Part 2 continues sequentially from Part 1.

The comets with discovery letter designations (continued)

2002 R2 (155P/Shoemaker)

S. Nakano, Sumoto, Japan, reported the CCD recovery of comet 1986 A1 (P/Shoemaker) independently by T. Oribe (1.03-m reflector, Saji; diffuse coma of diameter 10", hint of tail toward the west on R-band images, mag 18.0) on Sep 9.78 and by A. Nakamura (0.60-m reflector, Kuma; diffuse with some central condensation, coma diameter 12", mag 18.6, unfiltered images) on Sep 12.81. The indicated correction to the prediction on MPC 34423 is $\Delta(T) = -0.14$ day [IAUC 7969, 2002 Sep 13]. It has made no recent close approaches to Jupiter.

Visual observations were made between 2002 Dec (when the comet was at perihelion at 1.8 au) and 2003 Mar and were in the range of magnitude 12–14, around two magnitudes brighter than the CCD observations.

2002 R3 (LONEOS)

An apparently asteroidal 18th mag object reported by LONEOS on Sep 4.40 was posted on the NEOCP due to its unusual motion. CCD frames taken on Sep 7.4 UT by D. T. Durig, Sewanee, TN, with a 0.3-m reflector showed a hint of diffuseness perhaps 8"–10" in size on most of his images; his images on Sep 5.3 and 12.4 also showed a 'soft' appearance, the latter images hinting at a faint tail in p.a. 45°. CCD images taken on Sep 8.1 at Klet by M. Tichy & J. Ticha with the 1.06-m KLENOT telescope show the object as a slightly diffuse, faint coma of diameter 12", and on Sep 10.04 it was slightly diffuse with a faint coma of diameter about 12"–14"; it appeared diffuse also on images from Sep 13.03. At Modra, S. Gajdos & A. Galad found a coma diameter of about 5" on CCD images taken on Sep 12.1 (0.6-m reflector). Images taken with the

Palomar 1.5-m reflector by M. Hicks on Sep 14.4 clearly show a 5" coma and a slight elongation to the west in a 10-min r-band exposure [IAUC 7970, 2002 Sep 14]. The 'original' barycentric value of $1/a$ suggests that it was a 'new' comet from the Oort cloud.

2002 S1 (223P/Skiff)

B. Skiff, Lowell Observatory, reported his discovery of a comet on images taken by him in the course of the LONEOS program, on Sep 17.42 at magnitude 18.0. The object had a moderately condensed coma of diameter 10" and a tail 30" long in p.a. 285°. At Skiff's request, M. Hayes–Gehrke obtained a confirming 5-min CCD R frame (also on Sep 17, in twilight) with the Lowell Observatory's Perkins 1.8-m telescope, showing a 8" coma and a tail about 30" long in p.a. 280 or 285° [IAUC 7972, 2002 Sep 17].

An encounter with Jupiter in 1980 reduced its perihelion distance slightly, but otherwise there have been no significant changes to the orbit over the last century. The comet was numbered following its recovery in 2009.

2002 T1 (P/LINEAR)

M. Blythe & S. Partridge, Lincoln Laboratory, MIT, reported the LINEAR discovery of a 16th magnitude comet showing a coma and a possible tail in p.a. about 260° on Oct 3.26. Following posting on the NEOCP, other observers confirmed the cometary appearance, including Peter Birtwhistle, Great Shefford, UK (Oct 4.11 UT, $m_1 = 15.4$, faint 1' tail in p.a. 231°), and J. McGaha, Tucson, AZ (Oct 4.33, nuclear condensation of mag about 15.3 and diameter about 6", with a tail 45" long and about 12" wide in p.a. 235° curving toward the north) [IAUC 7983, 2002 Oct 4].

2002 T4 (54P/de Vico–Swift–NEAT)

K. Lawrence, S. Pravdo & E. Helin, JPL, reported the discovery on Oct 11.22 UT of a 19th magnitude comet (with a nuclear condensation of diameter about 4" and a tail about 20" long toward the south-southwest) on NEAT images taken at Palomar. M. Hicks reported that images taken by J. Young at Table Mountain on Oct 12.3 (through cirrus clouds) showed a diffuse coma and a faint 5" tail to the southwest. D. Balam, University of Victoria, reported that images taken by J. Clem with the 1.82-m Plaskett telescope (also on Oct 12.3) also showed the object to be cometary in appearance (3 pixels, or 3".3,



Figure 21. 2002 T7 (LINEAR) imaged by Martin Mobberley on 2003 Dec 17.

2002 T5 (P/LINEAR)

An apparently asteroidal object of mag 18.4 reported by LINEAR on Oct 5.39, posted on the NEOCP due to unusual motion, was found to be cometary in appearance. D. T. Durig & J. A. K. Blackwood, University of the South, Sewanee, TN, reported that CCD images taken with a 0.30-m reflector on Oct 18.4 showed the object to be diffuse with a hint of a tail 12"–15" long in p.a. 330° and a soft coma of diameter 5"–8". Images taken by G. Hug, Eskridge, KS, also with a 0.30-m reflector at about the same time, showed a nearly stellar coma with extension about 10"–15" long in p.a. about 280° [IAUC 7998, 2002 Oct 22]. Observers contributing to the preliminary orbit included Peter Birtwhistle.

2002 T6 (P/NEAT–LINEAR)

An object reported as asteroidal independently by the NEAT (Oct 4.50, mag 20.1) and LINEAR surveys (Oct 7.26, mag 19.4), and later placed on the NEOCP, was found cometary in appearance. P. Birtwhistle, Great Shefford, UK, reported that CCD images taken with a 0.3-m reflector on Oct 27.9 showed two faint, thin, straight tails in p.a. 107° (36" long) and 310° (39" long) and a nuclear condensation with diameter about 8". T. B. Spahr reported that 5-min exposures taken with the Mt Hopkins 1.2-m reflector on Oct 29.2 showed a small coma of diameter about 6" and an extremely faint tail about 10" long in p.a. 330° [IAUC 8002, 2002 Oct 29]. Stephen Laurie also contributed astrometry to the preliminary orbit.

2002 T7 (LINEAR)

Another object, of magnitude 17.5, discovered on Oct 14.42 and reported as asteroidal by the LINEAR survey, was found to be cometary in appearance. P. Birtwhistle, Great Shefford, UK, noted that

larger than nearby stars) [IAUC 7991, 2002 Oct 12]. A. Nakamura, Kuma, Ehime, Japan, quickly reported that Kenji Muraoka (Kochi, Japan) had identified the comet with 54P, last seen in 1965. The indicated correction to the prediction on MPC 34423 was $\Delta(T) = -7.5$ days.

Calculations by B. G. Marsden, Smithsonian Astrophysical Observatory, indicated that the comet passed 0.16 au from Jupiter on 1968 Oct 18 [IAUC 7992, 2002 Oct 13]. It will make another close approach to the planet in 2028.

Shanklin: The comets of 2002 (Part 2)

CCD images taken on Oct 28.0 showed the object to be slightly 'softer' than stars of similar brightness. T. B. Spahr reported that Mt Hopkins images taken on Oct 29.4 showed the object to be very slightly diffuse, again with it being slightly larger than the FWHM of nearby stars [IAUC 8003, 2002 Oct 29]. Observers contributing to the preliminary orbit also included Stephen Laurie and Rafael Ferrando. The final orbit suggests that it is a 'new' comet from the Oort cloud, and requires non-gravitational parameters to achieve a good fit to the observations. Michael Mattiazzo calculated the orbital plane crossings as 2002 Dec 26, 2003 Jun 27, 2003 Dec 25 and 2004 Dec 25.

Z. Sekanina, JPL, noted: *The sudden appearance of a prominent antitail is the result of unusual coincidences. Due to projection effects the antitail could not develop before the end of March 2004, at which time the comet was too close to the sun to be observed from the ground (and not close enough to show up in SOHO's C3 coronagraphic images). From the orientation in the available images of Apr. 17–20, the dust contained in the antitail is found to have been ejected most probably between discovery (mid-October 2002) and about 300 days before perihelion (the end of June 2003). Because the comet was not brightening dramatically between discovery (except perhaps in the first post-discovery days) and the 2003 conjunction with the sun, it is likely that the material in the antitail dates back to a fairly sudden onset of persistent dust production at or shortly before discovery (i.e., the comet was detected because it 'turned on' at about that time), or the comet's dust-emission activity picked up rapidly in mid-2003, when it was behind the sun. The steeper light curve beginning in August 2003 can support this scenario.*

In either case, there was no antitail around 2003 Dec. 27 and none is expected to appear around 2004 June 26, the times of the earth's transit across the comet's orbital plane. The angular deviation from the radius vector dropping below 90° implies the antitail's disappearance. There are two maxima in this angle, one on April 13, the second on May 21. Unless the dust production terminated early, more recent ejecta fill the entire sector between the antitail and the plasma tail. The visibility of this sector is affected by projection geometry and, to a degree, is anticorrelated with the antitail's prominence. Also, in long-exposure images, which show the antitail to extend further out, its slight curvature may be noticed toward greater position angles (counterclockwise) farther from the comet, although this effect may be concealed by decreasing brightness [IAUC 8330, 2004 Apr 23].

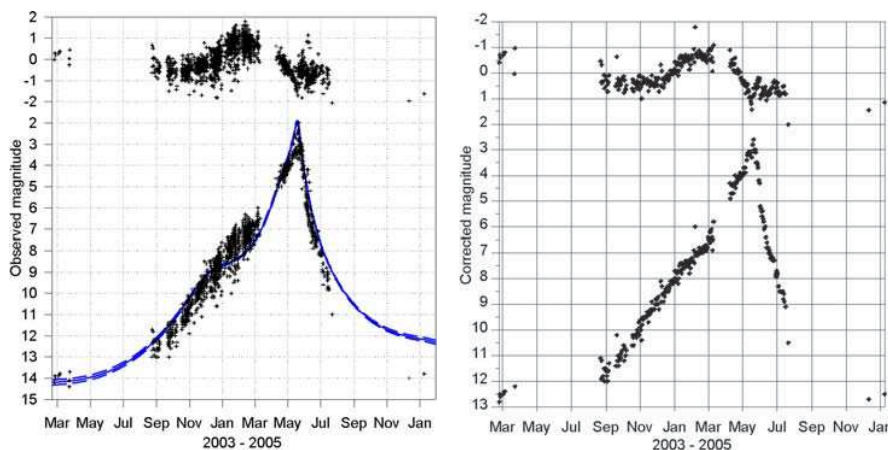


Figure 22. The lightcurve of 2002 T7 (LINEAR). Left: all observations; right: daily means.



Figure 23. 2002 T7 (LINEAR) imaged by Bill Ward on 2004 May 21.

Observations made in 2003 Aug put the comet around 13th magnitude. Jonathan Shanklin observed the comet on Sep 29.1, estimating it at 11.7 in the Northumberland refractor $\times 170$. The comet appeared significantly brighter than a week earlier. By Oct 27.03 the comet had brightened to 10.7, with a small 0.7' DC6 coma. It was visible in 25 $\times$ 100B on Oct 27.95, appearing nearly stellar at mag 11.1. On Nov 17.09 it was visible in 25 $\times$ 100B at mag 9.9, with a 1.3'

DC5 coma. Several reports in early December put it at around 8.5 with a 2' or larger coma.

