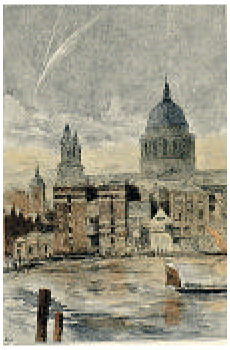

THE COMET'S TALE

Newsletter of the Comet Section of the British Astronomical Association

Volume 11, No 2 (Issue 22), 2004 October

The third International Workshop on Cometary Astronomy, Paris, June 2004

This IWCA was actually the 7^{th} cometary workshop as there had previously been four American workshops. The previous international ones were held in Italy in 1994 and Cambridge in 1999. The scientific sessions were held over June 4^{th} and 5^{th}, although most people arrived on Thursday, June 3^{rd} and toured Paris on the Sunday morning. Most participants stayed at the Hotel Ibis, a short bus ride from the Meudon observatory, though getting in through the observatory gates provided a tough test for the driver, which on one occasion led to part of the bus coming off! The meeting was held in the Salle du chateau of Meudon observatory, which was part of an old castle that was converted to an observatory some 120 years ago. The "Grande Lunette" (83cm refractor) is housed in a large dome at the top of the tower.

The chateau and dome at Meudon

The presentation to Nicolas

Some preliminary announcements included the presentation of a certificate to Nicolas Biver commemorating the naming of asteroid 26969, discovered by Jana and Milos Tichy, after Nicolas. Dan Green was working on an 18^{th} century comet catalogue by Nicolaas Strutch in conjunction with Dutch amateurs, which will be published by Harvard. The next IWCA will be in Japan in 2009 in conjunction with the solar eclipse. It will be hosted by the Japanese amateur comet group and will either be in Tokyo or Osaka in association with their annual comet conference. One in the US will follow it in 2017. There is the possibility of other workshops being held in Europe, perhaps in Germany, Italy or Spain.

My notes from the many lectures begin on page five and reflect what I heard the speakers say, which might not always be the same as what they themselves said or even what they intended to say, particularly as I finally found time to type them up several months after the event. On occasion my notes didn't make a great deal of sense, but I have typed them up as written. Where possible I have also included the individual abstracts or synopses of the talks provided by the authors.

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The Section newsletter is now free to all BAA Members who make contributions to the work of the Section. The cost for other postal subscribers is £5 for two years, extended to three years for those 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. You can also download the newsletter (in colour) from the Section web page.

Section News from the Director

Dear Section member,

It has been a very busy six months for me and I seem to have been away from Cambridge for a significant time. Since I returned from the Antarctic in March, I've spent time away in Hamburg and Hoenpeissenberg in Germany, Paris, Victoria Island in Canada, Oban in Scotland, the English Lake District, the Isle of Man, Yorkshire, Southampton and Exeter. All these trips have meant that I haven't been able to keep up with Section work to the extent that I would like. I'm hoping that the next six months will be quieter!

I am very conscious that many European associations have developed expert CCD observing groups and this is an area that I have not been promoting as much as I should. I am therefore very pleased to say that Nick James has agreed to become Assistant Director, with responsibility for CCD observations. He will be arranging a meeting for all CCD observers in the near future.

In order to widen the readership of the newsletter I am making it available (in colour) on the Section web page as a pdf file. If you are able to receive the newsletter in this way, please let me know, as this will save on postage costs. All those who have paid a subscription remain entitled to receive it by post. Whilst the web version includes colour, the printed version will remain in low resolution black and white. If you don't regularly view the Section web page and want an email reminder when the next issue is posted send me a note and I'll add you to an email list, though I won't send the actual pdf.

There has been some sad news. Nikolaj Chernykh died of a heart attack on May 26th. On August 5th XingMing Zhou, a noted discoverer of SOHO comets, was killed in a car crash. Fred Whipple, who first proposed that a comet had an icy nucleus, died on August 30th. He had discovered six comets. Obituaries of all three men have been published elsewhere. The Genesis spacecraft came in to land rather faster than intended, and whilst it demonstrated the effects of a high-speed impact, we must hope that when the Stardust spacecraft returns to the Earth it doesn't suffer the same fate.

This issue features my notes from IWCA III. This was a very good meeting, with lots of interesting presentations. Although the next IWCA is not until 2009, it would be good to have a European meeting before then, perhaps in 2006 or 2007. I am not sure if this should be part of the regular MACE meetings (which are mostly A), or a completely separate event. I will contact other European directors to see if we can arrange something, but would welcome suggestions from members.

This year sees the final Keedy award, which covers 2003 and 2004. This award was generously instituted by David Keedy to help promote comet observing in the BAA and constitutes a certificate and a book prize. Previous recipients have been George Alcock, Andrew Pearce, Brian Manning, Tony Ward, myself, Atilla Kosa-Kiss, James Lancashire, Alex Vincent, Gabriel Oksa, Melvyn Taylor, Michael Oates and Cliff Meredith. I will be choosing the recipient for this final award in the New Year, but do let me have nominations if you think there is someone particularly deserving.

There seems to have been a record spate of moderately bright comets this year, with 2P/Encke, 2001 Q4, 2002 T7, 2003 K4, and 2004 F4 all having reached naked eye brightness (even if they weren't all sufficiently well placed to be observed) and 2004 Q2 predicted to get that bright. Given that we still have the best part of three months to go, there may still be more to come. It does seem that there are still reasonable chances for amateurs to discover comets, with 2004 Q1 found on CCD images by Roy Tucker and 2004 Q2 found visually by Don Machholz. Both comets were reasonably well placed in the morning sky, but missed by the professional searches. 2004 R2 was discovered by a relatively small professional search programme and would have been well within amateur range. Earlier in the year Bill Bradfield discovered 2004 F4 visually and amateurs found 2004 H6 on SWAN images. Will there be a British cometary discovery? Our supernova patrollers have come close, so I think there is actually a good chance if you are prepared to devote the time to the task.

Since the last newsletter observations or contributions have been received from the following BAA members: James Abbott, Peter Birtwhistle, john Fletcher, Maurice Gavin, Massimo Giuntoli, Werner Hasubick, Nick James, Gabriel Oksa, Roy Panther, Jonathan Shanklin, Jeremy Shears, David Storey, and also from: Jose Aguiar, Alexandre Amorim, Alexander Baransky, Nicolas Biver, Reinder Bouma, Jose Carvajal, Tim Cooper, Haakon Dahle, Alphonse Diepvens, Stephen Getliffe, Virgilio Gonano, JJ Gonzalez, Pyotr Guzik, Roberto Haver, Guy Hurst, Michael Jager, Andreas Kammerer, Heinz Kerner, Attila Kosa-Kiss, Carlos Labordena, Martin Lehky, Rolando Ligustri, Michael Mattiazzo, Maik Meyer, Maciej Reszelski, Walter Robledo, Juan San Juan, Pepe Manteca, Jose Martinez, Stuart Rae, Hirohisa Sato, Tony Scarmato, Giovani Sostero, Magda Streicher, Seiichi Yoshida and Koos van Zyl (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*. Observations from groups that currently do not send observations to the BAA would be much appreciated as they make a valuable addition to the analyses.

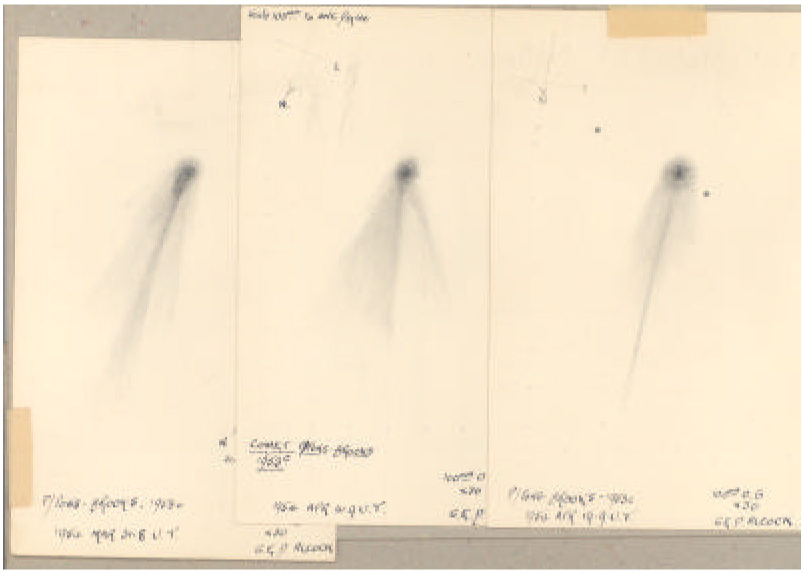
Comets under observation included: 29P/Schwassmann-Wachmann, 32P/Comas Sola, 53P/Van Biesbroeck, 56P/Slaughter-Burnham, 78P/Gehrels, 88P/Howell, 119P/Parker-Hartley, 121P/Shoemaker-Holt, 131P/Mueller, 160P/LINEAR, 2001 HT50 (LINEAR-NEAT), 2001 Q4 (NEAT), 2001 RX14 (LINEAR), 2002 T7 (LINEAR), 2003 K4 (LINEAR), 2003 T3 (Tabur), 2003 T4 (LINEAR), 2003 WT42 (LINEAR), 2004 F4 (Bradfield), 2004 H6 (SWAN), (2004 Q1 (Tucker), 2004 Q2 (Machholz), 2004 R2 (ASAS), 2004 S1 (Van Ness), 2004 T1 (LINEAR-NEAT).

Jonathan Shanklin

Tales from the Past

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

150 Years Ago: There had been trouble with the postage of copies of *Astronomische Nachrichten* to England when "subordinate officers" of the Post Office had insisted on treating them as letters and requiring letters postage. The Astronomer Royal had taken up the matter with the Secretary of the Post Office and had assurance that it was not liable to any charge. [*The text suggests that in those days scientific journals were delivered free.]* Sir Francis Beaufort forwarded from the Admiralty a very beautiful chart of the path of 1853 G1 as seen from Lord Howe's Island (32°S, 159°E), which was executed by Mr J Glen Wilson, HMS Herald. Professor Argelander wrote to the Astronomer Royal saying "without doubt you will before this time have found the fine comet [1854 F1], which is now visible in the evening twilight." and forwarded two sets of elements due to "the uncertainty whether the weather has been sufficiently favourable to enable you to obtain a competent number of observations for the determination of an orbit." J R Hind noted that it was very fine with the naked eye on March 30. Adams sent a set of elements based on observations by Professor Challis, made with the Northumberland refractor. The Rev. T W Webb sent some notes on the comet, which were published in June. It was first seen at Ross in the county of Hereford by "an intelligent little boy of ten years old, who noted 'a stranger in the sky'". In Webb's 9cm achromat it "appeared of a



Drawings of 12P/Pons-Brooks exhibited by George Alcock in 1954 pale orange or fiery hue, and of an aspect which would have been deemed in former times terrible and portentous". He also noted "on the first evening of my observations, as well as frequently afterwards, I thought there was, to the naked eye, aided only by a concave lens to correct near-sightedness, an appearance of blazing up or flashing, issuing from the head into the denser portion of the tail; of this Mrs Webb, whose eye is very sensitive to light, was on several occasions perfectly confident. These coruscations could not however be traced in the telescope. Mr Purchas, at Ross, observed nearly the same phenomena and on March 28 considered the nucleus as brilliant as ***b** Arietis* [2.6], with a tail extending 3° in the strong twilight.

