

The comets of 2002 (Part I)

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

This report is the thirteenth 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

The comets with discovery letter designations

2002 A1 (LINEAR) & 2002 A2 (LINEAR)

Two 19th magnitude objects of asteroidal appearance separated by less than 1° and having similar, somewhat unusual motion were reported by LINEAR on 2002 Jan 8.32. Further observations were made following placement of the objects on the Near Earth Object Confirmation Page (NEOCP), and predisccovery observations in 2001 Nov–Dec were identified at the Minor Planet Center in LINEAR and NEAT data. Orbit computations for the two objects gave very similar results (basically differing only in the date of perihelion) and showed that the objects were only 0.7 au from Jupiter at discovery.

Observations by T. B. Spahr & P. Berlind with the 1.2-m reflector at the F. L. Whipple Observatory on 2002 Jan 11.4 showed that the objects had faint, narrow tails around p.a. 250° . Independent observations by R. H. McNaught with the 1.0-m reflector at Siding Spring on Jan 11.6 showed that the first object, now designated 2002 A1, was slightly diffuse with a very faint 25" tail in p.a. 260° , and that the second object, 2002 A2, was almost stellar with a very narrow 20" tail in p.a. 250° . The 2001 Dec 13 & 17 observations of 2002 A1 originally appeared on MPS 45271 under the designation 2001 XG₁₁₅ [IAUC 7788, 2002 Jan 11]. The minimum distances from Jupiter were <0.4 au around 2001 Jul 8 & 18 for 2002 A1 and 2002 A2, respectively.

The comet(s) also passed close to Jupiter (0.14 au) on a previous return at the middle of the 18th century, and to Uranus (0.08 au) in 1819. Sekanina *et al.*³ show that the comets are of common origin and calculate that they separated in the late 1970s, when some 23 au from the Sun.

2002 A3 (LINEAR)

An 18th magnitude object reported as asteroidal by LINEAR on 2002 Jan 13.23 was noted by several CCD observers to be cometary: Jan 19.9 UT, slightly diffuse, $m_1 = 17.3$ (J. Nomen, Barcelona, Spain); Jan 20.6, 10" coma, $m_1 = 17.3$ (J. Broughton, Reedy Creek, Qld.); Jan 21.2, fuzzy coma of diameter about 10" (R. Dyvig, Quinn, SD); Jan 21.2, $m_1 = 17.0$, 22" tail in p.a. 250° (R. Fredrick, R. Trentman & R. Gruenke, Louisburg, KS) [IAUC 7799, 2002 Jan 21].

The value of the 'original' barycentric value of $1/a$, i.e. that pertaining before the comet suffered any planetary perturbations

during its present perihelion passage, gives an indication of the history of the comet. A value larger than about 0.0001 suggests that a comet has had a previous return to perihelion, whilst a value smaller than this indicates that it is most likely making its first visit from the Oort Cloud to the inner parts of the solar system. For this comet, its small value of +0.000025 suggests that it is a new visitor from the Oort Cloud.

2002 AR₂ (P/LINEAR)

An apparently asteroidal object of 19th magnitude recorded by LINEAR on Jan 6.15 and considered of only moderate interest was recognised at the Minor Planet Center to have been accidentally re-observed by LINEAR on three isolated nights in February and March, after which the orbit calculation suggested it might be a comet. It was therefore listed on the NEOCP. Observations with the 1.2-m reflector at Mt Hopkins Observatory by P. Berlind & T. B. Spahr on Apr 6.1 UT in poor conditions (high thin cirrus) showed that the images were softer than those of stars of similar brightness, and observations on Apr 7.2 showed the slightly diffuse images of a definite comet [IAUC 7869, 2002 Apr 7]. The comet has made no recent close approaches to Jupiter or Saturn.

2002 B1 (P/LINEAR)

An 18th magnitude object reported as asteroidal in appearance by LINEAR on Jan 26.09 and posted on the NEOCP, was found to be cometary on CCD images taken by M. Tichy & J. Ticha at Klet (coma diameter 7"–8" on Jan 29.8 & Feb 1.8 UT; coma diameter 9" with $m_1 = 17.7$ –18.0 and a faint tail in p.a. 165° on Feb 4.8) and by A. Galad & L. Kornos at Modra ('slightly diffuse' on Feb 1 & 2) [IAUC 7817, 2002 Feb 4]. It has a period around 31 years and its motion is affected by both Jupiter and Saturn.

2002 B2 (LINEAR)

An apparently asteroidal 19th magnitude object reported by LINEAR on Jan 23.40 and posted on the NEOCP was found to be cometary by M. Tichy & J. Ticha at Klet (coma diameter 6", with $m_1 = 17.2$, and faint 9" tail in p.a. 90° on Feb 3.05 UT) and by R. H. McNaught at Siding Spring (8" coma and 10" tail in p.a. 60° on Feb 6.66) [IAUC 7821, 2002 Feb 6]. It was quite distant and near peak brightness.

2002 B3 (LINEAR)

F. Shelly, Lincoln Laboratory, Massachusetts Institute of Technology, reported that an apparently asteroidal object of 19th magnitude, discovered by LINEAR on Jan 26.12 (and placed on the NEOCBP) was found to show a clear tail in p.a. about 330° on Feb 11.09 UT. T. B. Spahr, Harvard-Smithsonian Center for Astrophysics, reported that CCD images taken with the 1.2-m reflector at Mt Hopkins on Feb 12.13 showed the object to be very faintly diffuse with a faint extension in p.a. 315° [IAUC 7826, 2002 Feb 12]. It was very distant and near peak brightness.

2002 BV (172P/Yeung) = 2001 CB₄₀

An apparently asteroidal object of 20th magnitude discovered by amateur astronomer William Kwong Yeung, Benson, AZ, on CCD images taken with a 0.45-m reflector near Apache Peak on Jan 21.49 UT was identified by the Minor Planet Center with additional apparently asteroidal observations (including some by *Spacewatch* in 1998 and LINEAR in 2000–2001) made at several observatories, through its routine processing. These included a previous designation of 2001 CB₄₀. Noting the unusual nature of its orbit, T. Spahr obtained unfiltered CCD observations with M. Calkins at the 1.2-m reflector on Mount Hopkins on May 5, 6 & 7 that showed the object (m_1 about 17) larger than nearby stars of similar brightness and with a persistent faint tail about $5''$ long in p.a. 315° [IAUC 7986, 2002 May 9].

It is a Jupiter family comet and passed within 0.3 au of the planet in 1952 and will do so again in 2011. The former encounter reduced the perihelion distance from 3.3 to 2.2 au and the latter will increase it back again.

It was numbered 172 in 2005 September following identification of images on Palomar Sky Survey plates from the previous apparition in 1993 October.



Figure 1. Herbert Raab and Bill Yeung at MACE 2003.

2002 CF₁₄₀ (234P/LINEAR) = 2010 E4

An apparently asteroidal object discovered on 2002 Feb 8.32 by the LINEAR survey, and designated 2002 CF₁₄₀, was found to show cometary appearance on Mt Lemmon 1.5-m reflector CCD images taken by R. A. Kowalski in poor seeing on 2010 Mar 15. It was put into its present orbit by a close (0.13 au) encounter with Jupiter in 1999 March, which reduced the perihelion distance from 4.6 to 2.8 au. A further encounter in 2058 Feb will return the perihelion distance to 4.2 au.

2002 C1 (153P/Ikeya–Zhang)

The CBAT received word of the independent visual discovery of a 9th magnitude comet by Kaoru Ikeya (Mori, Shuchi, Shizuoka, Japan; 0.25-m reflector, $\times 39$ on Feb 1.41; communicated by S. Nakano, Sumoto, Japan; coma diameter $2''$ with weak condensation; motion about $5''$ northeastward in 30 min) and by Daqing

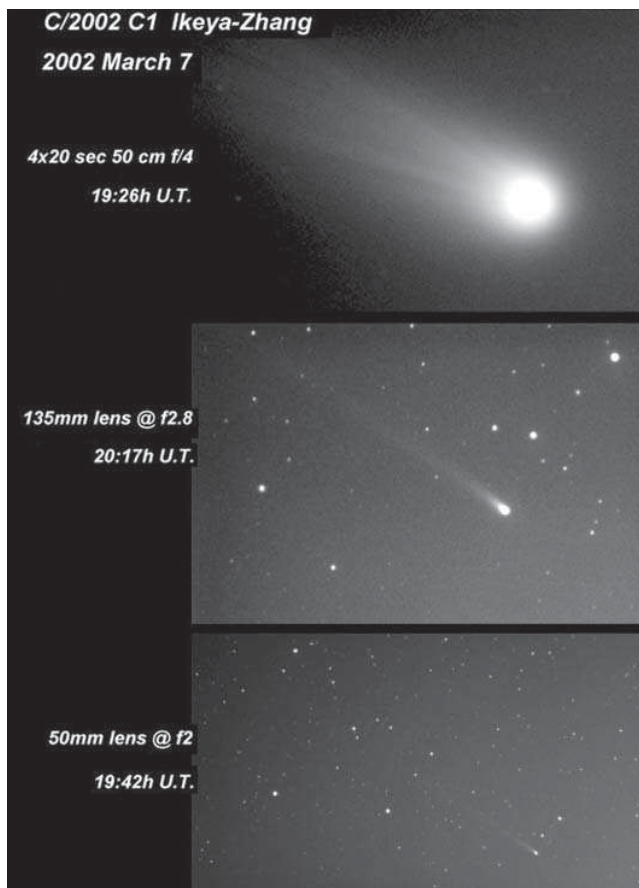


Figure 2. 153P/Ikeya–Zhang imaged by David Strange at three different scales on 2002 Mar 7, approximately equivalent to telescopic, binocular and naked eye views.

Zhang (near Kaifeng, Henan province, China; 0.2-m reflector on Feb 1.47; communicated by J. Zhu, Beijing University; coma diameter $3''$) [IAUC 7812, 2002 Feb 1]. Kaoru Ikeya discovered five comets in the 1960s, including the spectacular sungrazer Ikeya–Seki (1965 S1). P. M. Raymundo, Salvador, Brazil, made an independent discovery using a 0.25-m reflector on Feb 1.91, but by this time the IAUC had been issued.

B. G. Marsden & S. Nakano quickly noted the similarity of the orbits of 2002 C1 and 1661 C1 and that numerical integration of the

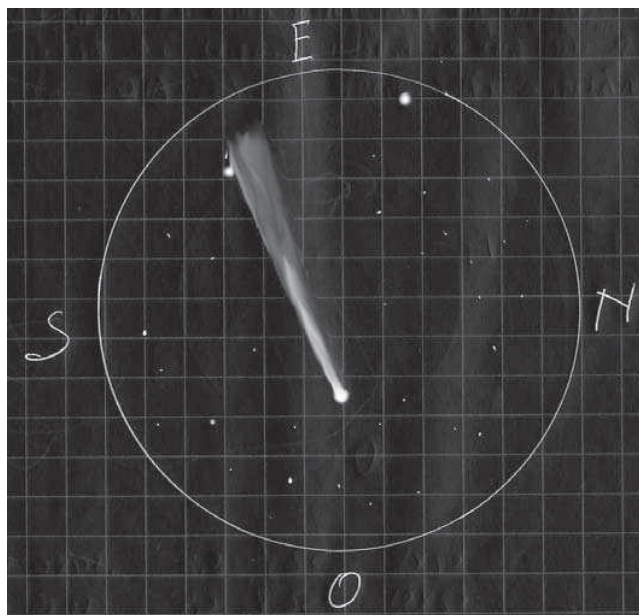


Figure 3. 153P/Ikeya–Zhang drawn by Toni Scarmato on 2002 Mar 11.