By mid-December observers were reporting some tail development, unusual in such a distant comet. For example James Abbott reported a 3.5' long tail on Dec 15.83 in his 0.30m reflector $\times 48$. By early February the comet had brightened to 7th magnitude, with observers reporting a tail of between 20' and 60'. By early March, before the comet went into solar conjunction, observers were putting it a little brighter than 7th magnitude, but clearly the rate of brightening had slackened off a little.

Alexandre Amorim recovered the comet after solar conjunction on Apr 9.36, estimating it at around 4.6 in 20 $\times$ 80B. The comet reached perihelion on 2004 Apr 23 at 0.61 au and peaked at around 3rd magnitude in early May. Roberto Haver reported it as 2.6 to the naked eye on May 9.83. It faded relatively quickly, so that by early June it was 5th magnitude, with the last naked eye observation reported on June 6.36 by David Seargent. By mid-July it was around 10th magnitude as it once again moved into solar conjunction. By the time it re-appeared in 2004 Dec it was 14th magnitude and the last visual observation was made in early 2005 January, although CCD measurements continued for another year.

The visual tail was longest in early 2004 May, with maximum

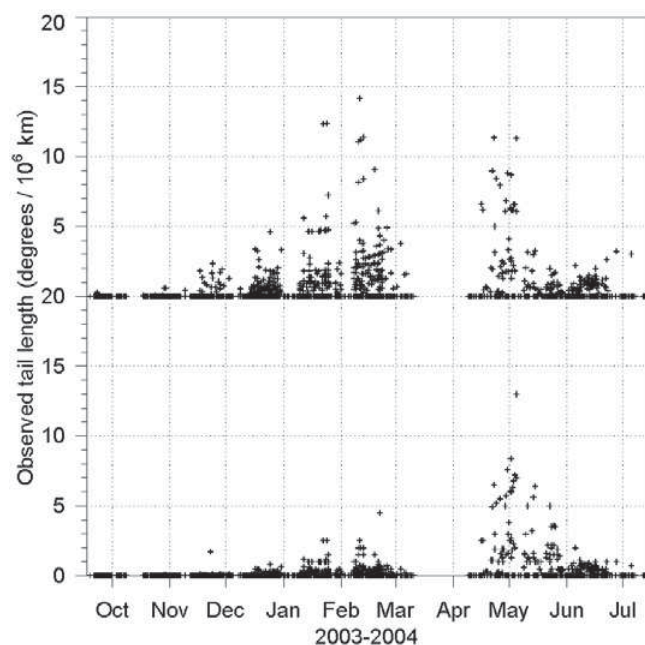


Figure 24. The tail length of 2002 T7 (LINEAR).

lengths of 8 to 13° for the ion tail being reported. These observations are confirmed by images (John Drummond, Ian Cooper, Terry Lovejoy), which tend to suggest that a maximum length of perhaps 43° was achieved around May 19, although by this time the visual tail was declining. When corrected for perspective, it appears that the visual tail was actually longest before perihelion, when the comet was more distant.

The coma increased in size, to reach a maximum of nearly 20' diameter in late 2004 Jan, declining as the comet approached conjunction. After conjunction it rapidly increased as the comet approached the Earth, reaching its maximum of around 30' in mid-May, when the comet was closest to Earth. Correcting for distance the physical size of the coma was greatest in late January and this perhaps explains both the scatter in total magnitude estimates around this time, and the variation in the lightcurve. Professional measurements suggested coma outflow velocities ranging from 1.7 to 2.0 km/s in 2004 April. The degree of condensation of the coma shows little pattern prior to perihelion. At perihelion it was strongly condensed, then quickly became more diffuse.

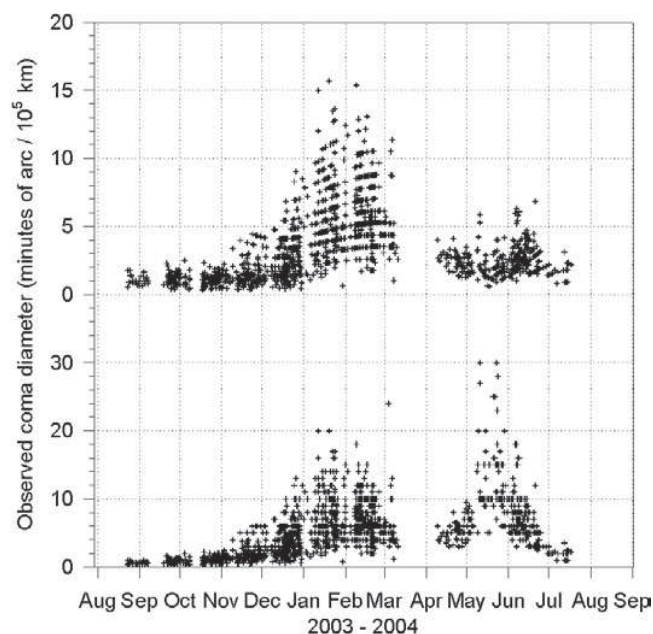


Figure 25. The coma diameter of 2002 T7 (LINEAR).

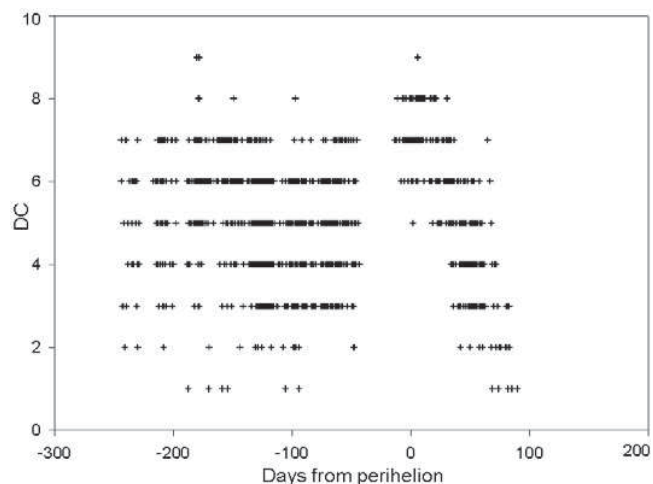


Figure 26. The degree of condensation (DC) of 2002 T7 (LINEAR).

2002 U2 (LINEAR)

M. Bezpalko, Lincoln Laboratory, MIT, reported the LINEAR discovery of a comet of magnitude 17.3 with a tail in p.a. about 270° on Oct 25.44. L. Sarounova, Ondrejov, reported that images taken with the 0.65-m reflector on Oct 26.0 showed a 10" coma ($m_1 = 15.5$) and a narrow tail at least 2' long in p.a. 280° [IAUC 8000, 2002 Oct 26].

This was LINEAR's 95th comet. The orbit suggests that it is not a 'new' comet from the Oort cloud. A few visual observations made it near 14th magnitude in 2003 January.

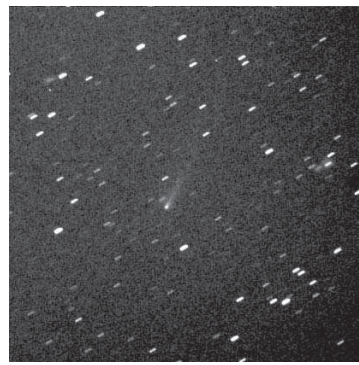


Figure 27. 2002 U2 (LINEAR) imaged by Rolando Ligustri on 2002 Nov 8.

2002 V1 (NEAT)

Steve Pravdo, JPL, reported the NEAT discovery, on CCD images taken with the 1.2-m reflector at Haleakala on Nov 6.60, of a magnitude 17.3 comet with a tail about 10" long in p.a. 225° . Following posting on the NEOCP, other CCD observers confirmed the cometary

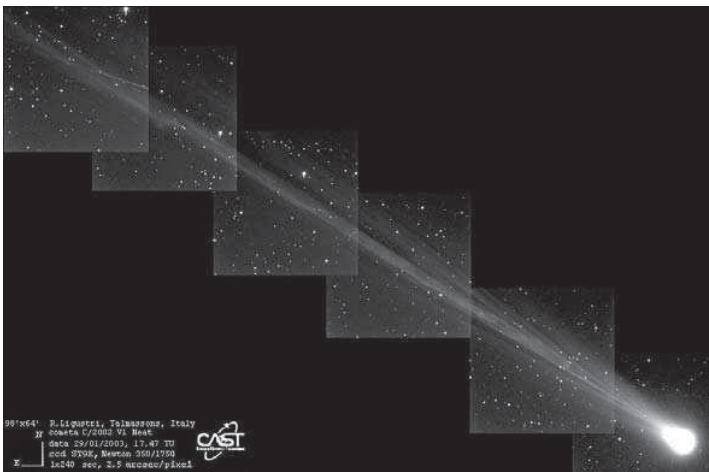


Figure 28. 2002 V1 (NEAT) imaged by Rolando Ligustri on 2003 Jan 29.

nature: P. Pravec & L. Sarounova (Ondrejov, 0.65-m reflector), coma diameter 0'.4, faint tail 0'.4 long in p.a. 250° ; M. Lehky (Hradec Kralove, Czech Republic, 0.40-m f/5 reflector), slightly diffuse coma of diameter about 5"; M. Blasco & S. Sanchez (Mallorca, 0.40-m Schmidt telescope), coma diameter 15" [IAUC 8010, 2002 Nov 6]. The orbit suggests that it was not a 'new' comet from the Oort cloud.

Professional observations in early January showed that the underlying continuum was well fitted with a 290K black body, approximately 14% above the blackbody radiative equilibrium temperature of 254K. Low-resolution spectroscopic observations (range 8–13 microns) showed a broad amorphous silicate feature with a 11.2-micron local peak, indicating the presence of crystalline olivine [IAUC 8053, 2003 Jan 16].

C. B. Cosmovici, Instituto di Fisica dello Spazio Interplanetario, Consiglio Nazionale delle Ricerche, Rome, reports that he and the rest of the ITASEL team of the Medicina 32-m radio telescope (M. Teodorani, S. Montebugni & G. Maccaferri) detected the 22-GHz water-maser line in comet C/2002 V1 at perihelion, using a fast, high-resolution spectrum analyser on Feb 17, 18 & 19 (when $r =$

0.101–0.121 au), during a strong coronal mass ejection (CME) detected by the SOHO spacecraft. The beam size was 2', corresponding to an observed region at the comet of about 80,000km.

The neutral water molecules show a velocity shift of -12.2 km/s with respect to the nucleus, confirming the previously observed peculiar strong acceleration of neutral water molecules in 1996 B2 (Hyakutake) at perihelion (Cosmovici *et al.* 1998, *Planet. Space Sci.* **46**, 467; in 1996 B2, the shift varied between 22 and 44 km/s). Neutral water molecules are normally ejected from the nucleus at velocities around 1 km/s. This peculiarity could be explained by assuming the sublimation of excited water molecules from accelerated ionised icy grains that form an extended source around the nucleus. The strong CME may have contributed to the acceleration mechanism [IAUC 8094, 2003 Mar 16].