100 Years Ago: At the April meeting Mr Maunder informed the audience about Brook's comet [1904 H1] that had just been discovered at the Smith Observatory, Geneva, New York. Harvard College had computed an orbit using pre-discovery observations, which Mr Crommelin said excited his incredulity as " it was of very short period, three years, was retrograde, moving at right angles to the ecliptic and near aphelion". He thought that it was a case when a dual solution was possible from three observations, and that they had chosen the wrong one. Mr Alex Hutt called attention to the fact that the three great comets of the last century had all appeared at times of sun-spot minimum, 1811, 1843 and 1858. Notes from Journals included one published in *Ap. J.* by Sebastian Albrecht on photographic observations of Borrelly's comet [1903 M1], which showed a recession in the tail of 45 – 70 kms^{-1} relative to the comet's head. At the May meeting there was further discussion on 1904 H1, as it was now obvious that the orbit was parabolic and had the third largest perihelion distance on record [2.71 AU]. Having got the good orbit it turned out that Harvard had measured nebulous objects on some of their pre-discovery plates instead of the comet. The annual report states that only 1904 H1 had been discovered during the 14th session, and very few observations had been made by Members. Encke's comet was expected to be bright that autumn.

50 Years Ago: At the Exhibition Meeting on April 28 George Alcock exhibited drawings of 12P/Pons-Brooks (1953 M1), and Harold Ridley a model of its orbit. Dr Merton gave a talk on recent comets. He said that there were discrepancies between visual and photographic observations of 1953 M1, however there had clearly been several outbursts and it seemed that the most recent had taken it to 6^m. It was expected to reach 4^m in June. There was some discussion on the merits of using short focus photographic lenses to take photometric images, as these would show comets as appearing similar to stars. The annual report notes that 54 observations of 1953 M1, and 72 of 1953 T1 (Abell) had reached the Director [*The archives show 25 magnitude estimates of 1953 T1, whilst those of 1953 M1 were sent to the ICQ in paper form by Graeme Keitch in the 1980s*]. Michael Hendrie, Roy Panther and Albert Jones were amongst the observers.

Another of George's drawings of comet 12P/Pons-Brooks

The third International Workshop on Cometary Astronomy

Continued from Page 1.

Session 1 – Comet discovery, follow up and communication (I)

Gary Kronk (USA), "Cometography". *The Cometography project has been over 20 years in the making and will span four volumes and roughly 3000 pages when completed during the next couple of years. There were numerous bridges that had to be crossed during the last two decades before even the first volume could be published. Some of these include the following:*

- The various challenges that were encountered just to acquire data from ancient times through the first couple of decades of the 19th century.

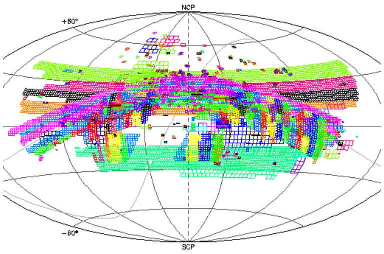
- The understanding of time, not just by knowing who used the Julian and Gregorian calendars, but also, the importance of knowing each observer's location in order to convert all pre-20th century data to universal time.

- The handling of Alexandre Guy Pingré's Cometographie of the 18th century.

When completed, Cometography will be the most complete catalogue of comet descriptions ever published. What is the future of Cometography?

His interest began in November 1973 with comet Kohoutek when he was at high school. He followed John Bortle's writing in S&T and Van Biesbrock in Popular Astronomy and liked their style. Comets – a descriptive catalogue was written whilst at university and had some restrictions due to the publisher and deadlines. He didn't think that Cometography would ever be published, but Brian Marsden had put CUP in touch with him. Compiling the work was difficult as he only spoke English and many sources were in foreign languages. The intention was to produce descriptions of all comets, however many European sources were not descriptive. With more recent comets there is too much information and reproducing it all would be repetitious and boring. Volume 2 between 1800 and 1820 was difficult as there were many short lived journals, not all available in the US. Post 1820 observations were in the main journals. Volume 3 is nearly complete and should be ready in November. Volume 4 is complete to 1995, but there are still 400 (or more) SOHO comets, 100 LINEAR etc to add.

Sebastian Hoenig (Germany), "Amateur discovery in the 21st century". *After a fairly large number of amateur comet discoveries in the 20th century the* *beginning of the new millennium was dominated by surveys. In the 1980s and early 1990s around one third of all new comets were amateur discoveries while the last few years revealed only 1 amateur discovery out of 30 or 40 comets. Current survey telescopes are located mainly in Arizona and New Mexico like LINEAR, LONEOS, CSS and Spacewatch, while NEAT has a second station on Hawaii. In general they use telescopes with large apertures and fast focal ratios covering wide fields, both each night and each lunation.*



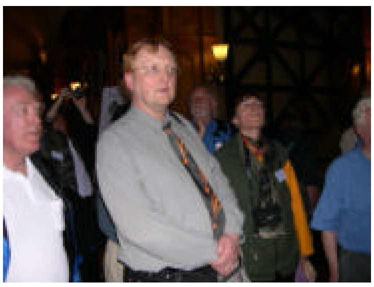
[Typical sky coverage by survey telescopes during half a lunation]

However a few comets are still discovered by amateurs. Such comets usually travel along holes where the big surveys have problems in operating or in the so far completely survey-free Southern hemisphere. Since it is expected that new surveys will fill the gaps in coming years, amateurs must develop new strategies using advanced technologies, virtual observatories and international cooperation. The talk will give a short introduction to the problem and will show how amateur comet discovery will survive in the shadow of present and upcoming sky survey projects.

The traditional techniques included large binoculars or fast telescope systems covering a few square degrees and reaching to 10^{th} – 11^{th} magnitude. Later photographic plates or films were used with Schmidt cameras or wide field lenses. Today's competitors include LINEAR, which may end in 2007 and NEAT, where the initial 10 year contract may end in 2006. This is now using the QUEST camera with 3.7° field and reaches 20^m in 60 seconds, but does miss fast moving objects. The surveys are mostly northern hemisphere, near (or far) from the ecliptic and avoiding crowded star fields. The SOHO satellite has the LASCO coronagraph (800 comets) and the SWAN camera (4 comets), however LASCO in particular has a limited field. SWAN has a 60 x60° hole in the solar direction and a 40 x 90° hole in the anti-solar direction. There is a high background in the southern Milky Way and a delay in publishing the images, but they do go down to 10^{th} – 11^{th} magnitude. So, amateurs should search in high (> -40°) southern declinations, along the Milky Way or north polar or ecliptic pole regions or at very low solar elongations. In the 21^{st} century amateurs with advanced CCDs on 25cm or larger telescopes reaching down to 19^{th} magnitude can compete directly with NEAT and LINEAR, eg Vello Tabur. International co-operation for sites, finances or telescope can pay dividends, eg C Juels and Paolo Holvorcem. In conclusion there may be no visual discoveries but there will be CCD ones. [Subsequently Roy Tucker discovered 2004 Q1 by CCD and Don Maccholz 2004 Q2 visually.]

Session 2 – Comet discovery, follow up and communication (II)

Milos Tichy (Czech Republic), "Confirmation of discoveries". *The majority of new ground-based discoveries of comets comes from large surveys. The first step of exploration of newly discovered cometary bodies consists of detection of their cometary features and confirmatory astrometric observations. A timely recognition of cometary features of a particular body having an unusual orbit can help in planning further research.*



Milos Tichy

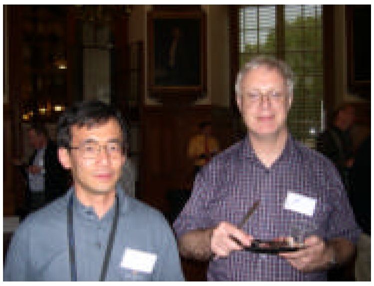
Visual discovery has become very difficult. Many discoveries start on the NEOCP. Often apparently asteroidal objects with unusual motion on LINEAR images show cometary features. Often older CCD chips are red sensitive and so could only detect dust details. Modern chips are sensitive in the blue so are better able to detect gas. Cometary nature is also shown by the diffuseness of an image compared to stars. A comet with coma only is fairly straightforward, eg Tichy 2000 U6. A stellar comet with tail is also fairly easy, eg Elst-Pizzaro 1996 N2. Others have a coma and tail, eg 1999 S4. Klet have a software package to do analysis of all objects in an image. The 0.57m telescope [IAU 046] was used to confirm about 60 comets between 1996 and 2002. There is a new 1.06m telescope [IAU 246] for the Klenot project. This has a 33' field and can reach 22^m in two minutes. It has made about 25 confirmations since 2002.

Maik Meyer (Germany), "Comet observing and the Internet". *Recent years have shown that the Internet had a great impact on amateur astronomy. Cometary astronomy especially was faced with an increased problem of observational bias of brightness estimations of comets, which still persists. On the other hand the Internet provides a lot of positive and useful possibilities for comet observers which were not available several years ago. The faster communication speed leads now to almost no delay between discovery and follow-up, unusual events (e.g. outbursts, fadings etc.) can be confirmed fast and the important exchange of experience and knowledge is profitable for all. The planning and preparation of an observing session can be done easily with Internet based tools and resources, the verification of observations as well as of possible discoveries is now an relatively easy task. All this serves the purpose of improving the quality of observations and of minimizing false or incorrect reports. However, care must be taken when using data found on the Internet regarding the up-to-dateness and accuracy. A selected overview of the most important tools and resources is given as a guide through the variety of possibilities.*

The Internet can lead to bias, erroneous/false reports, unverified reports and the spread of false news reports. You have to select the source and double check it for it to be of use. You can plan observations using magnitude sources, ephemeredes, orbital elements [Kinoshita]. The Hipparcos catalogue goes down to

12th magnitude, but you should avoid red stars. You can use Vizier. For fainter comets use Henden, Skiff or Landolt, or use Reinder Bouma's Astrosite. Verification is needed for faint comets at the limit of visibility, extraordinary behaviour or discovery. Education – the net is full of resources for the beginner, but which are good? This is the responsibility of national comet sections. Community – observers are a small group, the net provides an avenue for communication, to participate in international projects and see the publication of results. The yahoo comets-ml generally works well for discussion. Comet-obs posts unverified observations, with no rule for format. The comet-images list is very impressive. In conclusion don't overate it – the net doesn't replace actual observing.

Shigeki Murakami (Japan), Visual comet hunting. He had carried out an NEO survey simulation (See *Tale 21*) using 3000 virtual comets. Kazimieras Cernis also carried out a survey of comets from 1901 to 2000 and how LINEAR would have competed. 1) NEO surveys find bright absolute magnitudes. 2) Surveys reduce the number of visual discoveries by about 75% in the northern hemisphere and by about 50% in the southern hemisphere. 3) The larger aperture discovers more comets according to Cernis. On April 12th T Seki saw a 35' diameter 3.5^{m} object, moving east at around 1° per minute. It was photographically confirmed, but not identified. Brian Marsden doesn't think it was real. There are possibly many similar objects. There have been some real reports, eg 14P/Botha and a couple of reports from Bill Bradfield.



Shigeki Murakami and Tony Hoffman

Panel discussion. Gary would like to see Cometography extended beyond 2000, but needs international collaboration. Does the simulation take into account the discovery of comets in outburst? Are amateurs switching from visual to CCD "industrial" survey mode? – yes but….. LINEAR and NEAT generally only go to 60 – 70°. Stick to a small region and go deep. Don't think on industrial lines – professionals make mistakes, eg IRAS-Araki-Alcock. PanStarrs won't necessarily work. Don't become too professional. What lessons are there from Bradfield 2004 F4 and SWAN 2004 H6? There are quite a few false alarms, so the CBAT was reluctant to go without ground confirmation. Also the SWAN resolution is poor and you can get confusion with stars. Brian Marsden doesn't think any have been missed, however Christensen (2003 K2) wasn't confirmed until found independently, although seen earlier on SWAN. Charles Morris and Dan Green both vet observations before posting them. Charles Morris asserts that experienced observers at the same location with the same equipment will get the same results. When submitting observations observers should use the x notation if magnitudes are from guide/megastar rather than the primary Tycho catalogue. Brian Marsden would prefer to leave suspect objects on the NEOCP until confirmed or denied to avoid asteroids later being designated as comets. Some MPC staff however are keen to get designations out. Some amateurs expect NEOCP objects to be comets and so report objects (particularly with small instruments) as being diffuse.