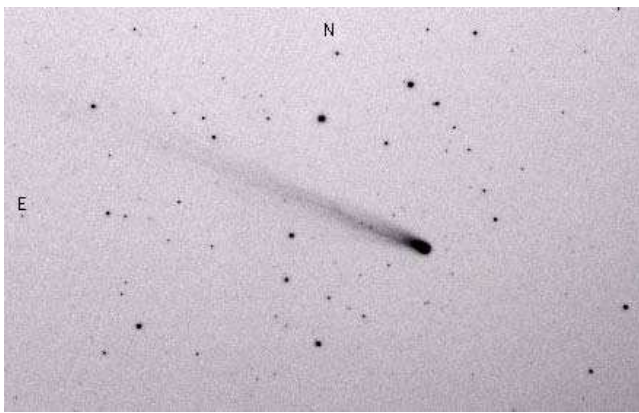


Figure 4. Image of 153P/Ikeya-Zhang taken by Denis Buczynski on 2002 Mar 11 using a 135mm telephoto lens with SXL8 CCD.

2002 orbit backward yielded a previous perihelion date within a couple of years of 1659, making the link rather likely. Another possibility was 1532 R1, but as more astrometric observations accumulated the link with 1661 C1 became more certain and it was eventually confirmed as the longest period comet so far known to return.

An orbit by Nakano & Hasegawa, which included non-gravitational parameters, linked 1661 C1 with 2002 C1 and from this they identified a comet seen in 877 February as being the same object. With this secure linkage they further identified a comet seen in 1273 February. With these linkages the perihelion dates are: 2002 Mar 18.98, 1661 Jan 29.06, 1273 Feb 4.79 and 877 Feb 13.66. They suggested that previous returns were in 458 Jul 31, 88 May and -269 Dec. They also provided the following notes:

Ichiro Hasegawa and I [Nakano] have found a comet in 877 identical with 2002 C1. This comet was seen around Alpha Andromeda-Gamma Pegasus on Feb 11 in the evening sky in Japan (Sandai Jitsuroku, Kanda, p.484). The comet was also seen in the western sky during 15 days in March in Europe (Chronicon Navaliciense, Pingre, p.350). The European comet in 877 was well observed in the morning sky, however it was also located in the low evening sky and would be seen during astronomical twilight over the western horizon during early March as a bright comet ($m_1 = 3$). After we computed a linked orbit for 877-2002, then we found another identical comet in 1273 which was recorded in Japan and Korea. The Japanese comet was seen in the west of the evening sky on Feb 5 (Moromori-ki, Kanda, p.547)

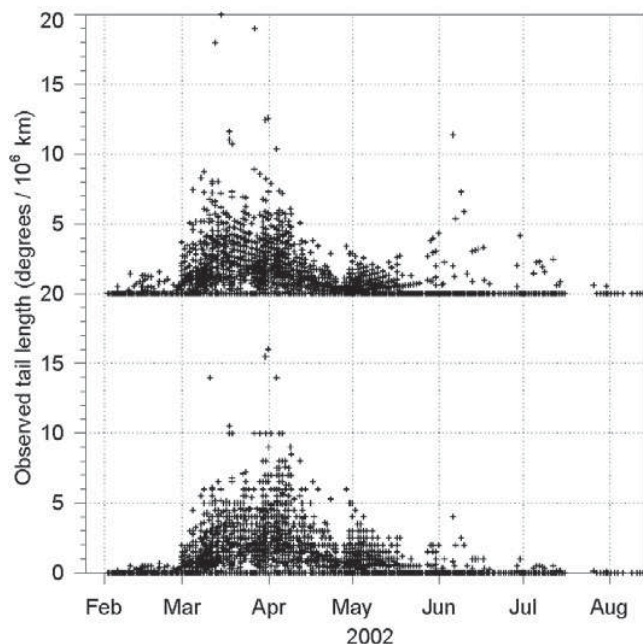


Figure 5. The tail length of 153P/Ikeya-Zhang.

and the Korean comet was seen in the east of the morning sky on Feb 17 (Koryo-sa).

Hirohisa Sato provided additional information about the earlier returns:

The comet of 877 Feb 11 has a record in Japan. 'On the 25th day in the first month of the first year of the Genkei reign-period a 'guest star' appeared to the west of the (Tung-) Pi (14th lunar mansion).' (Dainihonshi ch. 359; K; Hsi.) Ho Peng Yoke (1962)'s 'Ancient and Mediaeval Observations of Comets and Novae in Chinese Sources' p 176. Time is about 18:00? ('Tori-no-koku'). The comet of 1273 Feb 5 has a record in Japan. 'On the 16th day in the first month of the tenth year of the Bun-ei reign-period [1273February 5] a (hui) comet was seen.....' (Dainihonshi ch. 359; K.). Ho (1962) p194. A later observation on April 11 was of a 'guest star' and is not this comet. (Sato)

The comet seems to have been intrinsically brighter at the 1661 return. A possible explanation is that the comet's intrinsic brightness is variable, and this is clearly seen in the current lightcurve, which shows slow changes over the course of the apparition. Some orbit computers suggest that the comet of 1532 is also associated with this comet and may be the primary component of a fragmentation which occurred over 1000 years ago, but no further fragments have appeared to date.

In England King Charles II was crowned in 1660 and had created the Royal Society in the same year. In 1661, Isaac Newton was 18, and went up to Cambridge in June of that year. It is unlikely that he observed the comet as his notebooks suggest that the first comet that he observed was the one of 1664 December. Edmund Halley would have been too young to record the comet (he was 5 at the time), but later he computed an orbit similar to that of the 1532 comet and suggested a possible link. Charles Messier noted this possible link, but also that it had been refuted by Mechain.

The comet was observed and drawn by Hevelius. The optical quality of his telescope was far inferior to those of today and the features drawn⁴ may be imaginary. The comet's path was illustrated by Johann Gabriel Doppelmayr in 1742.⁵ Gary Kronk provides further description of the 1661 return in his *Cometography*.⁶

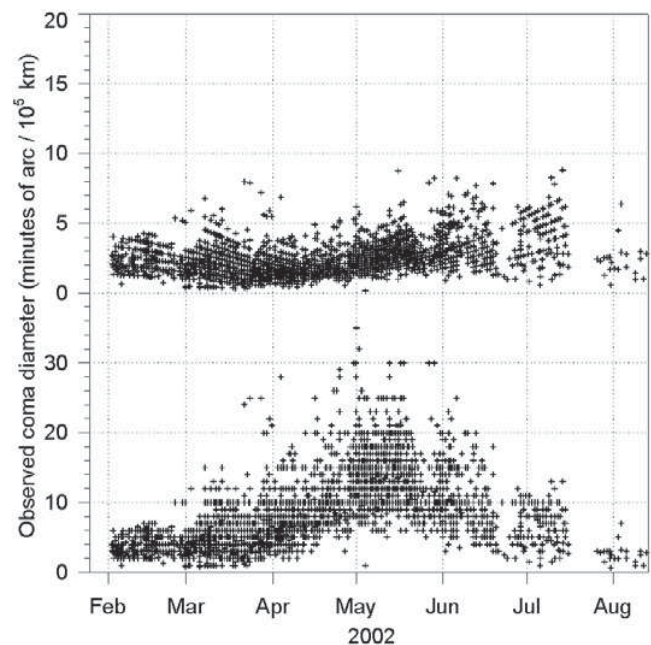


Figure 6. The coma diameter of 153P/Ikeya-Zhang.

Early observations in 2002 suggested that the comet might be brightening quite rapidly. On Feb 5.77 Jonathan Shanklin estimated it at 7.7 in the 20cm Thorowgood refractor $\times 40$, however other observers made it a little fainter on the same evening. On Feb 9.77 Shanklin made it 8.1 in the same instrument $\times 70$, though this time other observers were indicating a brighter magnitude. The coma was well condensed, DC 5–6, with a coma diameter of 4'. The comet was also easily visible in 14 $\times$ 100 and 20 $\times$ 80 binoculars.

Maciej Reszelski reported that the comet had reached mag 6.5 in 20 $\times$ 60B on Feb 15.72. On Feb 26.77 Shanklin observed the comet in rather bright twilight with 20 $\times$ 80B and estimated it at 5.9, with a 9' ion tail in p.a. 85. Werner Hasubick observed it on Mar 4.77, estimating it at 4.9 in 10 $\times$ 50B with a 1.5° long tail in p.a. 75. The first naked eye observations came a few days later. The comet was brightest at the end of the month, for example Roy Panther estimated it at 4.0 in 15 $\times$ 70B on Mar 26.84, with a 1° tail.

Guy Hurst noted it with the naked eye on April 15.89 and although fainter, Shanklin saw it on May 1.89. Stephen Getliffe was the last to report a naked eye observation, on May 28.94, when it appeared 30' in diameter at magnitude 5.5. Binocular and telescopic observers saw it fainter, but it remained well within binocular range throughout June. Gabriel Oksa, observing with 20 $\times$ 80B on June 18.88 estimated it at 7.7. Shanklin, observing with 20 $\times$ 80 Vixen binoculars in Cornwall under very dark skies on July 12.95, put the comet at around 9.5, but very diffuse.

No visual observations were made from the UK after mid-July, and the last visual observations came in mid-August, when the comet was around 12th magnitude. CCD observers followed it until October.

Although the observations suggest a sudden start to significant tail activity in late February, this is probably more a function of lunar phase, as this marks the time when the Moon began to wane. Visually the maximum tail length was at the beginning of April, when it was reported as up to 8° by the majority of observers, however a few reports had much longer tails. These observers often reported a different position angle to the majority, but it is not clear if the observers' eyesight was unusually sensitive to the ion tail, or if they had a good imagination. Deep photographs tend to support the latter interpretation, as they rarely show more than around 7° of tail.

The comet was closest to the Earth at the end of April, and this is clearly reflected in the observed coma diameter, which was largest at that time. The true diameter changed only slowly, perhaps being slightly smaller near the time of perihelion and slowly increasing in size for a few months after perihelion. The degree of

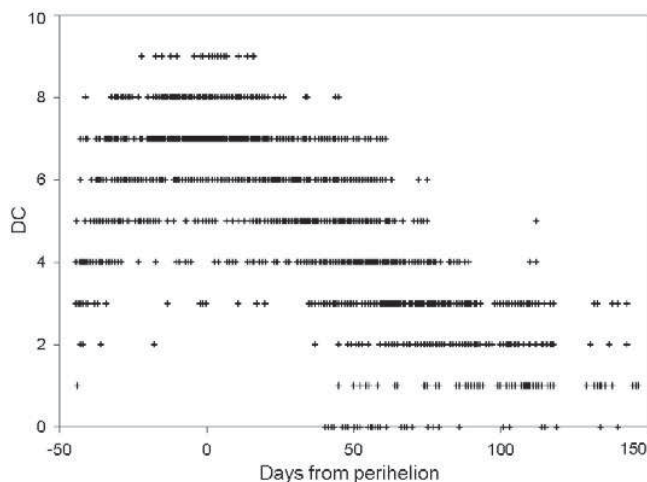


Figure 7. The degree of condensation (DC) of 153P/Ikeya–Zhang.