Some tentative visual observations in late Nov suggested that the comet was approaching 14th magnitude. By early Dec reports were suggesting that it was around 13th magnitude. Jonathan Shanklin observed the comet with the Northumberland refractor on Dec 4.94 estimating it at 12.3 and a much easier object than 2001 RX₁₄. A report from Mike Linnolt also suggested that the comet was 12th magnitude. It seemed to be brightening quite rapidly, and CCD observations indicated that it was a gassy comet. Michael Mattiazzo reported that on Dec 23.53 it was 9.4, with coma dia. = 8', DC = 3 in 25×100B.

By 2003 mid-January it had brightened further, with Gabriel Oksa finding it at 6.9 in 20×80B on Jan 11.70, despite strong moonlight. This rapid rate of brightening slowed, though Stephen Getliffe was the first to see it with naked eye on Jan 20.77. By contrast the number of observations increased dramatically, with many less regular observers starting to observe the comet. Entwistle made it 5.6 in 10×50B on Jan 30.80. By early Feb tail development was becoming significant with around 2° or more being visible.

Moonlight and low altitude were now interfering with observation from the UK. With a frontal system sitting over Cambridge on Feb 11 Jonathan Shanklin decided to travel west to find clear skies. After a couple of hours driving he encountered clear skies near Droitwich, and found a country site south of Ombersley. The comet

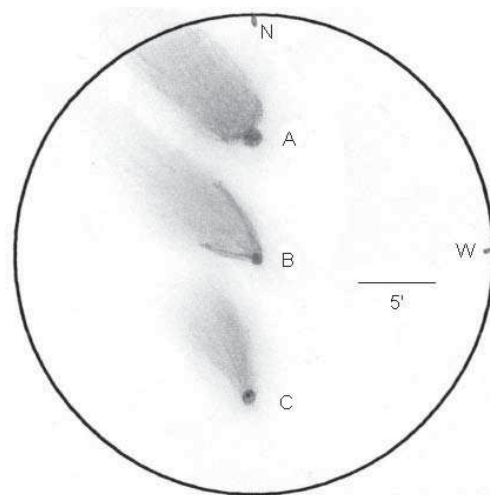


Figure 29. Sketches by Gabriel Oksa showing the evolution of comet 2002 V1 (NEAT) as seen in 8×20B over 2003 Feb 9, 12 and 13.

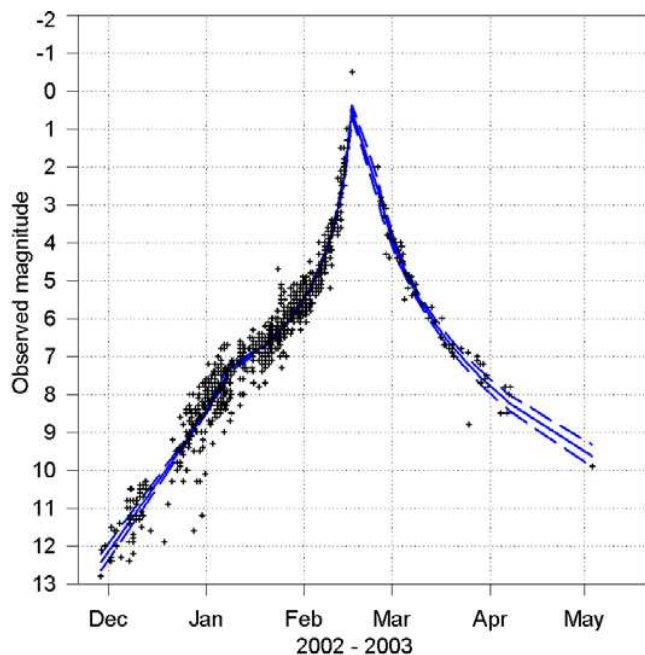


Figure 30. The lightcurve of 2002 V1 (NEAT), with composite fit.

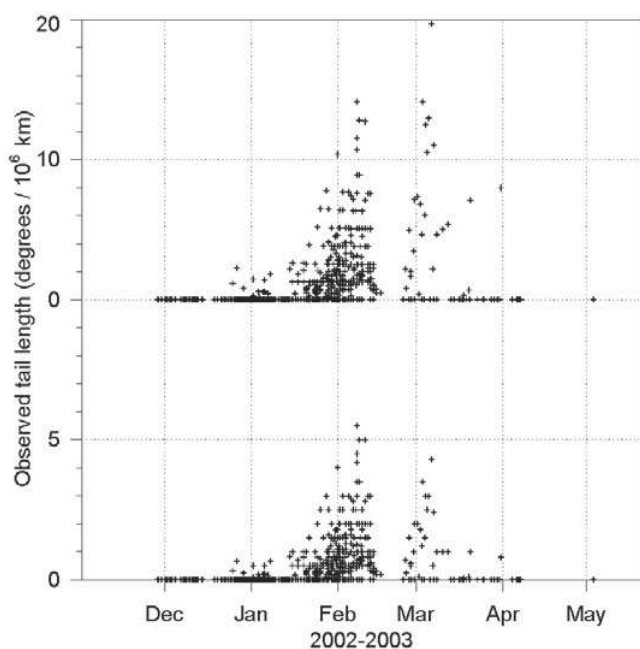


Figure 31. The tail length of 2002 V1 (NEAT).

was surprisingly easy in the twilight, showing a short tail and a creamy coloured nucleus. The total magnitude was 3.0, coma diameter 3' and DC8 in 10×50B.

The final pre-perihelion observation was made by Juan José González from his clear mountain location on Feb 16.29 when it was about -0.5 in his 11×80B.

The comet passed through the SOHO coronagraph field at perihelion, traversing across it between Feb 16 and 20. It was a bright object with a short broad tail, saturating the sensor.

Shanklin travelled south to Rothera station in Antarctica (67°S) in mid-Feb for his work with the British Antarctic Survey. Having failed to see the comet on 2003 Feb 18 or 22 he was able to re-observe it in deep twilight on Feb 25.10 when it was about mag 2.9 with a 0.7° long tail.

Post-perihelion observations were restricted to the southern hemisphere, and are much less frequent. Veteran observer Albert

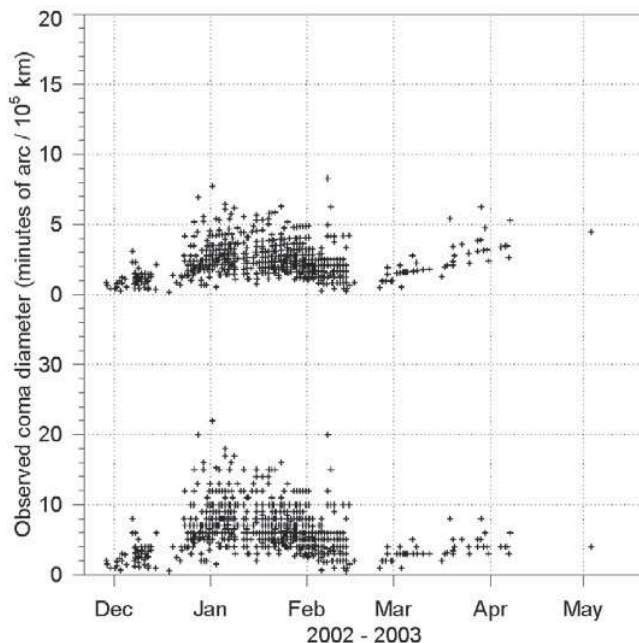


Figure 32. The coma diameter of 2002 V1 (NEAT).

Jones saw the comet on Mar 7.35 in his 45mm refractor, when it had already faded to 5.4. By late March it faded further, when Shanklin, now at Stanley in the Falkland Islands, observed it at 7.7 in 10×50B on Mar 29.02. The final observation was made by Michael Matti-azzo on May 3.40 when it was 9.9 in his 25×100B.

This is an unusual comet where the photometric behaviour is markedly different through the apparition, with notable changes at around 1.2 au inbound and again at perihelion. A composite fit is shown in Figure 30.

Visual tail development was never extensive, with a maximum of around 5° being reported in early Feb before the comet dropped too low in the twilight. The visual tail was slightly shorter after perihelion with up to around 4° being reported in early March, however this translates into a slightly longer physical tail. Prior to perihelion the comet's distance from the Earth lay within the range of 0.8 to 1.0 au, so the changes in observed coma diameter broadly match those of the physical coma. After perihelion the distance of the comet steadily increased to 2.5 au. The coma was generally largest around a month before perihelion, though this in part may simply reflect the better observing conditions. The DC shows a clear pattern and was greatest around the time of perihelion.

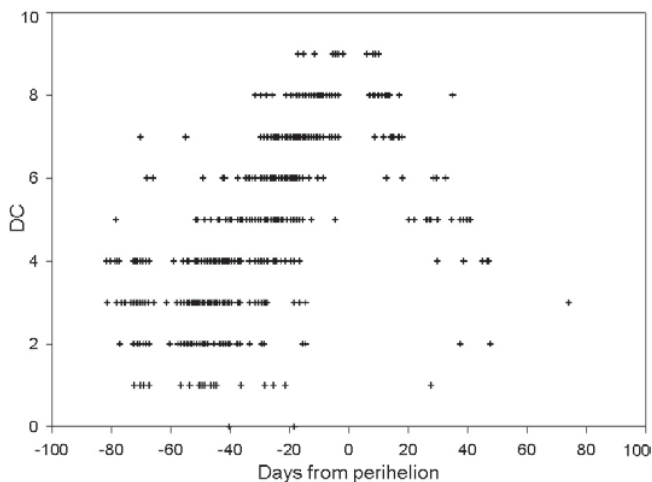


Figure 33. The degree of condensation (DC) of 2002 V1 (NEAT).

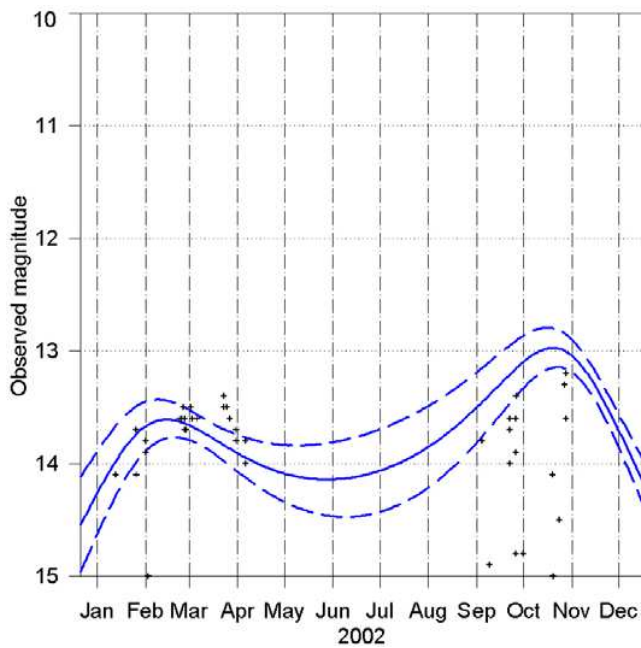


Figure 34. The lightcurve of 2002 X1 (LINEAR).