Session 3, Friday afternoon – cometary astrometry

Brian Marsden (USA/UK), "The need for and use of astrometric observations of comets". *Knowledge of their orbital parameters is obviously fundamental to our understanding of comets. Not only is such knowledge essential for the reliable extrapolation of where a particular comet might be found at some time in the future, but it is necessary for an appreciation of the whole phenomenon of comets--how they are distributed in space and, indeed, the dynamical forces and other physical processes to which they are subject.*

The computation of a cometary orbit requires the availability of observations of the comet's position at a finite number of specific times. That number could be as small as two (in which case some assumptions would have to be made about the orbit), or it might run into the thousands (which invariably represents a case of overkill). Nowadays the accuracy of an individual observation, obtained using an appropriate telescope and charge-coupled device and relative to background stars whose sky positions are taken from a modern catalogue, is expected to be on the order of one second of arc. Standard techniques exist for both the reduction of observations and the determination of orbits.

In the CCD era amateur astronomers are contributing to the cometary astrometric effort more than ever before. While this is to be welcomed, it is not without dangers. Although most of the amateurs undertaking this work do so commendably, a few are producing results that are consistently unsatisfactory, sometimes to the extent of minutes of arc. Imagination plays a role, particularly when an observer goes for a faint comet that has not been under observation for some time: in such a case it is absolutely essential to secure observations on two nearby nights, so that the reliability of the observations can be established by the consistency with which the orbit represents them. At the opposite extreme, several observers try only the bright comets that are well-placed and high in the sky at convenient hours of the night, but for which hundreds of observations have already been reported during the previous couple of weeks. These measurements may be good, and there is some easy publicity for the observers, but--honestly--there is simply no need for a dozen more quick measurements, and the effort would have been far better spent on trying to produce a few definitive observations of a more difficult object.

Some thoughts are offered on how amateurs might reconcile this dilemma, in the hope that their collective contribution can be made even more useful than it is.

Nineteenth century astrometry referenced to one star, but with checks, eg Holetschek of 10P/Tempel. In 1930 Van Biesbroeck made observations with dependencies on three reference stars. In 1960 Brian Marsden made some. This year the comet was observed by many amateurs. The MPC maintains various pages, eg NEOCP, observable comets, dates of last observation. Don't observe astrometrically if the comet was observed by several observers yesterday. Update elements once a week if there are observations on two or more nights. Newly discovered P/ comets are particularly important to enable recovery and to determine the non-gravitational parameters. SOHO measurements are consistent if not necessarily correct, so orbits may be a bit out.

Peter Birtwhistle (UK), "Introduction to the astrometry of comets: recommendations and problems". Peter lives close to the M4, some 60 km west of London. He has had a 30cm Meade LX200 GPS and Apogee AP47p since June 2002. He encounters the standard sort of problems – dew, focussing (use FocusMax software), dome sticking, tracking (use PEC, or tighten the RA lock grub screw), poor signal (use track and stack in Astrometrica, so fewer objects but more images). Automate using visual basic and ASCOM. Timing is important. Prefer UCAC2 or USNOB1 for measurement. Important to take flats and darks, but leave the CCD on the telescope. Windows 2000/XP are OK cf stability and the PC internal clock. Maxim DL came free with the camera, bundled with pinpoint for setting up the telescope. Dimension 4 for timekeeping. Some home written software, eg extrapolation of NEOCP and check of NEOCP for updates. He targets key known comets, generally <18th magnitude NEOCP objects – about 1 in 30 are comets. Beware of internal reflections causing false trails. Problem of centre of light for diffuse objects – give a long exposure. Need to copy NEOCP results sent to the MPC to the CBAT in case it is a comet.

Panel discussion. Widefield low resolution astrometry is not encouraged, but for some comets it is important, also to get photometry. Astrometry is much easier than photometry. Akimasa Nakamura and the Tichy's both use their own software. Gareth Williams also has a beginners page on the MPC web site. There are fewer astrometricists in the southern hemisphere, which can be a problem. The astrometry situation is much improved since 1999, but a few comets still need more observations. Some observatories are very poor. Some spurious observations may get published as the last observed measurement, particularly of short arcs of newly discovered periodic comets. It is useful to report negative observations if you have made an attempt for a comet that has not been observed for a while, or is near the end of a period of visibility. Professionals also need good astrometry for bright comets, eg Meudon radio astronomy observations etc. The non-gravitational parameters for 2002 T7 don't make much sense and this comet may need to have osculating elements to satisfy the necessary accuracy. The precision of elements given in MPECs is a tradition going back to when the MPC was at Cincinnati and it is recognised that this precision is often excessive. When lower precision has been given, eg 2dp for angles, there are complaints that people can't generate the elements from the ephemeris. Using an R filter can help to improve the signal to noise for some comets. You can use the technique of using successively smaller centroids and extrapolating to zero size to get a position.

Session 4 – Cometary photometry (I)

Dan Green (USA), "Progress and problems concerning cometary magnitudes". *The ICQ project has now completed 25 years of publication and archiving comet photometry. There have been many successes due to our standardizing the reporting format for photometric observations of comets. But there are still many questions and problems. I shall review our progress in the last 25 years and explain where more work needs to be done today to increase the scientific value of broadband cometary photometry.*

Why measure total magnitudes? – for the prediction of brightness, for planning, for historical continuity, sometimes the only physical information on comets. Work is in progress to expand the historical database. More than half of the short period comets are predictable from year to year. Past photographic magnitudes tended to be short astrometric exposures, giving m_2. Visual observers are the main source of magnitudes brighter than 13. There is very little CCD photometry from the southern hemisphere. Visual magnitude estimates have been standardised over the last 100 years, particularly in the last 20. There is no standardisation for CCDs, most are currently unfiltered, however they do extend down to 19th magnitude. There is the potential for better precision than visual observers. The leading comets are 1995 O1 and 1P/Halley in their respective classes. There is a US subgroup of the IAU looking at the determination of comet magnitudes. They are proposing a new system of giving the magnitude and a letter to indicate the coma size and bandpass. New comets tend to follow 7.5 log r.

Akimasa Nakamura (Japan), "Systematic difference between visual estimates and CCD photometry". *It is well known that CCD photometry of total magnitude of a comet yields a fainter result than visual estimates. This systematic difference has been believed to have two causes: a) Due to insufficient integration time for photometric work, the photometric aperture size is smaller than visually detectable coma size. (This is particularly the case for 'astrometric magnitude'). b) Since a CCD chip has its peak sensitivity in a redder area than the eye does, it is less sensitive to C_2 emission, which is dominant in comet coma. However, carefully conducted CCD photometry, in terms of both photometric aperture size and comparison star colour, of distant comets, which should scatter the Sun's continuum only, still has a systematic difference as much as a full magnitude.*

In this presentation, the author shows a very simplified model of comet profiles, and suggests that the difference could be caused by the characteristics of the human eye, which has a response that is *not linear but logarithmic to the light.*

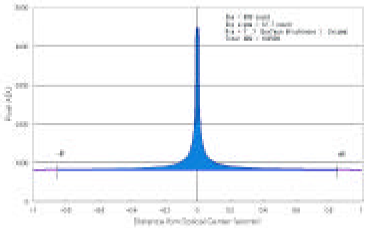


Fig.1 Simplified profile of a comet coma

For a distant 'dust-dominant' comet, whose dusts are ejected constantly and expand in a constant speed, the surface brightness of the coma decreases following 1/r, where r is the distance from the optical centre. Setting the photometric aperture size to 1'.7 (r=0'.85), within which the S/N of surface brightness is higher than 2, the total ADU count in this example is 102500.

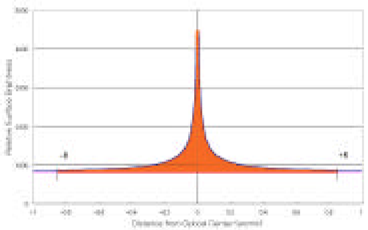


Fig.2 Visually detected profile of a comet coma

Since the human eye has a logarithmic response to the light, the visual profile is similar to figure 2. With the profile normalized to adjust its peak and sky background to those of figure 1, the total ADU count is 267800. Therefore, the difference is given as 2.5 log (267800/102500) = 1.04 magnitude.

There is a different spectral response between CCDs and the human eye. Different contrast in CCD frame can give a different magnitude thanks to using different aperture sizes. He tries to use a similar aperture to visual observers. 2001 HT_{50} was 0.72 brighter visually, but using the same coma size was 1.5 magnitudes fainter. The KAF 1600 chip is red sensitive compared to the eye and misses most of the C_2 emission, which implies that the comet should appear brighter to the eye. Convolving emission lines and the solar continuum with the eye's response or CCD response matches observation to about 0.6 for a gassy comet and 0.0 for a dusty one. The SI502a has a much more linear response, but the difference is still ~0.6/~0.1. The modelled surface brightness of the coma shows that the visual coma is slightly larger than the CCD and this could be the cause of the CCD apparently recording fainter magnitudes.

Charles Morris (USA), "Visual CCD comet photometry, the promise, the reality, the future". *CCD photometry provides accurate (and precise) brightness estimates of many astronomical objects. However, visual CCD photometry of comets has failed to live up to its potential. Instead of providing an accurate baseline for photometric studies of comets, visual CCD photometry is typically 1-2 magnitudes fainter than and has a scatter typical of observations made using the human eye. When applied to comets, there are observational issues that include the spectral response of the sensor, the use (or lack of use) of filters, (astrometric vs. photometric) exposure time, characteristics of the optical instruments, and comparison star magnitudes. The reduction methodology used to derive the reported magnitudes from the raw data also varies widely. In this talk, the methodology of visual CCD photometry of comets will be reviewed. The problems will be discussed and recommendations made to improve the resulting CCD magnitudes of comets.*

CCDs promise an accuracy of 0.1 or better and no systematic errors. Actually they get a similar scatter to visual observers and a bias of 0.5 to 2 magnitudes, generally due to a smaller coma being reported. It could be due to sensors, filters, exposure, comparison stars, reduction techniques (especially altitude). He believes most of the difference is due to lack of blue sensitivity missing C_2 and CN emission. R and V filters may make the problem worse. The dust to gas ratio remains roughly constant and the relative strength of the lines remains unchanged, the 470nm line makes a significant contribution. Model a 20" coma, peak count 250, beyond 20" at sky background. 1' visual coma adds about 1 magnitude. Can't do much at the moment – there is a better chance of capturing C_2 if you don't use a filter, much as the visual observer does. Also going to a darker site may reduce the sky background. Could apply an adjustment of 1 – 1.5 magnitudes to match the visual. Some rogue visual observations at the limit of the telescope are probably false. You need filter and comparison star magnitudes that match the naked eye and better chips.