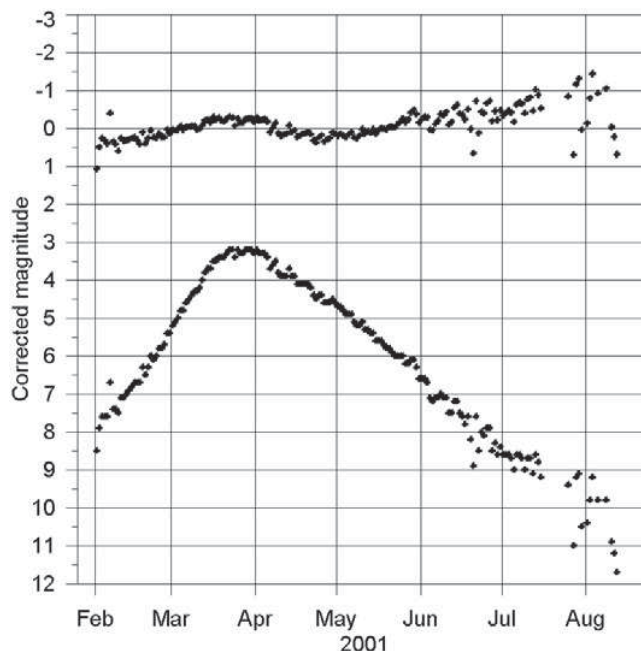


Figure 8. The daily mean corrected magnitude and difference from the mean lightcurve for 153P/Ikeya–Zhang.

condensation increased towards perihelion, and became more diffuse as the comet receded from the Sun. There is a lot of scatter in the DC, demonstrating that observers show a wide interpretation of the DC scale, although collectively come to agreement in changes in behaviour.

There are 3,478 visual observations made between Feb 2 and Aug 12 in the combined ICQ and BAA files, making it one of the most observed comets in this series of papers. The observations show that the comet's absolute magnitude slowly varied by around two magnitudes over the course of the apparition. Some analysts would divide the apparition into segments, producing a separate lightcurve for each segment in order to remove this variation, but this obscures some of the dynamic changes that are taking place.

In this series of papers a single lightcurve is fitted throughout the apparition of a comet, unless a clear outburst event takes place, or there is clear evidence of variation. Such slow variations from the mean curve are likely to be due to many factors, including changing rates or composition of outgassing material, changes in the amount of active surface, perhaps in response to changing insolation or to mantling of previously active areas. They could also reflect the presence of the 'delta effect'⁷ caused by the increased angular size of the coma when the comet was closest to Earth.

Professional observers turned their telescopes to the comet, showing the presence of sodium emission lines, HCN, HNC, CS and water, and dust shells and jets on the sunward side of the nucleus. The $(^{16}\text{O})/(^{18}\text{O})$ ratio in the water was consistent with the terrestrial ratio. Other studies suggested the presence of a sodium jet that was related to a dust feature. There was no evidence for strong silicate emission at 11 microns, but the data suggested a blackbody temperature of around 270K on May 22.

2002 C2 (LINEAR)

R. Huber & F. Shelley, Lincoln Laboratory, Massachusetts Institute of Technology, reported the discovery by LINEAR of an 18th magnitude comet on Feb 1.09 with a tail 42"–47" long in p.a. 12.5°. Cometary activity was confirmed via CCD observations by A. Galad & L. Kornos at Modra on Feb 1.8 ($m_1 = 16.3$, asymmetric coma extending 15" toward p.a. about 30°) and 2.7 UT (slightly diffuse with coma diameter about 10"), by J. Ticha & M. Tichy at Klet on

Table 1. Orbital data for the comets of 2002¹⁸ (sample)

Comet		<i>T</i>	<i>q</i>	<i>Q</i>	<i>e</i>	<i>P</i>	<i>T_j</i>	ω	Ω	<i>i</i>
1999 U4	Catalina–Skiff	2001 10 28.46	4.9153		1.0076		77.51	32.29		51.93
1999 Y1	LINEAR	2001 3 24.11	3.0912		1.0006		184.28	188.88		134.79
2000 CT ₅	LINEAR	2001 6 19.50	3.1561		0.9987		272.65	18.96		49.21
2000 OF ₈	Spacewatch	2001 8 4.77	2.1731		1.0018		256.07	117.09		152.44
2000 Y1	Tubbiolo	2001 2 2.21	7.9748		1.0032		181.74	239.40		137.98
2000 Y2	Skiff	2001 3 21.82	2.7687		0.9944		326.82	185.85		12.09

(The full table is available online at www.britastro.org/jbaa_supplement)

Feb 2.7 (coma diameter 10"), and by T. Payer at Dusseldorf, Germany, on Feb 2.8 (coma visible, $m_1 = 16.6$) [IAUC 7815, 2002 Feb 2]. The 'original' barycentric value of 1/a suggests that this is not a new visitor from the Oort cloud.

2002 CW₁₃₄ (214P/LINEAR)

A 20th magnitude object reported as asteroidal by LINEAR on Feb 7.47, given the designation 2002 CW₁₃₄ on MPS 50314, and later placed on the NEOCP, was found to show cometary activity: Mar 19.0 UT, diffuse with coma diameter 13" (M. Tichy and M. Kocer, Klet, 1.06-m reflector); Mar 23.0, diffuse, faint coma extended about 30" in p.a. 330° (G. Masi & F. Mallia, Campo Catino, Italy, 0.8-m reflector) [IAUC 7858, 2002 Mar 23]. It is a Jupiter family comet and made close approaches in 1952 Jan (<0.09 au) and 1962 Oct (<0.04 au). Another will occur in 2045 Aug (<0.02 au) and this will increase the perihelion distance from 1.8 to 2.6 au. It was numbered following recovery in 2009.

2002 CE₁₀ (P/LINEAR)

LINEAR discovered a 20th magnitude asteroid in a retrograde cometary-type orbit with period of 31 years on Feb 6.32 when it was 4.8 au from the Sun and still some 16 months from perihelion. Jonathan Shanklin suggested that it might begin to show cometary activity in the future. It did so in August.

N. Takato, T. Sekiguchi, & J. Watanabe, National Astronomical Observatory of Japan, obtained nine CCD images with the 8.2-m Subaru telescope of the apparently asteroidal object 2002 CE₁₀ on Aug 22.4 UT that show a very faint, straight tail about 21" long in p.a. 212°; the tail is also present on shorter exposures from Aug 21.5–21.6, when any coma as bright as the tail must have been <6" in diameter [IAUC 8193, 2003 Sep 3]. The closest the comet has come to Jupiter in the last century is 0.6 au, when it passed the planet out-bound in 1912 Dec, and it has made no close approaches to Saturn.

CCD observations show that the comet reached about 15th magnitude in 2002 September.

2002 E2 (Snyder–Murakami)

A new comet was discovered by US astronomer Douglas Snyder (Palomaras, Arizona, 0.50-m f/5 reflector) and Japanese astronomer Shigeki Murakami (Matsunoyama, Niigata, 0.46-m f/4.5 reflector ×68) on Mar 11. The comet was about 11th magnitude and moving northwards in Aquila. It was just past perihelion [IAUC 7850, 2002 Mar 12].

The orbit suggests that the comet came from the fringes of the

Oort cloud, but could have made a previous return to perihelion. Gravitational perturbations mean that it will not return again. There were some suggestions of a link to comet 1998 H1 (Stonehouse) based on the broad similarity of their orbital elements. Backward integration of the elements however shows that the orbits of the two remain distinct prior to their entry into the inner solar system.

Doug Snyder provided the following information to the comet mail list: *I was using a magnification of 149×, which was providing me with a field of 32' on my 20" f/5 Obsession. Occasionally, I would boost the magnification up to 212× to look at a particular object, but not for sweeping the skies. This was a deliberate search, although I am relatively new at comet searching. I had*

Table 2. List of BAA and TA visual observers.

James Abbott, Witham, Essex	Manos Kardasis, Greece
Jose Guilherme de Souza Aguiar, Brazil	Heinz Kerner, Germany
Alexandre Amorim, Brazil	Maxim Kititsa, Ukraine
Alexander Baransky, Ukraine	Attila Kosa–Kiss, Romania
Sandro Baroni, Italy	Carlos Labordena, Spain
Sally Beaumont, Windermere, Cumbria	Martin Lehky, Czech Republic
Mike Begbie, Zimbabwe	Gordon MacLeod, Reay, Caithness
Nicolas Biver, Hawaii	Steve Martin, Lustleigh, Devon
Reinder Bouma, The Netherlands	Jose Carvajal Martinez, Spain
Nicholas J. Brown, Australia	Michael Mattiazzo, Australia
Robert Bullen, Bognor Regis, Sussex	Cliff Meredith, Prestwich, Manchester
Paul Camilleri, Australia	Giannantonio Milani, Italy
Julie Chignell, Hook, Hampshire	Alexandra Mormyl, Ukraine
Emilio Colombo, Italy	Vladimir G. Mormyl, Ukraine
Tim Cooper, South Africa	Neil Morrison, Crawley, W. Sussex
Matyas Csukas, Romania	Gabriel Oksa, Slovakia
Hakon Dahle, Norway	Alexei Pace, Malta
Kostiantyn Didoboret, Ukraine	Roy Panther, Walgrave, Northants.
Alfons Diepvens, Belgium	Mieczyslaw L. Paradowski, Poland
Yu Dulitch, Ukraine	Andrew Pearce, Australia
Len Entwisle, Elland, West Yorkshire	Stuart T Rae, New Zealand
Sergio Foglia, Italy	Maciej Reszelski, Poland
James Fraser, Alness, Ross-shire	Ian Ridpath, Brentford, London
Mario Frassati, Italy	Andras Sajtz, Romania
Michael Gainsford, Burbage, Leics.	Juan M. San Juan, Spain
Stephen Getliffe, Longstanton, Cambs.	Toni Scarmato, Italy
Antonio Giambersio, Italy	David Seargent, Australia
Guus Gilein, Holland	Jonathan Shanklin, Cambridge to Antarctica
Massimo Giuntoli, Italy	Sergey Shurpakov, Russia
Shelagh Godwin, Godalming, Surrey	Oddleiv Skilbrei, Norway
Juan José González Suárez, Spain	Giovanni Sostero, Italy
Bjorn Granslo, Norway	William C. de Souza, Brazil
Paul Harper, Croydon, Surrey	David Storey, Douglas, Isle of Man
Werner Hasubick, Germany	Melvyn Taylor, Wakefield, W. Yorks.
Roberto Haver, Italy	John Vetterlein, Orkney
Alan Heath, Nottingham	Yevgen Vovk, Ukraine
Guy Hurst, Basingstoke, Hants.	Graham Wolf, New Zealand
Geoffrey Johnstone, Birdingbury, Warks.	Seiichi Yoshida, Japan
Albert Jones, New Zealand	Mauro Zanotta, Italy
Jo Jones, Rotherham, Yorkshire	
Andreas Kammerer, Germany	

Note that the lightcurves make use of all observations in the ICQ archives, complemented with those from the BAA and TA. Thanks are due to the many observers not listed here for their diligence in making the observations, and to Dan Green of the ICQ in compiling them into standard format.