2002 V2 (LINEAR)

An apparently asteroidal object of mag 18.6 discovered by LINEAR on Nov 5.31 and posted on the NEOCP was found to have cometary appearance. M. Tichy found a compact 6" coma on KLENOT images taken at Klet on Nov 7.13. Images taken by P. R. Holvorcem & Michael Schwartz with the Tenagra 0.81-m reflector on Nov 7.4 & 8.4 show the object diffuse with a coma diameter of about 8" [IAUC 8013, 2002 Nov 9]. The orbit suggests that it was not a 'new' comet from the Oort cloud. CCD observations show that the comet reached 18th magnitude at best.

2002 VP₉₄ (247P/LINEAR) = 2010 V3

An apparently asteroidal object of 19th magnitude was discovered by LINEAR on 2002 Nov 5.31 [MPEC 2002-V70, 2002 Nov 15]. Brian Marsden noted that it was not clear if the object was in fact a comet. It was finally confirmed as a comet in 2010 Dec when observations at the Haute Province Observatory as part of the T2 project showed that it had a tail. This was confirmed by follow-up observations and announced on MPEC 2010-Y29 on 2010 Dec 27. The orbit has been moderately stable over the period 1900–2100. The comet makes occasional approaches to the Earth, and was discovered during one in 2002, with the 2010 return being the closest of the period at 0.54 au.

2002 VQ₉₄ (LINEAR)

An apparently asteroidal object discovered by LINEAR on 2002 Nov 11.24 (announced on MPEC 2002-V71, 2002 Nov 15, where B. G. Marsden noted *whether this object is a comet or not is inconclusive*) was found to have a prominent 10" coma with a fanlike morphology spanning p.a. 180–300° on images taken by D. Jewitt on 2003 Aug 28.5 with the University of Hawaii 2.2-m telescope

[IAUC 8194, 2003 Sep 3]. It was discovered at 9.8 au from the Sun and did not reach perihelion until 2006 Feb. The orbit suggests that it was not a 'new' comet from the Oort cloud. CCD observations show that it reached 15th magnitude in 2007.

2002 X1 (LINEAR)

An object of mag 18.0 reported as asteroidal by LINEAR on Dec 5.44, and placed on the NEOCP due to its unusual motion, was found to be cometary on CCD images taken around Dec 7.4 by D. T. Durig (Sewanee, TN, 0.3-m reflector; 25" coma, $m_1 = 15.5$), by P. R. Holvorcem & Michael Schwartz (Nogales, AZ, 0.81-m telescope; diffuse with coma diameter about 10" and a hint of tail at p.a. about 300°), and by Gary Hug, R. Valentine & B. Leifer (Eskridge, KS, 0.30-m reflector; diffuse) [IAUC 8028, 2002 Dec 7]. The preliminary low inclination, small perihelion distance orbit was quickly replaced by a retrograde, larger perihelion distance orbit after Sebastian Hoenig pointed out that no object had been detected in SOHO images. The orbit suggests that it was not a 'new' comet from the Oort cloud. The comet reached 13th magnitude at its two oppositions.

2002 X2 (240P/NEAT)

K. J. Lawrence reported the discovery of a comet of mag 18.4 by the NEAT team (which now includes also R. Bamberg, E. Helin, S. Pravdo, M. Hicks & R. Thicksten) from CCD images taken with the 1.2-m Schmidt telescope at Palomar on Dec 7.17. Following posting on the NEOCP, J. Ticha & M. Tichy found the comet to show a 7" coma and a 14" tail in p.a. 45° on Klet images taken on Dec 8.8. P. Holvorcem reported that the co-addition of 3 120-s exposures taken with the Tenagra II telescope at Nogales, AZ, on Dec 8.20 showed a coma with diameter about 7" and a tail about 14" long in p.a. about 55°. F. B. Zoltowski, Edgewood, NM, notes that CCD images taken with a 0.3-m reflector on Dec 9.15 show the comet as diffuse with a 15" coma diameter and a possible faint tail in p.a. 240° [IAUC 8029, 2002 Dec 9]. It was numbered following its recovery in 2010.

2002 X5 (Kudo–Fujikawa)

S. Nakano, Sumoto, Japan, reported the visual discovery of a comet by Tetuo Kudo (Nishi Goshi-machi, Kikuchi-gun, Kumamoto-ken, Japan; Nikon 20×120 binoculars. Coma diameter 2'; central condensation visible, but no tail detected). This was confirmed by K. Kadota (Ageo, Saitama, Japan). 0.25-m f/5.0 reflector + CCD. Coma diameter 5'.5; tail at least 18' long in p.a. 331° [IAUC 8032, 2002 Dec 14].

J. Watanabe, National Astronomical Observatory of Japan, reported the independent visual discovery of this comet by Shigehisa Fujikawa, Oonohara, Kagawa, Japan, (Dec 14.858, 9; 4', 0.16-m reflector; report received by Watanabe prior to the issuance of IAUC 8032). Terry Lovejoy, Thornlands, Qld., Australia, (confirmed by Sebastian Hoenig) reported that, based on the appearance of other comets in the Solar Wind ANisotropy (SWAN) experiment on board the SOHO satellite, 2002 X5 appeared faintly visible at mag approximately 10–11 on SWAN images that were taken on six dates, Nov 6–13, and posted at the SOHO website [IAUC 8033, 2002 Dec 16].

The SWAN images and the pre-perihelion lightcurve suggest that the comet could have been found several months prior to the actual discovery, although the SWAN magnitudes are a little fainter than the extrapolated aperture corrected curve. It is possible that comet hunters were not looking for objects in the northern sky below the pole at this time.

R. W. Russell, D. K. Lynch & D. L. Kim, The Aerospace Corporation; M. L. Sitko, University of Cincinnati; and W. Golisch, NASA Infrared Telescope Facility (IRTF), report that spectroscopy of comet 2002 X5 was obtained on Jan 9.1 and 10.05–10.14 at 1.5–3.4 airmasses with the Aerospace Broadband Array Spectrograph System at the IRTF 3-m telescope. They observed a relatively smooth thermal-emission spectrum, over most of the spectral range covered (3–14 microns), whose shape resembled a black body near or slightly above the blackbody radiative equilibrium temperature of 340K. They did not detect any silicate emission features. A 3.4-micron C–H feature may be present in emission. The emission at 10.2 microns was extended at least 18" east–west and 10" north–south, using a 29" north–south chop. The beam only needed to be moved about 3" east–west to get to the half-power location, suggesting that the infrared emission was concentrated on the peak with an extended coma component. On Jan 10, the spectrum was essentially unchanged, though perhaps 5% brighter [IAUC 8062, 2003 Jan 30].

After a long spell of overcast skies, it cleared for Cambridge as dusk fell on Dec 17 and Jonathan Shanklin was able to observe the comet with his 0.15-m reflector $\times 80$, making it 8.5, DC3 and diameter 2.4' on Dec 17.73. This contrasts with observers using binoculars, for example Tony Scarmato, Calabria, Italy on Dec 17.70 made it 6.7, coma 5' in 7 $\times$ 50B and Guus Gilein from the Netherlands on Dec 18.21 made it 7.2, coma 5' in 10 $\times$ 50B. It was a little brighter in early 2003 Jan; Melvyn Taylor observing with 16 $\times$ 70B on Jan 5.27 put it at 6.8. Stephen Getliffe was one of the last to observe it prior to perihelion, estimating it at 5.3 in his 0.11m reflector on Jan 18.27.

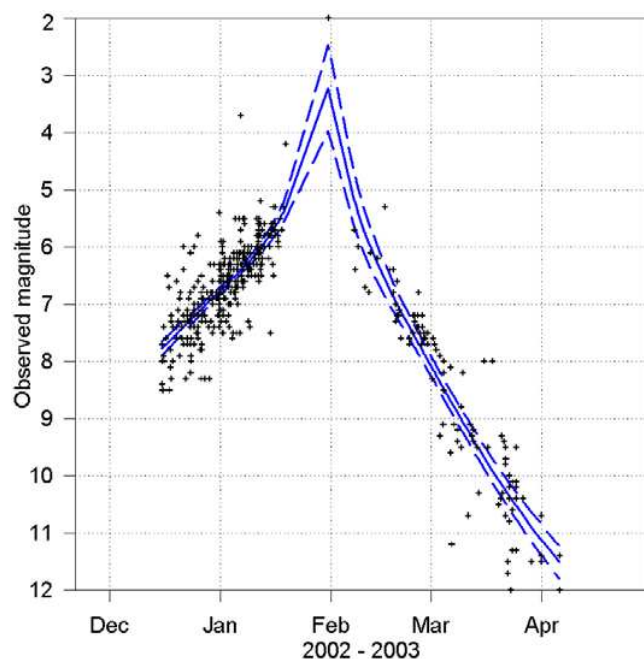


Figure 35. The lightcurve of 2002 X5 (Kudo–Fujikawa).

The comet was visible in the SOHO C3 coronagraph from Jan 25 to 31. It reached perihelion at 0.19 au on Jan 29.0, when it showed significant phase angle effects and faded significantly. After perihelion it appeared to brighten again, reaching around 1st magnitude. It was recovered after conjunction, but a little fainter than expected when Michael Mattiazzo reported it at 5.7 on Feb 7.51 in 25 $\times$ 100B, low in the twilight. Shanklin was able to observe it a few times on his visit south, on the final occasion on March 18.09 using his 90mm Orion ShortTube refractor (mostly used for solar ob-

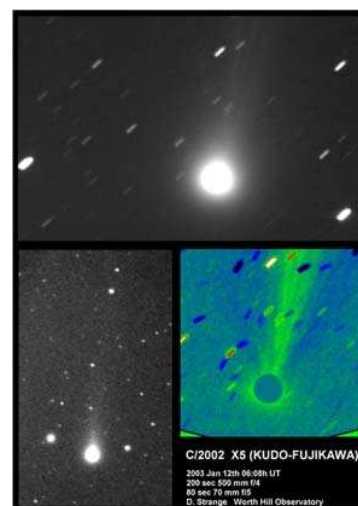


Figure 36. 2002 X5 (Kudo–Fujikawa) imaged by David Strange on 2003 Jan 12.

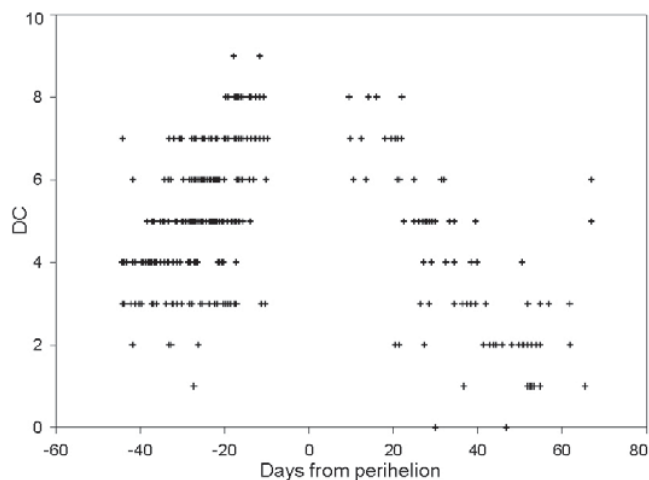


Figure 38. The degree of condensation (DC) of 2002 X5 (Kudo–Fujikawa).