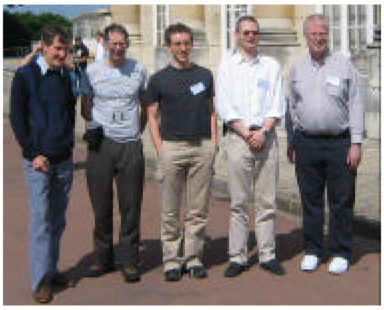
Panel discussion. Mike A'Hearn – should we give up the pursuit of getting a match to the visual observations and just use R with a cutoff at 640nm to measure dust only? Dan Green – There is a need for amateurs to become involved with spectrophotometry, which doesn't need a large telescope. Jonathan Shanklin – depends on the use – long term monitoring, or estimates of nuclear size. Milos Tichy – Can't get the same magnitude for a gas rich comet on Kodak 1600 and SITE chips. Giovanni Sostero – Need two ways – one to match the visual and one to study the physics of comets. Can we really control all variables, eg the projection of the tail on the coma. CCD scatter may be a function of non standardisation. Can the eye see C_2 (515nm) ? – yes, as the coma looks blue/green, however the "quantum efficiency" of CCDs and the eye are not the same, so it this may not be the whole reason. Perhaps signal to noise also plays a part. Joe Marcus – The Purkinje effect may play a part. The eye and CCD are very different in defining the edge of the coma. There may be some merit in widefield (eg telephoto) CCD photometry, however you need to be careful not to include the tail and there are still differences when the comet is faint. Mike A'Hearn – the dust distribution is 1/r, whilst C_2 is bell shaped. Distribution is an issue for techniques. Would expect changes in species distribution with r.

The great refractor of the Paris Observatory

This closed the first day's discussions and we boarded the bus for a reception and visit to the Paris Observatory, where there was an exhibition on the transits of Venus. Jacques Crovisier told us that Messier observed from the Hotel de Cluny, not far from the Paris Observatory. Day 2 started with a presentation on the work of various national groups.

Session 5, Saturday morning – Introduction of National Comet Groups

Alex Scholten (The Netherlands), "The Dutch comet group". The Dutch group formed in 1976 after the appearance of comet West. It has about 75 members and has logged 4,800 observations of 155 comets by 52 observers. Generally about 8 comets are observed each year. Bright comets boost the number of observations, which are normally around 100 per year. There are 5 or 6 main observers. 75% of the observations are made in the Netherlands. They have various publications – a bimonthly newsletter and reports on bright comets. They also have a web page.



SOHO comet finders: Xavier Leprette, Jonathan Shanklin, Sebastian Hoenig, Maik Meyer, Tony Hoffman

Nicolas Biver (France), The "commission des comètes" of the "Société Astronomique de France". The SAF was founded in 1887 by Camille Flammarion, with "commissions" or observing sections. There are currently 15 commissions. C Bertaud founded the comet commission in the 1970s. They have a web page and a mailing list with about 55 members. There are 70 members, with about 10 regular observers over the last year. They publish in the SAF journals and have two meetings a year, occasionally with observing camps. 8 – 10 comets are observed each year and half the observations are brighter than 10^m.

Jonathan Shanklin (UK), "The BAA comet section". I described the history of the BAA comet Section, which was founded a year after the BAA in 1891. There are 30,000 observations of 400 comets, including returns of 80 periodic comets in the archives. W F Denning was the first director, with A C D Crommelin the third. I am the 12th, but don't have any comets named after me, although I have discovered six on SOHO images. A few section members still hunt for comets, CCD observers are growing in number, but the main field is still visual observation. Analyses of the returns of comets each year are published in the BAA Journal. The absolute magnitudes of comets determined from the light curves show distinct differences between periodic and new comets. The visual observations of 2P/Encke show no significant change over the last 50 years, however modern CCD observations give a very different picture to simultaneous visual observations. I asked observers to try and submit both visual observations and images in exactly the right format, as otherwise it adds a lot to the Directors work.. I posed the question of whether observations from light polluted areas should be accepted (I favoured yes), and queried if some observers hallucinated, particularly when trying to observe comets on the limit of the conditions and telescope (again probably yes). Finally I asked if observations should only be accepted from experienced observers (here I favour taking all observations).

Akimasa Nakamura (Japan), "Japanese comet groups". The Hoshino-Hiroba group was founded in 1967. It has 200 members but only 20 are active. It makes 200 estimates per year. The OAA was refounded in 1960 by Honda. T Seki is Director. There are 170 members, 10 active and 30 observations per year. The main activity is hunting comets. A comet mailing list was set up in 1996 and has 58 members, with only 20 who are active, but they submit 1300 observations per year. After six months members who are not active are removed. There are about 100 active comet hunters, and of the roughly 40 living discoverers, maybe 30 are still hunting.

Maik Meyer (Germany), "The German comet section". The German section of the VdS was founded in 1984 in expectation of 1P/Halley by Andreas Kammerer and others. There are about 65 members, 20 contributing, 10 carrying out photometery, the others imaging, spectra, history or hunting. There is a bimonthly journal. The last section meeting prior to one held in February was in 1994. The oldest member, Gerber, discovered two comets in the 1960s and still does visual spectroscopy. The group aims to recruit more observers, promote CCD photometry and common projects and collaboration.

Giannantonio Milani (Italy), "The Italian comet section". The Italian group is part of UAI, and was founded in 1976. He is the co-ordinator. They have a web page maintained by Rolando Ligustri, a mailing list "GOC" and about six active collaborators. The main current project is "CARA". There is a slow switch to CCD observing.

Session 6 – Professional uses of cometary data obtained by amateurs.

Jacques Crovisier (France), "The long term evolution of cometary outgasing from the observations of amateur and professional astronomers." *Cometary activity is driven by the sublimation of ices in the nucleus: of water mainly when the comet is close to the Sun (typically r_h < 4 AU), and (presumably) of carbon monoxide farther from the Sun.*

The monitoring of the long-term evolution of cometary activity is a fundamental topic of cometary studies. This evolution differs from comet to comet. It provides clues to the sublimation mechanism of cometary ices and to seasonal effects. Such monitoring serves as a basis for predictions for organizing future observations. They are a requisite for the intercomparison of various phenomena when they are observed at different times.

A review of the main monitoring methods of cometary outgassing will be presented. Direct observations of CO and H_2O production rates are rare because *they involve costly and oversubscribed instruments (large telescopes, space observatories). Indirect observations (e.g., the OH radical from its radio lines at 18 cm and from narrow-band photometry in the near UV) are more handy, but they have their own limitations.*

The huge database of visual magnitude observations by amateur astronomers provides another approach to this topic. For comets from historical times, it provides a precious heritage which is often the only source of information. The empirical relation between visual magnitudes and gas production rates, even if it is physically ill-understood, is a very useful tool. For a systematic and timely exploitation of this database, standardization, fast communication and archiving are crucial points.

Water is the main source of cometary activity close to the Sun. It is difficult to observe directly, so need to monitor the dissociation products. Other indirect indicators are CN, C_2, HCN etc. The total visual magnitude is worthwhile if it can be related to $Q(H_2O)$. Afρ is discussed later. Many professional techniques have only become possible in the last 20 years, whereas visual magnitudes go back 100 years or more. Many instruments are restricted in the range of solar elongation that they can observe. SWAS & ODIN observed 10 comets from space. About 12 have been observed with large ground based telescopes in the infra-red. SWAN is good for seeing the H_α coma, but there is a long time lag in reducing the observations. Nancay observations at 18cm go back to 1973, with a new system installed in 2000 and cover some 80 comets. 2003 K4 has a much higher $Q(H_2O)$ than that of 2003 T3 or 2002 T7 at the same heliocentric distance, it is gassier than the average, but the value is still higher than expected for a 10^m comet. Different techniques have systematic errors and give some scatter when all are plotted together, however the statistical correlation gives log $Q(H_2O)$ = $30.8 - 0.27\ m_h$.

Mike A'Hearn (USA), "The Deep Impact project and Amateur Astronomy". *On 4 July 2005, the Deep Impact project will deliver a 360kg impactor into the nucleus of comet 9P/Tempel 1 at 10.2 km/s. The Deep Impact flyby spacecraft will take images and near-infrared spectra for an 800-sec window immediately following the impact. Because we know so little about the physical structure of cometary nuclei, cratering physicists disagree on what will happen as a result of the event. Effects could range from almost nothing observable at Earth to an increase in total brightness by 5 to 10 magnitudes on a time scale of 10 minutes.*

The Deep Impact project has organized a network of small-telescope observers to monitor the activity of the comet before and after the impact. This group collaborates through a special set of web pages. The data are collected at the University of Maryland, where Stef McLaughlin sets the goals and the standards for the observations to be useful. She also completes the reduction of the data in order to ensure homogeneity.

For the time of impact, the project is hoping that as many people as possible will observe with as many techniques as possible. One possible outcome of the Deep Impact experiment is that we will create a new active area on the nucleus, which might create a jet in the coma that persists, with modulation by the rotation of the nucleus, for months after the impact.

In this talk we will describe the Deep Impact project and the observing programs that might be carried out.

The project aims to create an artificial meteor impact. It will help to understand the difference between the interior and surface, basic cometary properties and search for pristine material. Launch is scheduled for December 30 – 31. Impact will be on 2005 July 4 at 06:00 UT. One day before impact the impactor is released. It is an independent spacecraft, weighing 360 kg and moving at 10 kms^{-1}, which gives an impact energy of 10^{19} J and should make a 100 metre crater. There are 800 seconds for the flyby spacecraft to observe with the highest resolution camera yet flown.

There is no agreement on what will happen. The team think that a gravity controlled crater is most likely. Assuming this is correct, then a 100 metre crater is formed to 27m depth in 200 seconds. The ejecta moves at 2 kms^{-1} at its fastest. This is equivalent to six days of normal activity. The comet should reach naked eye visibility for a while – perhaps 5^m decaying over a few days. The team will need all sorts of observations. [There are BAA observations from 1983 and 1994].

We need to pin down the rotation period – the team had 2 days of observing with the HST in May, for measurements of structure, eg jets and the light curve. This showed a variation of 0.4^m in 1.5 days. Amateur observations show jets. He expects to see a change in the light curve.

Laurent Jorda (France), "Cometary dust tails analysis from CCD images". *CCD imaging observations of dust tails have allowed us to retrieve interesting properties of dust particles such as dust size distributions and reliable mass production rates (e.g., Fulle 1989). A new method to analyse dust tails from CCD images will be presented. Preliminary results on several comets will be given during the talk.*

We can learn the dust size/mass distribution and its production rate. May also be able to tell what sort of gasses are present. Need a continuum filter to exclude gas and absolute calibration is not really required – the measurements could be done by amateurs. First remove the star background using median subtraction. Model by creating a synthetic image and comparing with the observed image. Eg anti-tail on Arend-Roland was caused by radiation pressure on particles >10 microns in size. Observations of 1994 N1 give a mass loss of 140 kgs^{-1}. Most of the mass is in particles in the size range 1 – 10 microns. A model for 67P is working well.

Zdenek Sekanina (Presented by Dan Green), "Professional uses of cometary dust imaging data from amateurs". He has made great use of amateur data. A variety of images are useful, including those showing tail development and morphology. Eg anti-tail on 2002 T7 image by Vello Tabur. High resolution imaging of coma, eg 2001 Q4 dust shells by Rolando Ligustri. To increase their value:

- Provide a full description, time, scale, orientation, instrument details and preset results.
- Computer process the image soon after taking it to check for the unexpected.
- Make follow up observations and be systematic – don't jump around, have one objective at a time.
- Share your findings, especially alerts for follow up.
- Get involved with campaigns.
- Always record your observations and keep them archived. Keep raw images.

Panel discussion. Joe Marcus – the eye perceives a smaller coma under higher magnification : $I = j_c^{3/2}\ \gamma^{-1/2}\ \beta^{1/4}\ \varphi^{-1/2}\ A^{-1/2}\ \Delta^{-3/2}$, where j_c is the surface brightness, γ the limiting threshold of human vision to contrast gradient, β the sky brightness, φ the exit pupil, Δ the comet earth distance. This gives $\log Q \sim -0.27m_v$ as observed, rather than the expected $\log Q \sim -0.4m_v$. He refers to this artefact of human vision as "magnitude-production rate disproportionation", or for short the "m-Q anomaly".

