THE COMET'S TALE

Newsletter of the Comet Section of the British Astronomical Association

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ASTEROIDS, COMETS AND METEORS 2002

Astronomers from all over the world gathered together in Berlin at the end of July for the triennial Asteroids, Comets and Meteors conference. The ACM series began in 1983 in Uppsala, moving to the US in 1991 then alternating between the new and old world. This year, in total there were 452 astronomers from 34 countries, with 22 from the UK, ranking us in 7th place well behind the USA (105) and Germany (77). The majority were professionals, although there were a few amateurs as well.

Sebastian Hoenig, Maik Meyer and Brian Marsden discuss SOHO comets in the Stadthall of the Technical University of Berlin.

Many exciting developments were reported, including the discovery of comet 2002 O4 (Hoenig), which was discovered by Sebastian Hoenig from Heidelberg on July 22. Full moon intervened and it wasn't until July 29 that the discovery was finally confirmed. It was an accidental discovery, and although Sebastian has done some comet searching, on this occasion he was doing some casual star-gazing after a spell of bad weather. Fortunately he was able to recognise the interloper and report his find. This was the first comet discovery from Germany since 1946 and drew a generous round of applause.

Also discovered during the conference was comet 2002 O6, which was the first real-time discovery from the SOHO SWAN instrument, which scans the sky in the ultra-violet. Confirmation from ground based observers made this only the second SOHO discovered comet to be observed from the ground. This discovery perhaps sounds the death knell for amateur comet discoveries. Between the SOHO LASCO and SWAN instruments and LINEAR and future search programmes there is little sky left for the amateur to search. There is perhaps a small band running about 8° north of the ecliptic to around 50° from the Sun in the evening sky, which SWAN cannot see, and there is a chance of a comet brightening in this region.

Another development that was announced at the meeting is an exciting project called PanSTARRS, planned by the University of Hawaii. This will search virtually all the northern sky (except the pole) to magnitude 24 (getting this faint in less than a minute), three times a month. There may be four telescopes, each of 1.8-m aperture and capable of reaching the magnitude limit within a minute over a 3° field. Each frame will be around a billion pixels giving a huge flow of data at around 2 Tb a night. There will be a NEO (Near Earth Object) in every other frame and it may discover 100 comets a month, with the chance of seeing some interstellar ones. Comets will be confirmed in real time as the resolution is around 0.6", far better than existing programmes. It will discover around 10,000 KBOs (Kuiper Belt Objects) in the first year and 600,000 asteroids a night. It will put the supernova searchers out of business too, as it will detect new objects as well as moving objects and find perhaps 100,000 a year. The project is funded to the tune of $40M and is likely to be on line within a few years. The problem will be following up all the objects it discovers and providing linkages between the moving objects.

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Subscription to the Section newsletter costs £5 for two years, extended to three years for members who contribute to the work of the Section in any way, for example by submitting observations or articles. **Renewals should be sent to the Director and cheques made payable to the BAA.** Those due to renew should receive a reminder with this mailing.

Section News from the Director

Dear Section member,

At the end of July I attended the Asteroids, Comets and Meteors meeting in Berlin. This event saw a large gathering of comet specialists and a large part of this issue is given over to my report of the meeting. One key message from the meeting is that there is likely to be a rapid growth in dedicated search telescopes. I fear that the day of the amateur visual comet discovery may have passed, unless SOHO fails before a replacement is in orbit. There is still however much useful work that the amateur can carry out. CCD observers can provide follow-up astrometry and confirmation of the cometary nature of newly discovered objects. Stephen Laurie recently made observations within 24 hours of an object being posted on the NEO confirmation page. Imagery also allows study of morphological changes in the coma and tail, and these are often used by professionals. Visual observers can continue traditional magnitude estimation as this allows long period comparison of returns of periodic comets. BAA observations show that the absolute magnitude of comet Encke has not changed significantly in the last 50 years.

There are a couple more comet meetings coming up. The Royal Astronomical Society has a meeting on December 13 devoted to "Cometary Science at the Launch of Rosetta". The meeting runs from 10:30 to 15:30 and takes place in the Geological Society Lecture Theatre in Burlington House. The organisers give this summary: *Recent years have seen marked advances in the study of comets, largely through ground-based observations of Hyakutake and Hale-Bopp, and in-situ measurements of Hyakutake and Borrelly. The imminent launch of the Rosetta mission is taken as an opportunity to review progress made in this field, and to discuss the questions and challenges to be addressed in the future. The meeting will cover all aspects of cometary science, from studies of the nucleus, dust, and coma, to comets' interactions with the solar wind."* Following this, there is a pro-am discussion meeting on 2003 May 10, provisionally in Liverpool. The meeting will include the first George Alcock memorial lecture and I am delighted to say that Brian Marsden has agreed to present the lecture. There will be further details about this meeting in the next issue, on the Section web page and in BAA Circulars.

I have been kept very busy over the summer with a variety of activities and still have some correspondence to catch up with. If you are waiting to hear from me, please accept my apologies and I hope to respond soon.

I will be visiting Antarctica again from mid February to early April, so the next issue of *The Comet's Tale* may be a little delayed from its nominal issue month of April. I will be in limited email contact (see address above - no pictures please), but will be unable to update the Section web pages. Whilst away I should be able to begin work on the Journal papers covering the comets of 1999 and 2000.

The visit is to set up our part of a big European project to investigate the ozone layer. Although we know the basic theory of how the ozone layer is destroyed, there is much fine detail still to discover. Several Antarctic stations are participating in the experiment, where balloons carrying ozone measuring sensors will be launched in carefully synchronised sequence to measure the same air mass as it passes over each station. We hope to discover which of several competing variations of the theory give the best match with observation.

Since the last newsletter observations or contributions have been received from the following BAA members: James Abbott, Sally Beaumont, Neil Bone, Owen Brazell, Denis Buczynski, Roger Dymock, Kenelm England, Len Entwisle, James Fraser, Mario Frassatti, Maurice Gavin, Massimo Giuntoli, Peter Grego, Werner Hasubick, Guy Hurst, Nick James, Geoffrey Johnstone, Gordon MacLeod, Brian Manning, Steve Martin, Cliff Meredith, Martin Mobberley, Gabriel Oksa, Roy Panther, Robin Scagell, Jonathan Shanklin, David Strange, Melvyn Taylor, John Vetterlein, Alex Vincent and Graeme Waddington and also from: Jose Aguiar, Alexandre Amorim, Alexander Baransky, Sandro Baroni, Nicolas Biver, Reinder Bouma, Nicholas Brown, Jose Carvajal, Tim Cooper, Matyas Csukas, Mike Feist, Rafael Ferrando, Sergio Foglia, Stephen Getliffe, Antonio Giambersio, Guus Gilein, Bjorn Granslo, Roberto Haver, Michael Jager, Andreas Kammerer, Heinz Kerner, Attila Kosa-Kiss, Gary Kronk, Martin Lehky, Rolando Ligustri, Pepe Manteca, Michael Mattiazzo, Maik Meyer, Antonio Milani, Andrew Pearce, Maciej Reszelski, Tony Scarmato, Hirita Sato, Carlos Segarro, Giovanni Sostero, Graham Wolf and Seiichi Yoshida (apologies for any errors or omissions). Without these contributions it would be impossible to produce the comprehensive light curves that appear in each issue of *The Comet's Tale*. I would welcome observations from any groups which currently do not send observations to the BAA.

Comets under observation were: 7P/Pons-Winnecke, 19P/Borrelly, 44P/Reinmuth, 46P/Wirtanen, 51P/Harrington, 65P/Gunn, 77P/Longmore, 1999 U4 (Catalina-Skiff), 1999 Y1 (LINEAR), 2000 SV74 (LINEAR), 2000 WM1 (LINEAR), 2001 A2 (LINEAR), 2001 B2 (NEAT), 2001 HT50 (LINEAR-NEAT), 2001 K5 (LINEAR), 2001 MD7 (LINEAR), 2001 N2 (LINEAR), 2001 OG108 (LONEOS), 2001 Q2 (Petriew), 2001 Q5 (LINEAR-NEAT), 2001 Q6 (NEAT), 2001 R1 (LONEOS), 2001 R6 (LINEAR-Skiff), 2001 TU80 (LINEAR-NEAT), 2001 X1 (LINEAR), 2002 C1 (Ikeya-Zhang) and 2002 E2 (Snyder-Murakami), 2002 O4 (Hoenig), 2002 O6 (SWAN).

Jonathan Shanklin

Tales from the Past

This section gives a few excerpts from past RAS Monthly Notices and BAA Journals.

150 Years Ago: Professor Secchi discovered a small comet in Gemini on August 25, which was suspected to be one of the parts of Biela's comet, and on September 15 he discovered the other portion. It was very faint, without nucleus, and of a long oval shape, the point turned to the Sun. The larger and brighter portion had not the same shape as when seen on August 25: it was altogether irregular and with two very feeble brushes. The centre was more luminous than the edges, but there was no nucleus.

100 Years Ago: In April BAA Member William R Brooks wrote about his discovery of comet 1902 G1 (Brooks). This was his 23rd comet, and the 12th from Geneva, New York. The comet Section annual report for the year notes that there were now 15 Members of the Section. It includes a report from John Grigg, of Thames, New Zealand, of his discovery of a comet on July 22 (26P/Grigg-Skjellerup). As he was preparing to note its position a fire broke out in his neighbourhood and his work for the evening ceased! He confirmed the object the next evening, though was still doubtful, as the weather was cloudy and foggy. His observations continued until August 2. This was his first evening find after 15 years of searching and was made using a 90 mm Wray. *[I visited Thames on 1998 September 18 - 19 and whilst there observed comet 1998 P1. Skies were still very dark and clear, but must have been even better a hundred years earlier. At the time I hadn't even realised the connection with John Grigg!]*

50 Years Ago: The Section annual report notes that eight comets were observed during the session and lists 28 observers.

Professional Tales

SOHO Comet 500 Discovered
Paal Brekke, NASA/ESA Press release

A small object spotted by Rainer Kracht of Elmshorn in Germany, in an image from SOHO received via the Internet, has been officially confirmed as Comet 2002 P3 (SOHO). It is the 500th comet discovered with the ESA-NASA solar spacecraft and it made its closest approach to the Sun at 16:05 Universal Time on Monday, 12 August. Diane McElhiney of won a contest run by the SOHO science team for guessing that date and time for SOHO-500. Her prediction was too early by only 103 minutes.

The LASCO coronagraph on SOHO, designed for seeing outbursts from the Sun, uses a mask to block the bright rays from the visible surface. It monitors a large volume of surrounding space, and as a result it became the most prolific discoverer of comets in the history of astronomy. Most of them are small sungrazer comets that burn up completely in the Sun's hot atmosphere. More than 75% of the discoveries have come from amateur comet hunters around the world watching the freely available SOHO images on the web.

The biggest tallies have come from Mike Oates in England, Rainer Kracht in Germany and Xavier Leprette in France. They went back over pictures from 1996-99 and found dozens of comets that the professionals had overlooked. Kracht, a mathematics, physics, computer science and astronomy teacher at the Kooperative Gesamtschule

Elmshorn in Elmshorn, Germany has discovered 63 comets since August 2001 with the help of SOHO data and images. Mike Oates from Manchester, England is the highest-scoring discoverer of comets ever, with 136 to his name, while Rainer Kracht has discovered 63.

Amateurs Win NEO Grants
Vanessa Thomas Astronomy.com © 1996-2002 Kalmbach Publishing Co.

It seems we've been hearing a lot more reports of asteroids and comets zipping past our planet lately. Has Earth recently entered a more populated space, increasing the number of encounters with these smaller neighbors? Nope. It's just that we humans recently have become more aware of our immediate cosmic surroundings and have begun to pay more attention to these near-Earth objects (NEOs).

To improve our awareness and understanding of these frequent passers-by (and potential impactors), the Planetary Society established the Shoemaker Near-Earth Object Grant program in 1997. Named after the late planetary geologist Eugene Shoemaker (who studied asteroids, comets, and their impacts with the larger bodies of the solar system), the grant helps both amateur and professional astronomers enhance their own NEO projects.

This year, the Planetary Society is awarding a total of $28,290 to five deserving NEO programs on three continents.

John Broughton of Reedy Creek Observatory in Queensland, Australia, is an active observer of NEOs and has discovered several asteroids, including those named after the Beatles, Elvis Presley, Buddy Holly, the Beegees, and Brian Wilson. Broughton will receive $8,140 from the Planetary Society to buy an Apogee CCD camera to use on a new computer-controlled 18-inch (46-centimeter) telescope, which will conduct follow-up observations of fast-moving NEOs and those not visible from the Northern Hemisphere.

Amateur NEO observer Matt Dawson will also purchase a new Apogee CCD camera to use at the Roeser Observatory in Luxembourg and the Cote de Meuse Observatory in France. The camera will allow Dawson to observe objects as faint as 21st magnitude.

Richard Kowalski of Florida founded the Minor Planet Mailing List four years ago to provide an opportunity for minor-planet observers around the world to communicate with each other. In the past, Kowalski has spent his own money to maintain the list, and will receive a $900 grant to support the list and related websites for the next three years.

Amateur astronomer James McGaha of Tucson, Arizona, will use $10,000 to automate the 24-inch (62-centimeter) telescope at his Grasslands Observatory 55 miles from his home. This will improve the telescope's efficiency in the NEO observations it makes.

Roy Tucker, also of Tucson, currently has three telescope-camera systems observing NEOs, but the resulting data is more than he can handle. Tucker will receive $2,950 for software and computer equipment to distribute his observations to other local amateurs who can help reduce and analyze the data.

The five winners were selected by an international advisory group from 37 proposals received from 13 countries. "With so many highly qualified proposals, the selection committee's choice was a difficult one," states the Planetary Society's announcement of this year's winners.

The Planetary Society is not yet accepting applications for the next round of Shoemaker NEO Grants, but you can watch for updates or learn more about the grant program from the Society's website.

Comets break up far and near
NASA News

Some comets may break apart over and over again in the farthest reaches of the solar system, challenging a theory that comets break up only occasionally and not too far from the Sun, says a researcher from NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif.

A system of comets called "sungrazers," named for their orbit that closely brushes the Sun, reveals important clues about how these bodies break up. Most sungrazing comets are tiny -- the smallest could be less than 10 meters (30 feet) across -- and move in a highway-like formation of comets that pass near the Sun and disintegrate.

Dr. Zdenek Sekanina, senior research scientist at JPL, reports in the September 10 issue of the Astrophysical Journal that many sungrazer comets arrive at the Sun in clusters and on parallel paths. He emphasizes that such tiny fragments would have disintegrated if they had come so close to the Sun on an earlier trip. Therefore, the parents of these tiny sungrazers must have broken up after their previous encounter with the Sun and continued to break up far from the Sun on their journey through the solar system.

Sekanina's sungrazer studies challenge an earlier theory that the only place these comets break up is very close to the Sun, as the strong pull of its gravity cracked their loosely piled chunks of dust and ice. The gradual, continuing fragmentation gives birth to all the sungrazers, the most outstanding examples of splitting comets.

"Astronomers never before realized that there could be a fairly orderly pattern in breaking up, so that one comet cascades into large families of smaller comets, and that this process could be an important part of a comet's natural life cycle," Sekanina said.

Sungrazers are not the only comets that can break up far from the Sun. Sekanina points to new observations of comet 57P/du Toit-Neujmin-Delporte, whose fragmentation has led to the formation of a similar, though less prominent, highway of tiny comets. All fragments separated from the comet beyond the orbit of Mars.

Images taken by the European Space Agency's and NASA's Solar and Heliospheric Observatory have shown the many tiny sungrazing comets. Nearly seven years' worth of images from the solar observatory revealed more than 400 sungrazers in the Sun's immediate neighborhood. Sekanina estimates that currently there may be as many as 200,000 sungrazer comets the size of the ones the observatory detected. [*However a paper at the ACM suggested that the distribution of SOHO Kreutz group comets was essentially random, and they do not form clusters*.]

Asteroids, Comets and Meteors 2002

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The following précis gives a flavour of the comet science discussed at the meeting. It is from my notes and reflects what I heard and have interpreted from speakers' talks and posters and may not be what they intended! Generally I have brought together themes and do not always credit specific speakers with the discoveries, nor should it be assumed that a named speaker made all the remarks in that section. In some cases I make comments, though I have avoided putting some that could be made, into print! Invited talks were normally 30 minutes, but other talks were only 10 minutes and speakers often spent most of the time introducing their paper and not presenting their conclusions. Abstracts of papers presented at the meeting are at http://berlinadmin.dlr.de/SGF/acm2002/. In order to encourage participants to stay to the poster sessions the organisers laid on German beer, wine and snacks for us to sample!