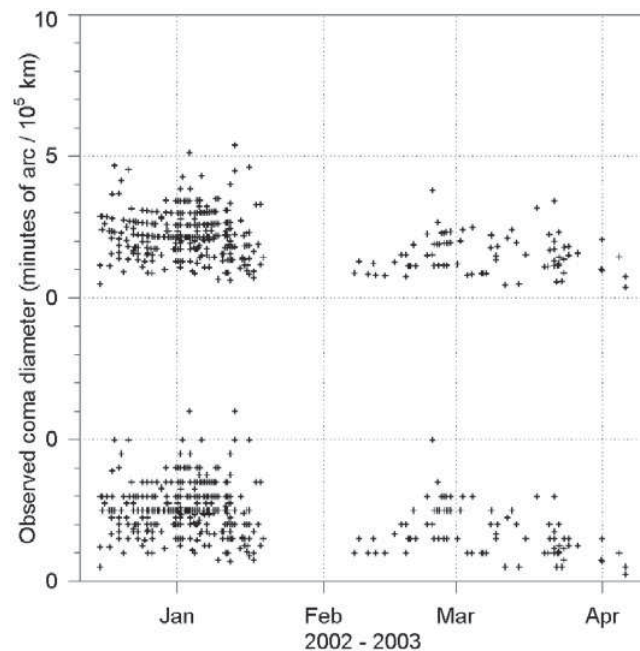


Figure 37. The coma diameter of 2002 X5 (Kudo–Fujikawa).

servation) when the comet had faded to about 8.0. It remained exclusively a southern hemisphere object until mid-March, but its re-appearance in northern skies did not attract much attention from observers, although it was fading rapidly. It was around 12th magnitude in early April when the final visual observations were made.

The lightcurve shows that overall the comet became a little fainter at perihelion, and faded more rapidly than it brightened. Separate magnitude parameters are given for pre- and post-perihelion and the lightcurve shown is a composite fit.

A short tail less than a degree long was seen prior to perihelion, and the best seen after perihelion was only 2° , when Andrew Pearce saw it on Feb 8.51 in 20×80B. The observed coma diameter reached a maximum of around $10'$, and appeared to shrink as the comet approached perihelion, probably due to the poorer observing conditions. The actual physical size changed little through the apparition. The coma DC followed the expected pattern of becoming most condensed around the time of perihelion.

2002 Y1 (Juels–Holvorcem)

A comet was found on CCD images taken with a 0.12-m f/5.0 refractor by Charles W. Juels (Fountain Hills, AZ) and Paulo R. Holvorcem (Campinas, Brazil) on Dec 28.44. Holvorcem reported that co-adding five 45-s and one 90-s exposures taken around Dec 28.5 revealed a coma $1'.8$ in diameter. Following posting on the NEOCP, several other observers reported on the cometary appearance of the object, including D. T. Durig (Sewanee, TN), who noted that 300-s CCD exposures with a 0.3-m reflector showed an inner coma of diameter $30''$ and a wider, diffuse glow of diameter $2'.5$ [IAUC 8039, 2002 Dec 29]. The orbit suggests that it was not a 'new' comet from the Oort cloud.

Paulo Holvorcem provides this background information: *Charles Juels and myself collaborate over the internet, with the help of 'fast' ADSL internet connections, which makes it easy to commu-*

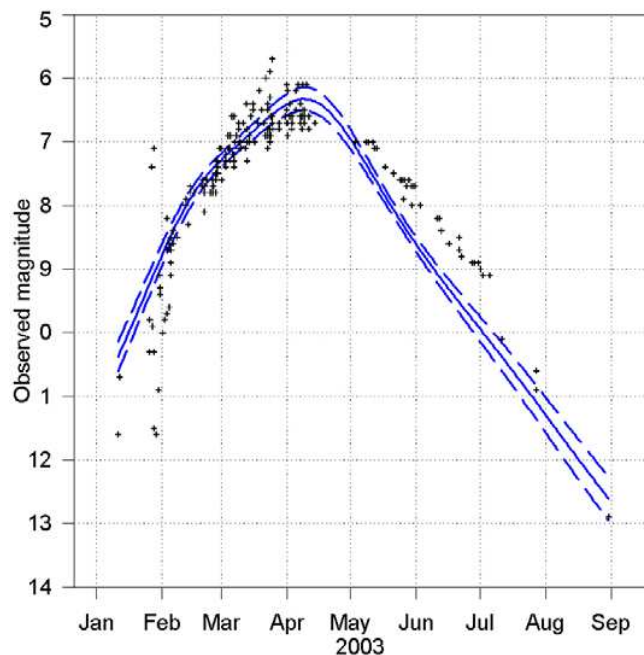


Figure 39. The lightcurve of 2002 Y1 (Juels–Holvorcem).



Figure 40. 2002 Y1 (Juels–Holvorcem) imaged near NGC 6946 by Rolando Ligustri on 2003 Feb 25.

nicate and transfer images in near-real time between Fountain Hills (near Phoenix, Arizona) and my home in Campinas, Brazil. From here I can schedule search and follow-up runs at Fountain Hills using software I wrote for this purpose (or they can be planned by Charles), and we can split the tasks of data analysis by transferring images over the internet. The astrometric observations from codes 926, 848, and 860, which you see in MPECs are obtained in an analogous way. These days I hardly leave my house to observe!

We were very lucky to find 2002 Y1 on the first night with the new 0.12-m f5 refractor on an automated (high-end) mount. For some time we had considered the idea of doing wide-field searches for new 'bright' objects, and this was our first experiment. The field of view of the SITe CCD is about 2.3×2.3 degrees. On that first night (December 28) we searched some 300 square degrees and were surprised to find an object of apparently diffuse appearance. Co-adding the discovery images and a few others taken for follow-up on the same night suggested a coma about $1.8'$ in diameter, which we didn't immediately report (it seemed too much luck, maybe it was not real). But we reported the positions immediately to the MPC, which posted the object (then referred to as HJ0080) on the NEOCP. It was soon confirmed by others, so we were sure that it was real. And if it was real, then the co-addition

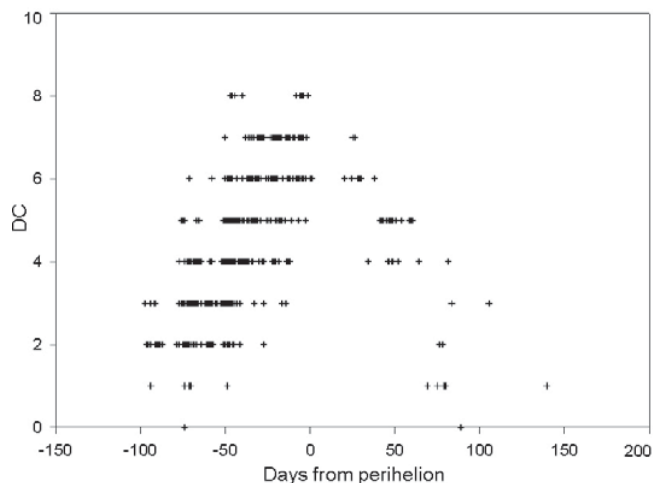


Figure 41. The degree of condensation (DC) of 2002 Y1 (Juels–Holvorcem).

of the images showed that it was a comet. We then reported the detection of the coma on December 29, and soon afterwards the comet was announced on an IAUC and an MPEC.

Some observations in early 2003 Jan suggested that the comet might be around 13th magnitude. Seiichi Yoshida estimated it at 10.7 in his 0.32-m reflector on Jan 11.79. Observations later in January after the Moon left the sky suggest that the comet had brightened to 10th magnitude. Observing on Feb 3.1 with 20×80B and 25×100B Jonathan Shanklin found the comet was a large, diffuse object of approximately mag 8. Observing with 15×80B on March 2.80 Guy Hurst found that the comet was 7.2. It was brightest in early April, and Stephen Getliffe found it 6.5 in 7×50B on April 2.17.

It passed through solar conjunction in the second half of April and became a southern hemisphere object. By now it was slowly fading. Alexander Amorim recovered it on May 3.35 when it was 7.0 in his 20×80B. A month later, Stuart Rae found it at 8th mag in his 15×70B on June 10, 11 & 12. By the end of July it was mag 10 and Andrew Pearce made the final observation on Aug 30.83 when it was 12.9 in his 0.41m reflector.

There was some tail development, but at best this was around one degree, for example Atilla Kosa–Kiss reporting a 1.2° tail in p.a. 18 on 2003 Apr 2.10. The observed coma was largest at the end of Feb, with the comet being closest to Earth in mid-month, when the Moon was full. The physical size of the coma changed little through the apparition. The coma DC followed the expected pattern of becoming most condensed around the time of perihelion.

The numbered periodic comets at perihelion in 2002

6P/d'Arrest

The comet made its 18th observed return, but this was a poor one, with the comet at a small elongation when in visible range. It was first observed by La Hire in 1678 and only four other periodic comets (Halley, Swift–Tuttle, Ikeya–Zhang and Tempel–Tuttle) have a longer observational interval. At a good return d'Arrest can reach naked eye brightness, but orbital perturbations have increased its perihelion distance over the past few returns and predictions suggested that it was unlikely that it would get brighter than mag 12 at this return. Only two CCD observations were reported, both made over a year before perihelion, when the comet was 21st magnitude.

7P/Pons–Winnecke

The comet was discovered by Jean Louis Pons with a 0.12-m refractor at Marseilles in 1819, but was then lost until rediscovered by Friedrich August Theodor Winnecke with a 0.11-m refractor in Bonn in 1858. He demonstrated the identity and recovered the comet in 1869. The perihelion distance has slowly been increasing since the early 1800s. It can make close approaches to the Earth and did so in 1927 (0.04 au), 1939 (0.11), 1892 (0.12), 1819 (0.13) and 1921 (0.14). An outburst of the meteor shower associated with the comet, the June Boötids, occurred on 1998 June 27.6.

On this return it was best seen from the southern hemisphere,

where a few observers made visual observations. The comet was brightest in June and July when it reached around 12th magnitude.

15P/Finlay

William Henry Finlay discovered this comet from the Cape Observatory on 1886 September 26, with a 0.18-m refractor. It was around 11th magnitude at this and the following return. In 1906 it passed 0.3 au from the Earth and reached 6th magnitude. Jupiter perturbations in 1910 gave an unfavourable return in 1913, but a good one in 1919, though they were unfavourable after that until 1953, when it was recovered. It has been observed at every return since 1953, and this was its 13th return. It is an intrinsically faint object and there are usually few visual observations. This was no exception, though CCD observations suggest that the comet reached 13th magnitude in February. A September perihelion would give favourable observing circumstances, under which the comet could reach 5th magnitude.