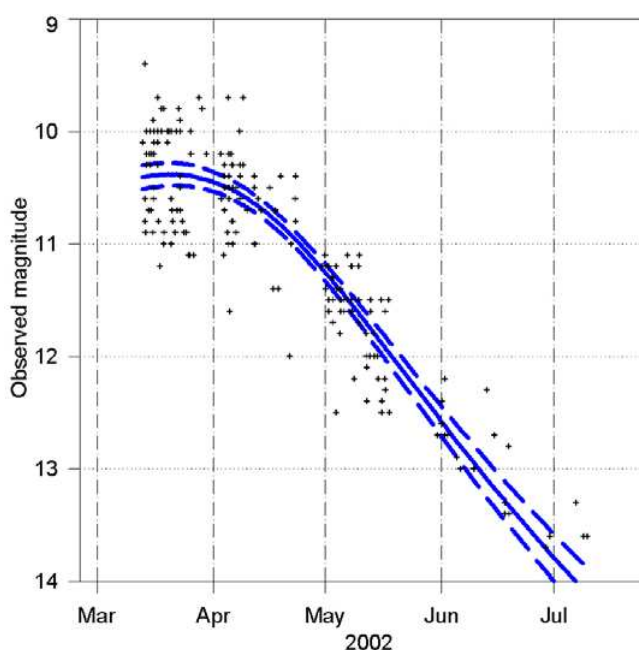


Figure 9. The lightcurve of 2002 E2 (Snyder–Murakami).

spent only about 70 hours up to the time of the finding. A real lucky find! I have been deep sky observing for about 20 years. Not that I'm too much of a believer in the psychic side of things, but my wife and I had gone out to dinner with another couple very involved in amateur astronomy and we ate at a Chinese restaurant (this was on Sunday evening, the evening before the discovery). After the meal, we received our fortune cookies. Mine read 'You will soon be the centre of attention'. On every other occasion where I get one of these fortunes, I just toss it away. On this particular evening, I stuck it in my shirt pocket and took it home with me. Well, I stayed up the entire night and 8 hours later I came across the comet. Now, for the time being, I guess I've been at the centre of attention! My wife wants to frame the fortune cookie – but gee, its only 70×13 mm!

The comet was near its brightest when discovered, and was found in the morning sky as it emerged from solar conjunction.

2002 EX₁₂ (169P/NEAT)

An object discovered by NEAT on 2002 Mar 15.27, was found to show a tail in late 2005 July by two independent groups of observers. It had not shown a tail when observed two months earlier. It reached perihelion at 0.6 au in mid-Sep 2005 and has a period of 4.2 years, the second shortest to date (2P/Encke has the shortest).

The orbit is secure, the object having been linked to observations made by *Spacewatch* in 1998 and the DSS in 1989, and it was then numbered 169. It has had no recent close encounters with Jupiter. Observations made near perihelion, when the comet was quite low, suggest a visual magnitude around 11.5, however no systematic observations were reported.

2002 EJ₅₇ (P/LINEAR)

A 19th magnitude, apparently asteroidal object discovered by LINEAR on Mar 13.20 was given the designation 2002 EJ₅₇. Additional observations of the object were located during routine processing at the Minor Planet Center, and these indicated that the orbit was unusual. The object was then placed on the NEOCP, resulting in CCD observations by J. Ticha & M. Tichy at Klet (diffuse with coma diameter about 10" on May 1.8 UT) and by R. H.

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McNaught at Siding Spring (circular coma with diameter about 7" on May 2.5) showing cometary activity [IAUC 7890, 2002 May 2]. Its orbit is affected by both Jupiter and Saturn and it passed within 0.1 au of the latter in 1964 Mar in an encounter which reduced the perihelion distance from 3.3 to 2.4 au.

2002 FI (Utsunomiya)

Syogo Utsunomiya from Minami, Oguni-machi, Aso-gun, Kumamoto-ken, Japan discovered his third comet on Mar 18.84, using 25×150 binoculars in the morning twilight. The 10th magnitude object was diffuse, with a weak condensation. Images show a tail up to 90' long [IAUC 7854, 2002 Mar 20].

The comet was highly condensed and showed a short tail when Shanklin observed it on Apr 6.14 and 7.15. Nicolas Biver, observing on Apr 10.16 noted a significant brightening, with the comet at mag 5.9 with a nearly



Figure 10. Syogo Utsunomiya.

Table 3. BAA and TA astrometric, CCD and photographic observers

Observer	Site	IAU Stn No.
Ron Arbour	South Wonston, Hants.	979
Peter Birtwhistle	Great Shefford, Berks.	J95
David Boyd	Wantage, Oxon	
Denis Buczynski	Conder Brow, Lancs.	978
Montse Campas	Spain	213
Rafael Ferrando	Spain	941
John Fletcher	Mount Tuffley, Gloucs.	J93
Mario Frassati	Italy	
Maurice Gavin	Worcester Park, Surrey	
Antonio Giambersio	Italy	162
Pierre Girard	Chicheley, Bucks.	
Virgilia Gonano	Italy	
Werner Hasubick	Germany	215
Luca Monzo	Italy	
Bjorn Granslo	Norway	206
Peter Grego		
Roberto Haver	Italy	157
Guy Hurst	Basingstoke, Hants.	
Nick James	Chelmsford, Essex	970
Michael Jager	Austria	A71
Heinz Kerner	Namibia	
Paul Kemp	New Zealand	
Gerhart Klaus	Switzerland	
Stephen Laurie	Church Stretton, Shropshire	966
Martin Lehky	Czech Republic	048
Rolando Ligustri	Italy	235
John Mackey	Werrington, Peterborough	963
Pepe Manteca	Spain	170
Michael Mattiazzo	Australia	
Cliff Meredith	Manchester	
Giannantonio Milani	Italy	
Martin Mobberley	Cockfield, Suffolk	480
Ramon Naves	Spain	213
Gabriel Oksa	Slovakia	
Arto Oksanen	Finland	
Alexei Pace	Malta	
Toni Scarmato	Italy	
Giovanni Sostero	Italy	473
David Strange	Worth Matravers, Devon	
Alex Vincent	Worthing, Sussex	
Bill Ward	Australia	
Brian Woosnam	Colwyn Bay, Clywd	

Note: This table also includes all BAA observers who made astrometric measurements during 2002.

Shanklin: The comets of 2002 (Part I)

stellar appearance, suggesting a recent outburst. The following morning he reported that the comet had brightened further, but had become more diffuse and showed jets. Stephen Getliffe, observing on Apr 16.15, put the comet at 4.1 in 7×50B with a half degree tail. On May 1.87 Shanklin estimated it at 6.3 in his new Vixen 20×80B, surprisingly easy, and with the Pleiades a beautiful sight just below the comet. Alexandre Amorim observed the comet with 20×80B on May 11.90 and estimated it at 8.3 and still very strongly condensed. Jose Aguiar observed it on May 17.89 and estimated it at 8.0 in 20×80B,



Figure 11. 2002 F1 (Utsunomiya) imaged by Giovanni Sostero on 2002 Mar 23.

with a very strongly condensed coma.

The comet was not well placed for observation, initially being low in the morning sky, and then moving to even lower in the evening sky with its solar elongation being between 20 and 30°. Although the overall lightcurve is quite consistent, there is a period in early April when

the comet was much fainter than the mean curve, after which the degree of condensation increased markedly. A possible explanation would be mantling of an active area thus suppressing activity, followed by a blow-out, restarting activity and creating a quasi-stellar nuclear condensation.

2002 FA₉ (235P/LINEAR = 2010 F2)

An apparently asteroidal object discovered on 2002 Mar 16.32 by the LINEAR survey, and designated 2002 FA₉, was re-discovered by Rob McNaught on CCD images taken with the 0.5-m Uppsala Schmidt telescope on 2010 Mar 20.61 and noted to show cometary

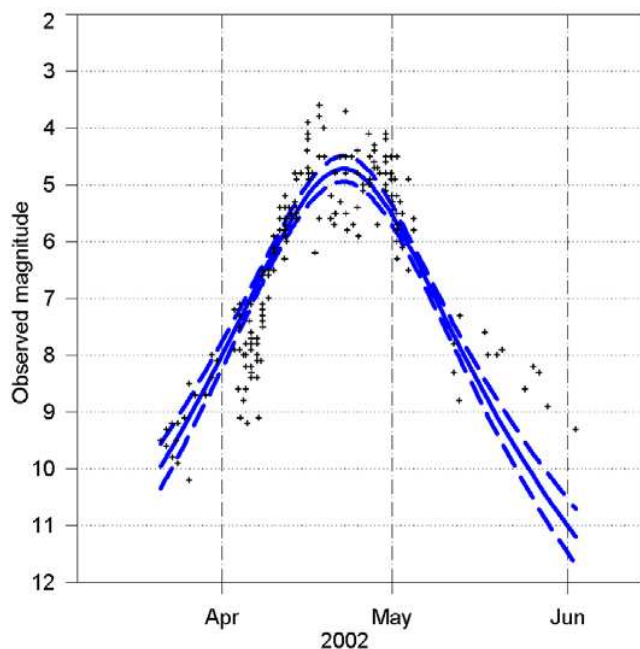


Figure 12. The lightcurve of 2002 F1 (Utsunomiya).

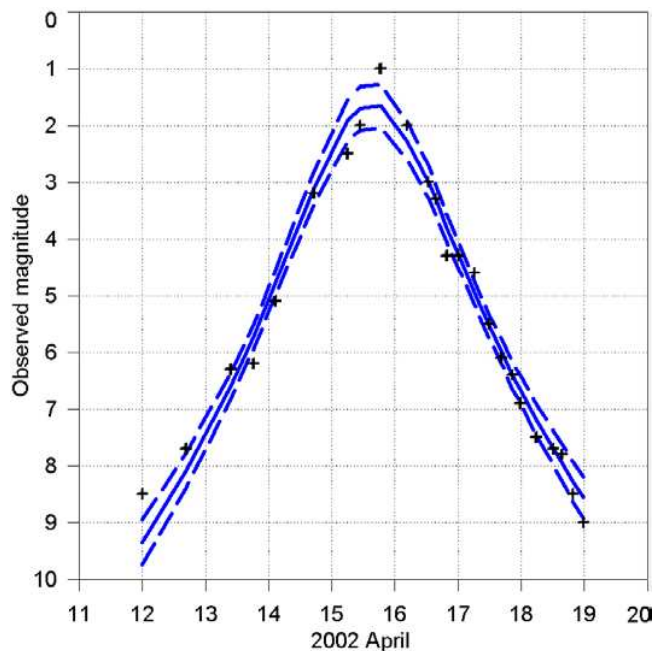


Figure 13. The lightcurve of 2002 G3 (SOHO), fitted on an assumed peak insolation 1.1 days earlier than the time of perihelion.

appearance. The comet makes occasional approaches to Jupiter, and was discovered following one in 1999 October which reduced the perihelion distance from 3.0 to 2.7 au. Another encounter in 2023 June will reduced it further to 2.0 au.