Some 'elder statesmen' were often didactic in their views and unknowledgeable outside their own sphere, and were often given undue deference. The general scientific conference system tends to encourage mainstream views, with little chance for individualistic ideas. Another point is that professional astronomers often get only a few nights observing at widely spaced times and as a consequence appear to underestimate their observational errors. Compilations from several sources often showed variation outside the error bars, and many did not even give error bars. It was noticeable that many papers from eastern European or Russian authors used old data from the 1970s and 80s.

Berlin was a light airy city, with lots of trees, wide pavements and comparatively little traffic. The S-bahn (overground train) system was very efficient and cheap, with clean carriages and plenty of space. For most of the conference it was very hot (30°+), which made the lecture and hotel rooms very stuffy. There were many pleasant pavement restaurants. Sight-seeing highlights included the Tiergarten, Schloss Charlottenberg, the Pergamon Museum (particularly the Ishtar gate) and a river cruise, though the famed Brandenburg Gate was under wraps. The next meeting will be 2005 in Rio de Janeiro, followed by 2008 in Baltimore. In the meantime there is a meeting in London on December 13 to discuss comets prior to the Rossetta encounter and I am organising a pro-am meeting on comets and meteors for 2003 May 10. Brian Marsden has agreed to give the inaugural 'George Alcock Memorial Lecture' at this meeting.

Comets

David Jewitt (U of Hawaii) kicked off proceedings with a talk entitled 'From Kuiper Belt to Cometary Nucleus'. Comets are collisionally produced in the Kuiper Belt (KB) and are modified on the journey inward. They may reside in the KB for 10^9 - 10^{10} years and only spend 10^7 as a comet and perhaps 4×10^5 as a Jupiter Family Comet (JFC). The thermal conduction time scale, τ_c, is approximately r^2/κ and for bodies with r larger than 5 km this is longer than the inward diffusion time, and for bodies larger than 2 km it is longer than their lifetime as a JFC. This means that comets are out of thermal equilibrium and are therefore "ice bombs". The sublimation life time is about the dynamical life time for bodies with r around 40 km so JFCs must die by sublimating away or growing a mantle, so there must be dead comets.

Comets spin up much faster than their dynamical lifetime thanks to the Yarkovsky effect. This can modify minor body orbits and rotation rates through re-radiation of sunlight and was invoked by many theorists to explain the inward migration of some orbits and the spin up and disintegration of some nuclei. Duncan Steel suggested that comets could break up through Joule heating due to a current flowing through a conducting coma.

The Kuiper belt is becoming better understood, but there are roughly the same number of these objects as there were main belt asteroids in 1900. A plot of the distant objects clearly shows the classic KBOs, plutinos (and clearly Pluto is just a large one of these and therefore NOT the ninth planet), SDOs (scattered disc objects) and Centaurs. Smaller bodies a likely to predominate. KBOs tend to be neutral to red in colour whereas comets are significantly bluer and similar to Trojan asteroids. Comets have no "ultra-red" material because as soon as they pass Jupiter/Saturn mantling by ejecta is faster than the dynamical lifetime. KBOs and Centaurs are therefore more diverse than comets because of this mantling. Comet light curves are generally more extreme than KBOs and Centaurs, by up to 2 magnitudes and are perhaps more elongated than simple collisional fragments. Comets are very dark compared to asteroids, though probably 10% of NEOs are dead comets. Comets are less dense (at 500 gm/cc) compared to KBOs (1500) implying they are very porous, though even KBOs are pretty porous. Comets are probably weakly bonded collisional rubble piles, with perhaps more 50% pore space.

There are no KBOs with low e and with perihelion at 50 AU. This possibly marks the edge of the primordial solar nebula, or it could reflect stellar encounters or a trans-Neptunian planet. A stellar encounter with a 1/3 solar mass star, passing at 200 AU with an inclination of 30° provides the best fit and can explain the SDOs. 95P/Chiron started a new outburst in 2000/01, which might last until 2003. Since 1965 its absolute V magnitude has varied between 5.1 and 7.3 and is currently around 6.

The Space Telescope has been used to observe comet nuclei and when combined with data from ISO (infra-red satellite) it is possible to make deductions about their size and albedo. 10P/Tempel is quite a large object, whilst 45P/Honda-Mrkos-Pajdusakova is the smallest.

55P/Tempel-Tuttle has 5% albedo, whilst 19P/Borrelly is the most elongated. There are large numbers of small objects with radii less than a km. SPC (Short Period Comets) are not significantly bluer than KBOs. For small SPC cometary activity may cover 100% of the surface. The large diversity in colour reflects primordial variation. Colour studies provide the first evidence for a physical link from KBOs to dead comets, and there is a colour shift over dynamical evolution. Comments made after talks include that just because things are the same colour doesn't mean that they are the same. For example everything in a greengrocers that is green is not necessarily an apple. A rubble pile is what you get when you drop a load of rocks out of the back of a truck. This is not the same as a gravitational aggregate, which is what a dynamicist means by a rubble pile.

At the DS1 encounter with 19P/Borrelly the coma had less than 1% of the intensity of the nucleus. The physical properties are generally similar to asteroids. The overall albedo was 2.9%, which is within the error bars for that measured for 1P/Halley, but it varied between 1% and 5%, with two peaks in the distribution. A few asteroids have similarly low albedos, including NEOs but Iapetus or the rings of Uranus are the best match. The bond albedo is only 0.9%, so the surface is a good absorber of energy, which is why it is hot. There is evidence that the regolith is 'fluffier' than any other body. There are two terrains - roughly 50/50 'desiccated' and 'smooth', although the 'smooth' (or mottled) terrain is rougher at the pixel scale and perhaps reflects ponding of material. The surface is probably covered in 'native' particles, ie comet dust. Mottled terrain shows dark areas, which may be the sites of former jets, as the present jets map back to dark regions. There is some evidence that as the comet outgasses the surface gets darker, so these areas may be older. Geology includes dark spots, circular depressions, ridges and fractures, but no impact craters. Around 6- 8% of the surface was active. The upper layer of refractory material was hot at 300 K, with no sign of water ice. The rotation pole was located at 214° -5°, with the primary jet near the pole. This location implies that seasonal effects should be present, with peak sublimation from 2001 August to mid-September, followed by a rapid switch off. There may be a secondary jet in the opposite hemisphere. The mass of the comet is around 1.8 x 10^{13} Kg, with dimensions 4 x 4 x 8 km, giving a density of 0.27 that of water, although it could be higher in the range 0.29 - 0.83. It rotates with a period of 25±0.5 hours. There was a steep fall off in gas production (a factor of 20 - 30x) between 1.36 and 1.89 AU. A polar source is continuously in sunlight during September, but three months later is in darkness and will remain in darkness for the next six years. The source has a total area of around 3.5 km^2, about 4% of the total surface area. New features seen in DS1 images include hemispheric jet bases and loop features. Dust impacts were only detected near closest approach, with the nominal size of the particles 1.3μm. There were some double hits, implying a separation between particles of 2.5 - 25 metres. The dust is very red, implying large grains. There is evidence for fragmentation of icy particles (10 - 100 micron) near the nucleus. Modelling shows that the comet can form a stable crust, which is thicker at the poles.

The 2MASS survey has detected 265 comets of which 117 were periodic. It found prediscovery images of a couple of comets. Association is by position within a relatively wide window, which gives significant false detections for asteroids. It also implies that there may be undiscovered comets present in the data-set. The ISO survey data is also now publicly available and this may hold previously undiscovered observations of comets and asteroids. LONEOS/LINEAR/NEAT/Catalina don't search below -30° or above 80° or closer than 6 hours from the Sun, though occasional special searches go to 4 hours. LONEOS avoids the milky way and concentrates on the ecliptic.

Another possible space mission is NESS (Near-Earth Space Surveillance), which is being studied by the Canadian Space Agency. This is a small satellite in sun-synchronous earth orbit. It would scan ±20° from the ecliptic and 45 - 70° from the Sun to 20^m using a 15cm f6 Maksutov. It would have 2" astrometric precision. It would observe comets closer to the Sun than present search programmes and would search for Kreutz comets. In some eclipse geometries it could search even closer to the Sun.

The Stardust spacecraft encounter with comet 81P/Wild (the pros were not very good at using the correct identifications for comets) takes place on the same day as the launch of the Deep Impact spacecraft. Stardust is a dust return mission but will provide imagery at 10 - 20 metres resolution. Unfortunately the comet is at only 33° elongation at the time of the encounter, but all ground based observations will be of use. Contour will explore the evolutionary diversity of comets and has imaging better than 5 metres. Deep Impact will investigate the interior of the nucleus ("a crude experiment but interesting") and can image to around 1.5 metres; it will also benefit from ground based observations. They don't really know what sort of crater to expect. A strong surface gives a small crater with diameter to depth ratio of 3:1 and an ejecta cone that detaches. A porous surface fives a small deep crater and if the surface is weak it will excavate material to give a 60 - 240 m crater with a ratio of 4:1, which is what the team is working on. No missions will measure a comet's mass before Rossetta. There are no planned missions to an OCC (Oort Cloud Comet), though Contour could be targeted at one. An OCC is one that is making its first trip into the inner solar system and which has a Tisserand invariant less than 2; the Tisserand invariant is a measure of an object's gravitational interaction with Jupiter. There is a proposal for a comet surface sample return over the next decade, though cryogenic storage and return of a sample is a long way off.

Olivier Groussin and Philippe Lamy suggest that there is a rapid increase in water production in comet 46P/Wirtanen prior to perihelion, with the active fraction of the surface increasing from 10% to 85% in 10 days when the comet is at around 1.5 AU. The albedo is less than 10%. After perihelion the activity again reduces to 10%. They suggest that a one metre thick mantle blowing off causes the change. The paper is based on a few data points measured in 1997 and could equally be another example of under-estimation of observational errors. Another paper suggested that both 46P and Hale-Bopp need to have a low matrix heat conductivity and large active areas to explain the measured molecular fluxes.

A dust trail from 22P/Kopff has recently been detected. It comprises of large (cm sized), dark (1% albedo) particles similar to the parent comet KBOs and Centaurs.

The SOHO C3 LASCO coronagraph has a 77.6mm f9.3 lens, which allows a 1' resolution and can observe out to 15° from the Sun. Comet 96P/Machholz was observed over a phase angle from 160 - 114°, though incoming observations were overexposed. Klaus Jockers et al suggest that the comet shows a phase effect when very close to perihelion. The polarisation curve fits quite well to the expected curve, but appears to be a little higher. The tail is dominated by dust emission. Unfortunately the speaker ran out of time to present his conclusions.

Sebastian Hoenig, Maik Meyer and Brian Marsden at ACM2002

Brian Marsden reviewed orbit computations for the SOHO comets. Some comets were clearly not members of the Kreutz group, and as numbers increased close pairs began to appear, followed by members wider displaced in time. These become known as members of the Meyer, Marsden and Kracht groups, though all three groups have a similar longitude of perihelion (~100°), which is similar to that of the daytime Arietids, 96P/Machholz and the Quadrantids. This is odd! The Meyer group have a higher latitude of perihelion (50°) than the other two groups (10°) and the Marsden group has a greater inclination than the Kracht group. There may be a fourth group comprising of three members so far (2000 Q1, 2000 Y6, 2000 Y7), and clearly most SOHO comets are members of groups. In answer to a question on whether the groups are uniform in time, Brian replied that the objects look asteroidal and the search is perhaps not yet complete.

Michael Kueppers et al looked at the possibility of detecting cometary ions from Kreutz fragments as they pass the earth. The maximum size of the Kreutz fragments is ten to around 50 metres for a solid body sublimating completely. If tidal splitting occurs (such as seen in Ikeya-Seki) they could be as large as a few hundred metres. From a sample of 386 SOHO Kreutz comets there is no convincing evidence for the non-random distribution of perihelia times on small timescales, as proposed by Sekanina (ie comet pairs). The Earth could pass through a disrupted plasma tail in September/early October, but the chance is only around 2% a year given the observed comet frequency.

Hiroshi Kimura (Doug Biesecker was a co author) began his talk and by showing a nice painting of comet 1882 R1 by Ichigoro Ogawa and said that the tail was interpreted as an omen of a rich harvest. Dust grains include a major population of sub micron silicate grains, in aggregates containing more olivine than pyroxene. Pyroxene sublimes at around 5 solar radii, whereas olivine sublimes at around 10 solar radii. Kreutz group comets fade as they approach closer to the Sun, with two groups of light curves. One begins to fade at 11 - 12 solar radii, with perhaps another weaker group at 7 - 8 radii. There are perhaps sub-peaks at 11.2 and 12.3 radii, which reflect different dust properties - amorphous and crystalline olivine. There is no correlation with the comet orbits.

A poster by Teemu Makinen et al describing the discovery of comet 2000 S5 had a post-it note added during the meeting noting that Masayuki Suzuki had made a possible real-time discovery. Daily summary pages are on the web at http://sohowww/data/summary/swan/swan-images.html Magnitudes are accurate to around ±1 and positions to around 15'. Comets can be seen down to 11 - 12 magnitude. 2000 S5 was discovered during a second assessment of the Lyman alpha images using a neural net system to detect moving images. It might have disintegrated after perihelion and is best searched for on its inbound leg. There is a chance that an amateur astronomer may have recorded it on a photograph or image. The assessment suggested that search programmes were missing around 5% of the brightest comets. SWAN has observed comets 2P, 19P, 21P, 41P, 45P, 46P, 55P, 73P, 81P, 96P, 103P, 141P, 1995 O1, 1995 Y1, 1996 B1, 1996 B2, 1996 N1, 1996 Q1, 1997 J2, 1997 K2, 1997 N1, 1997 O1, 1997 Q1, 1997 T1, 1998 H1, 1998 J1, 1999 H1, 1999 J3, 1999 N2, 1999 S4, 1999 T1, 2000 S5, 2000 W1, 2000 WM1, 2001 A2 and 2001 Q2.

When comets with semi-major axes greater than 100 AU are sub-divided into groups of different dynamical age Fernandez found that there were significant differences in inclination between the afe groups. The ratio of prograde to retrograde orbits also varies with $1/a_{orig}$. A plot of $1/a_{orig}$ shows two peaks - one from the inner Oort Cloud and one from the outer Oort Cloud, which has a boundary at around 3 x 10^9 AU. Comets from the outer cloud are all new, but the inner ones have to traverse the Jupiter/Saturn region as Centaurs (because the change in energy is proportionately smaller), which is why there is an excess of retrograde orbits in this class. The excess of prograde orbits in the outer cloud could be due to too small a sample, or because the distribution reflects some memory of the original formation orbit. Another paper suggested that comet aphelia are aligned along a great circle, which implies an impulsive component to the flux. There is also a pattern of orbital element correlations. This is unlikely to be caused by observational bias (ie selection effects or bad data). The lack of comets along the galactic equator is due to galactic forces, but there are two peaks in longitude which are not expected from the galactic tide. Of 27 new orbits between the 11th and 14th catalogues 9 are in this distribution. The comets in the great circle distribution are more tightly bound. The most likely cause is a Jovian sized companion in the Oort Cloud.

Some recent research on cometary volatiles presented by Michael Mumma uses measurement of several parent species within a short space of time. Eight of nine comets studied have similar chemistry, though 1999 S4 is an exception. CO shows evidence for a distributed source in Hale-Bopp and varies by a factor of 20 between different comets. Compared to water most comets show about 2% methanol and 0.6% ethene. The studies show that the Oort cloud does contain comets that are chemically diverse, with 2/3 forming beyond 30 AU and the remaining third forming between 5 and 30 AU. Polarisation measurements help enhance dust features, eg shells in Hale-Bopp. There are three classes of comet: low polarisation, high polarisation and Hale-Bopp. What causes the difference is not known. Long term monitoring of Hale-Bopp from 7 AU on the way in, through perihelion and out to 14 AU shows significant short-term variation in molecular species, especially CO. The transition from a CO to H_2O dominated coma occurs between 3 and 4 AU. At large solar distances water production rates depend on a complex combination of seasons, spin state, r and the thermal properties of the nucleus. CO production rates depend only on r and it doesn't sublimate from great depths, so the nucleus may be very inhomogeneous. Generally production was higher after T, but it modelling suggests that it depends on seasonal effects. A lower limit for the nuclear radius is 13 km. The rotation axis was constant between 1995 and 2002. There were at least four active regions on Hale-Bopp, with a continuously active northern fan. Some outbursts were in a 'palm-tree' pattern and others included 'boulder spitting' as mini-comets. Small condensations were seen in the coma of 1996 B2 over a period of around 20 days, which were possibly mini comae around icy fragments between 5 and 100 metres in diameter. One effect of this spallation of fragments is that the nucleus remains extremely cold. The structure appears to be a thin layer of crystalline ice, over a mixed layer of amorphous and crystalline ice then a pristine nucleus. This structure is quite different to that of JFCs. LPCs experience strong thermal stress close to the surface.