We need to preserve astronomical objects for scientific study, however there is no need to worry if they are common [*wasn't that said about passenger pigeons, whales, cod, squid etc??*]. We have delivered more kinetic energy to the moon than we will to 9P. About 1 – 2 months before impact the exact impact time will be chosen to suit the HST, and it will be known to about 30 seconds. The impact may change the non gravitational parameters. The launch window is 3 – 4 weeks. They could launch in March to get to 73P/Schwachmann-Wachmann. There is an extended mission possible to 103P/Hartley or 46P/Wirtanen. 9P is a better target than 73P.

Session 7, Saturday afternoon – Cometary photometry (II).

Laurent Jorda (France), "The [Afrho] parameter and the cometary activity. *The [Afrho] parameter is a parameter defined by A'Hearn et al. (1984) to measure the activity of comets. This parameter is proportional to the dust "filling factor", the ratio of the integrated cross section of the dust particles and the projected surface of the diaphragm in the field of view. The use of this parameter will be discussed. Simple ways of calculating it from calibrated CCD images of comets will be explained and illustrated with examples.*

The total magnitude depends on the diaphragm used and the wavelength and is a mix of dust and gas emissions. Afrho allows the monitoring of the dust emission rate of comets, dust properties through reddening and the gas to dust ratio. It is almost independent of the diaphragm radius and wavelength. A = bolometric albedo of the dust grains, f = filling factor, ie the ratio of dust to total surface in the aperture, rho = radius of the aperture. To measure it you need a CCD, filter, FOV and photometric sky. You need to remove stars, do an absolute calibration, then calculation.

$\mathrm{Afrho} = (2\Delta r)^2/\rho\ .\ i_s(\lambda\rho)/i_s(\lambda)$
where i_s is the solar irradiance.

You can also get it by measurement of the radial profile much more easily. There are some problems with wavelength dependence and factors within the diaphragm, eg dust jets, fans, nucleus contamination. It assumes a stationary state in the coma. It is directly comparable to professional measurements.

Giannantonio Milani (Italy), "The Afrho approach in cometary comae photometry and the CARA project". *Cometary comae photometry has been greatly improved with the availability of CCD detectors. In recent years a group of active observers of the Italian Comet Section have been exploring the potentiality offered by CCDs used unfiltered as well as coupled with wide band BVRI Johnson-Cousins photometric filters. In particular we were looking for an ideal compromise between scientific results and an affordable observing and reduction technique, useful for amateur astronomers. A first step concerned the use of fixed measuring windows, defined in km on the coma, with quite promising results. As second step we approached to the Afrho quantity, widely used by professional astronomers for studying cometary dust within the coma. The Afrho proved to match well what we were looking for and it represents a powerful tool for investigating cometary comae and their photometric profile. As a result a specific advanced project, named CARA (Cometary ARchive for Amateur astronomers), was developed with the main goal to realize an archive, based on the Afrho quantity, useful both to amateur and professional astronomers. In this approach CCD observations are considered as a specific technique, not related to the visual observing one, and most recommended photometric bands are R and I, or other specific ones (wide or narrow) useful for isolating spectral regions where we have mostly light reflected from dust. The project was born with the collaboration of some professional astronomers and in its inner phase already produced interesting data on comet 67P used in the investigations related to the Rosetta mission.*

He wanted to make better use of cometary images. The project is a photometric database using specific apertures, based on Afrho. Measuring the dust component is at present the main target of the program. Contributors are welcome as CARA is a continuing project. The CCD needs a linear response. Reflectors are preferred. R, I (Cousins) and S (Vilnius) filters are recommended, (not UBV), unfiltered (with "red sensitive" CCDs) is OK for dusty or faint comets. The project is developing two software platforms – windows and linux – for calculation. Initial releases can be freely downloaded. The linux version includes a tool for aperture photometry from a fits image. It uses a simple archive format for processed data. You can cross check against various standard apertures at the comet [50, 25, 12.5,000 km at the comet]. Results show an outburst in 2000 WM_1, a light curve of 67P and fading of 157P after its outburst, this includes V measurements as the comet was then inactive, so there was no C_2 contamination. 2002 T7 shows an apparent brightening, but this is most likely a phase effect.

Observations of 2001 Q4 suggest S band is most reliable and gives a much better Afrho value. This band matches fairly well the passband of the 647 nm and 650 nm (10 nm FWHM) filters that are a relatively cheap solution for an amateur narrowband approach, however only bright comets are measureable. The next CARA meeting was to be June 19 – 20 at Crni Vrh in Slovenia.

Giovanni Sostero (Italy) "Some experiences on cometary CCD photometry". *The wide diffusion of digital imaging techniques has provided amateurs with a new opportunity for studying comets. Thanks to the good linearity of CCDs, it's now entirely possible for any backyard observer to determine comae brightnesses with a new level of accuracy. Unfortunately this procedure doesn't come without drawbacks. The author introduces a tentative standardization for CCD comet's photometry, developed within the Italian Comet Section. Aperture photometry is conducted with windows corresponding to a fixed amount at the comet distance (usually 100,000 Km and sub-multiples) in order to reduce the amount of variable parameters; the magnitude of the reference stars for B and V is taken from the Hipparcos-Tycho catalogue, while the R and I are obtained from a polynomial detrending (starting from V and B-V). For the monitoring of the dust emissions, a narrowband filter (10 nm FWHM) centred at 647 nm has been chosen. Some results obtained so far with this technique are shown, as well as the potentials for narrowband photometry of gaseous species.*

We do need filter photometry as there is variable emission from the comet and CCD chips have a variable response. Standard filters are not designed for cometary work and cannot isolate individual lines. Read has fewer emission lines. He suggests using a standard aperture of 100,000 km and multiples or fractions of this. A careful choice of reference stars is needed: B & V from Tycho/Hipparcos and use a polynomial from B-V to get R and I. You get very different images in different bands. 2000 WM_1 shows commencement of water sublimation at r = 3. There is some evidence for colour variation with time and also with size of aperture. Coma profiles differ between comets. 153P/ data agreed better with visual observation before perihelion compared to after. CCDs give significantly different magnitude parameters. He is moving towards trying narrowband filters, but these don't allow much light through, thus requiring longer exposures or larger apertures. The project is allowing good comparison between observers.

Mark Kidger (Spain/UK), "How to standardise CCD data". *A difficulty that observers face when taking data of comets is how to standardise their data to make it compatible with other observers using different instruments. The widespread use by amateurs of CCD cameras of high sensitivity and good cosmetic quality enormously increases the possibilities of photometric coverage of comets given that photometry is calculated automatically with astrometric observations. Although the MPC database now contains huge amounts of comet photometry, the lack of any standard method for taking this data means that the dispersion in photometry of a comet in the MPC database may be as large as 2 magnitudes at a given date even for magnitudes given as "N". In this paper we explore a standard system of multi-aperture photometry that is widely used by Spanish and Italian observers based on the USNO A2.0 catalogue and a series of standard photometric apertures that produces photometry consistent to 0.2 magnitudes in R even within the limitations that most amateurs work to of not having broadband filters. The suitability of the USNO catalogue for photometric work is examined critically and examples of comet light curves and coma profiles are shown, including a study of dust activity in the ROSETTA target comet 67P/Churyumov-Gerasimenko and in C/2001 Q4 (NEAT) and C/2002 T7 (LINEAR). A transformation of USNO A2.0 to the standard Landolt BVR system is presented.*

We now get good astrometry. The significance of the associated photometry is dubious. The Spanish group started in 1999 and now has 40 – 50 active observers.

a) Don't make things too complicated.
b) Adapt the method to what you can do.
c) Don't be too demanding – better quality may not be worth the effort.
d) Most amateurs don't have filters or good skies.

He uses a standard aperture of 10" and treats unfiltered data as R. He uses USNO A2.0 as an approximation to R. Sky subtract with the median of the frame. They initially used *Astrometrica*, but now use a routine called *FOCAS*. The typical dispersion is 0.2^m and they can calculate Afrho. Observations of 2002 T7 are generally OK to 0.2^m, apart from J87 who is a professional astrophysicist. For 67P Afrho shows an unusual light curve, with two outbursts. There was good correlation with professional data for 46P/ at the time of perihelion. He suggests that this comet also outburst. He suggests using 10", 20" … 60" apertures, which is possible with *FOCAS*. The coma profile is after r^{-1}, but in large apertures the sky background is a problem – the median is 18.2/sq". The professionals regard 19.5 as too polluted (this adds up to 11^m in a 30" aperture). There are many USNO A2.0 has many stars in the field, is better than B1 and UCAC and agrees well with Landolt, however a few stars have large errors. Both *Astrometrica* and FOCAS use all the stars and throw out the bad ones. Sky subtraction is the biggest problem and he recommends using *FOCAS*.

Panel discussion. Giovani Sostero says that USNO A2 has been calibrated against Tycho, so you might as well use Tycho magnitudes. There may also have been systematic errors across plate boundaries. He prefers his fixed linear aperture window to a fixed angular scale on the grounds that it will exclude many morphological phenomena. However, Mark's evidence was clear. There was much acrimonious discussion. It is worth collaborating to purchase standard filters, however the problem of sizes still exists.

Session 8: Cometary photometry (III)

Joe Marcus (USA), "Forward scatter enhancement of comet brightness". *Mie theory predicts that at small scatter* *angles, q (= 180° - phase angle), strong forward scattering (FS) of sunlight by micron-size comet dust grains should occur. This effect was clearly documented in the infrared photometry of Comets C/1976 V1 (West) and C/1980 Y1 (Bradfield) as 2-fold (at q = 50°) to 10-fold (at q = 31°) increases in R(q), the ratio of scattered light to emitted heat radiation, as compared to baseline side-viewing geometry at q ~ 100°. FS functions for fluffy comet grains can be derived from extensive theoretical and experimental modeling in the literature. These studies show that below q = 30°, the brightness over baseline increases nearly exponentially – to about 30-fold at q = 20° and up to an astonishing 300-fold or more as q approaches 0°. Despite its dramatic impact, the FS function is still not widely recognized in the cometary astronomy community. Yet it goes far to explain unusual and anomalous brightness observations in the historical record, particularly naked-eye daylight sightings of comets – for example, of C/1861 J1 (q = 25°), C/1910 A1 (27° £ q £ 40°), C/1927 X1 (8° £ q £ 48°) and 1 P/Halley in 1222 (q = 44°) and 1910 (q = 1.5°). C/1861 J1 became so bright as to cast shadows at 26° £ q £ 28° while in deep twilight. The daylight visibilities of the major Kreutz sungrazers owe in large measure to the r^{-4} brightness dependence at very small heliocentric distances, but forward scattering also plays a significant role. I applied an FS function to successfully predict that C/2004 F4 (Bradfield) would flare to magnitude -2.5 to -3 when it reached q_{min} = 16° on Apr. 18 UT in the SOHO LASCO C3 coronagraph field. Likewise, 96 P/Machholz flared in SOHO centered on 2002 Jan. 8 when q_{min} = 13°. The first infrared observation of a comet was not of C/1965 S1 (Ikeya-Seki), as is commonly thought, but rather the great daylight C/1927 X1 (Skjellerup-Maristany), by Carl Lampland at Lowell Observatory. I have reduced his unpublished radiometry data in the Lowell archives and find a 14-fold enhancement of R(q) at q = 30° on Dec. 16.9 UT as compared to R(q) at q = 89° on Dec. 19.9 UT. The forward-scattered continuum spectrum was so powerful on Dec. 16 that it temporarily overwhelmed the sodium emission lines, which otherwise were visible on Dec. 17-19 as the comet exited forward-scatter geometry.*

It is very noticeable in foggy conditions that when looking towards the Sun you can get 100 fold increase in brightness. The geometry for forward scattering is the comet between the Earth and Sun. Many things influence scatter – the composition of the dust, its size make up (ie core/mantle), shape, packing etc. The Greenberg model has a long silicaceous core, a refractory organic mantle and ultrafine small carbonaceous flecks, which correspond to the CHON particles detected by the Halley spacecraft. Polarisation also changes with scattering angle. Modelling of both a theoretical and Greenberg model has been carried out. Comets have many different grains and are different to each other. Gas may attenuate the 5^m – 6^m forward scatter enhancement seen at extreme scatter angles near 0° by up to 3^m. The first recent demonstration of the effect was in comet West.