2002 GI (SOHO)

A non-sungrazing group comet discovered in real-time C2 images by Rainer Kracht on Apr 2. It remained at a small elongation from the Sun and was not detected from the ground.

2002 G3 (SOHO)

XingMing Zhou discovered a moderately bright comet on C3 frames on Apr 12.4, with Jonathan Shanklin making an independent discovery shortly afterwards. The bright, slow moving, object appeared at the bottom of the frames beginning at around 00:00 on Apr 12 and was moving up and to the left. It had no obvious tail, and was brightening quite rapidly. It was brightest around Apr 15.8, reaching around 1st magnitude. Ac-

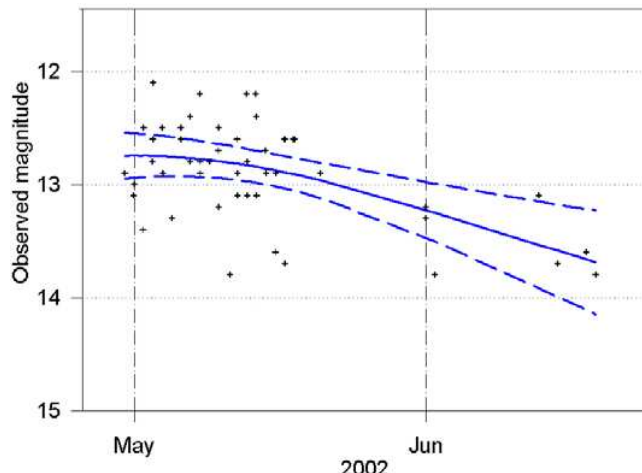


Figure 14. The lightcurve of 2002 H2 (LINEAR).

cording to the published orbit, perihelion was on Apr 16.7. It was already fading early on Apr 16, although it had grown a short tail. It faded significantly faster than the ephemeris predicted.

The lightcurve, using estimates made by Jonathan Shanklin from SOHO images, is however fairly consistent, and suggests possible different interpretations. If it is assumed that the comet was brightest at its actual perihelion, and the time of perihelion adjusted accordingly, a good fit to the observations is obtained. The astrometric positions, although poor, do not offer sufficient latitude to allow this possibility for this comet (Maik Meyer, e-mail). Maximum insolation (solar energy input) usually occurs close to perihelion, but the rotation pole might be orientated such that maximum insolation of the active areas occurred away from this time. The magnitude parameters given here are on the basis that maximum insolation was on Apr 15.6.

2002 H2 (LINEAR)

A rapidly moving object discovered by LINEAR on 2002 Apr 22.41 and reported as cometary, was confirmed and found to be around 13th magnitude by other observers. The orbit suggests that the comet had made a previous visit to the inner solar system and has a nominal period of around 5000 years. It was discovered when nearing its closest to the Earth and faded after discovery.

2002 J4 (NEAT)

S. Pravdo, E. Helin & K. Lawrence, Jet Propulsion Laboratory, reported the discovery by NEAT, on CCD images taken on May 13.45 UT with the Palomar 1.2-m Schmidt telescope, of an 18th magnitude comet with nebulosity extending about 5" toward the southwest. Following posting on the NEOCP, additional observations obtained elsewhere on May 13.9 confirm the cometary nature: P. Kusnirak at Ondrejov (0.65-m reflector; $m_1 = 18.3$, faint 7" coma slightly elongated to the southwest); M. Tichy & M. Kocer at Klet (1.06-m KLENOT telescope; compact coma of diameter 16"); and L. Kornos at Modra (0.6-m reflector; $m_1 = 16.6$, coma diameter about 15"). Additional observations made by LONEOS and LINEAR on May 4, 7, & 8 were then identified by the Minor Planet Center staff [IAUC 7899, 2002 May 13]. The

Table 4. Magnitude parameters of the comets of 2002

a. Standard magnitude parameters

Comet	No. obs.	r (au)	H1	K1	H10	H15	Notes
A1 (LINEAR)	3 c	4.7			7.6±0.1	4.3±0.1	
A2 (LINEAR)	3 c	4.7			6.9±0.1	3.5±0.1	
A3 (LINEAR)	12	5.2–5.9			5.0±0.2	1.4±0.2	
B1 (LINEAR)	1 c	2.4			10.7	8.8	
B2 (LINEAR)	5 c	3.8–3.9			8.3±0.4	5.4±0.4	
B3 (LINEAR)	2 c	6.1			6.0±0.4	2.1±0.4	
C2 (LINEAR)	7 c	3.3–3.9			7.6±0.2	4.8±0.2	
CE ₁₀ (LINEAR)	3	2.3			9.8±0.1	8.1±0.1	
E2 (Snyder–Murakami)	193	1.5–2.4	7.0±0.1	9.9±0.6	7.0±0.0	5.9±0.0	
F1 (Utsunomiya)	185	0.4–1.0	9.1±0.2	14.3±0.6	8.0±0.1	9.3±0.1	
G3 (SOHO)	26 c	0.1–0.3	18.4±0.6	14.3±0.6	14.5±0.2	19.1±0.1	[a]
G3 (SOHO)	26 c	0.1–0.3	21.2±0.5	17.7±0.6	14.3±0.2	18.7±0.1	[b]
H2 (LINEAR)	50	1.7–2.0			8.6±0.1	7.4±0.1	
J4 (NEAT)	10 c	3.8–5.6	7.2±1.6	7.0±2.2	5.1±0.2	1.7±0.2	
J5 (LINEAR)	18 c	5.7–7.0	6.4±2.7	6.7±3.4	3.8±0.1	-0.1±0.1	
K1 (NEAT)	6 c	3.2–3.4			9.0±0.2	6.4±0.2	
K2 (LINEAR)	8 c	5.3–6.3			6.0±0.1	2.3±0.1	
K4 (NEAT)	12 c	2.8–2.9			8.9±0.3	6.7±0.3	
L9 (NEAT)	1 c	8.0			1.9	-2.7	
O4 (Hoenig)	567	0.8–1.5	8.5±0.0	4.9±0.4	8.3±0.0	8.2±0.0	[c]
O6 (SWAN)	160	0.5–1.0	9.2±0.1	4.2±0.4	9.9±0.1	10.6±0.1	
O7 (LINEAR)	91	1.3–3.2	9.4±0.4	2.5±1.0	6.7±0.1	4.9±0.1	
P1 (NEAT)	7 c	6.8–8.0	9.2±2.5	4.7±2.9	4.7±0.1	4.1±0.1	
Q2 (LINEAR)	7	1.3–1.4			11.2±0.0	10.6±0.0	
Q3 (LINEAR)	3 c	1.3–1.4			13.0±0.4	12.4±0.4	
Q5 (LINEAR)	28	1.4–2.3	9.3±0.5	9.0±2.5	9.1±0.1	8.1±0.1	
R3 (LONEOS)	28 c	3.9–4.9	2.3±2.6	15.9±4.1	6.0±0.1	2.9±0.1	
T7 (LINEAR)	1584	0.6–5.7	5.2±0.0	5.7±0.1	4.2±0.0	3.1±0.1	
U2 (LINEAR)	16 c	1.2–2.0	12.5±0.5	10.1±2.9	12.6±0.2	11.8±0.2	
V1 (NEAT)	894	0.1–2.0	7.1±0.0	9.3±0.1	7.1±0.0	7.5±0.1	[all]
V1 (NEAT)	284	1.2–2.0	6.0±0.1	18.3±0.6	7.3±0.0	6.5±0.0	[pre i]
V1 (NEAT)	546	0.1–1.2	6.8±0.0	7.5±0.1	7.2±0.0	8.0±0.1	[pre ii]
V1 (NEAT)	64	0.3–1.8	5.6±0.0	6.4±0.2	6.1±0.1	6.8±0.2	[post]
V2 (LINEAR)	32 c	6.8–7.8			3.3±0.1	-0.9±0.1	
VQ ₉₄ (LINEAR)	35 c	6.8–10.3			1.5±0.2	-3.2±0.3	
X1 (LINEAR)	28	2.6–3.1	8.1±1.3	5.7±2.9	6.2±0.1	3.9±0.1	
X3 (SOHO)	4c	0.0–0.1			21.6±0.1	28.1±0.1	
X4 (SOHO)	4c	0.0–0.1			20.7±0.3	27.2±0.4	
X5 (Kudo–Fujikawa)	461	0.2–1.6	7.2±0.0	6.7±0.2	7.5±0.0	7.9±0.1	[all]
X5 (Kudo–Fujikawa)	354	0.4–1.2	6.8±0.0	4.7±0.2	7.3±0.0	7.8±0.1	[pre]
X5 (Kudo–Fujikawa)	107	0.2–1.6	8.0±0.1	7.0±0.3	8.0±0.1	8.0±0.1	[post]
7P/Pons–Winnecke	10	1.3–1.6			10.9±0.2	10.2±0.3	
15P/Finlay	8 c	1.0–1.3			11.1±0.4	10.9±0.4	
22P/Kopff	23 c	1.7–3.1	4.4±0.6	21.0±1.6	8.5±0.2	6.6±0.2	
30P/Reinmuth	10	1.9–2.2			9.1±0.2	7.6±0.2	
31P/Schwassmann–Wachmann	6 c	3.4–3.7			8.5±0.2	5.8±0.2	
46P/Wirtanen	59	1.1–1.5	8.6±0.2	5.5±2.6	8.1±0.1	7.8±0.1	[d]
54P/de Vico–Swift–NEAT	4 c	2.2–2.4			12.7±0.2	10.9±0.1	
57P/du Toit–Neujmin–Delporte	9	1.7–1.8			10.3±0.2	9.1±0.2	
67P/Churyumov–Gerasimenko	20	1.3–1.8			8.9±0.2	8.1±0.2	
67P/Churyumov–Gerasimenko	38 c	1.3–2.0	9.5±0.5	8.9±2.7	9.3±0.2	8.5±0.2	
77P/Longmore	22 c	2.4–2.8			9.4±0.2	7.3±0.2	
89P/Russell	6 c	2.5–2.9			10.3±0.2	8.1±0.2	
90P/Gehrels	11 c	3.0–3.2			8.5±0.1	6.0±0.2	
92P/Sanguin	37	1.8–1.9			9.9±0.1	8.6±0.1	
96P/Machholz	20 c	0.1–1.1	12.9±0.5	13.2±0.8	11.0±0.4	13.9±0.3	
115P/Maury	3 c	2.6–2.7			11.5±0.2	9.4±0.2	
124P/Mrkos	2 c	2.4–2.5			12.4±0.2	10.5±0.2	
125P/Spacewatch	1 c	1.6			13.5	12.5	
152P/Helin–Lawrence	4 c	3.3–3.5			8.7±0.1	6.1±0.1	
153P/Ikeya–Zhang	3678	0.5–2.6	6.2±0.0	7.1±0.0	6.3±0.0	6.6±0.0	
154P/Brewington	10	1.6–1.8			7.6±0.1	6.4±0.1	
155P/Shoemaker	6	1.8–2.0			9.1±0.4	7.7±0.4	
189P/NEAT	3 c	1.2			17.0±0.3	16.7±0.3	
214P/LINEAR	2 c	1.9			13.7±0.2	12.3±0.1	
215P/NEAT	3 c	3.3			8.4±0.2	5.8±0.2	
221P/LINEAR	4 c	1.8–1.9			13.0±0.3	11.7±0.3	
223P/Skiff	5 c	2.7–3.0			9.9±0.1	7.6±0.0	
225P/LINEAR	2	1.2			15.2±0.1	14.8±0.1	

Table continues (with notes to the above) on the following page

orbit suggests that the comet is a new visitor from the Oort cloud. Only one visual observation was made, with Michael Mattiazzo estimating it at about 14.5 in his 0.28m Schmidt–Cassegrain on 2003 Jun 3.63.