A lot of species have been measured in high resolution spectra of 2000 WM1. These include C_2, NH_2, CN, C_3, CO, H_2O^+, CH^-, CO^+, CH^+ and C_2^-. The ratio of C^{12}/C^{13} is close to the terrestrial, but that of N^{14}/N^{15} is only half, though comparable to that in Hale-Bopp. The outbursts of 2001 A2, which is a gas rich comet of the Halley class (or possibly a water poor Borrelly type*) [note that chemists use a different naming convention to the dynamicists*], were associated with fragmentation, except the one on July 12. CN, CH, CH^+, C_3, C_2, NH_2, and O[I] were detected in its spectra. P/2001 Q2 is also a Halley type comet. The ortho/para spin temperature for 1P, 1995 O1, 1999 S4 and 2001 A2 is around 28K, suggesting an origin in the Saturn/Uranus region, whilst that for 103P is around 35K. Complex chemicals ('pre-biotic') can form in comets. 19P is in the C_2 depleted class of comets. The source for C_2 may be C_2H_6 or ethane for comets depleted in C_2, whereas CH_3C_2H or CH_2CCH_2 may be the source for C_3, although another possibility is C_3H_8.

Many groups had observed 2002 C1. NH_3 had been detected for the first time in the infrared, at a few x 10^{26} in the month after perihelion. This was only 0.7% that of water. C_2H_4 (di-acetelyne), only observable in the infrared, was also detected at around 0.05% water, with HC_3N also detected. A sodium tail was seen. CO was much higher in 1999 T1 at 13% than in 2001 A2 or 2000 WM1 at <1%. The preliminary estimate for 2002 C1 was 8% of water. The presence of a hot component at 300 - 500 K suggests a CO_2 source.

Daniel Boice reviewed processes in the coma. At 1 AU the inner coma is dominated by collisions in a moderately active comet. The mean free path is around a metre, and an inner boundary layer exists several mean free paths above the nucleus. The outer boundary is the transition to free flow at 10^4 - 10^5 km. In between there is reactive fluid dynamics, but no solar wind or magnetic effects. Solar visible radiation initiates sublimation from the nucleus. To model what goes on a multi-fluid approach including neutrals, ions, electrons, H, H_2, dust etc is adopted and the continuity equations are solved separately. The most important terms are the inhomogenous ones, such as chemistry, mass {condensation, evaporation, etc}, momentum and energy that are related to sources and sinks and are particularly affected by He and H. The near nucleus region is very asymmetric, because of jets etc, but is approximately symmetric by 100 km. All this is solved and velocity & temperature profiles are derived that generally agree with the observations. Parent species generally follow a $1/r^2$ distribution, but daughter species have various patterns as the parents are broken down by solar ultra-violet radiation to give many daughters. There are differences between what happens when the sun is active and when it is quiet. Radiative transfer in the coma is complex, with factors such as optical depth and shadowing playing a part. Extreme UV penetrates into the innermost region. Water dominates at distances less than about 2 - 3 AU from the Sun, with carbon monoxide at greater distances. Gas phase reactions vary in importance with distance from the Sun and from the nucleus. Close to the nucleus electrons are coupled to water through inelastic collisions, but further out they decouple giving a steep rise in electron temperature to 10^4 K. Dust gives distributed gas sources and can lead to heating of gas through radiative heating. Generally even the best models don't give a brilliant fit to the observations and it seemed that the model was more important than reality, with one not even incorporating a dusty crust.

Water is difficult to observe from the ground, but the Odin satellite can measure it from space using emissions at around 550 GHz and has observed comets 1999 H1, 2001 A2, 2000 WM1, 2002 C1 and 19P. Comet 1999 H1 (Lee) produced 4 tonnes per second and generally production rates were 2 x 10^{28} - 2 x 10^{29} s^{-1}. 2001 A2 showed strong self absorption as it had a very strong emission line.

In 2002 C1 $H_2^{18}O$ was detected and the $^{16}O/^{18}O$ ratio was around 500, similar to the cosmic ratio. Nicolas Biver and his colleagues had used several millimetre wave telescopes to compare 25 comets. CH_3CN was quite variable. The HNC/HCN ratio varied with solar distance. The variation in CH_3OH was far greater than in HCN (<1% to 6%, around 2% in JFC). H_2CO was also variable, with a weak correlation with CH_3OH in LPC. Four CO rich comets were all HFC and CO was low in SPC. H_2S was quite variable at 0.1% - 1.5%. CS/HCN may also vary with solar distance, being about 0.8 at 1 AU. Generally NH_3 is around 0.5% of water.

The FUSE spacecraft has observed lots of UV emission lines, and around 50% remain unidentified. There is no evidence for argon in comets from the observations, so it must be at least 10 times less than solar. Comets can't therefore be the source of argon in Venus' atmosphere. FUSE has made the first detection of neutral nitrogen in comets, but can't account for the source. By looking at isotope ratios and relative concentrations they have showed that comet 1999 T1 was never warmer than 40 - 45 K and comets 2001 A2 and 2000 WM1 were never warmer than 60 K.

Some comets show no features in the coma. The features in those that do may be stationary or varying, and if varying may be periodic or one off. Jets are consistent with active areas. Projection effects are very important, eg a double jet feature may be explicable if we are looking directly at it. 1993 Y1 (McNaught-Russell) and 1996 Q1 (Tabur) only showed gas jets - there were no dust jets. 1P/Halley also showed some gas jets with no dust. They seem fairly common, so gas and dust jets may be formed in different ways.

The solar wind at solar minimum is very variable in equatorial regions, with speeds of 300 km s^{-1} and disconnection events in comet ion tails are observed. At polar latitudes (>30°) the wind is fast and constant at around 750 km s^{-1}. At solar maximum it is variable even in polar regions, with much less fast smooth wind conditions. John Brandt and others have used amateur photographs and images to investigate how the wind changes. 2001 A2 (LINEAR) showed a slender ion tail for most of December and January, with no disconnection events, implying a slow polar wind. 2002 C1 has shown lots of disconnection events, which are a good match to current sheet crossings. There is an equatorial type of solar wind north of the heliospheric current sheet (HCS) and polar south of it, though the polar wind was slower than 750 km s^{-1}. The location of the HCS may vary from that expected from the photospheric magnetic field measurements. 2002 Q4 (NEAT) will be a good probe of solar wind conditions.

A glitch in proton numbers measured by Ulysses was seen on 1996 May 1, with a coincident change in the magnetic field. If caused by an encounter with the tail of 1996 B2 (Hyakutake) this implied a tail 3.8 AU long and with a 740 km s^{-1} wind speed the particles would have been emitted 8 days earlier. The tail is a long curved structure, about twice the diameter of the Sun at the spacecraft distance. The orientation was not quite as expected. There is a question of how it lasted so long, and possibly magnetic field draping protected it. Images taken on April 23 will be important in understanding the observations. On March 1, the Earth was inside the tail, which was curved, though less so than in May. This could give a longer tail than predicted by geometrical considerations, however the feeling was that observers reporting very long tail lengths might have been confused by the geigenshine.

X-ray emissions from comets were now thought to be caused by charge exchange of highly ionised atoms, eg O^{6+}, in the solar wind picking up electrons from the coma. A clear emission line was seen in 1999 S4 prior to its breakup. C^{5+} and O^{7+} were seen in 1999 T1 (McNaught-Hartley).

Paul Weissman reported on cometary nuclei. We have imaged 1P/Halley and 19P/Borrelly, but at best the resolution is 50 metres. There are various models of a nucleus: Classical Whipple, Fractal Aggregate, Rubble Pile and Icy Glue. The middle two are more likely as there is no heat source that could head the nucleus more than a few Kelvin and there is lots of evidence for the two models. 1999 S4 showed metre sized cometisimals and Kreutz sungrazers break up to metre to 10 metre sized objects. All the Kreutz fragments and comets seen so far would only sum to a body a few kilometres in size. 1993 F2 (D/Shoemaker-Levy) stretched at perijove, fragmented and then re-accreted into the objects seen. This concept explains lots of the features of the size distribution, with the biggest objects in the centre and the re-entry where there seems to be a greater surface area than can be explained by the mass. The regolith may hide any rubble structure. The maximum density is 1.65 for a tightly packed agregate, though actual estimates (for example from non-gravitational forces) suggest a value of 0.4. The breakup of 1993 F2 suggests a value about 1 and the same comes from IDPs (Interplanetary Dust Particles). However meteorites show a higher density than their parent bodies. The size distribution of nuclei varies as $N(r) > r \sim r^{-1.6}$; smaller objects are probably under-represented and the original distribution may be steeper. Perihelion distance has no effect on the derived slope parameter. 22P/Kopff has a rotational light curve of 12.3 hours and amplitude 0.5^m, which implies an axial ratio of more than 1.59. For 2P/Encke it is 7.26 hours and 0.3^m and the comet is probably smaller than 4 km. For 6P/d'Arrest it is 7.2 hours and 0.1^m, giving a size of 1.5 km. Generally the measured sizes are 1.5 to 2.5 km for an assumed albedo of 4%. The nuclei of 28P and 124P when far from the Sun are redder than the Sun.

Gonzalo Tancredi spoke about ways of measuring the nucleus diameter. It can either be visited, observed when very distant or the effect of the coma subtracted. For the latter two techniques a plot of the absolute magnitude against r should either show a constant value or reach a minimum. A phase coefficient and a geometric albedo of 4% is used to estimate the effective radius. There are good results for this technique with comets 1P and 19P, which have been visited. There is general agreement between ground based and HST measurements, except for 147P/Kushida-Muramatsu, where the HST value is clearly wrong. The survey of JFCs to q=2 is complete (ish) and suggests a magnitude index of -3.4 (or a cumulative index of -0.8). To measure more distant comets a telescope larger than 3 metres is needed. Of around 230 JFCs, 100 have had their nuclear magnitude determined, however there may be biases. The distribution is nearly linear up to a nuclear magnitude of 17, but then flattens with a cut-off at 20. Very few intrinsically faint comets with q < 2 have been found recently. Options are that break-up removes the small ones, mantling occurs, or they loose all their volatiles.

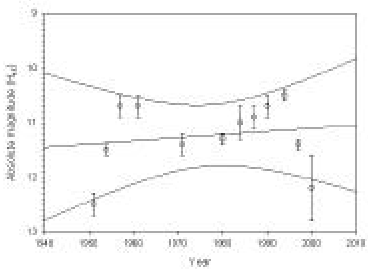
Hal Levison looked at fading in comets. There is a big inconsistency between models of delivery of OCCs into the inner solar system and the observations, so OCCs must disrupt. Two dormant external returning comets have been observed, but there should have been 200! There is a similar ratio for extinct HFCs, with 9 seen compared to a prediction of 1100. JFCs however don't disrupt at this rate, with some 20% being dormant; a typical example is 2000 QN_{130}. Dynamically new comets are often anomalously bright, however there is still a problem with the flux being much higher than observed. A full copy of this talk is at http://www.boulder.swri.edu/~hal/talks.html. Modelling suggests that the majority of new OCCs reach q at 30 - 40 AU, with roughly constant numbers reaching perihelion between 0 and 30 AU. The JFCs must come from a flattened Kuiper belt. Another modelling paper looked at the origin of JFC and HFCs from SDOs. There are a number of differences between theory and observation. The SD model produces more JFC than HFC as observed, but a thick disk cannot be the source for them.

Carey Lisse et al looked at ageing in comets. Short period comets emit dust as large dark particles of high mass whilst LPCs emit small high albedo particles. They suggest that SPCs become extinct by mantle formation over a period of 10^3 - 10^4 years, disintegrate, or are ejected from the solar system or hit the Sun. 1999 S4 probably didn't break-up as a result of rotational splitting.

A replacement for a successful model must be able to predict, fit the observations and be physically realistic. The classical non-gravitational model of Marsden was invented years ago to improve orbital fits and includes radial and transverse forces linked to g(r). This can be modified to include a normal component and a delayed maximum. A newer model is the rotating jet model, averaged over one rotation. For 19P/Borrelly the classic model gives a poor fit to the observations. The modified model does better, with a ΔT of 51 days before perihelion, when the reported rotation pole was in the solar direction. If the jet is at the rotation pole the new model matches the observations. For 2P/Encke the modified model does no better than the classical model, and whilst the jet model does better, it gives a different rotation pole to that derived by Sekanina. Sekanina's pole doesn't match the light curve over the last twenty years, though the new pole position does match his precessed pole position. The model confirms Sekanina's two source regions, with 2° per apparition precession, with an obliquity pole of 35±15° and a rotation pole at 220° RA, 40° dec and the jet positions remaining constant.


Jonathan Shanklin, Brian Marsden and Sebastian Hoenig at the ACM.

I presented a paper on BAA comet observations and included an updated version of the estimated absolute magnitude of 2P/Encke over the last 50 years, which shows no significant change. I also showed that periodic comets tend to have a larger log r coefficient than do non-periodic comets. There is a general trend for comets with a brighter absolute magnitude to have a larger log r coefficient, though this does not apply to 'new' comets from the Oort cloud. There is no obvious correlation between absolute magnitude and perihelion distance. I've put a version of the poster on the web, including all the figures.



The absolute magnitude of 2P/Encke

The CLICC/A catalogue of comet magnitude estimates has been extended for 21 LPCs observed between 1959 and 1976. It can be found at http://www.ta3.sk/~astrsven

Comet 53P was in a Jovian moon like orbit some 600 - 1000 years ago. It is not a Trojan, though it is currently close to a 'horse-shoe' like orbit with respect to Jupiter. P/1997 V1 is in a 'horse-shoe' like orbit and may have been a Trojan in the past. In the future it will do 11 retrograde orbits about Jupiter. P/1998 U4 may undergo temporary capture in the future for around 500 - 2000 years. P/1999 WJ7 is at the end of a period of 'horse-shoe' like orbit and P/2000 Y3 is in a 'horse-shoe' orbit.

The radial profile of SDO 29981 (1999 TD10) measured from images is flatter than stellar images and it therefore shows evidence for a coma.

Asteroids

There are several asteroid missions planned. Dawn to Vesta and Ceres for orbital mapping and Muses C, which will launch at the end of this year, to 1998 SF36. Stardust is flying past Annefrank on November 2 and will test operations for 81P/Wild.

2002 NT7 had an impact probability of 1:70,000 up to July 23. Now an impact in 2019 is not possible, but one in 2060 is at 10^{-7} though negative on the Palermo scale. Several speakers on impact topics and orbital calculation were rather too wrapped up in the maths of their calculations, with little attention to the real world. It would need 30 Arianne launches to deflect it from a 2060 encounter. The Italian Spaceguard centre and JPL plan to create a database of each observing station so that a statistical distribution of errors and biases can be applied to each astrometric observation. In order to reach the Spaceguard target (all km sized NEOs within 10 years) searches would have to be complete to 21.5^m now - they aren't! LINEAR would take until around 2035, though PanSTARRS could do it in six years. Undiscovered NEOs are probably intrinsically harder to discover and all the search teams together will only get to 90% by 2014.

A solar concentrator gives quite an effective means of moving a small NEO over a five year or longer period. Several NEOs require a smaller ΔV to rendezvous with, than do Mars or Venus, and one has a smaller value than for the moon. A hit from a large object is likely every 400,000 years with a small one every 1000 years. Objects on imminent collision course with the Earth will be undetectable due to their lack of motion 3 - 4 weeks before impact.