Comet Tebbutt 1861 J1 was bright enough to cast shadows when only 8° up on the evening of June 30. The light curve suggests that it should have been around – 1. when actually it was about –7. 1927 X1 was observed at 1.6° from the Sun's edge with a scattering angle of 7.8°. It was also spotted in daylight from India and Flagstaff. It was about 5^m brighter than the best curve at small angle. Some infra red observations of the same comet follow a similar trend to West and Bradfield. Halley was observed in daylight in Hobart in 1910. The Kreutz comet Howard-Koomen-Michels 1979 Q1 in front of the Sun on the basis of scattering. 1882 R1 was followed to the disc of the Sun. SOHO comets show a seasonal effect because of the scattering angle, and most recently 2004 F4 showed the same effect as it passed through C3.

Sebastian Hoenig asked: - 2003 T12 was 8^m – if due to scattering, how much dust? It could only be seen if dust enhanced it.

Philippe Morel (France), "Automated magnitude codification with a microcomputer". *The magnitude estimation of comets is easy to do but ICQ codification is not. The goal of this EXCEL calculation page is to help with formatting observations to the ICQ and IAUC web page standards. Thanks to links to specialized pages, it is possible to record all of the items requested. Once all fields have been filed , the calculation page provides two chains of characters, one coded for the ICQ, the other for IAUC web page.*

Most observers estimate the standard parameters, eg magnitude, coma diameter, DC. Problems start with coding, as each character must be in the right position. The coding is done with an Excel spreadsheet and currently gives the ICQ and IAUC formats. It will remember standard details about each observer. He also has another tool to plan observations, similar to Richard Fleet's GraphDark. Dan Green commented that the ICQ CCD format looks daunting, but actually mostly stays the same for each observer. Dan will put links on the ICQ web page. Observers were reminded to check the printed version of the ICQ to make sure that their observations were published correctly.

Michal Drahus and Waclaw Waniak (Poland) – "Research on the rotation of cometary nuclei". *We present our vision of a global network dedicated for precise continuous CCD photometry of comets. Its goal would be to determine the rotation period of comets, based on periodical changes in their light curves. Moreover, long-term results from such a 'global telescope' would demonstrate any significant angular acceleration of cometary nuclei. It was suggested that studies of the spinning-up process may be a key to solve the phenomenon of comet splits, as rotational break-up is known to be one possible mechanism. Nowadays, the amount of observational data is very scarce, compared to publications based on a theoretical approach.*

Two years ago we started an observation program of distant comets (beyond 5 AU): C/2001 K5 (LINEAR) and C/2002 T7 (LINEAR). We use a 0.5-m (f/12) Cassegrain telescope with a Photometrix CCD and an *autoguider system with a non-sidereal tracking option. After careful reduction of data, we have been able to keep the photometric error below 0.03 magnitude for comets of about 16 mag in R. Our research showed that precision needed for rotational studies can be reached even by well equipped amateurs. However, such research is extremely difficult for a single observatory, due to incompleteness of the light-curves.*

Therefore, our goal is to establish a world-wide network of advanced amateurs and semi-professional observers. The idea comes from the Whole Earth Telescope (WET), which provided us with splendid results that have broadened our knowledge about pulsating stars.

In 1846 astronomers observed the fragmentation of comet Biela; of some 45 others most cannot be explained. Rotational fragmentation of an elongated body is one possibility. The period may change significantly on the way in to or out of perihelion. Most observed periods lie between 6 hours and 100 hours (Halley). They would like to collaborate with other groups.

Cracow observatory is about 10 km out of town, and has a 500mm cassegrain. A stacked image of 2001 K5 put it at 16^m on 2003 June 28. They used a standard reduction. There was some evidence for variable brightness and a frequency analysis suggested a period of 20.54 hours, with an amplitude of 0.1^m. They would like other observers to join in so as to gain better longitude coverage. The work needs a 0.5m or larger telescope and filters.

Posters sessions.

Takaaki Oribe (Japan) – *Saji Observatory is main attraction at Saji Astro Park. The park is one of the greatest public observatories for the people in Japan. Saji's 3,200* [yes, that is 3,200] *residents constructed their observatory at Saji village in 1994. There is a 1.03-m reflecting telescope and a planetarium. We have observed minor bodies in the solar system since 1995. I report major results of observation in Saji Observatory until now.*

Francois Launay (France) – Photos of 1881 K1 taken by Jules Janssen at Meudon. One of the earliest photos of a full comet and tail.

Bernd Brinkman (Germany) – stunning pictures of 2001 Q4 and 2002 T7 taken from Namibia.

Pat Stonehouse (USA) – Drawings and images suggesting comet depictions from cave drawings to the future robotic observer.

Table. Comets that are targets of space missions

Comet	*Space Mission*
1P/Halley	*ICE, Vega-1, Vega-2, Sakigake, Susei, Giotto*
21P/Giacobini-Zinner	*ICE*
26P/Grigg-Skjellerup	*Giotto*
19P/Borrelly	*Deep Space 1*
2P/Encke	*CONTOUR*
73P/Schwassmann-Wachmann	*CONTOUR*
81P/Wild	*Stardust*
46P/Wirtanen	*Rosetta*
67P/Churyumov-Gerasimenko	*Rosetta*
9P/Tempel	*Deep Impact*

Jana Ticha (Czech republic) – The KLENOT project, with details of the instrumentation, software and results. *The KLENOT project is a project of the Klet Observatory, Czech Republic, devoted to astrometric observations of Near Earth objects, distant objects and comets.The improved effort of the large NEO surveys resulting in an increasing number of newly discovered NEOs calls for continuous follow-up astrometry to secure an accurate orbit determination of discovered bodies first in discovery opposition and then during next apparitions. Considering this urgent need of astrometric follow-up, the fact that many of these targets are fainter than magnitude 20.0V and our results and experience in minor planet and comet CCD astrometry done at Klet using 0.57-m reflector since 1993, we decided to bring into operation a new 1-m class facility working on a permanent basis - the KLENOT telescope. The regular observing of the telescope started in March 2002 (the MPC code 246). Results of two years of KLENOT Project contain hundreds of confirmation of newly discovered NEOs, dozens of Virtual Impactors (V.I.) astrometry, two NEO discoveries (Apollo 2002 LK and Aten 2003 UT55), over ten comet confirmations, and comet recoveries (C/2002 A1 and C/2002 A2).*

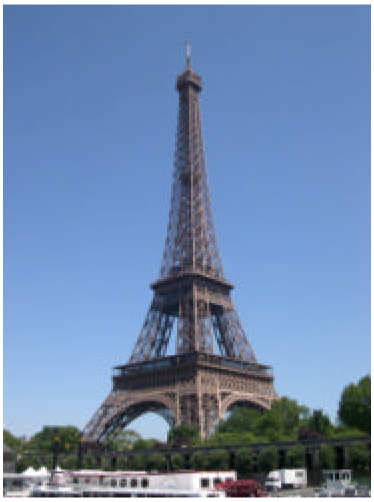
Vitaly S. Filonenko (Ukraine) (who was unable to be present and didn't actually submit his posters) "Light Curves and Photometrical Peculiarities of Comets - the Targets of Past and Future Space Missions".

The light curves of ten periodic comets - the targets of space missions (Table) were constructed on basis of the visual estimations of cometary integral brightness. The next results of our investigations of these light curves are presented:
1) adjusted values of cometary photometrical parameters Hy and n, theirs changes and evolution;
2) outburst activity and its evolution;
3) phase dependencies of comets obtained from theirs light curves and values of cometary phase coefficients;
4) influence of solar activity on the cometary brightness and outbursts.
The comparative analysis of photometrical peculiarities of these comets is presented.

Vitaly S. Filonenko (Ukraine), "Some Results of Investigations of Cometary Light Curves and Outburst Activity".

The main results of our long-term investigations of light curves, photometrical peculiarities and physical characteristics of comets are presented. We have obtained the next new results.
1) A new peculiarity of the cometary light curves was found.

It is the sudden changes of photometric parameter n and absolute magnitude Hy on the same heliocentric distances before and after perihelion of cometary orbits.
2) The influence of phase dependence of cometary brightness on the visual light curves of comets has been discovered for the first time. The phase coefficients of some comets have been determined.
3) A new phenomenon in the outburst activity of comets has been discovered: the brightness outbursts occurred on the same heliocentric distances during different appearances of periodic comets. It is a new observational criterion for development of mechanism of cometary brightness outburst activity.
4) A catalogue of more than 500 real brightness outbursts of comets observed during 1927-2002 has been compiled.
5) A new numerical index of cometary brightness outburst activity characterizing a power of non-stationary flash processes in comets has been proposed.
6) A mean period of brightness outburst activity of comets has been determined. The value of this period is T = 6.8d+-0.6d. Since 4T = 27d, which conforms to the mean rotation period of the Sun, this is a new argument of influence of solar activity upon the cometary integral brightness.



Concluding remarks etc

Dan Green would like to see amateurs getting involved with spectroscopy and spectrophotometry. Stick to critical comets for astrometry – short period comets close to the Sun and in the Southern Hemisphere. Other CCD observers could move to photometry. Mike A'Hearn noted that the question of precision depends on the problem – light curves need a few 100ths, the r variation 1/10 to resolve structure.

Dan noted that the emphasis of the talks was very different compared to 1999, particularly with reference to CCD work. He appreciated the use of web discussion groups. He encouraged contributors to write up their presentations as papers for the ICQ. Please comet to Japan next time.

Nicolas Biver, the driving force behind the local organisation was glad that there had been no PowerPoint hang-ups! He thanked the SOC and the Paris and Meudon Observatories. I would like to thank him in particular for all the hard work put in to make this an excellent meeting.

Professional Tales

Many of the scientific magazines have articles about comets in them and this regular feature is intended to help you find the ones you've missed. If you find others let me know and I'll put them in the next issue so that everyone can look them up.

Fragmentation Hierarchy of Bright Sungrazing Comets and the Birth and Orbital Evolution of the Kreutz System. I. Two-Superfragment Model Zdenek Sekanina and Paul W. Chodas, *Jet Propulsion Laboratory.*

A back-and-forth orbit integration technique, developed for our previous investigation of the splitting of the parent of the sungrazers C/1882 R1 and C/1965 S1, is now applied in an effort to understand the history and orbital evolution of the Kreutz sungrazer system, starting with the birth of two subgroups, which show prominently among the bright members and whose inception dates back to the progenitor's breakup into two superfragments. The integration technique is used to reproduce the motion of comet C/1843 D1 - the second brightest sungrazer known and presumably the most massive surviving piece of superfragment I - from the motion of C/1882 R1 - the brightest sungrazer on record and arguably the most massive surviving piece of superfragment II. Running the orbit of C/1882 R1 back to A.D. 326, the progenitor comet is found to have split at a heliocentric distance of 50 AU and nearly 30 yr before perihelion. The superfragments acquired separation velocities of ~8 m s-1 in opposite directions. Using the same technique, we show next that (1) the motions of two additional sungrazers, C/1880 C1 and C/1887 B1, are matched extremely well if these objects shared a common parent with C/1843 D1, and (2) C/1963 R1 (Pereyra), the second brightest subgroup I member on record, is more closely related to subgroup II objects (such as C/1882 R1 and C/1965 S1) than to C/1843 D1. This finding raises serious doubts about the major role of the subgroups in the system's orbital history and offers an incentive for considering an alternative dynamical scenario. The fragmentation models for C/1963 R1 and two additional bright sungrazers, C/1945 X1 and C/1970 K1, suggest that (1) these comets may have been the most massive pieces of the fragment populations formed from their respective disintegrating parents, and (2) the course of evolution of the Kreutz system at the upper end of the mass spectrum may be better ascertained from the distribution of the sungrazers' arrival times than from the sources of subgroups. If so, the fragment hierarchy should be determined primarily by the cascading nature of the fragmentation process, which was recently shown by Sekanina to control the evolution of minor fragments as well. The sungrazer system's estimated age is in any case very short, less than 1700 yr.