Table 4. Magnitude parameters of the comets of 2002 (continued)**b. Linear magnitude parameters**

Comet	No. obs.	Days	H1	K1	ΔT	
O4 (Hoenig)	567		6.0±0.0	0.0486±0.0028	45.7±0.5	[all]
O4 (Hoenig)	241		5.8±0.1	0.0731±0.062		[pre]
O4 (Hoenig)	326		6.1±0.1	0.0433±0.0031		[post]
Q5 (LINEAR)	28	1.4–2.3	9.3±0.2	0.0289±0.0032	–20.4±2.8	
46P/Wirtanen	59	–20–82	7.7±0.2	0.0259±0.0067	–31.6±4.1	

The magnitude of the comets can be calculated from the standard equation:

$$m = H_1 + 5.0 * \log(\Delta) + K_1 * \log(r)$$

For many comets there are insufficient visual observations to calculate K_1 accurately and so a value of 10 or 15 is assumed, which gives the constant H_{10} or H_{15} respectively.

Some comets do not follow the standard equation and are better fitted with a linear equation: $m = H_1 + 5.0 * \log(\Delta) + K_1 * \text{abs}(t - T + \Delta t)$, where t is the Julian date, T the JD of perihelion and Δt an offset. If Δt is positive the comet is intrinsically brighter prior to perihelion.

CCD observations have been used to determine the magnitude parameters of comets with insufficient visual observations; these are indicated by c after the number of observations. A correction for aperture of 0.0033 mm⁻¹ and the observer corrections derived in previous papers^{19,20} have been applied and the H values are reduced to zero aperture.

Notes:

[a] Prior to fade

[b] T adjusted to give maximum insolation on April 15.6

[c] A two part linear lightcurve gives the best fit.

[d] A linear lightcurve gives a better fit

2002 J5 (LINEAR)

An apparently asteroidal 18th magnitude object discovered by LINEAR on May 15.38 was found to be slightly diffuse with a coma diameter of about 10" on CCD images taken by M. Tichy & M. Kocer with the 1.06-m reflector at Klet on May 16.0 UT [IAUC 7904, 2002 May 18]. The orbit suggests that this is a 'new' comet from the Oort cloud.

2002 JN₁₆ (22 I P/LINEAR)

An apparently asteroidal object of 18th magnitude reported by LINEAR on May 9.28, designated 2002 JN₁₆, and having an unusual orbit was found by C. A. Trujillo, California Institute of Technology, to be cometary (coma extended 10"–15" from the nuclear condensation in p.a. 270°) on images taken on May 17.2 UT as part of a program by M. Brown and himself with the 1.2-m Schmidt telescope at Palomar. At Trujillo's request, J. Tonry obtained images of 2002 JN₁₆ through clouds with the University of Hawaii 2.2-m reflector at Mauna Kea on May 22.35 that show a similar appearance and $m_1 = 17.2$ [IAUC 7907, 2002 May 22].

It is a Jupiter family comet. It made a close approach to Jupiter in 1954 January (<0.03 au) and will make another in 2025 July (<0.2 au), though neither encounter makes dramatic changes to the orbit. It was numbered following recovery in 2009.

2002 K1 (NEAT)

K. Lawrence, E. Helin & S. Pravdo, Jet Propulsion Laboratory, reported the discovery of a comet with a tail about 8" long toward the southwest (and $m_2 = 19.4$ –19.6) on images taken with the 1.2-m NEAT telescope at Haleakala on May 16.55. Confirming CCD images by E. S. Barker at McDonald Observatory (0.76-m reflector) showed a 15" tail toward the southwest [IAUC 7902, 2002 May 17].

2002 K2 (LINEAR)

Another apparently asteroidal LINEAR discovery of 18th magnitude, found on May 16.37, has also been found to be cometary on

Klet CCD images that show a compact coma of diameter about 7"–8" on May 16.9 and 18.0 UT [IAUC 7904, 2002 May 18]. The 'original' barycentric value of 1/a implies that the comet had made a previous visit to the inner solar system.

2002 K4 (NEAT)

S. Pravdo, E. Helin & K. Lawrence, Jet Propulsion Laboratory, reported the discovery of a 19th magnitude comet (with nuclear condensation of diameter about 4" and tail extending about 10" to the southwest) on NEAT images taken at Haleakala on May 27.51 UT, with confirming NEAT images taken at Palomar on May 28 [IAUC 7909, 2002 May 28]. With an intermediate period orbit, it approached 1 au from Saturn in 2006 on its way to aphelion.

2002 L9 (NEAT)

An object of 18th magnitude originally reported as asteroidal on NEAT CCD images taken at Palomar on Jun 13.41 was posted on the NEOCP due to its unusual orbit. S. Pravdo later suggested the object was cometary, in particular on Jul 2 noting a central condensation of diameter 3" surrounded by a spherical nebulosity of diameter about 8" [IAUC 7931, 2002 Jul 2].

The 'original' barycentric value of 1/a suggests that this is a 'new' comet from the Oort cloud.

2002 LZ₁₁ (2 I 9 P/LINEAR)

An 18th mag apparently asteroidal object with not-unusual motion recorded by the LINEAR project on 2002 Jun 5.30, and linked over 2002 Jun 5–13 and designated by the Minor Planet Center as 2002 LZ₁₁ (but indicated on MPEC 2002-L64 as having a cometary orbit), was accidentally re-observed by LINEAR on numerous occasions in 2002 July and during 2003 July–Nov (and by LONEOS on 2003 Oct 16). E. Christensen, University of Arizona, recognised 2002 LZ₁₁ as having cometary appearance on 2003 Nov 17 in CCD images (mag 16.6–16.9) obtained accidentally by the Catalina Sky

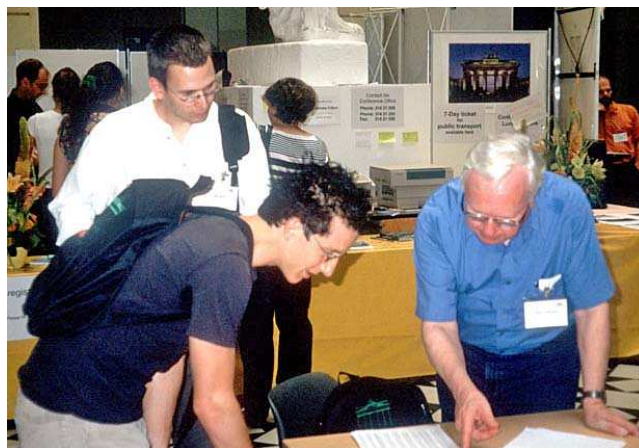


Figure 15. Sebastian Hoenig, Maik Meyer & Brian Marsden at the Meeting on Asteroids, Comets and Meteors held in Berlin from 2002 July 29 to Aug 2.

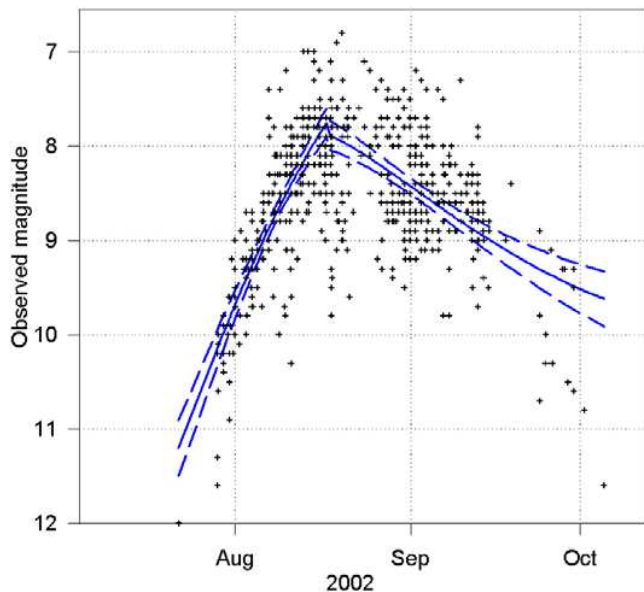


Figure 16. The lightcurve of 2002 O4 (Hoenig).

Survey (0.68-m f/1.8 Schmidt) on 2003 Oct 29.

Further images on Nov 17 by Christensen apparently confirmed the cometary appearance, as did images obtained the following day at the request of the Minor Planet Center by J. Young (0.61-m reflector at Table Mountain Observatory), who described the object as having a round coma, 7" across, with a featureless fan-shaped tail about 15"–20" long in p.a. 190–280° [IAUC 8240, 2003 Nov 18]. The object was presumably in outburst as the indicated ephemeris would have made it 17th magnitude in 2002 and it was not found to be cometary by any surveys. It was numbered following recovery in 2009. The most recent perturbing approach to Jupiter was in 1944, which made minor changes to the angular elements.

2002 LN₁₃ (237P/LINEAR) = 2010 L2

A cometary object discovered by the Wide-field Infrared Survey Explorer (WISE) on 2010 Jun 10.57 was quickly linked by the WISE team to an asteroidal object found by LINEAR on 2002 Jun 6.23. The comet suffers occasional encounters with Jupiter. One in 1918 reduced the perihelion distance from 3.4 to 2.5 au, and another in 2013 February reduced it further to 2.0 au.

2002 O4 (Hoenig)

On July 22, a report of an apparent visual comet discovery of a 12th magnitude comet on Jul 22.00 was received from Sebastian Hoenig, Dossenheim, Germany. The object clearly showed motion to the north. Due to poor initial positions and bright moon, attempts to recover the object visually by A. Hale (Cloudcroft, NM) and Hoenig were unsuccessful. On Jul 27, S. Nakano (Sumoto, Japan) reported that K. Kadota (Ageo, Saitama, Japan), following a request by A. Nakamura (Kuma, Ehime, Japan), successfully imaged a comet while searching for the object reported on Jul 22. Additional observations were received after the comet was posted on the NEOCP [IAUC 7939, 2002 Jul 27].