Binary asteroids were a big theme of the meeting and William Merline gave an introductory talk. There are 7 TNOs (Trans Neptunian Objects) with known satellites, 8 MBAs (Main Belt Asteroids) and 14 NEOs, with a further 8 binary NEOs detected from light curves. They have densities between 1 and 3 (times water). There are a variety of formation mechanisms. The TNO satellites must have formed in situ, but the NEOs by fragmentation. The TNOs are mostly cubewanos, and are too wide to have formed by collisional breakup. Sizes range from 1:1 to 1:20. A small secondary is likely to arise from ejecta form an oblong object. Rotational fission will give rise to close equal components. Tidal disruption is likely to be common in NEOs. He showed an impressive animation showing the effects of adaptive optics. Dactyl was the first positive detection in 1993, with Eugenia/Petit Prince in 1998. Some light curves give convincing evidence of duplicity. Dactyl probably formed from a cratering event on Ida as its surface is only around 30 My old. Arecibo has 7.5 metre range resolution and gives clear views of NEO binaries. All NEO binaries are fast rotators and about 17% of NEOs are binary, suggesting that tidal disruption gives rise to rubble piles. 216 Kleopatra is an M type asteroid in the shape of a 'dog bone' and may be a residual metallic core frozen into shape.

The shortest measured rotation period of any asteroid is 76.8 seconds. Smaller objects rotate faster, but it is impossible to measure much faster periods with sub 2-m class telescopes. It is possible to get fast rotators from the break up of a rubble pile. Possibly 50% of the most easily accessible NEOs are fast rotators and therefore not easy to land on! Most asteroids with regolith will have ponds and cracks, which fill with fines if seismic shaking force is comparable to gravity. They show weak to moderate albedo features and even large bodies may show irregularities.

The binaries are important individually, as a population and because the NEO, MBA and TNOs are different. NEO 2000 DP107 is a pair of 800 and 300 m diameter separated by 2.6 km. Radar observations give very good, rich data. The secondary is always brighter in radar images, which can currently only view NEOs. About 16% are binary, with typical size ratios of 1:3, with the secondary orbiting at 5 times the primary radius, with a period of about a day. Densities are between 1 and 2.6 implying high porosity. Primaries are spherical and fast rotators. MBA can be detected with adaptive optics on large telescopes. There are observational selection effects and satellites that are faint or at small separations won't be seen. A few percent of MBAs are binary, with typical size ratios of 1:10, with the secondary orbiting at 10 times the primary radius, with a period of about four days. Densities are between 1.2 and 2.3, even for M type asteroids, which is an implausible porosity for them to be the source of iron meteorites. There are a few large contact binaries, eg Nysa, Daphne and Hector. TNO binaries can be seen with HST or medium sized ground based telescopes. No new binaries were seen in a sample of 200, however two and an already known one, were found in a set of 75 imaged with WFPC. About one percent of TNOs are binary (or possibly 4%), with typical size ratios of 1:1 to 1:3, with the secondary orbiting at 10 - 100 times the primary radius, with a period of 60 - 600 days. So far there is no information on density.

Formation of binaries could be by tidal splitting (NEOs only), rotational fission, impact or disruptive capture. The large separations of TNOs are not caused by tidal evolution and their formation mechanism is unknown. We would expect the secondaries of NEOs to be rotationally locked, like the moon. NEO binaries form by spin-up and mass shedding, most likely the result of disruption during close planetary encounters. MBA binaries form from impact ejecta. The low density implies either a high porosity or a high volatile content.

The rotational variant of the Yarkovsky effect called YORP can explain some of these rapid rotations. Asteroids can spin up and self destruct. These forces are as important as gravity and collisions in asteroid evolution. The Yarkovsky effect on bodies smaller than 20 km can transform MBAs into NEOs. The YORP effect is important for spin, obliquity and configuration of km sized asteroids. There is evidence for the Yarkovsky effect working in the orbits of members of the Eos family and modelling suggests an age of 2.1 Gy. Asteroid groups can be identified from their proper elements and another recently identified group is the Karin group, which from its compact grouping must be young. Integrating the orbits back in time gives a breakup age of 5.8 My, with the original body 25 km across. This means that members of the group should show fresh surfaces, perhaps with water ice, and they may be the source of some zodiacal dust bands. A satellite visit to members of the group could help measure the Yarkovsky effect, satellite formation and crater counts (though these are probably dominated by debris). The spin vectors for Koronis family members are bi-modal.

Al Harris (JPL) asked 'How many Tunguskas are there?'. One way of estimating how many NEOs there are is to look at the re-detection rates by search programmes of already known bodies. To estimate the size of craters we can look at lunar impacts, where the size of crater/size of body ratio increases for smaller bodies up to 1:50. Discovery statistics need to be corrected for 'missing' detections near the limit of the system, and at faint magnitudes the efficiency may be 10^{-5}. Up to a limit of H=18 (roughly equivalent to a kilometre) there are around 1100 objects. For smaller objects the statistics are poor. To make an estimate he took 1000 known NEOs, ran the elements for 100 years and found 5000+ passages at less than 0.3 AU. He then convolved this with the LINEAR coverage, though note that LINEAR can't detect objects moving at more than 12° per day (which is why they often don't see close approachers until after they pass). This gave an estimate of 10^6 Tunguska sized objects or 1 per 1000 years. A questioner however noted that acoustic monitoring suggests an object this size every 120 years.

Boris Ivanov and Jay Melosh had numerically modelled asteroid impacts and concluded that they do not induce volcanism. Oceanic crust is young, less than 250 My, and there are no major (> 300 km) crater remnants. Hot spots are small, and unlikely to be hit. Flood basalts link to tectonic activity. A large impact can create a hot spot, but this is created by shock heating and is not intrinsic to the Earth itself. Melting is 1 - 3 orders of magnitude less than associated with large igneous provinces. It would be unlucky to hit a young hot spot and therefore this is not a regular geological process. There are varying estimates of the ratio of long period comets to asteroid impacts ranging from 5 to 30%. We have some idea of the LPC flux now, but how can we tell the difference in impact structures? David Wallis suggested by possibly using the difference in azimuth of impact direction as the orbital distribution in the two groups is different. Measuring the crater bowl shape asymmetry gives the impact direction and crater rays may confirm this for some lunar and Martian craters. There has been no practical study so far, and questioners were sceptical if the technique would work.

IDPs are quite different to meteorites : they are small grains with a high carbon content and probably originate in a few discrete sources. The three main zodiacal dust bands may be associated with asteroid families or perhaps a recent break-up. Perhaps as many as 85% of IDPs come from one source, possibly Veritas, a C-type asteroid, which broke up around 50 My ago. Dust must have been more significant away from the present epoch, possibly giving a climate signal. The near 100 Ky periodicity in the Quaternary climate might be related to chaotic transport of NEOs through variation in the orbital eccentricity of Mars.

The Klet observatory has a new, specially designed 1m f3 telescope, with 1024 pixel CCD camera and a 33' field for the KLENOT project, which is designed to provide astrometry of NEOs, comets, Centaurs, TNOs etc and in particular to make follow up observations. They have provided confirmation for 48 NEOs, including a 21.9^m Amor object, 5 comets and the 'B' component of 57P. They have discovered an Apollo 2002 LK. It can be worth measuring the position of around three numbered minor planets during the course of astrometric work as this can help trace errors of measurement or systematic effects. Station 940 shows residuals of around 1" in RA and dec over the last few years, with 951 having 0.6" and 0.4" respectively.

There are no KBOs with low eccentricity orbits beyond 50 AU. Deep searches should have found them, unless they are located in a thin disk in the invariable plane of the solar system. Alternatively they could have been cleared by a recent stellar passage or a Mars like planetoid at 60 AU. There are many biases in the follow up of TNOs, for example if the object is assumed to be a plutino it is most likely to be recovered if it is one. To do good statistics it is necessary to use a well characterised survey and this shows that some 20 - 25% are SDOs and <3% plutinos, with a new class of Extended SDOs. Richard Donnison suggests that there should be a predominance of large bodies in the TNO distribution.

Meteors

There are over 100 years of observations of meteors from comet 1P/Halley. Sadly Anton Hajduk didn't use any BAA data in his talk. Ondrejov data shows multiple peaks in Orionid observations, with significant shifts from one year to the next. Both Orionids and eta Aquarids extend over 14 days and the link with comet Halley is established beyond doubt. The eta Aquarids last from L 37 - 51°, with enhanced activity between 42.5 and 47°, whilst the Orionids last from 202 - 216° with a double maximum between 208 and 210°. The mass index is 2.2 and 1.8 respectively.

Double station recording from Ondrejov suggests that brighter Orionid and perhaps Perseid meteors start higher in the atmosphere (120 Km). Slow meteors penetrate more deeply (to 80 Km). They do not see cometary (ie fragile) meteoroids on orbits with small perihelion distances. Generally light curves from the Perseids, Orionids and Leonids are symmetric with peak brightness near the middle. Pavel Koten has written meteor video processing software - the present version is for DOS, but a Windows version is being developed.

A Russian speaker suggested the existence of meteor micro-showers with activity of perhaps 1/10 that of major showers. He suggested that they might arise by gravitational separation from the major showers. Unfortunately he didn't see some of the major showers and I suspect that there may be noise in his data.

The North Taurids are active from October 16 - November 29, whilst the South Taurids are active from October 4 to November 24. Meteors generally associated with the Taurid complex are active from September 16 to December 29 (N) and September 25 to December 19 (S). It is important to take account of radiant motion as it moves through over 90° in RA. 1993 KA2, 1998 VD31, 1999 VK12 and 2002 MX are probably associated with the complex, but 2201 Oljato is probably not. Taurids generally have a higher critical mass than the Orionids (5 mg cf 0.8 mg). Ziolkowski suggests that 2P/Encke and 1966 T1 (Rudnicki) are both member of the Taurid complex. If so, integrating back the orbit of 2P until the longitude of perihelion agrees with that of 1966 T1 should give the time of separation. This gives 4.35 x 10^4 years, comparable to the period of 1966 T1, which is about 4.5 x 10^4 years.

There are two more Leonid storms expected in 2002 on November 19 at 03:58 - 04:15 and 10:36 - 11:15. The second peak is from the 1866 trail and may have a peak ZHR of 2850, with a 2 hour duration. There is a Lorentzian distribution of particles long each debris trail, and the trail is displaced from year to year. Bright Leonids (~-2) tend to be brightest at the end of their flight, and these probably have greater strength and are larger. The final flare of a fireball may be richer in CaAl. 0^m meteors tend to have a variety of light curves. There is no evidence for ageing in Leonid meteors from different trails, though there are significant differences. A network of video cameras in Japan recorded the 2001 shower. Significant variations in the rates from north to south reflect the structure of the trail. The population index was higher at 2.2 after the 1815 (4 revolution) peak compared to 1.9 before the 9 revolution peak. The Japanese also set up a network of school observers. The results are scattered but the mean of 171 groups (1800 students) agrees well with the IMO results. Australian image intensifier results from 2001 shows peaks at 18:02±3 (9 revolution, 1699) and 18:17±3 (4 revolution, 1866) but no evidence for an 18:30 peak reported by visual observers. Short lived enhancements of Leonid rates (> 15 within a few seconds) in a linear distribution (cf Shoemaker-Levy 9) cannot be explained by ejection from the comet as the ejection velocity would have to be around 0.003 mm/sec, much less than the expected 30 cm/sec. It probably occurred after the last perihelion of the debris, about 6 days before encountering the Earth. Peter Jenniskens suggests that there could be a further significant Leonid shower in 2006. The visibility of 'periodic' outbursts is governed by Jupiter pulling around the solar system barycentre.

A fireball recorded by the European Fireball Network on 2002 April 6 lead to the recovery of a 1.7 Kg meteorite by amateur astronomers in July and this was exhibited at the meeting. It was found a little to the east of the predicted fall ellipse. The orbit is clearly related to that of Pibram and implies the existence of a meteroid stream. Another fireball on 2001 November 17 was so bright (-18^m) that it was detected by a radiometer at night.

The Arecebo radar shows a clear peak in fast meteors between 04 and 08 LAT. An unusual fireball was photographed from Ondrejov, which showed an apparently 'strong' meteor in a retrograde orbit, with q 1.01, Q 6.0 and lacking in sodium. Sodium lacking meteors occur in two groups: those in sun approaching (q < 0.25) prograde orbits with low to moderate inclinations and an inner halo with q ~ 1 and in high inclination, often retrograde orbits. They could be related to the exinct HFC as proposed by Levison, however the non-chondritic structure argues against this. Inner halo meteoids are subject to significant hearing and this suggest there may be highly processed material in the Oort cloud.

Comets with aphelia less than 7 AU produce the bulk (90%) of meteoric material. HFC produce 5% and long period comets (P > 200 y) 5%. The model predicts the observed helion/anthelion distribution of sporadic meteors.

Conclusion

Richard Binzel summarised the meeting for the final talk. He thought that inter-relationships between the various bodies were amongst the most important aspects. We are getting some geophysics of asteroids, for example on Eros. Fundamental questions about comets remain. They have an aggregate structure. We are getting better nuclear magnitude distributions. 2/3 of OCC formed beyond 30 AU with rest forming between 5 and 30 AU. The Oort Cloud is the source of long and short period comets, with the Kuiper belt for JFC. TNOs are a growing field and we have discovered the same number as there were MBA in 1900. There are dynamically "hot" objects, which are blue/grey in colour, and "cool" objects (ie in stable orbits) that are red. Satellites are very important. Probably one size does not fit all. Highlights for meteors included the Leonids, recovery of the Neuschwanstein meteorite (only the 3rd European recovery) and the link of IDPs to showers. The Yarkovsky effect is important for meteorite delivery.

Review of comet observations for 2002 April - 2002 September

The information in this report is a synopsis of material gleaned from IAU circulars 7881 – 7979 and The Astronomer (2002 April–2002 September). Note that the figures quoted here are rounded off from their original published accuracy. Lightcurves for the brighter comets are from observations submitted to The Astronomer and the Director. A full report of the comets seen during the year will be published in the Journal in due course. I have used the convention of designating interesting asteroids by A/Designation (Discoverer) to clearly differentiate them from comets, though this is not the IAU convention.

7P/Pons-Winnecke Although few confirmed observations were received, reports circulating on the internet suggested that the comet entered visual range in April. It was several magnitudes fainter than expected and the majority of observations were made from the Southern Hemisphere.

22P/Kopff Although it continues to brighten, the solar elongation decreases and it is poorly placed when at its brightest (11^m) at the end of the year.

29P/Schwassmann-Wachmann This annual comet has frequent outbursts and over the past few years seems to be more often active than not, though it rarely gets brighter than 12^m. This comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity.
It spends 2002 in Capricornus and was at opposition in early August, fairly close to Neptune. Unfortunately opportunities for UK observers are limited, as its altitude will not exceed 20° from

this country. The comet has undergone a series of outbursts over the summer.

This comet appears again to be in outburst, as indicated by the following total-magnitude estimates (visual unless otherwise noted): Mar. 20.83 UT, [16: (T. Kojima, Chiyoda, Japan, 0.25-m reflector + CCD); 27.80, 14.4 (Kojima); May 8.46, 13.5 (A. Hale, Cloudcroft, NM, 0.41-m reflector); 9.46, 13.3 (Hale); 21.45, 13.3 (Hale); June 8.39, 12.3 (Hale; near-stellar appearance); 9.75, 12.0 (A. Nakamura, Kuma, Ehime, Japan, 0.60-m reflector + CCD; strong condensation). [IAUC 7918, 2002 June 13]

46P/Wirtanen is a morning object in 2002, fading from its best magnitude of 11. The solar elongation only increases from around 45° to 60° by the end of the year, so it is never very well placed. The first visual observation was reported in early August when the comet was around mag 11.5. Observations reported around the equinox suggest that the comet has experienced an outburst and has brightened to magnitude 9. The comet is in Virgo in November and December.

Observations received prior to the outburst (7) give a preliminary light curve of 8.5 + 5 log d + [15] log r which is quite similar to that of 1997.

57P/du Toit-Neujmin-Delporte is currently too faint for visual observation. It was observed in outburst at the 1996 return and in July 2002, as it approached perihelion, NEAT discovered a secondary component. A further 18 components were discovered by Fernandez et al at the University of Hawaii.

A faint object reported as a possible NEO candidate on 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 (which was not included in the dataset) by more than 0.2 deg on the 1.2-m Palomar Schmidt frames. NEAT had reported the brighter comet on July 1 (see MPEC 2002-N14), but a check with Pravdo on July 12 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 and 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 and F. Mallia (Campo Catino, 0.8-m f/8 reflector), whose coaddition of five images (for a total integration of 20 min) showed a well-defined 12" coma and a delicate northeast-southwest elongation. The object was again included in the July 13 NEAT NEO-candidate report but with no remark about its appearance.