18D/Perrine–Mrkos

This comet was last seen in early 1969, when it was brightest after perihelion. Discovered in 1896 and seen at only five returns despite a six year period, it has had something of a chequered history, with quite large variation in intrinsic magnitude from return to return, suggestive of outburst behaviour. It was not seen at this return.

22P/Kopff

22P/Kopff was discovered photographically by A. Kopff at Konigstuhl Observatory in 1906, when it was around mag 11. The next return was unfavourable, but it has been seen at every return since then. Following an encounter with Jupiter in 1942/'43 its period was reduced and the perihelion distance decreased to 1.5 au. The following return was one of its best and it reached 8th magnitude. The next return was unusual, in that it was 3 mags fainter than predicted until perihelion, when it brightened by 2 mags. It suffered another encounter with Jupiter in 1954, but this made significant changes only to the angular elements. 1964 was another good return and the comet reached 9th magnitude.

The 2002 return was not favourable and only a few observations were received, suggesting that the comet reached 12th magnitude in September.

26P/Grigg–Skjellerup

John Grigg discovered this comet with a 90mm refractor from Thames, New Zealand in 1902 July. It was lost until recovered by J. F. Skjellerup during a search with a 75mm refractor at Rosebank, Cape Town in 1922 May. This was the first return since 1922 at which it was not observed, though the period of visibility is always quite short.

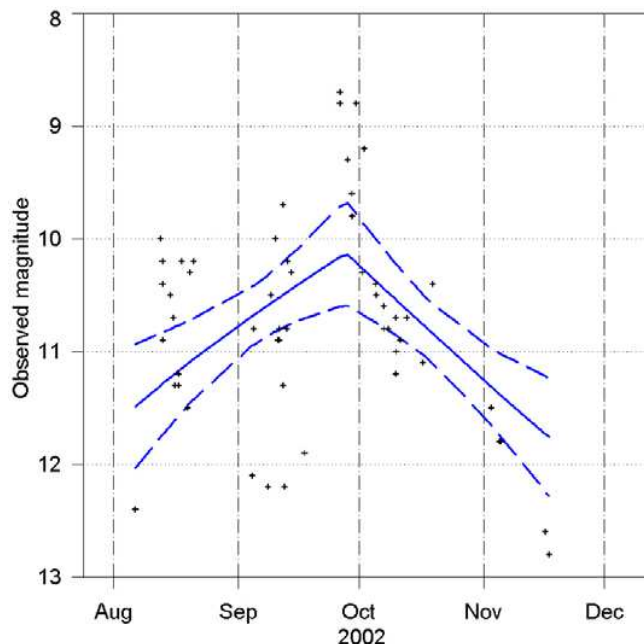


Figure 42. The lightcurve of 46P/Wirtanen.

28P/Neujmin

Although visual observations were made at the last return in 1984, this time round only CCD images were obtained. These indicate that the comet was around 16th magnitude in June. The ephemeris suggests that it should have continued brightening and might just have come within visual range for southern hemisphere observers towards the end of the year, prior to becoming poorly placed.

30P/Reinmuth

Karl Reinmuth discovered this comet during the course of a minor planet survey at Heidelberg Observatory in 1928. This was a good return and it reached mag 12, however an encounter with Jupiter in 1937 increased the perihelion distance and it was missed in 1942/'43. The perihelion distance reduced again for the 1988 and following returns and 2002 was its best return since discovery, with the comet not far from opposition when near perihelion. Visual observers made it 13th magnitude when at its brightest in February and March 2003.

31P/Schwassmann–Wachmann

The German pair's second comet was discovered in 1929 at mag 11 and it has been observed since at every return. The comet encountered Jupiter in 1997, shifting the perihelion to 3.35 au and returning it to the low eccentricity orbit that it had prior to an encounter in 1926. This substantially reduced its peak brightness, and only CCD observations were received this time, with the comet reaching 17th magnitude in 2002 February.

46P/Wirtanen

Carl A. Wirtanen discovered the comet at Lick in 1948. It is in a chaotic orbit, and its perihelion distance was much reduced due to approaches to Jupiter in 1972 and 1984. It has been reported to outburst, but BAA data suggests that it has just been rejuvenated

Shanklin: The comets of 2002 (Part 2)

after the perihelion distance was reduced. A December perihelion would give a close approach to the Earth and this will be achieved in 2018. In 2002 the perihelion was in August, and the comet was exclusively a morning object.

The first visual observation was reported in early August when the comet was around mag 11.5. Observations suggest that the comet peaked at around 9th magnitude in late September. Jonathan Shanklin observed it on Oct 19.18, estimating it at 10.4 in his 0.2-m LX200 ×75. The comet faded and the last visual observations in mid-November made it around 13th magnitude. The observations are best fitted by a linear type lightcurve, with the comet brightest about a month after perihelion.

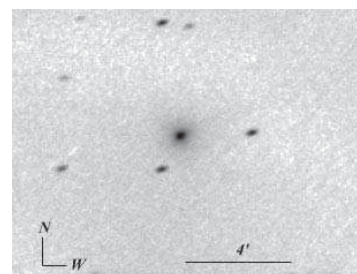


Figure 43. 46P/Wirtanen imaged by Giovanni Sostero on 2002 Oct 2.

57P/du Toit–Neujmin–Delporte

Perturbations by Jupiter in 1872 and 1884 reduced the perihelion distance from 1.7 to 1.3 au, but the comet was not discovered until 1941, when there was a perihelic opposition, the best possible between 1800 and 2000. It was independently found by Daniel du Toit at Harvard's Boyden Station in Bloemfontein, South Africa on July 18; by Grigory Neujmin at Simeiz Observatory, Crimea on July 25 and by Eugène Delporte at the Royal Observatory, Uccle, Brussels on August 19. The comet may have been in outburst at discovery, as it was comparatively much brighter than at subsequent observed returns. It was lost for the next four returns. Further perturbations in 1954 and 1966 returned the perihelion distance to near its previous value and it remains at around 1.7 au. The comet was recovered in 1970 thanks to exceptionally accurate predictions by Brian Marsden. It again outburst at the 1996 return. The 2002 return was the best since 1964. Another Jovian encounter in 2038 will reduce the perihelion distance slightly to 1.6 au.

A faint object reported as a possible NEO candidate on 2002 July 12.21 by S. Pravdo, Jet Propulsion Laboratory, on behalf of NEAT and described as appearing cometary was recognized at the Minor Planet Center as being on the line of variation and to have the motion of comet 57P, but to be displaced from that brighter comet by more than 0.2° on the 1.2-m Palomar Schmidt frames. NEAT had reported the brighter comet on July 1, but a check with Pravdo did not reveal anything obvious at the July 1 expected position of the new object. Following a request by the Minor Planet Center, M. Tichy & J. Ticha (Klet, KLENOT 1.06-m reflector) located the new object, describing it as diffuse and having a coma of diameter $8''$ – $10''$; as did G. Masi & F. Mallia (Campo Catino, 0.8-m f/8 reflector), whose co-addition of five images (for a total integration of 20 min) showed a well-defined $12''$ coma and a delicate northeast-southwest elongation. The positions are fully consistent with the orbital elements for comet 57P with T for this 'component B' delayed by 0.19 day. Comet 57P was anomalously bright at its unfavourable 1996 return, when m_1 was 13.3, some 5 magnitudes brighter than expected, at the first post-perihelic observation on July 24.8 [IAUC 7934, 2002 July 13].

Y. R. Fernandez, D. C. Jewitt & S. S. Sheppard, University of Hawaii, report the detection of an additional 18 components (C–T)

of comet 57P in observations taken on July 17.5 and 18.4 with the University of Hawaii 2.2-m reflector. The components range from well condensed to diffuse with little central condensation and have comae of diameter 1"–5". Components I, K, L, N, P, and T show a lack of central condensation [IAUC 7935, 2002 July 20].

Z. Sekanina, JPL, noted: *Very preliminary analysis of the relative astrometry of the two brightest nuclei has been completed, employing a new computer code recently developed by P. W. Chodas and myself. The parameters of the standard model for split comets are now determined with full account of the planetary perturbations and the nongravitational effects on the principal nucleus. The results suggest that nucleus B could have broken off from primary A near perihelion in 1996. If the event had occurred exactly at perihelion, plausible values for the nongravitational deceleration ($4\text{--}8 \times 10^{-5}$ solar attraction, as B is obviously a persistent companion; cf. Sekanina 1982, Comets, ed. L. L. Wilkening, pp. 251–287) require that B separated from A with a reasonably low velocity, whose transverse component ranged from 0.5 to 1 m/s in the direction opposite the orbital motion and whose normal component was some 0.4–0.5 m/s toward the north orbital pole. These solutions are independent of the radial component of the separation velocity.*

Similar solutions are also found for separation times 100 days before and after perihelion, except that the deceleration then correlates with both the transverse and radial components. Because of the comet's extremely low orbital inclination, it is doubtful that the separation parameters can ever be determined with high accuracy. It is unlikely that companions C–T are all products of the same event. In particular, C–F were probably released from A more recently than B was. Some of nuclei M–T may be fragments of B, but a more complex fragmentation hierarchy is also possible [IAUC 7946, 2002 August 3].

Further to this report, Sekanina noted: *I was able to link the observations of the August 7 secondary nucleus with those of companion F on July 17. An excellent fit (mean residual 0".26) suggests that F separated from nucleus A most probably in the*

second half of May 2001, a little more than 400 days before perihelion at a heliocentric distance of about 3.6 AU. By contrast, all attempts to fit the offsets on the assumption of a separation near the 1996 perihelion have failed, leaving systematic residuals of a few arcsec. The 2001 solution is rather insensitive to the adopted nongravitational deceleration, if it is on the order of several units of 10^{-4} solar attraction. The derived separation velocity is then about 5 m/s, mostly in the orbital plane [IAUC 7957, 2002 August 19].

A few visual observations were made, which show that the primary component was around 13th magnitude from 2002 July to September, and the comet was followed by CCD observers until November.

67P/Churyumov–Gerasimenko

The comet, which is the target of the *Rosetta* mission, was well observed by visual and CCD observers at the 2002 return. Details are given in the author's paper on 'The brightness of 67P/Churyumov–Gerasimenko'.⁸

77P/Longmore

The comet was discovered by Andrew Longmore on plates taken with the 1.22m UK Schmidt at Siding Spring on 1975 June 10. The comet was perturbed into its present orbit by an encounter with Jupiter in 1963, which reduced the perihelion distance from 3.0 au to 2.4 au. A further encounter in 2046 will reduce it further to 1.9 au.

A couple of visual observations were made in 2002 March, when the comet was around 14th magnitude. CCD observations were made throughout the first half of the year.

89P/Russell

This comet was discovered by Ken Russell on plates taken with the 1.22m UK Schmidt at Siding Spring on 1980 Sept 28. The orbit has been fairly stable over the last century, and two distant Jovian encounters later this century make only small changes to it. A few CCD observations show it fading from 17th to 18th magnitude between 2002 August and November.

90P/Gehrels

The comet was discovered by Tom Gehrels on plates taken with the 1.22m Palomar Schmidt on 1972 Oct 11. The orbit shows little change over the last couple of centuries, and doesn't change in the next century. CCD observations show that the comet was around 17th magnitude between 2002 September and December.