The 'original' barycentric value of $1/a$ is – 0.000772. It is somewhat unusual for a comet

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to have a negative 'original' value for $1/a$ as this implies that it originates from outside the solar system, and this is one of the largest on record. It is possible that non-gravitational effects should be applied to the comet's orbit. The Earth passed through the orbital plane at the ascending node of the comet on Aug 13.8.

Professional infrared observations suggested a temperature of around 280K on Aug 1.54, compared to an expected equilibrium blackbody temperature of 243K, with a silicate-emission feature present [IAUC 7950, 2002 Aug 8]. The excess suggests the additional presence of carbonaceous, ferrous or similar compounds which absorb in the visible and emit in the infrared.

Jonathan Shanklin was able to observe the comet on Aug 4.9. He estimated it at 9.5 in the Thorngood refractor ×40, with a 3' coma and DC3. The comet was brightening quite rapidly as several reports on Aug 6 put it as bright as 8th magnitude. Werner Hasubick made it 7.9 in 10×50B on Aug 15.84, when it was near its brightest. It then began to fade slowly until the equinox, when a more rapid decline set in. An image taken by Giovanni Sostero on Sep 30 (Figure 17) shows a diffuse coma with only a faint condensation, typical of a disintegrating comet.

The last visual observation was made just after perihelion, when Nicolas Biver estimated it at about 11.6 in his 0.26-m reflector on Oct 5.18, with a diffuse coma of 2' diameter. K. Kadota, Ageo, Saitama, Japan (0.30-m reflector) reported (via S. Nakano) $m_1 = 13.3$ on a CCD image taken on Oct 10.82 UT, but Y. Ezaki (Toyonaka, Osaka, Japan, 0.20-m reflector) could not find the comet to a magnitude of about 15 on an image taken two nights later [IAUC 7995, 2002 Oct 17].

The coma was largest in mid August, when the comet was closest to the Earth. A photograph taken on Aug 8.83 by Toni Scarmato shows a green coma, characteristic of Swan band emissions. There is no clear pattern to the reported DC, although there is an impression of a general decrease from the beginning of August to the end of September.

It seems likely that the comet was discovered following an outburst, although the DC and coma estimates do not follow the typical pattern of such events, where an initially stellar point evolves into a diffuse coma. The discovery event then seems to have led to either the break-up of the comet, or a nearly complete cessation of its activity.

2002 O5 (189P/NEAT)

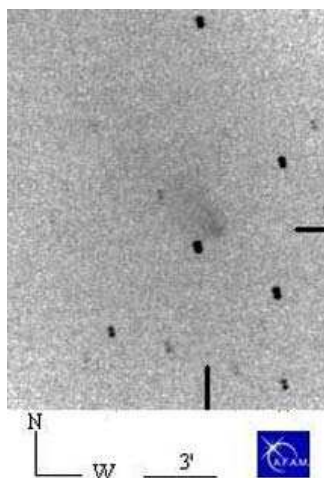


Figure 17. The remains of 2002 O4 (Hoenig) imaged by Giovanni Sostero on 2002 Sep 30.

S. Pravdo & K. Lawrence, Jet Propulsion Laboratory, reported the discovery of a 16th magnitude comet (with nuclear condensation of diameter about 6" and tail extending 12" to the southwest) on NEAT images taken at Haleakala on Jul 30.25 UT. After the object was placed on the NEOCP, confirmation of cometary activity was reported by: R. Fredrick, K. Smalley & R. Trentman, Louisburg, Kansas, with a 0.75-m reflector (tail 40" long in p.a. 130°); P. M. Kilmartin, Mt John Observatory, New Zealand, with a 0.6-m reflector (short tail in about p.a. 130°); and R. H. McNaught & G. J. Garrard, Siding Spring Observatory, Australia, with a 1.0-m reflector (tail 13" long in p.a. 125°) [IAUC 7942, 2002 Jul 31].

It is an intrinsically very faint comet ($H_0 = 19$) and has made no recent close approaches to Jupiter. At a favourable return, such as in 2012, it can pass 0.2 au from the Earth. It was numbered following its recovery in 2007.

2002 O6 (SWAN)

This interesting comet was discovered by Masayuki Suzuki using real-time SOHO-SWAN data and was the first SWAN discovery to be observed from the ground. The preliminary orbit suggested that the comet was passing close to the Earth and would brighten on its way to perihelion at 0.5 in early September.

Akimasa Nakamura provided this discovery information: *Masayuki Suzuki posted the discovery circumstances of 2002 O6 to the comet-obs mailing list (in Japanese). According to that, although he is a frequent visitor to the SWAN webpage (and has checked images from time to time since this spring), his discovery of 2002 O6 was accidental.*

Inspired by Sebastian's Hoenig's discovery, he downloaded SWAN images taken on July 25 and 27, to see whether he could find 2002 O4 or not. He found TWO moving objects: the dimmer one was 2002 O4, and the brighter one looked like 2001 Q4 (NEAT). But he noted that the latter should have been much fainter because 2001 Q4 was around 16th magnitude, so he thought it might be a new comet! He considered observing it himself on the night of his discovery (July 31), but gave up due to bad weather and its position (way out of his observable sky). So, he sent his discovery report to the CBAT without confirmation.

He is an astrometrists at code 347.

He also noted the comet was visible on the images taken on July 13, 16, 18, 20 as well (faint, though), and later measured their positions and sent them to the CBAT in response to the request by Carl Hergenrother.

M. Suzuki, Utsunomiya, Tochigi, Japan, reports the discovery of a comet on publicly accessible images taken with the SWAN instrument on the SOHO spacecraft on Jul 25 and 27. Pre-discovery images were found on images taken as early as Jul 13. Visual confirmation was reported by A. Hale, Cloudcroft, New Mexico, with a 0.20-m reflector (coma diameter 4'; magnitude measurement hampered by twilight, moon and clouds). CCD frames taken by J. Broughton, Reedy Creek, Australia, with a

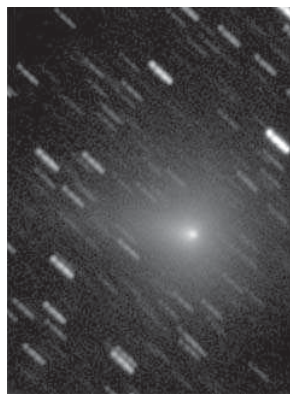


Figure 18. 2002 O6 (SWAN) imaged by Pepe Manteca on 2002 Aug 11.

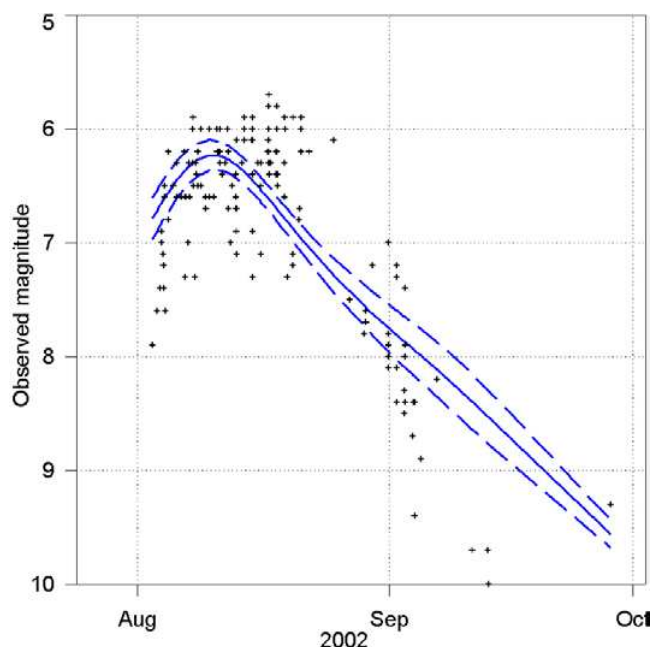


Figure 19. The lightcurve of 2002 O6 (SWAN).

0.25-m reflector also confirm the object's cometary nature [IAUC 7944, 2002 Aug 1].

Visual observations in early August showed that the comet was slowly brightening and it reached around mag 6. Jonathan Shanklin observed it after a long meteor watch on Aug 12/13 and found it an easy object in 20×80B at 6.1. Reports by Bjorn Granslo at the end of August showed that it had faded significantly as he observed it at 7.6 in 12×50B on Aug 29.07. It reached perihelion in early September, but observations by Shanklin suggested that the fade was continuing, with the comet at 8.7 in his 0.20-m SCT on Sep 3.84. By mid month it was 10th magnitude and sinking back into the morning twilight. A single report by Carlos Labordena put it at 9.3 with a 3' tail on Sep 28.20. It would probably have been too faint for visual observation when its elongation improved in November.

Schmidt photographs of 2002 O6 taken by Michael Jaeger near Vienna on Sep 13.125 show no nuclear condensation and a 4'×1' coma of total magnitude about 9.5 with an 8' tail in p.a. 0°. K. Kadota, Ageo, Japan, reported (via S. Nakano, Sumoto, Japan) that his images taken on Sep 10.809 & 17.813 also show no condensation, the coma having faded from $m_1 = 11.2$ to 12.1 during the past week [IAUC 7974, 2002 Sep 20].

The comet was brightest when it was closest to the Earth around Aug 8. It has a relatively faint absolute magnitude and it seems likely that this was another comet that gave up the ghost as it approached the Sun.

2002 O7 (LINEAR)

An apparently asteroidal 20th magnitude object reported by LINEAR on Jul 29.17 was found to be cometary by A. Boattini on CCD images taken with the 0.60-m Schmidt at Campo Imperatore on Aug 2.9 and by J. Ticha & M. Tichy with the 0.57-m telescope at Klet on Aug 4.9 (comet slightly diffuse with a coma of diameter 8'') [IAUC 7949, 2002 Aug 5].

M. Mattiazzo, Wallaroo, S. Australia, reported that a CCD image taken by himself on 2003 Sep 27.8 showed that the comet had apparently disrupted, revealing only a diffuse sunward-pointing 'antitail' of debris. Requests from the Central Bureau were sent to several observers at the time, seeking confirmation and additional details. Nothing further was received. But in December, G. P. Tozzi (Istituto Nazionale di Astrofisica, Arcetri), along with H. Boehnhardt *et al.*, reported that they searched for the comet on Dec 3 (when its predicted total magnitude was about 10) with several telescopes at the European Southern Observatory, including the 2.2-m reflector (R filter), the New Technology Telescope (+ JHK filters), and the 3.6-m reflector (+ VRI filters); the comet could not be detected to a limiting magnitude of R about 20.5 within an area 30'×30' centred at its predicted position [IAUC 8250, 2003 Dec 4].

The orbit suggests that this was a 'new' comet from the Oort cloud. The comet brightened relatively slowly and no visual observations were made after 2003 July although perihelion at 0.9 au was not until September. As noted in the IAUC, CCD observations in late September by Michael Mattiazzo suggested that the nucleus had disintegrated.

The comet did not have a particularly faint absolute magnitude, nor did it come very close to the Sun, perhaps emphasising the point that cometary behaviour is difficult to predict.