The positions are fully consistent with the orbital elements for comet 57P on MPC 45964 (ephemeris on MPC 44939) with T for this "component B" delayed by 0.19 day (i.e., to 2002 July 31.37 TT). It should be noted that comet 57P was anomalously bright at its unfavourable 1996 return (T = 1996 Mar. 5.7; m1 = 13.3 at the first postperihelic observation on July 24.8--see MPC 27482--some 5 mag brighter than expected). [IAUC 7934, 2002 July 13]

Y. R. Fernandez, D. C. Jewitt, and S. S. Sheppard, University of Hawaii, report the detection of an additional 18 components (C-T) of comet 57P (cf. IAUC 7934) in observations taken on July 17.5 and 18.4 UT with the University of Hawaii 2.2-m reflector. R-band magnitudes range from 20.0 to 23.5. 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. The components are delayed with respect to T = 2002 July 31.181 TT for component A by the following times (in days): C, +0.012; D, +0.037; E, +0.053; F, +0.078; G, +0.156; H, +0.164; I, +0.170; J, +0.180; (B, +0.188); K, +0.194; L, +0.194; M, +0.224; N, +0.226; O, +0.240; P, +0.271; Q, +0.309; R, +0.311; S, +0.313; and T, +0.354. [IAUC 7935, 2002 July 20]

Total magnitude estimates for the primary component (visual unless otherwise noted): June 5.71 UT, 15.6: (A. Nakamura, Kuma, Ehime, Japan, 0.60-m reflector + CCD); 9.68, 15.4 (Nakamura); 18.70, 15.7 (K. Kadota, Ageo, Saitama, Japan, 0.18-m reflector + CCD); July 5.27, 13.4 (A. Hale, Cloudcroft, NM, 0.41-m reflector); 10.24, 13.3 (Hale); 10.95, 14.1 (K. Sarneczky, Agasvar, Hungary, 0.38-m reflector); 11.59, 14.5 (Y. Ezaki , Toyonaka, Osaka, Japan, 0.30-m reflector + CCD). [IAUC 7937, 2002 July 24]

Z. Sekanina, Jet Propulsion Laboratory, writes: "Very preliminary analysis of the relative astrometry of the two brightest nuclei (cf. MPEC 2002-O10) 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 (4-8x10^-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. All examined solutions yield essentially the same ephemeris, which shows that the projected separation of B from A will diminish in the coming weeks. The offsets and position angles are as follows (0h UT): 2002 Aug. 4, 853", 259.1 deg; 14, 814", 259.1; 24, 758", 259.0; Sept. 3, 694", 258.7; 13, 631", 258.3; 23, 571", 257.7; Oct. 3, 516", 257.0.

It is unlikely that companions C-T (cf. IAUC 7935) 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. Accurate astrometry on existing images and additional observations may allow one to make more, but not very, definite statements in the future." [IAUC 7946, 2002 August 3]

65P/Gunn was discovered in 1970 after a perturbation by Jupiter in 1965 had reduced the perihelion distance from 3.39 to 2.44 AU. In 1980 two prediscovery images were found on Palomar plates taken in 1954. The comet can be followed all round the orbit as it has a relatively low eccentricity of 0.32. It returns to perihelion in May next year.

The visual and CCD observations received so far (13) give an uncorrected preliminary light curve for the 2002 apparition of 4.8 + 5 log d + [15] log r

67P/Churyumov-Gerasimenko is a morning object in 2002. Again the elongation is not good, increasing from around 50° to 100° at the end of the year. The comet's track closely parallels that of 46P/Wirtanen ending the year on the border of Leo and Virgo. A few observations reported on the internet suggest that it was around 13th magnitude in September.

92P/Sanguin This comet was discovered in 1977, when it reached mag 13.5. The period is 12.4 years, which makes alternate returns unfavourable and in 1989 it only reached 18th mag in large aperture telescopes. Magnitude predictions for the present return, which is similar to the discovery return, were based on the 1989 return and made no allowance for the method of magnitude estimation. To the surprise of some, the comet was an easy object of 13th magnitude in early September. This is actually more or less exactly the brightness expected on the basis of the discovery return.

I observed it with the Northumberland refractor on September 1.88, estimating it at 13.3.

Kracht Group comets

2001 Q8 SOHO (IAUC 7952, 2002 August 10)
2001 R8 SOHO (IAUC 7952, 2002 August 10)
2001 R9 SOHO (IAUC 7952, 2002 August 10)
2001 N2 SOHO (IAUC 7956, 2002 August 19)
2002 Q8 SOHO (IAUC 7963, 2002 August 31)
2002 Q10 SOHO (IAUC 7969, 2002 September 13)

were discovered with the SOHO LASCO coronagraphs and have not been observed elsewhere.

Kreutz group comets

1998 V9 SOHO (IAUC 7916, 2002 June 7)
1998 X12 SOHO (IAUC 7916, 2002 June 7)
1999 W2 SOHO (IAUC 7898, 2002 May 13)
2000 C7 SOHO (IAUC 7919, 2002 June 14)
2000 F2 SOHO (IAUC 7913, 2002 May 30)
2000 F3 SOHO (IAUC 7913, 2002 May 30)
2000 H6 SOHO (IAUC 7899, 2002 May 13)
2000 H7 SOHO (IAUC 7899, 2002 May 13)
2000 T5 SOHO (IAUC 7919, 2002 June 14)
2000 T6 SOHO (IAUC 7919, 2002 June 14)
2001 H8 SOHO (IAUC 7918, 2002 June 13)
2001 J5 SOHO (IAUC 7931, 2002 July 2)
2001 K10 SOHO (IAUC 7931, 2002 July 2)
2001 L11 SOHO (IAUC 7952, 2002 August 10)
2002 G4 SOHO (IAUC 7882, 2002 April 22)
2002 G5 SOHO (IAUC 7882, 2002 April 22)
2002 H1 SOHO (IAUC 7882, 2002 April 22)
2002 H3 SOHO (IAUC 7886, 2002 April 29)
2002 H4 SOHO (IAUC 7886, 2002 April 29)
2002 H5 SOHO (IAUC 7886, 2002 April 29)
2002 H6 SOHO (IAUC 7886, 2002 April 29)
2002 H7 SOHO (IAUC 7948, 2002 August 3)
2002 J1 SOHO (IAUC 7897, 2002 May 9)
2002 J2 SOHO (IAUC 7897, 2002 May 9)
2002 J3 SOHO (IAUC 7899, 2002 May 13)
2002 J6 SOHO (IAUC 7909, 2002 May 28)
2002 J7 SOHO (IAUC 7909, 2002 May 28)
2002 J8 SOHO (IAUC 7913, 2002 May 30)
2002 K3 SOHO (IAUC 7909, 2002 May 28)
2002 K5 SOHO (IAUC 7913, 2002 May 30)
2002 K6 SOHO (IAUC 7913, 2002 May 30)
2002 K7 SOHO (IAUC 7913, 2002 May 30)
2002 K8 SOHO (IAUC 7951, 2002 August 10)
2002 K9 SOHO (IAUC 7951, 2002 August 10)
2002 K10 SOHO (IAUC 7951, 2002 August 10)
2002 L1 SOHO (IAUC 7916, 2002 June 7)
2002 L2 SOHO (IAUC 7916, 2002 June 7)
2002 L3 SOHO (IAUC 7918, 2002 June 13)
2002 L4 SOHO (IAUC 7918, 2002 June 13)
2002 L5 SOHO (IAUC 7919, 2002 June 14)
2002 L6 SOHO (IAUC 7922, 2002 June 17)
2002 L7 SOHO (IAUC 7930, 2002 July 2)
2002 L8 SOHO (IAUC 7930, 2002 July 2)
2002 M1 SOHO (IAUC 7930, 2002 July 2)
2002 M2 SOHO (IAUC 7930, 2002 July 2)
2002 M3 SOHO (IAUC 7935, 2002 July 20)
2002 M4 SOHO (IAUC 7935, 2002 July 20)
2002 M5 SOHO (IAUC 7935, 2002 July 20)
2002 M6 SOHO (IAUC 7935, 2002 July 20)
2002 M7 SOHO (IAUC 7935, 2002 July 20)
2002 M8 SOHO (IAUC 7948, 2002 August 3)
2002 N1 SOHO (IAUC 7936, 2002 July 22)
2002 O1 SOHO (IAUC 7936, 2002 July 22)
2002 O2 SOHO (IAUC 7936, 2002 July 22)
2002 O3 SOHO (IAUC 7936, 2002 July 22)
2002 P2 SOHO (IAUC 7956, 2002 August 19)
2002 Q7 SOHO (IAUC 7963, 2002 August 31)
2002 Q11 SOHO (IAUC 7969, 2002 September 13)
2002 Q12 SOHO (IAUC 7969, 2002 September 13)
2002 Q13 SOHO (IAUC 7969, 2002 September 13)
2002 Q14 SOHO (IAUC 7969, 2002 September 13)
2002 R6 SOHO (IAUC 79xx, 2002 September)
2002 R7 SOHO (IAUC 79xx, 2002 September)
2002 S2 SOHO (IAUC 79xx, 2002 September)
2002 S3 SOHO (IAUC 79xx, 2002 September)

were discovered with the SOHO LASCO coronagraphs and have not been observed elsewhere. They were were not expected to survive perihelion.

One of the brighter objects was 2002 J3, discovered by Kazimieras Cernis on May 13. I 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. I should have spotted it the previous day as I had looked at the C3 images on Monday evening.

Marsden Group comets

2002 R1 SOHO (IAUC 7969, 2002 September 13)
2002 R4 SOHO (IAUC 79xx, 2002 September)

were discovered with the SOHO LASCO coronagraphs and have not been observed elsewhere.

Meyer Group comets

1997 O2 SOHO (IAUC 7931, 2002 July 2)
1997 U8 SOHO (IAUC 7931, 2002 July 2)
1997 U9 SOHO (IAUC 7931, 2002 July 2)
1998 V8 SOHO (IAUC 7916, 2002 June 7)
1998 W7 SOHO (IAUC 7916, 2002 June 7)
1999 F3 SOHO (IAUC 7898, 2002 May 13)
1999 K16 SOHO (IAUC 7842, 2002 March 5)
1999 L9 SOHO (IAUC 7842, 2002 March 5)
2000 J8 SOHO (IAUC 7899, 2002 May 13)
2000 N4 SOHO (IAUC 7899, 2002 May 13)
2000 X9 SOHO (IAUC 7919, 2002 June 14)
2001 C7 SOHO (IAUC 7936, 2002 July 22)
2001 K11 SOHO (IAUC 7952, 2002 August 10)
2001 L10 SOHO (IAUC 7952, 2002 August 10)
2001 R7 SOHO (IAUC 7952, 2002 August 10)
2001 V6 SOHO (IAUC 7952, 2002 August 10)
2001 X10 SOHO (IAUC 7952, 2002 August 10)
2002 A4 SOHO (IAUC 7875, 2002 April 12
2002 H8 SOHO (IAUC 7951, 2002 August 10)
2002 P3 SOHO (IAUC 7956, 2002 August 19)
2002 R8 SOHO (IAUC 79xx, 2002 September)

were discovered with the SOHO LASCO coronagraphs and have not been observed elsewhere. 2002 P3 was SOHO 500.

Other SOHO comets

1997 S4 SOHO (IAUC 7931, 2002 July 2)
2001 D1 SOHO (IAUC 7936, 2002 July 22)
2002 Q6 SOHO (IAUC 7963, 2002 August 31)
2002 Q9 SOHO (IAUC 7969, 2002 September 13)
2002 R5 SOHO (IAUC 79xx, 2002 September)

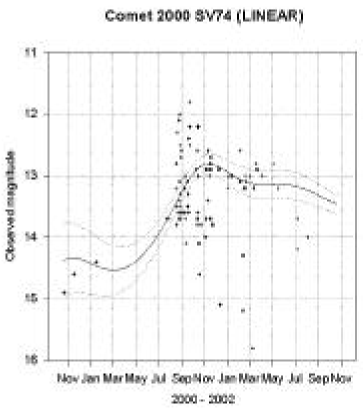
were discovered with the SOHO LASCO coronagraphs and have not been observed elsewhere. C/2002 R5, discovered in C2 imagery on September 5 by Rob Matson, appears to be related to

C/1999 R1, a point first made by R. Kracht. [MPEC 2002-S35, 2002 September 22]

2000 S5 (SOHO) was an unusual SOHO discovery, found in 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. Nevertheless it might be dectable on images taken in November or December 2000. [MPEC 2002-H41, 2002 April 24]

T. Makinen, Finnish Meteorological Institute, Helsinki, reports the discovery of another apparent comet (cf. IAUC 7327) from the second systematic survey of hydrogen Lyman-alpha emission appearing on SWAN images (wavelength range 10-180 nm) taken from the SOHO spacecraft during September-November 2000 (discovery observation below). Makinen notes that all comets brighter than total visual mag approximately 11 can be seen on the SWAN full-sky maps. The stated uncertainty in the reported positions is 0.5 degree due to the resolution of the SWAN instrument.

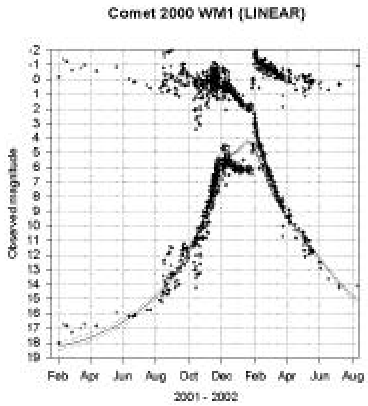
Further positional and orbital information, together with an ephemeris to encourage searches of archival optical images, are given on MPEC 2002-H41. Derived total visual magnitudes from the Lyman-alpha fluxes (using a formula by Jorda et al. 1992, Asteroids, Comets, Meteors 1991, 285): 2000 Sept. 21.77 UT, 10.8; Oct. 1.42, 10.0; 5.23, 9.4; 7.35, 8.4; 10.38, 7.7; 12.45, 7.3; 14.37, 7.5; 17.40, 7.8; 21.38, 7.9; Nov. 4.42, 8.2. [IAUC 7885, 2002 April 25]



2000 SV74 (LINEAR) This distant comet will slowly fade from 13th magnitude. The scatter in observations is largely due to differences between visual and CCD methods.

88 observations received give an uncorrected preliminary light curve of m = 9.0 + 5 log d + 2.1 log r.

2000 WM1 (LINEAR) became visible to UK observers again in April, but it quickly become large and diffuse and few observations were reported.



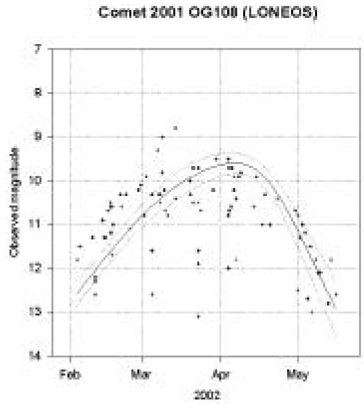
859 visual observations received give an preliminary light curve of m = 6.7 + 5 log d + 9.6 log r which does not take into account the outburst.

2001 HT50 (LINEAR-NEAT) The comet could reach 11th mag or brighter at its two oppositions in 2003. 5 observations give a preliminary light curve of 1.7 + 5 log d + [10] log r

2001 K5 (LINEAR) The comet is distant and will remain at around 14th mag visually for some time. 23 observations give a preliminary light curve of 1.9 + 5 log d + 9.0 log r

2001 OG108 (LONEOS). On March 28.84 I was able to see it in the Thorrowgood refractor, despite strong moonlight and observing through trees, estimating it at 10.2. The comet became quite a diffuse object making it difficult to locate.

82 visual observations give a preliminary uncorrected light curve of 9.3 + 5 log d + 17.2 log r. Moonlight and the rapid rate of brightening would probably have prevented visual observation before early February.



2001 Q4 (NEAT) The comet was discovered when still over 10 AU from the Sun. The latest elements give T as 2004 May 15.9 with q at 0.96 AU. Brian Marsden notes on MPEC 2002-R45 that the "original" and "future" barycentric values of 1/a are +0.000022 and -0.000723 (+/- 0.000022) AU**-1, respectively. [2002 September 11] The "original value of 1/a suggests that this is a new visitor from the Oort cloud.