92P/Sanguin

The comet was discovered by Juan Sanguin with the 0.51m double astrograph at El Leoncito, Argentina, on 1977 Oct 15. The comet has occasional distant encounters with Jupiter, but they have made little change to the orbit. For a 13th magnitude comet it was sur-

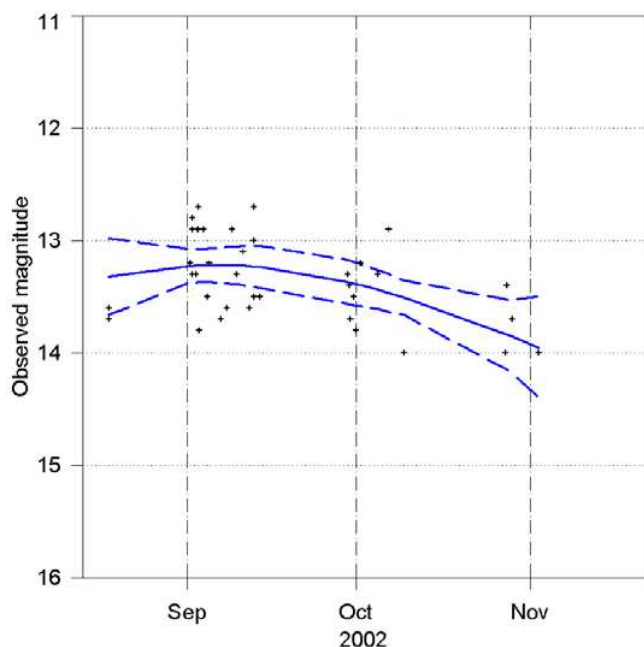


Figure 44. The lightcurve of 92P/Sanguin.

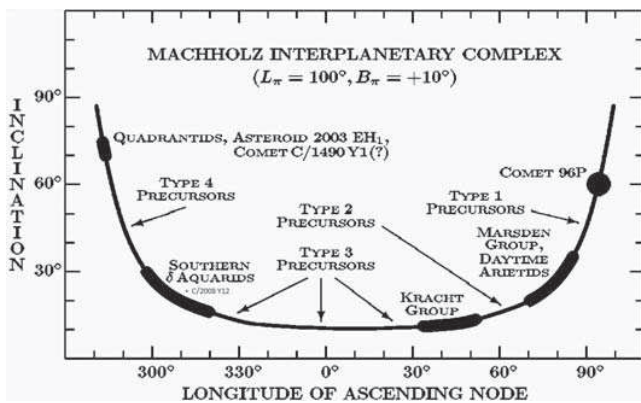


Figure 45. The Machholz complex (from Sekanina & Chodas).⁹

prisingly well observed, with CCD observations supplementing visual observations from 2002 June to December.

96P/Machholz

Don Machholz discovered this comet on 1986 May 12 with 29×130B. The orbit is evolving relatively rapidly, with the perihelion distance decreasing from 0.13 au at discovery to 0.09 au at the end of this century. It will pass 0.3 au from Earth in 2028 June. The comet is the largest known object in the complex of objects that includes the Quadrantid, delta Aquarid and daytime Arietid meteors, and the Marsden and Kracht groups of SOHO comets. This is described in more detail by Sekanina & Chodas,⁹ who show that the angular orbital elements of these objects undergo rapid evolution, and may originate from a single body.

The comet is rarely well placed for ground based observation, but Michael Mattiazzo was able to see it on 2001 Dec 16 & 17 with his 0.28m reflector when it was about mag 13.5 and at only 10° altitude. It passed through the SOHO coronagraph field between 2002 Jan 6 & 9. This was quite a spectacular passage, with the comet entering the field head first, and rotating round during perihelion passage so that it left tail first. It steadily brightened, entering the field at around 3.5 and leaving it at around -2, though at this point the sensor had saturated. After perihelion Kenichi Kadota was able to image the comet from Jan 13 to Feb 14 as it faded from around 5.5 (Cousins I) to 14.7.

115P/Maury

The comet was discovered by Alain Maury on plates taken with the 1.22m Palomar Schmidt on 1985 Aug 16, though it was not announced for another three weeks. The orbit is fairly stable with no significant changes over the period 1900 to 2100. Three CCD measurements were made in 2002 May and June by Akimasa Nakamura, when the comet was 19th magnitude.

124P/Mrkos

Antonin Mrkos discovered a fast moving object on plates taken at the Klet Observatory on 1991 March 16. On subsequent plates he noted that it was diffuse and about 14th magnitude. The comet

was put into its present orbit by encounters with Jupiter in 1904 and 1916 which reduced the perihelion distance from 1.7 to 1.4 au. Further encounters in 2010 and 2022 will increase it to 1.8 au by the end of the century. Five CCD observations were made between 2001 Sept and 2002 Feb, when it was around magnitude 20. It has a fairly favourable return in 2014 when it gets to within 0.7 au of the Earth, but it will still be a CCD object unless it outbursts.

125P/Spacewatch

The comet was found by Tom Gehrels in *Spacewatch* images taken on 1991 Sept 8 with the 0.91m reflector. At the time it was the faintest comet discovered, at a nuclear magnitude of 21.1. It was slightly brighter than expected at the next return, reaching 14.5 in 1996 July. The comet experiences occasional perturbations by Jupiter, some of which increase and others decrease the perihelion distance, which varied between 1.7 and 1.5 au in the 20th century. Further encounters this century will increase it to 1.9 au. There was only one positive CCD image of the comet taken at this return, when it was 18th magnitude on 2002 March 12.

Other comets at perihelion in 2002

2000 SV₇₄ (LINEAR)

Since the report on the comets of 2000 was published,¹⁰ a few further observations of this comet have come to light, with the comet estimated at a little brighter than 14th magnitude in 2003 February and March by several observers. Revised magnitude parameters are given here.

258P/PanSTARRS = 2012 HI

Pan-STARRS discovered a 22nd magnitude comet on 2012 April 27.43. Images of the comet were then found in Mt Lemmon survey data from Feb 7 and March 28, and *Spacewatch* data from March 29. As the orbit became better defined, observations from 2002 were found, though it has not yet been given an identity for this return. A series of encounters with Jupiter between 1917 and 1940 reduced the perihelion distance from 5.0 to 3.7 au, and another in 2091 will increase it to 5.2 au.

The following comets were also at perihelion during 2002: 2000 WM₁ (LINEAR), 2001 C1 (LINEAR), 2001 K5 (LINEAR), 2001 N2 (LINEAR), 2001 OG₁₀₈ (LONEOS), 2001 P3 (39P/Oterma), 2001 R1 (201P/LONEOS), 2001 RG₁₀₀ (158P/Kowal-LINEAR), 2001 T3 (P/NEAT), 2001 T4 (166P/NEAT), 2001 U6 (LINEAR), 2001 WF₂ (182P/LONEOS), 2001 X1 (LINEAR), 2001 Y1 (152P/Helin-Lawrence), 2003 F6 (211P/Hill), 2003 K1 (*Spacewatch*) and 2003 QX₂₉ (P/NEAT). Those found prior to 2002 have already been described^{10,11} and those found in 2003 are described on the Section web page covering the comets of 2003¹² and periodic comets 201–299.¹³

Many comets were discovered with the SOHO LASCO coronagraphs and were not observed elsewhere. The majority were sungrazing comets of the Kreutz group and were not expected to survive perihelion. Some of the comets showed no tail at all and it