2002 O8 (215P/NEAT)

K. Lawrence, Jet Propulsion Laboratory, reported the discovery of a 17th magnitude comet (with nuclear condensation of diameter about 6" and a tail extending about 10" to the west) on NEAT images obtained on July 29.32 UT. Confirmation of cometary activ-

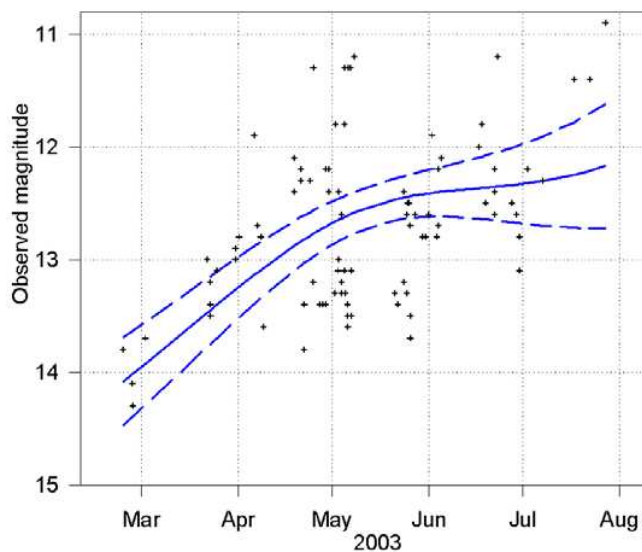


Figure 20. The lightcurve of 2002 O7 (LINEAR).

ity was reported by A. C. Gilmore and P. M. Kilmartin on CCD images taken with the 0.6-m reflector at Mt John University Observatory on Aug 4.4 (faint tail 40" in p.a. 255°). Prediscovery observations were identified in NEAT data from Jul 16.5, LINEAR data from Jul 5.4 and *Spacewatch* data from 2001 May 22.3 and Jun 11.2 [IAUC 7949, 2002 Aug 5].

It is a Jupiter family comet and will pass 0.48 au from the planet in 2013 Jun in an encounter which makes moderate changes to the orbital elements.

2002 P1 (NEAT)

S. Pravdo, K. Lawrence & E. Helin, Jet Propulsion Laboratory, reported the NEAT team's discovery with the 1.2-m Schmidt telescope at Palomar of a 19th magnitude comet with a 7" tail in p.a. 235° on Aug 7.39. Confirmation of the object's diffuse appearance was provided by G. Hug, Farpont Observatory [IAUC 7950, 2002 Aug 8]. The 'original' barycentric value of $1/a$ suggests that the comet has paid a previous visit to the inner solar system.

2002 Q1 (P/Van Ness)

Michael E. Van Ness, Lowell Observatory, reported his discovery of a 17th magnitude comet with a moderately condensed 24" coma and a fan-shaped tail about 200" long in p.a. 270° on LONEOS images taken on Aug 17.44. The cometary nature was confirmed by several other CCD astrometric observers on Aug 18, who all reported a generally diffuse coma with diameter about 14"–25"; several also noted a tail about 25"–120" long in p.a. 260–270° [IAUC 7956, 2002 Aug 19]. The comet was due to return to perihelion in 2009, but was not recovered; perhaps because it was poorly placed for several months around the time of perihelion. The comet had approached within 0.52 au of Jupiter in 1992 October in an encounter that reduced the perihelion distance from 1.7 to 1.5 au.

2002 Q2 (LINEAR) and 2002 Q3 (LINEAR)

S. Adams, Lincoln Laboratory, Massachusetts Institute of Technology, reports the discovery of two comets, both with coma diameter about 90" and both in the same field and moving in the same direction on LINEAR images taken on Aug 26.14. Following posting on the NEOCP, additional CCD observers confirmed both objects were cometary in appearance. On Aug 26.9, P. Kusnirak (0.65-m f/3.6 reflector, Ondrejov) found 2002 Q2 to be well condensed with a coma of diameter about 20" and $V = 17.7$, whereas

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2002 Q3 appeared very diffuse without condensation and coma diameter about 25". A. Galad (0.6-m reflector, Modra) reported 2002 Q2 to be diffuse with $m_1 = 17.2$, and Stephen Laurie (0.35-m reflector, Church Stretton, UK) reported the same object as diffuse with an 8" coma. P. R. Holvorcem & M. Schwartz (0.36-m reflector, Cottage Grove, OR) found 2002 Q2 to be diffuse with a coma of diameter about 17" and $m_1 = 17.1$ on Aug 27.3, whereas they noted 2002 Q3 to be 2–2.5 mag fainter with a hint of diffuseness. The available astrometry confirmed the apparent relationship of the two comets (with 2002 Q2 as the primary component) [IAUC 7960, 2002 Aug 27]. Maik Meyer pointed out that the preliminary elements were similar to those of 1994 N1 (Nakamura–Nishimura–Machholz).

S. S. Sheppard & D. C. Jewitt, University of Hawaii, reported that CCD images of 2002 Q3 on Sep 4.3 & 5.3 taken with the 2.2-m reflector at Mauna Kea showed three separate fragments a few arcsec apart; the brightest, component A ($R = 21.7$; photometry through a 1"-radius aperture), appeared elongated; component B was at $R = 22.1$ and component C at 22.6 [IAUC 7966, 2002 Sep 6].

Z. Sekanina, JPL, noted: *Applying my model for the split comets and using a code developed recently by P. W. Chodas and myself, I have calculated a set of fragmentation parameters based on 73 differential astrometric observations taken between August 26 and September 13. 2002 Q2 is the main component. The derived separation time of 2002 Q3 from 2002 Q2 is 1970.2 (± 1.2 yr), when the parent comet was at a distance of 56 ± 1 au from the sun, the separation velocity was $0.18 (\pm 0.01)$ m/s, and 2002 Q3 (component A) was subjected to a relative deceleration of $34.8 (\pm 1.3)$ units of 10^{-5} solar gravitational acceleration. A fragmentation sequence for the components of 2002 Q3 itself has been determined, based on the astrometry from the period 2002 September 4–14.*

It is found that (i) nucleus A, the original, eastern component, is the primary, (ii) the component labelled C on September 10 and 14 is identical with C on September 4–5, and (iii) the new, southern condensation from September 10 and 14, called D, is different from B. [The offsets of B from A on September 4–5 show irreconcilable discrepancies (in excess of 3") when attempts are made to link them with the offsets of the C component on September 10 and 14.]

It appears that C separated from A before 1980, a satisfactory solution indicating a fragmentation time in 1973 (± 4 yr), at about 52 au from the sun, a separation velocity of about 0.1 m/s, and a relative deceleration of about 6 units of 10^{-5} solar gravitational acceleration. One cannot exclude the possibility that C separated directly from 2002 Q2 about the time, or even before, component A did. The only satisfactory solution for D suggests that it broke off from A on 2002 July 5 ± 2 days (at about 1.5 au from the sun) with a relative velocity of 1.3 m/s and has been subjected to a deceleration of 12 ± 1 units. The history of nucleus B remains unknown [IAUC 7978, 2002 Sep 25].

The primary comet, 2002 Q2, was just bright enough for visual observation, with Reinder Bouma and Werner Hasubick amongst others recording it in the first half of September when it was at its brightest, a little fainter than 12th magnitude and very diffuse. By then it was rapidly moving south, and fading, and there were no observations later in the month when there was no moonlight.

2002 Q4 (I 54P/Brewington)

Fernanda Artigue, Herbert Cucurullo & Gonzalo Trancredi, Observatorio Astronomico Los Molinos, Montevideo, recovered comet 1992 Q1 (P/Brewington) at 17th magnitude, with a diffuse coma of diameter 20" and central condensation, on CCD images taken on Aug 26.98 and 27.98 with a 0.46-m telescope in the course

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of the Búsqueda Uruguaya de Supernovas, Cometas y Asteroides (BUSCA) project. The correction to the prediction on MPC 40670 is $\Delta(T) = +0.52$ day [IAUC 7961, 2002 Aug 28]. Following recovery, the comet was numbered 154.

Visual observations of the comet were made from 2002 Dec to 2003 Mar, and show the comet brightening to a peak at around 11.5 in 2003 Feb.

2002 Q5 (LINEAR)

L. Manguso, Lincoln Laboratory, MIT, reported the discovery of a 17th magnitude comet on Aug 28.22 on LINEAR images. Following posting on the NEOCP, the object's cometary nature was confirmed by several CCD observers. J. Nomen (0.40-m Schmidt telescope, Ametlla de Mar, Spain) reported a 20" coma ($m_1 = 16.7$) and a 1' tail in p.a. 140° on Aug 29.0. Near the same time, P. Kusnirak (0.65-m f/3.6 reflector, Ondrejov) found the comet to be slightly diffuse with a coma diameter of 10" and a faint tail toward the southeast on R-band images. On Aug 29.3, P. R. Holvorcem & M. Schwartz (0.36-m reflector, Cottage Grove, OR) found a coma diameter of about 20" and $m_1 = 15.6$ on 90-s exposures [IAUC 7962, 2002 Aug 29]. The orbit suggests that it was a 'new' comet from the Oort cloud.

Although perihelion was at 1.2 au in 2002 Nov, it was unfortunately on the opposite side of the Sun to the Earth at the time. Some well placed observers were able to see it some months before and after this time, when it was around 13th magnitude. A linear type lightcurve with the comet brightest some 20 days after perihelion gives a better fit to the available data than a standard curve.

2002 Q6 (SOHO)

This was a non-sungrazing-group comet discovered in real-time C2 images by Xavier Leprette on Aug 23.

2002 Q9 (SOHO)

This was a non-sungrazing-group comet discovered in archival C2 images from Aug 19 by Rainer Kracht on Aug 31.

2002 Q15 (230P/LINEAR) = 1997 A2 = 2009 U6

An apparently asteroidal object of 18th magnitude discovered by LINEAR with the 1.0-m reflector on 2009 Oct 27.43 was found to show a cometary appearance by other astrometrists. Following improved astrometry S. Nakano identified observations of the comet among single-night data from NEAT at the two preceding apparitions in 1997 and 2002, with it being assigned the identifications 1997 A2 and 2002 Q15. Rob Matson independently located the images corresponding to these observations, together with some additional ones and provided measurements. The comet's approach to a distance of 0.88 au from Jupiter in 2007 Sep means that the orbital period, currently 6.27 years, was previously 6.48–6.49 years. The orbit is fairly stable over the period 1900–2100. There is a moderately close approach to Earth (0.55 au) in 2015 Dec.

2002 Q16 (245P/WISE) = 2010 LI

A comet was discovered in images from the WISE satellite on 2010 Jun 2.50. The comet showed a coma and tail, and was around mag

20 when confirmed with ground based images. Richard Miles made confirming observations with the Faulkes Telescope North. In 2010 Sep Rob Matson identified the comet on NEAT images from Palomar taken in 2002 Aug and Sep, and the comet was given the identity 2002 Q16 for this return. The orbit is fairly stable over the period 1900–2100, although there is a Jupiter encounter in 2097.

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Editor's note

Part 2 of this paper, covering the remaining comets with discovery letter designations, the numbered periodic comets at perihelion in 2002, and other comets and objects observed during the year, will appear in a later Journal.