The comet should be a bright object in May 2004. Adopting a conservative magnitude law (7.5 log r), suggests a peak of around 3rd magnitude, whereas the standard 10 log r gives around 0 magnitude.

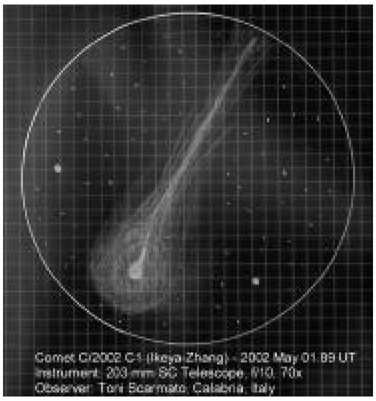
2001 RX14 (LINEAR) Brian Marsden notes on MPEC 2002-R45 that the "original" and "future" barycentric values of 1/a are +0.000778 and +0.000259 (+/- 0.000003) AU**-1, respectively. [2002 September 11] The "original value of 1/a suggests that this is not a new visitor from the Oort cloud.

The comet reaches perihelion at 2.06 AU in January 2003 and could reach 10th mag. Visual observers were reporting it at around 13th magnitude in early September 2002.

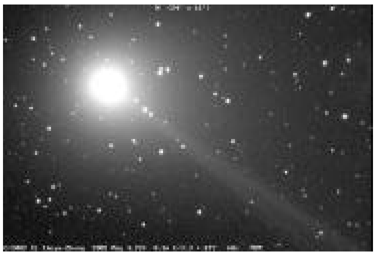
2002 BV (P/Yeung) = 2001 CB_40 An asteroid reported to the MPC by William Kwong Yeung of Benson, Arizona who was taking CCD images from near Apache Peak with a 0.45-m reflector on January 21.49 was linked to asteroidal observations by Spacewatch and LINEAR, including 2001 CB40. This showed it to have a cometary orbit and Timothy Spahr was able to take images with the 1.2-m telescope on Mt Hopkins which showed it to be a comet. [IAUC

7896, 2002 May 9] The comet has a period of 6.6 years and was at perihelion at 2.24 AU in mid March. It will fade from 17th magnitude. It is a Jupiter family comet.

2002 C1 (Ikeya-Zhang)
H. E. Matthews, National Research Council, Victoria, British Columbia, and Joint Astronomy Centre, Hawaii (JAC); and T. B. Lowe, JAC, report pointed spectral-line observations of comet C/2002 C1 made at the James Clerk Maxwell Telescope, Mauna Kea, in the 1.3-mm and 0.8-mm bands: "The beamwidths to halfpower are about 21" and 13", respectively. We have detected the groundstate rotational transitions HCN 4-3 and 3-2, HNC 4-3 and 3-2 and CS 5-4. Observed integrated intensities (in mainbeam brightness K km/s) were: 3.65 and 0.71 (HCN 3-2, HNC 4-3, Mar. 23.95 UT), 4.10 (HCN 3-2, Mar. 28.82), 0.71 (HNC 3-2, Mar. 29.85), 18.4 (HCN 4-3, Mar. 30.98) and 4.47, 0.62 and 0.74 (HCN 3-2, HNC 3-2, CS 5-4, Apr. 7.93). CO has not been detected in two attempts (CO 3-2, Mar. 23.95 and CO 2-1, Apr. 7.93), the absolute upper limit to the peak signal being 0.1 K. The velocity width (km/s) to halfpower measured using the HCN lines was 2.6 (Mar. 23.93), 2.4 (Mar. 28.82), 2.2 (Mar. 30.98) and 2.2 (Apr. 7.87) and thus appears to show a decrease with increasing r." [IAUC 7876, 2002 April 13]



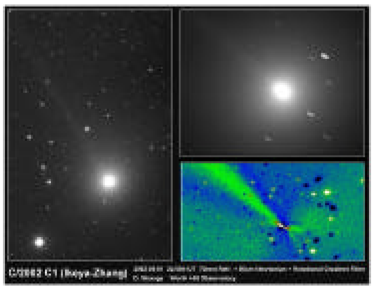
A. Lecacheux, Observatoire de Paris; and N. Biver, European Space Agency, ESTEC, on behalf of the Odin Solar System Topical Team and of the Odin Team, report: "The Odin submillimetric space telescope observed water lines in comet C/2002 C1 with a high spectral resolution (80 m/s) from Apr. 21.9 to 28.3 UT. The H_2O 110-101 line at 556.936 GHz was detected with a peak integrated line intensity of 21.6 K km s**-1 on Apr. 26.8 inside the 2' Odin beam. This corresponds to a preliminary water-production rate of 1.7 x 10**29 molecules/s, taking into account opacity effects. The 110-101 line at 547.676 GHz of the (^18)O isotopic variety of water was also detected. The average of Apr. 23.7-28.1 observations yields an integrated line intensity of 0.24 +/- 0.02 K km s**-1. Within model uncertainties, the inferred H_2^(18)O production rate is consistent with the terrestrial ^(16)O/^(18)O ratio." [IAUC 7910, 2002 May 28]



An image by Martin Mobberley on May 4

G. Cremonese, Istituto Nazionale di Astrofisica (INAF) and Osservatorio Astronomico, Padova; A. Boattini, M. T. Capria, M. C. De Sanctis, and G. D'Abramo, Istituto di Astrofisica Spaziale e Fisica Cosmica, CNR, Rome; and A. Buzzoni, INAF and Telescopio Nazionale Galileo (TNG), report observing the sodium distribution in the coma of comet C/2002 C1 on Apr. 20.17 UT, using the 3.5-m TNG reflector (+ high-resolution spectrograph SARG; resolving power 43000; spatial coverage 26") with a narrow-band filter to isolate the sodium-D lines. Two long-slit spectra (one parallel and the other perpendicular to the sun-comet vector) show cometary sodium emissions clearly visible due to the comet's geocentric velocity of -8.3 km/s. In the first spectrum, the sodium emissions are clearly asymmetric with respect to the slit center, corresponding to the nuclear region, extending to the edge of the slit in the tail direction (about 4000 km). Even in the second spectrum, a slight asymmetry is visible in the sodium emissions with stronger intensity toward the southwest, suggesting the presence of a sodium jet that is most likely related to a dust feature. [IAUC 7914, 2002 June 2]

J. E. Lyke, M. S. Kelley, D. C. Jackson, R. D. Gehrz, and C. E. Woodward, University of Minnesota (UM), report 1- to 12-micron photometry of this comet on May 22.37 UT at the Mt. Lemmon Observing Facility 1.52-m telescope (+ UM bolometer + IRTF narrowband 'silicate' filters). No evidence for strong silicate emission was observed at 11 microns; short-wavelength data were fit to a 5800-K reflected solar blackbody, while the observed spectral energy distribution at longer wavelengths yields a blackbody color temperature of 270 +/- 15 K. Observed magnitudes: [J] = 10.87 +/- 0.02, [H] = 10.42 +/- 0.01, [K] = 10.26 +/- 0.01, [L'] = 8.78 +/- 0.28, [M] = 6.49 +/- 0.29, [N] = 1.98 +/- 0.24, [8.81 microns] = 2.81 +/- 0.34, [10.27 microns] = 1.33 +/- 0.06, [11.70 microns] = 1.18 +/- 0.31, and [12.49 microns] = 0.34 +/- 0.31. [IAUC 7921, 2002 June 17]



An image taken by David Strange on May 1 showing jet structure in the coma.

The link with the comet of 1661 is confirmed, but it seems to have been intrinsically brighter at that return. An explanation is that the comet's intrinsic brightness is variable, and this is clearly seen in the current light curve, which shows a slow brightening 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, so it may be worth searching along the orbital track for further fragments.

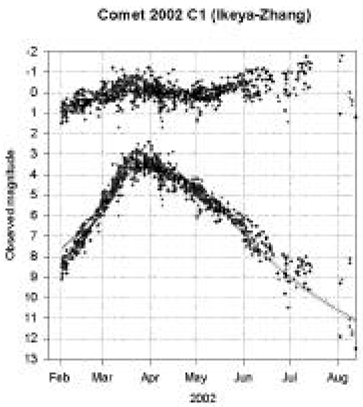
A suggestion from Michael Mattiazzo is that the earth passed through the orbital plane of the comet around June 24-25 and this may have contributed to the apparent slow fade in brightness.

A naked eye observation on May 1.89 put it at around 4.5. An observation with 20x80B on May

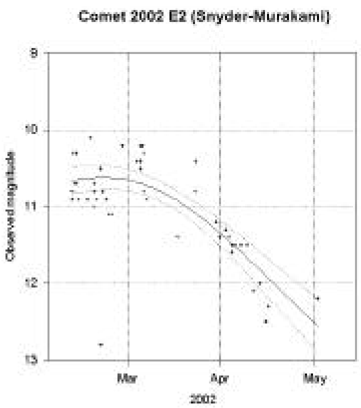
22.91 put it at 6.1. An observation with 20x80B on May 31.94 put it at 6.4. Observations with 20x80 Vixen binoculars in Cornwall under very dark skies in mid July put the comet at around 9.5, but very diffuse. The diffuse nature of the comet made it hard to pick out in light polluted regions and few observations were received after mid August.

The comet has been very well observed and it has become the second most observed comet in the Section files, after Hale-Bopp.

1158 observations give an aperture corrected preliminary light curve of m = 6.1 + 5 log d + 6.7 log r The comet's absolute magnitude has slowly varied by around two magnitudes over the course of the apparition, though interestingly most of the variation took place when the comet was outbound beyond 1 AU.

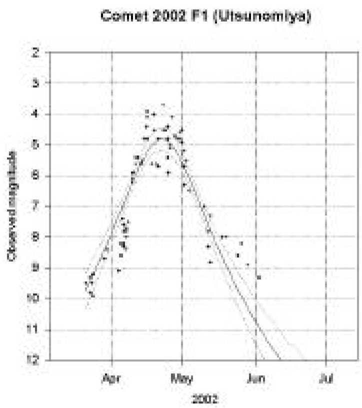


2002 E2 (Snyder-Murakami) Brian Marsden notes on MPEC 2002-L42 [2002 June 10] that the "original" and "future" barycentric values of 1/a are +0.000289 and -0.000180 (+/- 0.000023) AU**-1, respectively. The original value implies that the comet is not a new visitor from the Oort cloud.



46 observations received give a preliminary light curve of m = 7.1 + 5 log d + 9.8 log r

2002 EJ57 (P/LINEAR) A 19th magnitude object discovered by LINEAR on March 13.20, and noted by the Minor Planet Centre to have an unusual orbit, has been found to be cometary. The object is in a 17 year periodic orbit. Perihelion was in mid December at 2.6 AU and the object will fade. [IAUC 7890, 2002 May 2] Its orbit is affected by both Jupiter and Saturn.
An apparently asteroidal object discovered by LINEAR was given the designation 2002 EJ_57 (observations on MPS 55777-55778). 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 NEO Confirmation Page, resulting in CCD observations by J. Ticha and M. Tichy at Klet (diffuse with coma diameter about 10" on May 1.8 UT) and by R. H. McNaught at Siding Spring (circular coma with diameter about 7" on May 2.5) showing cometary activity. [IAUC 7890, 2002 May 2]



2002 F1 (Utsunomiya) A photograph submitted by Alex Vincent shows the comet at around 3rd magnitude on April 18, significantly brighter than reported by visual observers. I glimpsed the comet in very hazy conditions on April 23.86, estimating it at 4.5, with a 0.4 degree long tail. On May 1.87 I estimated it at 6.3 in my new Vixen 20x80B, surprisingly easy, and with the Pleiades a beautiful sight just below the comet. Antonio Giambersio made it 5.2: on May 1.79 in 16x70B. Alexandre Amorim observed the comet with 20x80B 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 20x80B, with a very strongly condensed coma.

73 observations received give a preliminary light curve of m = 8.8 + 5 log d + 13.3 log r

2002 H2 (LINEAR) A rapidly moving object reported by LINEAR has been found to be cometary. It was at perihelion on March 23 at 1.63 AU and faded from around 13th magnitude.
Brian Marsden notes on MPEC 2002-L43 [2002 June 10] that the "original" and "future" barycentric values of 1/a are +0.004146 and +0.003921 (+/- 0.000098) AU**-1, respectively. The original value implies that the comet is not a new visitor from the Oort cloud.

2002 J4 (NEAT) S. Pravdo, E. Helin, and K. Lawrence, Jet Propulsion Laboratory, report the discovery by NEAT, on CCD images taken on May 13.45 UT with the Palomar 1.2-m Schmidt telescope, of a 18th mag comet with nebulosity extending about 5" toward the southwest. Following posting on the NEO Confirmation Page, 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 and 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, and 8 were then identified by the Minor Planet Center staff. [IAUC 7899, 2002 May 13] The comet will not reach perihelion until October 2003, at 3.6 AU. It could reach 13th magnitude when brightest.

2002 J5 (LINEAR) An apparently asteroidal 18th mag object discovered by LINEAR on May 15.38 has been found to be slightly diffuse with a coma diameter of about 10" on CCD images taken by M. Tichy and M. Kocer with the 1.06-m reflector at Klet on May 16.0 UT. [IAUC 7904, 2002 May 18]
The comet is distant and will reach perihelion at 5.7 AU in September 2003.

Brian Marsden notes on MPEC 2002-L45 [2002 June 10] that the "original" and "future" barycentric values of 1/a are +0.000010 and -0.000036 (+/- 0.000028) AU**-1, respectively, suggesting that this is a "new" comet.

2002 JN16 (P/LINEAR) An apparently asteroidal object of 18th mag reported by LINEAR on May 9.28, designated 2002 JN_16, and having an unusual orbit (e.g., MPEC 2002-J42) has been found by C. A. Trujillo, California Institute of Technology, to be cometary (coma extended 10"-15" from the nuclear condensation in p.a. 270 deg) 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 JN_16 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]

Perihelion is at the end of July at 1.8 AU and the object is in a 6.6 year periodic orbit. It will brighten a little, but is unlikely to exceed 17th mag. It is a Jupiter family comet.

A/2002 JE109 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 May 11.30. It is in a 6.1 year orbit, with perihelion at 1.68 AU and an eccentricity of 0.50. It is close to perihelion and will fade. [MPEC 2002-K11, 2002 May 17] The orbit is typical of a Jupiter family comet, though there have been no recent approaches to Jupiter. The perihelion distance has varied from 1.5 to 1.7 AU over the last few hundred years, but there have been no significant changes to the angular elements.

A/2002 JC68 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 May 7.32. It is in a 5.3 year orbit, with perihelion at 1.39 AU and an eccentricity of 0.54. It reaches perihelion in September and will fade. [MPEC 2002-L27, 2002 June 7] The orbit is typical of a Jupiter family comet, though there have been no recent approaches to Jupiter.

A/2002 JW115 (Spahr) is an asteroid, of 20th magnitude, discovered by Tim Spahr at the Whipple observatory on 2002 May 7.17. It is in a 5.5 year orbit, with perihelion at 1.83 AU and an eccentricity of 0.41. It is approaching perihelion and will remain of similar brightness. [MPEC 2002-K21, 2002 May 20] The orbit is typical of a Jupiter family comet, and the object was 0.6 AU from the planet in 1950.

2002 K1 (NEAT) K. Lawrence, E. Helin, and S. Pravdo, Jet Propulsion Laboratory, report 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) show a 15" tail toward the southwest. [IAUC 7902, 2002 May 17]
The comet is distant and just past perihelion at 3.2 AU.

2002 K2 (LINEAR) Another apparently asteroidal LINEAR discovery of 18th mag, 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 comet is faint and distant. It will reach perihelion at 5.2 AU and is just past perihelion. It will not brighten significantly

2002 K4 (NEAT) S. Pravdo, E. Helin, and K. Lawrence, Jet Propulsion Laboratory, report the discovery of a 19th mag 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]
It will reach perihelion in July, at 2.8 AU. It is periodic, with a period of around 64 years. It will brighten a little.

A/2002 KK3 (LONEOS) is an asteroid, of 19th magnitude, discovered by LONEOS on 2002 May 18.28. It is in a 5.4 year orbit, with perihelion at 1.08 AU and an eccentricity of 0.65. It is close to perihelion and will remain at a similar brightness. [MPEC 2002-K24, 2002 May 20] The orbit is typical of a Jupiter family comet and the object was 0.7 AU from the planet in 1977. It approached to 0.15 AU of the Earth in 1986.