Table 5. SOHO comets

Comet	IAU Circular	Comet	IAU Circular	Comet	IAU Circular	Comet	IAU Circular
a) Kreutz group							
1998 H5	7842, 2002 Mar 5	2002 K10	7951, 2002 Aug 10	2002 W4	8100, 2003 Mar 25	1997 U9	7931, 2002 Jul 2
1998 H6	7842, 2002 Mar 5	2002 L1	7916, 2002 Jun 7	2002 W5	8103, 2003 Mar 31	1998 V8	7916, 2002 Jun 7
1998 V9	7916, 2002 Jun 7	2002 L2	7916, 2002 Jun 7	2002 W6	8106, 2003 Apr 3	1998 W7	7916, 2002 Jun 7
1998 X12	7916, 2002 Jun 7	2002 L3	7918, 2002 Jun 13	2002 W7	8106, 2003 Apr 3	1999 F3	7898, 2002 May 13
1999 H8	7839, 2002 Mar 1	2002 L4	7918, 2002 Jun 13	2002 W8	8111, 2003 Apr 8	1999 K16	7842, 2002 Mar 5
1999 H9	7839, 2002 Mar 1	2002 L5	7919, 2002 Jun 14	2002 W9	8263, 2004 Jan 7	1999 L9	7842, 2002 Mar 5
1999 J13	7839, 2002 Mar 1	2002 L6	7922, 2002 Jun 17	2002 W10	8263, 2004 Jan 7	1999 P7	7863, 2002 Mar 29
1999 K17	7842, 2002 Mar 5	2002 L7	7930, 2002 Jul 2	2002 W11	8263, 2004 Jan 7	2000 B8	7853, 2002 Mar 14
1999 M4	8022, 2002 Nov 24	2002 L8	7930, 2002 Jul 2	2002 W12	8263, 2004 Jan 7	2000 J8	7899, 2002 May 13
1999 W2	7898, 2002 May 13	2002 M1	7930, 2002 Jul 2	2002 W13	8263, 2004 Jan 7	2000 N4	7899, 2002 May 13
2000 F2	7913, 2002 May 30	2002 M2	7930, 2002 Jul 2	2002 W14	8263, 2004 Jan 7	2000 X9	7919, 2002 Jun 14
2000 F3	7913, 2002 May 30	2002 M3	7935, 2002 Jul 20	2002 W15	8263, 2004 Jan 7	2001 C7	7936, 2002 Jul 22
2000 G3	8073, 2003 Feb 14	2002 M4	7935, 2002 Jul 20	2002 W16	8263, 2004 Jan 7	2001 K11	7952, 2002 Aug 10
2000 H6	7899, 2002 May 13	2002 M5	7935, 2002 Jul 20	2002 W17	8263, 2004 Jan 7	2001 L10	7952, 2002 Aug 10
2000 H7	7899, 2002 May 13	2002 M6	7935, 2002 Jul 20	2002 X3	8034, 2002 Dec 14	2001 R7	7952, 2002 Aug 10
2000 T5	7919, 2002 Jun 14	2002 M7	7935, 2002 Jul 20	2002 X4	8034, 2002 Dec 14	2001 V6	7952, 2002 Aug 10
2000 T6	7919, 2002 Jun 14	2002 M8	7948, 2002 Aug 3	2002 X7	8264, 2004 Jan 9	2001 X10	7952, 2002 Aug 10
2001 H8	7918, 2002 Jun 13	2002 N1	7936, 2002 Jul 22	2002 X8	8264, 2004 Jan 9	2002 A4	7951, 2002 Aug 10
2001 J5	7931, 2002 Jul 2	2002 O1	7936, 2002 Jul 22	2002 X9	8264, 2004 Jan 9	2002 H8	7951, 2002 Aug 10
2001 K10	7931, 2002 Jul 2	2002 O2	7936, 2002 Jul 22	2002 X10	8264, 2004 Jan 9	2002 P3	7956, 2002 Aug 19
2001 L11	7952, 2002 Aug 10	2002 O3	7936, 2002 Jul 22	2002 X11	8264, 2004 Jan 9	2002 R8	7984, 2002 Oct 5
2002 C3	7839, 2002 Mar 1	2002 P2	7956, 2002 Aug 19	2002 X12	8264, 2004 Jan 9	2002 T2	7991, 2002 Oct 12
2002 C4	7839, 2002 Mar 1	2002 Q7	7963, 2002 Aug 31	2002 X13	8266, 2004 Jan 12	2002 U6	8025, 2002 Dec 2
2002 C4	7839, 2002 Mar 1	2002 Q11	7969, 2002 Sep 13	2002 X14	8266, 2004 Jan 12	2002 V4	8073, 2003 Feb 14
2002 D1	7839, 2002 Mar 1	2002 Q12	7969, 2002 Sep 13	2002 X15	8266, 2004 Jan 12	2002 X6	8073, 2003 Feb 14
2002 E1	7850, 2002 Mar 12	2002 Q13	7969, 2002 Sep 13	2002 X16	8269, 2004 Jan 15	2002 Y2	8073, 2003 Feb 14
2002 E3	7862, 2002 Mar 28	2002 Q14	7969, 2002 Sep 13	2002 Y3	8266, 2004 Jan 12	Note: 2002 P3 was SOHO 500.	
2002 F2	7862, 2002 Mar 28	2002 R6	7984, 2002 Oct 5	2002 Y4	8269, 2004 Jan 15		
2002 F3	7862, 2002 Mar 28	2002 R7	7984, 2002 Oct 5	(A comet announced as 2002 W18 appears to be identical to comet 2002 W12.)			
2002 G2	7873, 2002 Apr 10	2002 S2	7975, 2002 Sep 21				
2002 G4	7882, 2002 Apr 22	2002 S3	7984, 2002 Oct 5				
2002 G5	7882, 2002 Apr 22	2002 S6	7986, 2002 Oct 7				
2002 H1	7882, 2002 Apr 22	2002 S8	7991, 2002 Oct 12				
2002 H3	7886, 2002 Apr 29	2002 S9	7991, 2002 Oct 12				
2002 H4	7886, 2002 Apr 29	2002 S10	7991, 2002 Oct 12				
2002 H5	7886, 2002 Apr 29	2002 T3	7991, 2002 Oct 12				
2002 H6	7886, 2002 Apr 29	2002 U1	8000, 2002 Oct 26				
2002 H7	7948, 2002 Aug 3	2002 U3	8022, 2002 Nov 24				
2002 J1	7897, 2002 May 9	2002 U4	8022, 2002 Nov 24				
2002 J2	7897, 2002 May 9	2002 U5	8022, 2002 Nov 24				
2002 J3	7899, 2002 May 13	2002 U6	8025, 2002 Dec 2				
2002 J6	7909, 2002 May 28	2002 U7	8025, 2002 Dec 2				
2002 J7	7909, 2002 May 28	2002 U8	8025, 2002 Dec 2				
2002 J8	7913, 2002 May 30	2002 U9	8025, 2002 Dec 2				
2002 K3	7909, 2002 May 28	2002 V3	8073, 2003 Feb 14				
2002 K5	7913, 2002 May 30	2002 V6	8099, 2003 Mar 25				
2002 K6	7913, 2002 May 30	2002 V7	8099, 2003 Mar 25				
2002 K7	7913, 2002 May 30	2002 W1	8100, 2003 Mar 25				
2002 K8	7951, 2002 Aug 10	2002 W2	8100, 2003 Mar 25				
2002 K9	7951, 2002 Aug 10	2002 W3	8100, 2003 Mar 25				
				b) Marsden group			
				1998 A2	7853, 2002 Mar 14		
				1998 A3	7853, 2002 Mar 14		
				1998 A4	7863, 2002 Mar 29		
				1999 N5	7854, 2002 Mar 20		
				1999 P6	7863, 2002 Mar 29		
				1999 P8	7863, 2002 Mar 29		
				1999 P9	7863, 2002 Mar 29		
				2000 C7	7919, 2002 Jun 14		
				2002 R1	7969, 2002 Sep 13		
				2002 R4	7984, 2002 Oct 5		
				2002 V5	8073, 2003 Feb 14		
				c) Meyer group			
				1997 G7	7841, 2002 Mar 4		
				1997 H4	7841, 2002 Mar 4		
				1997 H5	7841, 2002 Mar 4		
				1997 O2	7931, 2002 Jul 2		
				1997 U8	7931, 2002 Jul 2		
				d) Kracht group I			
				1999 M3	7853, 2002 Mar 14		
				1999 N6	7854, 2002 Mar 20		
				2001 Q8	7952, 2002 Aug 10		
				2001 R8	7952, 2002 Aug 10		
				2001 R9	7952, 2002 Aug 10		
				2001 N2	7956, 2002 Aug 19		
				2002 Q8	7963, 2002 Aug 31		
				2002 Q10	7969, 2002 Sep 13		
				2002 S4	7984, 2002 Oct 5		
				2002 S5	7984, 2002 Oct 5		
				2002 S7	7986, 2002 Oct 7		
				2002 S11	7991, 2002 Oct 12		
				e) Kracht group II			
				2002 R5	7984, 2002 Oct 5		
				f) SOHO comets not assigned to a group			
				1999 O4	8025, 2002 Dec 2		
				2000 S5	7885, 2002 Apr 25		

is possible that some observations of the supposed infra-Mercurial planet Vulcan were actually tiny Kreutz group comets. Some confirmation of this theory is given by ground-based CCD images taken of 2008 O1 (SOHO) during the total solar eclipse of 2008 August.

Table 5 lists the IAU *Circulars* announcing the Kreutz comets and those of the Marsden, Meyer and Kracht groups not previously mentioned. Further background is given in previous papers, on the Section web page covering the comets of 2002¹⁴ and on the Sungrazing Comets web page.¹⁵

One of the brighter Kreutz objects was 2002 J3, discovered by Kazimieras Cernis on May 13. Jonathan Shanklin independently discovered it at 08:30 on May 14, however this was 18 hours after the discovery had been posted and by then the comet was very obvious. Shanklin might have spotted it the previous day as he had looked at the C3 images on the previous evening.

Other comets and objects observed during the year

29P/Schwassmann–Wachmann

This annual comet normally has frequent outbursts and for a number of years seems to have been more often active than not. Historically it rarely got brighter than mag 13 in outbursts, however even this is remarkable for an object that is more distant than Jupiter from the Sun. It is possible however that its pattern of behaviour has changed. In the first half of 1998 it was in outburst on several occasions and this also occurred in 1999. 2000 was exceptional for the apparent lack of outbursts, whereas it was in almost continuous outburst in 2004. The randomly spaced outbursts may be due to a thermal heat wave propagating into the nucleus and triggering sublimation of CO in-

side the comet. This comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity.

In 2002 the comet was not well placed for observation from the UK, as it was in Capricorn when at opposition in early August. Better placed observers reported almost constant activity between mid-June and early December, with the comet varying between 12th and 14th magnitude.

Other objects of interest

Some asteroids have orbital characteristics that are similar to those of some periodic comets, and are worth including in observing programmes in case they develop cometary features. Some of those discovered during 2002 include: A/2002 AR₄ [LINEAR], A/2002 AO₇ [LINEAR] = (163070), A/2002 AF₂₉ [NEAT], A/2002 AO₁₄₈ [LINEAR], A/2002 FC [LONEOS], A/2002 GJ₈ [NEAT], A/2002 JE₁₀₉ [LINEAR], A/2002 JC₆₈ [LINEAR], A/2002 JW₁₁₅ [Spahr], A/2002 KJ₈ [NEAT], A/2002 LJ₂₇ [LINEAR], A/2002 MT₃ [NEAT], A/2002 RN₃₈, A/2002 RN₁₀₉, A/2002 RC₁₁₈ [LINEAR], A/2002 RP₁₂₀ [LONEOS], A/2002 UO₃ [LINEAR] = (170013), A/2002 WW₁₇ [NEAT], A/2002 XG₃₆ [LINEAR], and A/2002 YK₂₉ [LINEAR]. The discovery search programme, which is the likely name if the object shows cometary features, is given in square brackets. Further information about these objects is given on the Section web page covering the comets of 2002.¹⁴

As experience in detecting comets in SOHO images and understanding of their orbital groupings developed, further objects were discovered in archival images dating back to 1997. These objects are also listed in Table 5. One of these, 2000 S5, was an unusual discovery, found in archival SWAN imagery. Although having a perihelion distance of 0.60 au, it remained outside the LASCO field of view and was too far south and/or in the twilight for northern hemisphere comet hunters [IAUC 7885, 2002 April 25].

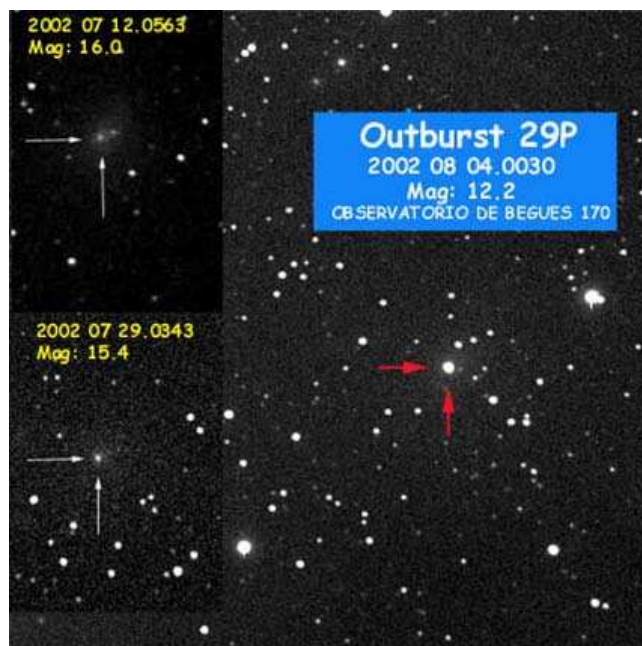


Figure 46. 29P/Schwassmann–Wachmann imaged at the start of an outburst on 2002 Aug 4 by Pepe Manteca. Inset are images taken on Jul 12 showing a fading outburst, and Jul 29 showing a minor outburst.

The Edgar Wilson Award

The 2002 Award was divided between Vance Avery Petriew, Regina, SK, Canada, for P/2001 Q2; Kaoru Ikeya, Shizuoka, Japan and Daqing Zhang, Henan province, China, for 2002 C1; Douglas Snyder, Palominas, AZ, USA and Shigeki Murakami, Niigata, Japan, for 2002 E2; Syogo Utsunomiya, Kumamoto, Japan, for 2002 F1 and William Kwong Yu Yeung, Benson, AZ, USA for P/2002 BV.

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