Are Comets 42P/Neujmin and 53P/Van Biesbroeck parts of one Comet? J. Pittichova, K. J. Meech, G. B. Valsecchi and E. M. Pittich, American Astronomical Society DPS meeting

We want to present preliminary results of the observations of the physical parameters of comets

42P/Neujmin and 53P/Van Biesbroeck: brightness, nucleus activity, rotation period, light-curve and color changes from our first three optical observing runs (March, and May 2003) at Mauna Kea, using UH 2.2m telescope and Tek2048 CCD camera. Comets 42P/Neujmin and 53P/Van Biesbroeck have very well determined orbits, and their orbital histories are very interesting. Their current orbits are not very similar to each other; however, numerical integrations have shown that both comets had a rather close approach to Jupiter in January 1850, and that, before 1850, the two orbits were nearly identical. Given the extremely low probability of a chance coincidence of the six orbital elements at a given time, the natural conclusion is that the two objects are fragments of a single comet that split sometime in the late 1849 or early 1850.

Among the known cases of split periodic comets, this one is peculiar for a number of reasons: 1. the splitting was probably not due to tidal stresses, since the 1850 encounter with Jupiter took place well outside the Roche lobe; 2. it is the only case discovered through a dynamical study; 3. in the only other case of splitting of a Jupiter family comet, that of 3D/Biela, the fragments did not survive for more than a couple of revolutions, whereas in the present case both fragments have passed perihelion more than ten times since the splitting.

If these two comets are fragments of a single parent body, then they should show a certain degree of physical and chemical similarity, which we would like to obtain from spectroscopic observation in 2004, when both comets are close to their perihelion.

Spitzer Observations of the Dust Coma and Nucleus of 29P/Schwassmann-Wachmann. J. A. Stansberry et al. *AJ supplement, Spitzer special issue.*

We obtained thermal images and spectra of comet and Centaur object 29P/Schwassmann-Wachmann in late November, 2003. Images at 8, 24 and 70 µm reveal an extensive coma. At 24 µm the coma extends at least 8 arcmin from the nucleus, and exhibits a single jet. The dust production rate is estimated as < 50 kg/s. The 24 to 70 µm colour temperature of the coma is 160K. The debris trail is also detected at 24 µm, and has an optical depth ~7±3x10^{-9}. Thermal models fitted to photometry at 8, 24 and 70 µm indicate a nuclear radius of 27±5 km, larger than all previous size estimates, and a geometric albedo of 0.025±0.01, lower than any other Centaur object, but consistent with other comets. Analysis of the jet morphology indicates a rotation period in excess of 60 days. The spectra reveal features at 11.3 and 34 µm which are tentatively identified as emission from olivine, including forsterite. This is the first identification of the mineralogy of the dust emitted by a Centaur object.

Springer Competition Runner-Up

Thanks to the generosity of Springer-Verlag the comet Section was able to run a competition in spring 2003, with prizes being copies of the new book on *Observing Comets* by Nick James and Gerald North. The winning entries and first runners up have already appeared in the *The Comet's Tale* and this time we feature the final runner up. A review of the book, by Guy Hurst, appeared in the August 2003 Journal and one by John Bortle appeared in the September 2003 issue of Sky and Telescope. The book is a valuable addition to the observers' library and I can strongly recommend it.

Comet 1995 O1 (Hale-Bopp) on 1997 March 12 drawn by Sidney Hurring

THE CAMBRIDGE-CONFERENCE NETWORK (CCNet)

The following abstracts are taken from the CCNet, which is a scholarly electronic network devoted to catastrophism, but which includes much information on comets. To subscribe, contact the moderator Benny J Peiser at <b.j.peiser@livjm.ac.uk>. The electronic archive of the CCNet can be found at http://abob.libs.uga.edu/bobk/cccmenu.html

What is a comet made of? Space Daily, 10 August 2004

A new method for looking at the composition of comets using ground-based telescopes has been developed by chemists at UC Davis. Remnants from the formation of our solar system, the makeup of comets gives clues about how the Earth and other planets formed. William Jackson, professor and chair of chemistry at UC Davis; researchers Alexandra Scodinu and Dadong Xu; and Anita Cochran of the University of Texas at Austin have developed methods to use visible and ultraviolet spectroscopy to study the chemical composition of comets.

Spectroscopy, a powerful technique in chemistry, splits light into a spectrum of colour. Chemicals show a distinct pattern of peaks or lines in a spectrum. But the emission spectrum of comets in the visible and ultraviolet bands is full of thousands of lines, making it difficult to identify any one component.

The researchers took one suspected chemical, carbon disulfide, and used spectra measured in the laboratory under conditions similar to those in a comet. They compared this spectrum with that from comet 122P/De Vico to identify carbon disulfide in the comet. The spectrum of this molecule is such that it could not have been detected by other methods.

The technique makes it possible to look at the chemical composition of comets on their first visit to the inner solar system, which are difficult to reach with space probes and may have a different composition than comets that have been close to the sun many times, Jackson said.

Detection of organic compounds such as benzene would show that these and more complex chemicals were present in the early solar system and could have contributed to the origins of life, he said.

The research is published in the June issue of the Astrophysical Journal.

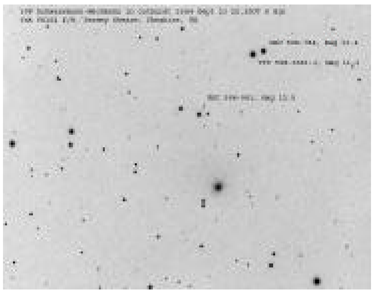
Extreme albedo comets and the impact hazard. W. M. Napier (Armagh Observatory), J. T. Wickramasinghe and N. C. Wickramasinghe (Cardiff). *Monthly Notices of the Royal Astronomical Society (2004)*

Dynamical balance arguments which involve the capture of long-period comets from the Oort cloud imply that there should be >1000 times more Halley-type objects than are actually observed. If the active comets rapidly become dormant, with albedos comparable to those of known cometary surfaces, hundreds of such bodies should by now have been detected, whereas in fact only a few have been found. If on the other hand they disintegrate to dust, we show here that the debris would create a bright, near-spherical zodiacal cloud and >15-30 strong annual meteor showers, also contrary to the observations. Here we demonstrate that the surfaces of inactive comets, if composed of loose, fluffy organic material like cometary meteoroids, develop reflectivities that are vanishingly small in visible light. The near-Earth objects may therefore be dominated by a population of fast, multi-kilometre bodies too dark to be seen with current NEO surveys. Deflection strategies that assume decades or centuries of warning before impact are inapplicable to this hazard.

Review of comet observations for 2004 April - 2004 October

The information in this report is a synopsis of material gleaned from IAU circulars 8304 – 8419, The Astronomer (2004 May – 2004 September) and the Internet. 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.

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 12m. It is possible that its pattern of behaviour is changing. In early 1996 it was in outburst for several months. In the first half of 1998 it was in outburst on several occasions and this also occurred in 1999. The randomly spaced outbursts may be due to a thermal heat wave propagating into the nucleus and triggering sublimation of CO inside the comet. **This comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity.**



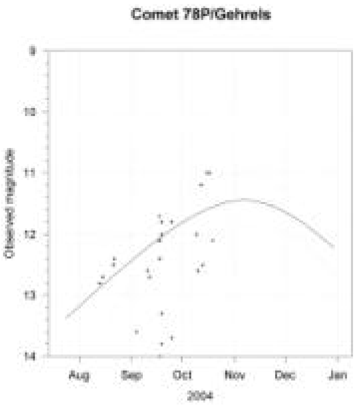
It begins the year in Aquarius, but spends most of the year in Pisces, reaching opposition at the end of September. The comet is an ideal target for those equipped with CCDs and it should be observed at every opportunity. UK based observers should be able to follow it throughout the second half of the year.

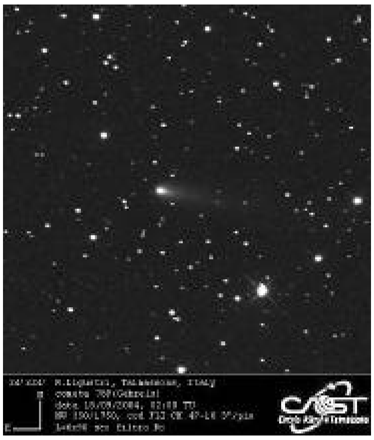
The comet was reported in outburst in July. A second outburst was reported in mid August. Another outburst began in mid September and I estimated it at 12.1 and DC6 in the N'land refractor x185 on September 18.96

78P/Gehrels Tom Gehrels discovered this comet at Palomar in 1973. Its perihelion distance is slowly decreasing and is currently around the lowest for 200 years. The eccentricity is slowly increasing, with a marked jump in both following a moderately close approach to Jupiter in 1995. This return is extremely favourable, with the comet reaching opposition and perihelion within a fortnight of each other. At the last return the comet reached 12th magnitude and it should do at least a magnitude better this time round. It should become within visual range of favourably placed observers by late spring, but UK observers will probably need to wait until July when it should be a 12th magnitude object in the morning sky. It continues to brighten on its way to opposition and by October should be at 10th magnitude. It spends most of the apparition in Aries, where it completes its retrograde loop in mid December, by which time it is fading towards 11th magnitude. By 2005 it is well past its best, and it will be fading from 11th magnitude, getting too faint and low in the evening twilight in 2005 April. It begins 2005 in Aries, but spends most of this period in Taurus.

Juan José González reported the comet at mag 12.8 in his 20cm LX200 on August 13.14, with a small well-condensed coma. I observed it at 13.3 in the N'land refractor x185 on September 18.98. By mid October it was an easy object in the large refractor.

The 2004 observations are insufficient to fit both parameters, but suggest 5.0 + 5 log d + [20] log r





88P/Howell Ellen Howell discovered the comet in 1981 with the 0.46-m Palomar Schmidt. It passed 0.6 AU from Jupiter in 1978, which reduced the perihelion distance, but the biggest change to its orbit occurred in 1585 when an encounter reduced q from 4.7 to 2.4 AU. The standard light curve was not a good fit to the observations at the last return and a better fit was obtained using a linear light curve that peaked 28 days after perihelion, thus confirming the view that the comet is brighter after perihelion.

2001 Q4 (NEAT) A. Lecacheux, N. Biver, J. Crovisier, and D. Bockelee-Morvan, Observatoire de Paris, on behalf of the Odin Team, write: "The H_2O 110-101 line at 556.936 GHz was observed in comet C/2001 Q4 on Mar. 6.6 UT with high spectral resolution (80 m/s). The line integrated intensity (main beam brightness temperature) was 2.7 +/- 0.1 K km/s over the 2-hr observation. This corresponds to a preliminary water-production rate of 1.3 x 10**29 molecules/s, taking into account opacity effects." [IAUC 8304, 2004 March 15]

C. E. Woodward, University of Minnesota; D. H. Wooden, NASA Ames Research Center; and D. E. Harker, University of San Diego, report 8-13-micron spectrophotometry of this comet on May 11.2 UT using the NASA Ames HIFOGS spectrometer at the Infrared Telescope Facility 3-m reflector: "Silicate-feature emission was observed with a flux-to-continuum ratio of 1.6, including emission from crystalline silicates at 9.3, 10.0, and 11.2 microns. The 10- micron peak flux was 1.6 x 10**-16 W cm**-2 micron**-1, and the observed N-band magnitude was -0.22 +/- 0.07. A blackbody fit to the local continuum yields a color temperature of 310 +/- 4 K." [IAUC 8339, 2004 May 13]

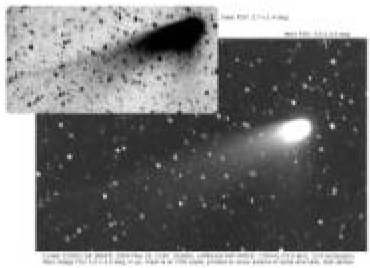
2001 Q4 imaged by Bill Ward on May 9 using the AAT as a guide scope.