A/2002 KL6 (NEAT) is an asteroid, of 17th magnitude, discovered by NEAT on 2002 May 27.42. It is in a 4.7 year orbit, with perihelion at 1.04 AU and an eccentricity of 0.63. It is at perihelion in July and will brighten a little. [MPEC 2002-K70, 2002 May 29] The orbit is typical of a Jupiter family comet, though there have been no recent close approaches. The object can approach the earth to within 0.07 AU.

A/2002 KJ8 (NEAT) is an asteroid, of 20th magnitude, discovered by NEAT on 2002 May 18.23. It is in a 6.1 year orbit, with perihelion at 1.37 AU and an eccentricity of 0.59. It is at perihelion at the end of July and will brighten a little. [MPEC 2002-K74, 2002 May 31] The orbit is typical of a Jupiter family comet and it approached to 0.24 AU in 1871.

2002 L9 (NEAT) An object of 18th mag originally reported as asteroidal on NEAT CCD images taken at Palomar on June 13.41 was posted on the NEO Confirmation Page due to its unusual orbit. S. Pravdo later suggested the object was cometary, in particular on July 2 noting a central condensation of diameter 3" surrounded by a spherical nebulosity of diameter about 8". [IAUC 7931, 2002 July 2]
It will reach perihelion in 2004 at 7 AU and will brighten a little when nearer perihelion.

A/2002 LV (LINEAR) is an asteroid, of 18th magnitude, discovered by LINEAR on 2002 June 1.37. It is in a 5.1 year orbit, with perihelion at 0.92 AU and an eccentricity of 0.69. It is at perihelion in late August and will brighten to 15th magnitude. [MPEC 2002-L14, 2002 June 3] The orbit is typical of a Jupiter family comet, though the high inclination (31 degrees) keeps it relatively far from the planet. The more distant encounters are slowly changing the orbital elements and are currently tending to reduce the inclination. It is a potentially hazardous object and can approach to 0.027 AU of the Earth at the descending node. This year it approaches within 0.14 AU on July 29.

A/2002 LJ27 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 June 8.31. It is in a 6.0 year orbit, with perihelion at 1.67 AU and an eccentricity of 0.49. It is close to perihelion and will fade. [MPEC 2002-L62, 2002 June 13, 5-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent approaches.

A/2002 MS3 (NEAT) is an asteroid, of 19th magnitude, discovered by NEAT on 2002 June 30.24. It is in a 7.6 year orbit, with perihelion at 0.92 AU and an eccentricity of 0.76. It is at perihelion in early September and will brighten a little. [MPEC 2002-N05, 2002 July 1] The orbit is typical of a Jupiter family comet, though there have been no recent close approaches to the planet.
Further observations show that it is actually in an Apollo type orbit.

A/2002 MT3 (NEAT) is an asteroid, of 19th magnitude, discovered by NEAT on 2002 June 30.24. It is in a 4.5 year orbit, with perihelion at 0.89 AU and an eccentricity of 0.67. It was at perihelion in late April. It is a potentially hazardous object and can approach within 0.03 AU of the Earth [MPEC 2002-N06, 2002 July 1] The orbit is typical of a Jupiter family comet and it approached within 0.4 AU in 1928.

2002 O4 (Hoenig) The discovery of this was announced during the ACM meeting, which was particularly appropriate, as the discoverer is German. This was the first comet to be discovered from Germany since 1946 and it was an accident! Sebastian Hoenig is a keen amateur astronomer and after a long period of cloudy weather a clear spell drew him out to a dark sky location. Whilst scanning for globular clusters in the Andromeda region with his 25-cm LX200, an unexpected fuzz caught his eye. He knew that there wasn't supposed to be anything in the area, but hadn't come prepared for any serious observing. He took the approximate RA and Dec from his roughly set-up GoTo system and wrote the co-ordinates along with a rough sketch on the label of an empty water bottle. He reported the details to the CBAT, but it wasn't until five days later that he finally received confirmation of his find. In addition to this comet, Sebastian has discovered around a two dozen comets on SOHO LASCO images, but these all bear the name SOHO.

An image by Cliff Meredith on August 19

On July 22, a report of an apparent visual comet discovery of a 12th mag comet on July 22.00 was received from Sebastian Hoenig, Dossenhiem, 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 July 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 July 22. Additional observations were received after the comet was posted on the NEO Confirmation Page. [IAUC 7939, 2002 July 27]

An image by Martin Mobberley on September 3.87 with his 0.3m LX200.

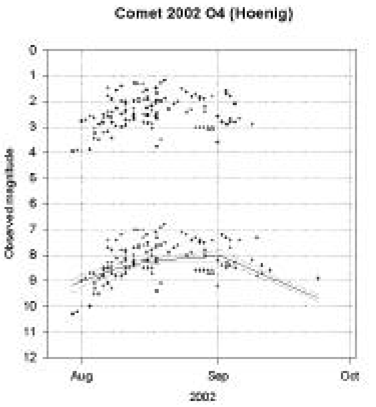
Sitko, Lynch, Russell, Hammel and Polomski report similar spectroscopy of comet C/2002 O4 on Aug. 1.54 UT: "The infrared flux peaked near 10 microns, suggesting a temperature of around 280 +/- 20 K (equilibrium blackbody temperature = 243 K). There was a silicate-emission feature between about 8.5 and 11.5 microns extending about 20 percent above the continuum. Narrow-band [M] and [N] magnitudes were 9.7 and 4.4, respectively, both +/- 0.1." [IAUC 7950, 2002 August 8]

The latest orbit on MPEC 2002-R48 has a note from Brian Marsden that 'the "original" and "future" barycentric values of 1/a are -0.000694 and -0.000230 (+/- 0.000054) AU**-1, respectively.'[2002 September 11] It is somewhat unusual for a comet to have a negative "original" value for 1/a and this is one of the largest on record. It is possible that 'non gravitational' effects should be applied to the comet's orbit.

After my return from the ACM meeting in Berlin (where I met up with Sebastian and Maik Meyer) I was able to observe the comet on August 4.9. I estimated it at 9.5 in the Thorrowgood refractor x40, with a 3' coma and DC3. The early observations suggested that the comet was brightening quite rapidly as several reports on August 6 put the comet as bright as 8th magnitude. A photograph taken on August 8.83 by Toni Scarmato shows a green coma, characteristic of Swan band emissions. I observed it with 20x80 binoculars on August 10.91 and made it 7.8.

An image by Denis Buczynski on September 10

The comet's brightness then stalled and it did not significantly brighten any further. A suggestion from Michael Mattiazzo is that the earth passed through the orbital plane of the comet around August 13-14 and this may have given the apparent rapid rise in brightness. Observations up to the equinox suggested that the comet was fading slightly. Further observations reported on the internet towards the end of the month suggest a more dramatic fade and it seems unlikely that it will survive perihelion, unless it experiences an outburst comparable to 2000 WM1.



130 observations give a preliminary light curve of m = 8.4 + 5 log d + 5.4 log r Alternatively a slightly better fit is given by a linear type of light curve, peaking some 30 days before perihelion.

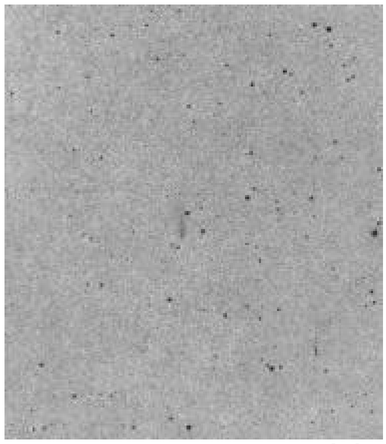
2002 O5 (P/NEAT) S. Pravdo and K. Lawrence, Jet Propulsion Laboratory, report the discovery of a 16th mag comet (with nuclear condensation of diameter about 6" and tail extending 12" to the southwest) on NEAT images taken at Haleakala on July 30.25 UT. After the object was placed on the NEO Confirmation Page, confirmation of cometary activity was reported by: R. Fredrick, K. Smalley, and R. Trentman, Louisburg, Kansas, with a 0.75-m reflector (tail 40" long in p.a. 130 deg); P. M. Kilmartin, Mt John Observatory, New Zealand, with a 0.6-m reflector (short tail in about p.a. 130 deg); and R. H. McNaught and G. J. Garradd, Siding Springs Observatory, Australia, with a 1.0-m reflector (tail 13" long in p.a. 125 deg). [IAUC 7942, 2002 July 31].

The preliminary orbit suggests that it is in a short period orbit with P around 5 years and is near perihelion. It is intrinsically very faint (H0=19) and will fade. The orbital period is the third shortest of current P/ comets. At a favourable return it can pass 0.2 AU from the Earth.

2002 O6 (SWAN) This interesting comet was discovered by Masayuki Suzuki using real-time SOHO-SWAN data and is the first SWAN discovery to be observed from the ground. The first orbit showed that the comet was passing close to the earth and would brighten. It had perihelion at 0.5 AU in early September.

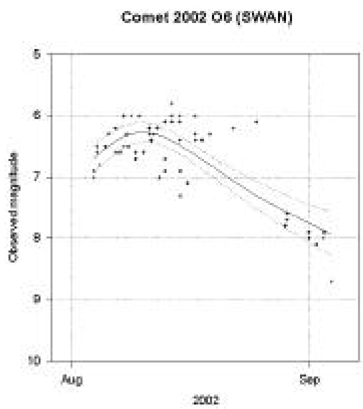
Akimasa Nakamura provides the following discovery report:
Masayuki Suzuki posted the discovery circumstances of C/2002 O6 to the comet-obs mailing list (in Japanese). According to that, although he is a frequent visitor to the SWAN webpage (and has checked images time to time since this spring), his discovery of O6 was accidental.
Inspired by Sebastian's discovery, he downloaded SWAN images taken on 25th and 27th of July, to see whether he could find C/2002 O4 or not. He found TWO moving objects: dimmer one was C/2002 O4, and the brighter one looked like C/2001 Q4 (NEAT). But, he noted the latter should have been much fainter because Q4 was around 16 mag.... it might be a new comet! He considered a possibility to observe it by himself on the night of his discovery (July 31th), 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 astrometrist at code 347, BTW.)
He also noted the comet was visible on the images taken on 13, 16, 18, 20th 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 July 25 and 27 UT. Prediscovery images were found on images taken as early as July 13. Visual confirmation has been 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 0.25-m reflector also confirm the object's cometary nature. [IAUC 7944, 2002 August 1]



Comet 2002 O6 (SWAN) imaged by Michael Jager on September 13.125. The image is a composite of 6.5 and 5.5 min exposures on a 250/450 mm Schmidt camera using hypered TP2415. The faint cigar shaped coma is typical of a disintegrating comet.

Observations in early August showed that it was slowly brightening and it reached around mag 6. I observed it after a long meteor watch on August 12/13 and found it an easy object in 20x80B. Reports by Bjorn Granslo at the end of August show that it has faded significantly to around 7.5. Observations by myself in early September suggest that the fade is continuing, with the comet at mag 8



56 observations give a preliminary light curve of m = 9.2 + 5 log d + 4.1 log r

2002 O7 (LINEAR) An apparently asteroidal, 20th mag, object reported by LINEAR on July 29.17 UT has been 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 and 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 August 5]

The comet does not reach perihelion until September 2003, when it may reach 6th magnitude. At its brightest it will be a southern hemisphere object, but should be visible as a telescopic object from 2003 March to 2004 January. [MPEC 2002-P13, 2002 August 5]

2002 O8 (P/NEAT) K. Lawrence, Jet Propulsion Laboratory, reports the discovery of a 17th mag 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 (discovery observation appears below). Confirmation of cometary activity 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 deg). Prediscovery observations have been identified in NEAT data from July 16.5, LINEAR data from July 5.4 and Spacewatch data from 2001 May 22.3 and June 11.2. [IAUC 7949, 2002 August 5]

It is in a periodic orbit of 8 years and perihelion at 3.2 AU and is a Jupiter family comet. It will fade.

2002 P1 (NEAT) S. Pravdo, K. Lawrence and E. Helin, Jet Propulsion Laboratory, report the NEAT team's discovery with the 1.2-m Schmidt telescope at Palomar of a 19th mag comet with a 7" tail in p.a. 235 deg on August 7.39. Confirmation of the object's diffuse appearance has been provided by G. Hug, Farpoint Observatory: [IAUC 7950, 2002 August 8]

The preliminary orbit suggests that it is a distant object past perihelion and will fade.

A/2002 PD43 (NEAT) is an asteroid, of 17th magnitude, discovered by NEAT at Paolomar on 2002 August 7.45. Prediscovery images were taken only hours earlier by W Yeung. It is in a 4.2 year orbit, with perihelion at 0.11 AU and aphelion at 5.07 AU and is classied as an Apollo type asteroid. It is a potentially hazardous object and can approach within 0.035 AU of the Earth. It was at perihelion in mid June. [MPEC 2002-P51, 2002 August 12]

2002 Q1 (P/Van Ness) Michael Van Ness of the LONEOS team discovered a 16th magnitude comet on 2002 August 17.44. It is periodic with a period of around 6.6 years and is past perihelion. It will fade.

2002 Q2 (LINEAR) and 2002 Q3 (LINEAR) LINEAR has found a pair of comets, moving on parallel tracks in the same field. The brighter (Q2) is about 17th mag and Q3 is a couple of mags fainter. The preliminary orbit suggests that they are just past perihelion in a high inclination orbit. BAA observer Stephen Laurie was able to provide confirming astrometry within 24 hours of the discovery. Maik Meyer points out that the preliminary elements are similar to those of 1994 N1 (Nakamura-Nishimura-Machholz). Some recent observations are putting Q2 at around 13th magnitude.

2002 Q4 (154P/Brewington) has been recovered at 17th mag by F. Artigue, H. Cucurullo, and G. Trancredi at the Observatorio Astronomico Los Molinos, Montevideo. The correction to the prediction on MPC 40670 is Delta(T) = +0.52 day.

The comet is making its first return in 2003 since its discovery in 1992. It was discovered by Howard J Brewington of Cloudcroft, New Mexico, as a small diffuse 10m object on August 28.41 using a 0.40-m reflector x55. This was his fourth discovery and his second periodic one. The comet is in a Jupiter crossing orbit, but has not approached the planet for several revolutions. At a favourable return it could reach 7m.

We may pick it up in November as it brightens to 10th magnitude and we will be able to follow it into the New Year as it continues to move north. It is an evening object, but its solar elongation decreases from 80° in November to 50° at the end of the year. It will not reach perihelion until 2003. By October it is moving north-eastwards in Capricornus and ends the year in Aquarius.

2002 Q5 (LINEAR) LINEAR has discovered another comet. It reaches perihelion in November, but unfortunately it is on the opposite side of the Sun to the Earth at the time and will not get brighter than 15th magnitude.

2002 R2 (155P/Shoemaker) (1986 A1) has been recovered by T Oribe and A Nakamura at 18th mag. The correction to the prediction on MPC 34423 is Delta(T) = -0.14 day. It is making its first return since discovery. It will be quite faint, around 14-13th magnitude in November and does not get much brighter by the time it reaches opposition in February 2003. It moves eastwards from Cancer into Leo at the end of the year.

2002 R3 (LONEOS) is a distant comet that will reach perihelion next year, however it will not brighten much from its present 17th magnitude.

A/2002 RC118 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2002 September 6.34. It is in a 5.2 year orbit, with perihelion at 1.28 AU and an eccentricity of 0.57. It is at perihelion in mid November and will brighten to 17th mag. [MPEC 2002-R40, 2002 September 8, 3-day orbit] The orbit is typical of a Jupiter family comet, though there have been no recent approaches.

A/2002 RP120 (LONEOS) is an asteroid, of 17th magnitude, discovered by LONEOS at Lowell Observatory on 2002 September 4.41. The orbit is retrograde, with a period of around 300 years and perihelion distance at 2.47 AU, with aphelion over 90 AU from the Sun. It reaches perihelion in early October, when it may brighten to 16th mag. [MPEC 2002-R43, 2002 September 10, 6-day orbit] The orbit is more typical of a long period comet, though so far there is no sign of cometary activity.

A/2002 RA126 (NEAT) is an asteroid, of 20th magnitude, discovered by NEAT at Palomar on 2002 September 11.14. It is in a 5.2 year orbit, with perihelion at 1.04 AU and an eccentricity of 0.65. It is past perihelion and will fade. [MPEC 2002-R61, 2002 September 12, 2-day orbit] The orbit is typical of a Jupiter family comet and can approach both Jupiter and the Earth.

2002 S1 (P/Skiff) was found by Brian Skiff during the course of LONEOS survey work. The 18th magnitude comet is past perihelion. It is in a periodic orbit of around 8.3 years, and will remain at its present brightness until the end of the year.

For the latest information on discoveries and the brightness of comets see the Section www page: http://www.ast.cam.ac.uk/~jds or the CBAT headlines page at http://cfa-www.harvard.edu/cfa/ps/Headlines.html

2002 EDGAR WILSON AWARDS

The Smithsonian Astrophysical Observatory (SAO), part of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, has announced the recipients of the 2002 Edgar Wilson Award for the discovery of comets by amateurs during the calendar year ending June 10. The award was set aside as part of the will bequeathed by the late businessman Edgar Wilson of Lexington, Kentucky, and administered by the SAO. The following seven discoverers will receive plaques and a cash award:

Vance Avery Petriew of Regina, Saskatchewan, Canada, for his visual discovery of comet P/2001 Q2 on 2001 August 18.
Kaoru Ikeya of Mori, Shuchi, Shizuoka, Japan, and **Daqing Zhang**, Kaifeng, Henan province, China, for their independent visual discoveries of comet C/2002 C1 on 2002 February 1.
Douglas Snyder of Palominas, Arizona, and **Shigeki Murakami** of Matsunoyama, Niigata, Japan, for their independent visual discoveries of comet C/2002 E2 on 2002 March 11.
Syogo Utsunomiya of Minami-Oguni, Aso, Kumamoto, Japan, for his visual discovery of comet C/2002 F1 on 2002 March 18.
William Kwong Yu Yeung of Benson, Arizona for his charge-coupled-device (CCD) electronic-camera discovery of comet P/2002 BV.

Observers Ikeya and Utsunomiya have had their names attached to comets previously. Comet C/2002 F1 was Utsunomiya's third named comet; he also won the Edgar Wilson Award in 2001 for C/2000 W1 (Utsunomiya-Jones). Ikeya became world-famous in the 1960s for a string of five comet discoveries between 1963 and 1967, with comet C/1965 S1 (Ikeya-Seki) becoming the brightest comet of the last century -- visible in broad daylight to the unaided eye as it skimmed closely by the sun's surface in October 1965.

The six visual discoveries of this past year involved four different comets and represent the most new comets discovered by visual observers since 1994. Automated CCD searches with large professional telescopes have dominated comet discovery since 1998. Utsunomiya's discovery was made with large 25x150 binoculars. The other discoveries were all made with moderate-sized reflecting telescopes having mirrors with diameters ranging from 25 to 50 cm.

Yeung's discovery image was obtained on 2002 January 21, but he reported the object initially as stellar in appearance and it was given a minor-planet (rather than cometary) designation; CCD images taken by Timothy Spahr at the SAO station on Mount Hopkins in Arizona in early May showed that P/2002 BV was indeed cometary with a faint tail, and Yeung's object was announced as a comet on May 9 (IAU Circular 7896).

The brightest comet of the bunch, C/2002 C1 (Ikeya-Zhang), became a faint naked-eye object in March and April for northern-hemisphere observers. It is of special interest because it is the first return of this comet to the inner solar system in 341 years, since it was last observed in 1661. Carefully made observations in February and March 1661 by the Polish astronomer Johannes Hevelius have allowed astronomers to confirm that the two apparitions belong to the same comet, though for centuries it was speculated erroneously that the 1661 comet might be identical with a comet seen in 1532. Comet 2002 C1 is now the comet with the longest orbital period that has been definitely seen at two or more returns to perihelion (closest approach to the sun).

In 2001, there were only two recipients of the Award, for their independent visual discoveries of a single comet (Albert Jones of New Zealand and Syogo Utsunomiya). Of the 20 Award recipients in the first four years, twelve have been for visual discoveries, seven for discoveries from CCD images, and one for a discovery from a photograph. The countries with the most recipients so far are the United States (5), Japan (4), and Australia (4). In years when there are no eligible comet discoverers, the Award will be made instead to amateur astronomers judged by the Central Bureau for Astronomical Telegrams (CBAT) to have made important contributions toward observing comets or promoting an interest in the study of comets.

David A. Aguilar & Christine Lafon, Public Affairs, Harvard-Smithsonian Center for Astrophysics

Comet Prospects for 2003

2003 sees the return of 16 periodic comets. The brightest of the year is predicted to be 2P/Encke, which is making its 59th predicted return at the end of the year and may reach 6th magnitude. 2001 Q4 (NEAT) reaches perihelion in 2004 and may reach binocular visibility at the end of the year. Several other long-period comets discovered in previous years are still visible.

Theories on the structure of comets suggest that any comet could fragment at any time, so it is worth keeping an eye on some of the fainter periodic comets, which are often ignored. This would make a useful project for CCD observers. As an example 51P/Harrington was observed to fragment in 2001. Ephemerides for new and currently observable comets are published in the *Circulars*, Comet Section Newsletters and on the Section, CBAT and Seiichi Yoshida's web pages. Complete ephemerides and magnitude parameters for all comets predicted to be brighter than about 18^m are given in the International Comet Quarterly Handbook; details of subscription to the ICQ are available from the comet section Director. The section booklet on comet observing is available from the BAA office or the Director.

This year sees comet **2P/Encke's** 59th observed return to perihelion since its discovery by Mechain in 1786. The orbit is quite stable, and with a period of 3.3 years apparitions repeat on a 10-year cycle. This year the comet is well seen from the Northern Hemisphere prior to perihelion, which is in late December. The comet tracks through Andromeda during October and early November, then accelerates southwards through Cygnus and begins December in Ophiuchus. The comet might be observable from October until early December, when it could be 6^{th} magnitude. This magnitude may however be optimistic as observations from the SOHO spacecraft in 2000 showed that it suddenly brightened after perihelion, by which time it will be at a poor elongation. A possible explanation of this behaviour is that Encke has two active regions, an old one with declining activity, which operates prior to perihelion and a recently activated one present after perihelion. There is, however, little evidence for a secular fading in the archive of BAA observations of the comet. The comet is the progenitor of the Taurid meteor complex and may be associated with several Apollo asteroids.

22P/Kopff reached perihelion at the end of 2002 and although it is near its brightest, the solar elongation is poor and it is unlikely to be seen this year.

29P/Schwassmann-Wachmann is an annual comet that has frequent outbursts and seems to be more often active than not at the moment, though it rarely gets brighter than 12^m. It begins the year in Capricornus, but spends most of the year in Aquarius, reaching opposition at the beginning of September. The comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity. UK based observers should be able to follow it throughout the second half of the year.

30P/Reinmuth was at perihelion last year, and is a little brighter at the start of this year, although only 14^{th} magnitude. Best seen in the morning sky, it reaches opposition in March, but by then is fading quite rapidly. The comet was discovered during the course of a regular photographic asteroid survey by Karl Reinmuth at Heidelberg Observatory on a photograph exposed on 1928 February 22.96. If the comet gets as bright as predicted this could be the best return since the comet's discovery.

43P/Wolf-Harrington does not reach perihelion until 2004, but it gets to 14^{th} magnitude in September and should be 13^{th} magnitude at the end of the year. It is favourably placed in the evening sky and CCD observers should certainly have a go at following the comet. This will be its tenth observed return, which was discovered in 1924, then lost until 1951. The comet is in a chaotic orbit, and made a close approach to Jupiter in 1936 which reduced its perihelion distance from 2.4 to 1.6 AU. It made an exceptionally close (0.003 AU) approach to Jupiter in 1841, which switched its previous perihelion distance into the new aphelion distance.

53P/Van Biesbroeck is an interesting object. George van Biesbroeck discovered it at Yerkes observatory in September 1954. Stan Milbourn and George Lea calculated the best recovery orbit and the comet was duly recovered in May 1965. Back calculating the orbit shows that it made a moderately close approach to Jupiter in 1850, which reduced q from 2.7 to 2.4 AU and reversed the nodes. The pre 1850 orbit is very similar to that of 42P/Neujmin 3 and it is likely that they are fragments of the same parent. The comet has a relatively favourable return and just reaches 14^{th} magnitude, however it lies south of the equator and will be difficult to observe from the UK.

65P/Gunn was discovered in 1970 after a perturbation by Jupiter in 1965 had reduced the perihelion distance from 3.39 to 2.44 AU. In 1980 two pre-discovery images were found on Palomar plates taken in 1954. The comet can be followed all round the orbit as it has a relatively low eccentricity of 0.32. At the last return in 1996 it reached 13^{th} magnitude and it will do a little better this time, as it is at opposition when at perihelion. It will be at moderate southern declination throughout the apparition and is essentially unobservable from the UK.

66P/du Toit has only been observed at alternate returns and its last return in 1988 was about the worst possible. It was discovered by Daniel du Toit at the Boyden Observatory in South Africa on 1944 May 16. The discovery return was a good one, with the comet approaching to within 0.5 AU of the Earth, and the comet reached 10^{th} magnitude. It was not found at the 1959 return, nor was it initially found in 1974, however in January 1975 a further inspection of search plates taken ten months previously revealed a diffuse image of the comet. This return is moderately favourable, and the comet could reach 13^{th} magnitude, however, as at the discovery return, it will essentially be a Southern Hemisphere object.

81P/Wild is a new comet that made a very close (0.006 AU) approach to Jupiter in September 1974. Prior to this it was in a 40-year orbit that had perihelion at 5 AU and aphelion at 25 AU. The comet was discovered by Paul Wild with the 40/60-cm Schmidt at Zimmerwald on 1978 January 6. The Stardust spacecraft is due to visit the comet in 2004 and recover material for return to earth in 2006. The comet reaches perihelion in September, but unfortunately the elongation is very poor and the comet will be difficult to observe at this return.

95P/Chiron is an unusual comet in that it is also asteroid 2060. It reaches 17^m when at opposition in July in Sagittarius. CCD V magnitudes of Chiron would be of particular interest as observations show that its absolute magnitude varies erratically. It was at perihelion in 1996 when it was 8.5 AU from the Sun and will be nearly 19 AU from the Sun at aphelion in around 50 years time.

116P/Wild was discovered on 1990 January 21.98 by Paul Wild with the 0.40-m Schmidt at the Zimmerwald station of the Berne Astronomical Institute at a photographic magnitude of 13.5. At its brightest the comet only reached 12^m, but it was surprisingly well observed. The comet was perturbed into its present orbit after a close approach to Jupiter in mid 1987. The comet is at perihelion in January, but is poorly placed for viewing from the UK. It brightens from 13th magnitude at the beginning of the year to 12th magnitude in April as it nears opposition but is a long way south. It remains brighter than 13th magnitude until July.

123P/West-Hartley was discovered by Richard West on an ESO survey plate taken on March 14 and independently by Malcolm Hartley on a UK Schmidt plate taken on May 28. The comet has made no recent close approaches to Jupiter. It reached between 13th and 14th magnitude at the last return in 1996. It should achieve a similar brightness this time round, but is at its brightest early in the New Year after its December perihelion.

154P/Brewington makes its first return since its discovery in 1992. It was discovered by Howard J Brewington of Cloudcroft, New Mexico, as a small diffuse 10^m object on August 28.41 using a 0.40-m reflector x55. This was his fourth discovery and his second periodic one. The comet is in a Jupiter crossing orbit, but has not approached the planet for several revolutions. At a favourable return it could reach 7^m, but this return is not particularly favourable. It is an evening object, of around 10 - 11th magnitude, but its solar elongation decreases from 50º at the beginning of the year and we will loose it in the March twilight.

Comets reaching perihelion in 2003

Comet	T	q	P	N	H1	K1
2001 RX14 (LINEAR)	Jan 18.8	2.06			6.5	10.0
116P/Wild	Jan 21.6	2.17	6.48	2	1.2	25.3
79P/du Toit-Hartley	Feb 15.3	1.23	5.27	3	14.0	15.0
154P/Brewington	Feb 19.4	1.59	10.66	1	8.5	13.5
P/Tritton	Mar 6.0	1.43	6.32	1	12.5	10.0
2001 YX127 (P/LINEAR)	Mar 6.9	3.42	8.54		12.5	10.0
65P/Gunn	May 11.9	2.45	6.80	6	5.0	15.0
25D/Neujmin	May 26.4	1.27	5.38	2	10.5	10.0
127P/Holt-Olmstead	Jun 12.5	2.16	6.34	2	14.0	10.0
2002 R3 (LONEOS)	Jun 14.9	3.86			8.5	10.0
36P/Whipple	Jul 6.7	3.09	8.51	10	8.5	15.0
2001 HT50 (LINEAR-NEAT)	Jul 8.8	2.80			4.5	10.0
118P/Shoemaker-Levy	Jul 16.8	2.01	6.49	2	8.7	10.0
100P/Hartely	Aug 18.0	1.98	6.29	3	8.9	15.0
66P/du Toit	Aug 28.2	1.27	14.70	2	12.0	9.5
94P/Russell	Aug 29.2	2.23	6.58	3	9.0	15.0
2002 J5 (LINEAR)	Sep 19.3	5.73			11.0	5.0
2002 O7 (LINEAR)	Sep 20.3	0.89			6.5	10.0
81P/Wild	Sep 25.9	1.59	6.40	4	6.9	11.4
2002 J4 (NEAT)	Oct 3.2	3.63			5.5	10.0
53P/Van Biesbroeck	Oct 9.4	2.42	12.52	4	8.0	15.0
123P/West-Hartley	Dec 9.1	2.13	7.58	2	11.5	10.0
2P/Encke	Dec 29.9	0.34	3.30	58	11.0	15.0

The date of perihelion (T), perihelion distance (q), period (P), the number of previously observed returns (N) and the magnitude parameters H1 and K1 are given for each comet.

Note: $m_1 = H1 + 5.0 * \log(d) + K1 * \log(r)$

155P/Shoemaker reaches perihelion in 2002 December, and is making its first return since discovery. It will be quite faint, around 14-13th magnitude when it is at opposition in February. It moves northwards in the sickle of Leo.

Several recently discovered parabolic comets will be visible during 2003. 2001 HT50 (LINEAR) will be a morning object of around 12th magnitude at the start of the year, but it quickly moves towards opposition. It brightens a little, but becomes poorly placed for observation after April. It reaches perihelion whilst in solar conjunction, but re-emerges towards the end of August at around 11th magnitude. The earth continues to approach it until October, when it is fractionally brighter, and it then fades slowly to the end of the year. 2001 Q4 (NEAT) doesn't reach perihelion until 2004, but will be brightening into visual range at the end of 2003. It is however a Southern Hemisphere object and UK observers will have to wait until it heads north in 2004. 2001 RX14 (LINEAR) will be around 10th magnitude at the start of the year. It is a fraction brighter in February, just after perihelion, and only fades slowly, so we will be able to follow it until it sinks into the twilight in June. Initially it is well placed on the borders of Ursa Major and Canes Venatici, then tracks southwards passing through Leo in April and May. 2002 O7 (LINEAR) should come within reach of visual observers in March and UK observers will be able to follow it until mid year. It continues brightening, but is best placed for Southern Hemisphere observers. Brightest after its September perihelion, it should still be an easy binocular object when it passes within a few degrees of the South Pole in November.

Several other comets are at perihelion during 2003, however they are unlikely to become bright enough to observe visually or are poorly placed. 94P/Russell, 100P/Hartley, 118P/Shoemaker-Levy and 127P/Holt-Olmstead have unfavourable returns 2002 J4 (NEAT) is unfavourably placed for viewing from the UK, whilst 36P/Whipple, 79P/du Toit-Hartley, 2001 YX127 (LINEAR), 2002 J5 (LINEAR) and 2002 R3 (LONEOS) are intrinsically faint or distant comets. Ephemerides for these can be found on the CBAT WWW pages. 25D/Neujmin has not been seen since 1926 and P/Tritton has not been seen since 1978.

Looking ahead to 2004, the highlight will almost certainly be 2001 Q4, which may become brighter than 3rd magnitude at perihelion. Several periodic comets have favourable returns, but they will all be telescopic objects.

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Lunar interference plot for the next six months, produced using GraphDark 2 by Richard Fleet.