J. L. Wilde and M. L. Sitko, University of Cincinnati; and D. L. Kim and R. W. Russell, The Aerospace Corporation, report 3-13- micron spectrophotometry of comet C/2001 Q4 obtained on May 14.1 UT with the Mt. Lemmon 1.5-m University of Minnesota telescope (+ Aerospace Broadband Array Spectrograph System; 8".5 aperture; 51" chop throw; integration times 20 min on the comet and 10 min on the reference star, beta Gem): "A smooth comet continuum was seen to rise from 3 to 5 microns and from 7.1 to 8.4 microns, a little above the blackbody (about 310 +/- 5 K) that was fit to the continuum points on either side of the strong, structured silicate feature seen from 8.4 to 12 microns. This temperature is consistent with the temperature reported by Woodward et al. (IAUC 8339) but is dependent upon assumptions of where the silicate grain emissivity becomes much less than the emissivity of the (assumed) gray-body grains that emit the underlying continuum. The grain temperature is about 9 percent higher than that of an equilibrium blackbody at the heliocentric distance of the comet. The continuum was fairly flat beyond 12 microns. The rising flux above the blackbody from 7 microns towards 3 microns may be due to scattered sunlight, thermal emission from grains with a mix of temperatures and optical properties, or both. Structure is seen in the silicate feature, but at slightly different wavelengths from those reported by Woodward et al. Here, emission peaks are seen at 10.5 and 11.2 microns, with no feature at 9.3 microns. The silicate-feature-to- continuum ratio was about 1.65, also consistent with the report by Woodward et al. With our aperture, the comet has narrowband (about 0.25 micron) magnitudes and combined random errors (due to calibration star and comet) of [3.5 microns] = 5.44 +/- 0.09, [4.5 microns] = 3.44 +/- 0.03, [5 microns] = 2.96 +/- 0.03, [8 microns] = -0.10 +/- 0.01, [10.5 microns] = -1.65 +/- 0.01, and [12 microns] = -1.72 +/- 0.03. The combined comet-and-calibration-star systematic intensity uncertainty is estimated at about 5 percent. The ratio of this brightness to that of Woodward et al. is consistent with a roughly linear dependence on aperture, or a 1/R radial grain-density dependence from the comet nucleus." [IAUC 8342, 2004 May 19]

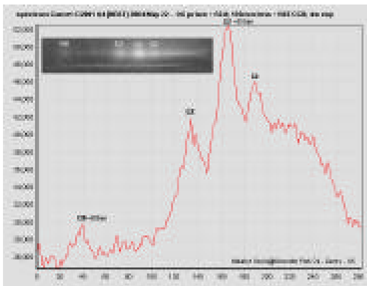
J. Lecacheux, LESIA, Meudon Observatory; and E. Frappa, St-Etienne Planetarium, write: "We have observed the concentric dust shells of comet C/2001 Q4 with the Pic-du-Midi 1.05-m reflector during six 3-hr sessions from May 14 to 19, around the time of perihelion. Direct measurement of the radial expansion on consecutive exposures yields 163 +/- 20 m/s. From the measured 12000-km shell interval, a first approximation of P = 20.5 +/- 3 hr can be inferred for the period of nucleus rotation, suggesting the exclusion of any value shorter than 17-18 hr. Then by blinking images of the inner shell taken at 1-day or several-day interval(s), and assuming constant expansion velocity, we obtain a refined probable period P = 23.2 +/- 0.25 hr. We also followed a small dust jet rotating counterclockwise (facing the sun) on May 14; its estimated angular motion of about 16 deg/hr agreed with the above period. Fibrous-like features, not more 300 km wide, appear within the brightest shell at 10000-15000 km from the nucleus; they show a pure radial expansion and no other morphology change in 3 hr, and they recur in the following shell 0.9 day later. In fact, we observe a complex of 3 or or 4 muddled components (sub-shells), issued from so many active regions and with slightly different expansion rates." [IAUC 8349, 2004 May 31]

S. M. Brafford, University of Dayton; M. L. Sitko, University of Cincinnati; and R. W. Russell and D. L. Kim, The Aerospace Corporation, report 3-13-micron spectrophotometry of comet C/2001 Q4, obtained on May 31.2 UT with the Mt. Lemmon 1.5-m University of Minnesota telescope (+ Aerospace Broadband Array Spectrograph System; 8".5 aperture; 49" chop throw; integration times 10 min on the comet and 20 min on the reference star, alpha Lyr): "A smooth comet continuum was seen to rise from 3.5 to 8.4 microns, beyond which a strong silicate emission band was observed. An underlying blackbody continuum with a temperature of about 345 +/- 10 K was fit to the continuum flux at 5, 8.4, and 12 microns. This grain temperature is about 24 percent higher than that of an equilibrium blackbody at the heliocentric distance of the comet, and higher than that observed on May 14.1 (IAUC 8342) using the same instrument and telescope when the comet was closer to the sun. Structure is seen in the silicate feature, including emission peaks at 10.5 and 11.2 microns. The silicate-feature-to-continuum ratio was about 1.43 +/- 0.04, lower than that reported on May 14.2. No scattered solar flux was detected at the shorter wavelengths after subtracting the thermal continuum. With our aperture, the comet has the following narrowband (about 0.25 micron) magnitudes and combined random errors (due to calibration star and comet, as well as variations due to the presence of real spectral structure): [3.7 microns] = 6.8 +/- 0.3, [4.7 microns] = 4.60 +/- 0.11, [5 microns] = 4.27 +/- 0.06, [8 microns] = 1.71 +/- 0.06, [10.5 microns] = -0.54 +/- 0.02, and [12 microns] = -0.49 +/- 0.03 (the stated errors are standard deviations of the mean)." [IAUC 8351, 2004 June 11]

Further to IAUC 8351, W. J. Carpenter (University of Cincinnati), M. L. Sitko, R. W. Russell, and D. L. Kim report additional 3-13-micron spectrophotometry of C/2001 Q4, obtained on June 17.2 UT at Mt. Lemmon (integration time 45 min; reference star alpha Boo): "A smooth comet continuum was seen to rise from 3.5 to 8.4 microns, beyond which a moderate silicate emission band was observed. An underlying blackbody continuum with a temperature of about 305 +/- 5 K was fit to the continuum flux at 5, 8.4, and 12 microns. This grain temperature is about 16 +/- 2 percent higher than that of an equilibrium blackbody at the heliocentric distance of the comet. The silicate-feature-to-continuum ratio was about 1.26 +/- 0.02 -- lower than the values of 1.65 reported on May 14.2 (IAUC 8342) and 1.43 reported for May 31.2 (IAUC 8351). During the period of observation, the strength of the silicate feature above the continuum was unchanged. The crystalline olivine feature at 11.2 microns continues to be present with approximately the same contrast as orginally seen. With our aperture, the comet has the following narrowband (about 0.25 micron) magnitudes and combined random errors: [3.7 microns] = 7.75 +0.45/-0.33, [4.7 microns] = 5.68 +0.20/-0.17, [5 microns] = 5.61 +0.23/-0.18, [8 microns] = 1.96 +/- 0.10, [10.5 microns] = 0.43 +/- 0.03, [12 microns] = 0.15 +/- 0.02." [IAUC 8358, 2004 June 18]

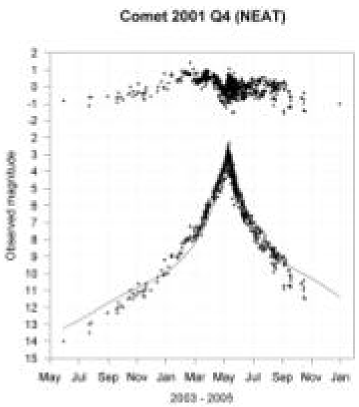


Brian Marsden notes on MPEC 2004-K64 [2004 May 29] that The "original" and "future" barycentric values of 1/a are +0.000042 and -0.000703 (+/- 0.000001) AU^-1, respectively. He further notes on MPEC 2004-L37 [2004 June 12] that Non-gravitational parameters A1 = +1.49 +/- 0.03, A2 = -0.2965 +/- 0.0282 from 1106 observations . The "original" value of 1/a suggests that this is a new visitor from the Oort cloud. Michael Mattiazzo gives the date of the orbital plane crossings as 2004 October 23.



I observed the comet from the UK on May 10.8 and found it somewhat disappointing under rather hazy skies. In 20x80B it was 4.0, with a 15' DC5 coma and hints of a 0.8 degree long tail. Between May 16 and 23 I was staying at Hohenpeissenberg in the Bavarian alps and was able to observe the comet on several occasions. My first observation on May 16.8 put it at 3.5 in 10x25 binoculars, with a 2.7 degree long tail. By May 20.8 it had faded to 4.4, with a 1.5 degree long tail. It continues to fade very slowly, and by June 12.9 was 6.1, though still with a faint 0.5 degree tail. By mid August it had faded to 8.5, but was still an easy binocular object. By mid September it required a telescope, and I estimated it at 10.2 on September 18.92 in a 30cm reflector, however other observers were estimating it a little fainter.

910 observations give a preliminary uncorrected light curve of 5.7 + 5 log d + 5.8 log r

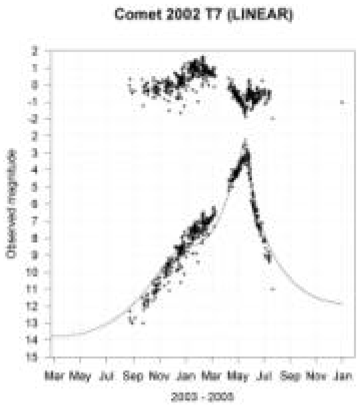


2002 T7 (LINEAR) E. S. Howell, Arecibo Observatory, reports that observations of the 18-cm OH lines in this comet, made with A. J. Lovell and F. P. Schloerb at Arecibo Observatory, result in the following production rates: Apr. 10.63 UT, log Q(OH) = 29.4; 15.60, 29.3; 16.59, 29.4; 17.59, 29.5 (uncertainties of order 10**28 mol/s). Line shapes are consistent with parent outflow velocities ranging from 1.7 to 2.0 km/s. Spectra obtained on Apr. 14-15 reveal an excess of 10-20 percent around cometocentric velocities of +3 km/s. [IAUC 8329, 2004 April 23]

Z. Sekanina, Jet Propulsion Laboratory, writes: "The sudden appearance of a prominent antitail is the result of unusual coincidences. Due to projection effects the antitail could not develop before the end of March 2004, at which time the comet was too close to the sun to be observed from the ground (and not close enough to show up in the SOHO's C3 coronagraphic images). From the orientation in the available images of Apr. 17-20, the dust contained in the antitail is found to have been ejected most probably between discovery (mid-October 2002) and about 300 days before perihelion (the end of June 2003). Because the comet was not brightening dramatically between discovery (except perhaps in the first post-discovery days) and the 2003 conjunction with the sun, it is likely that the material in the antitail dates back to a fairly sudden onset of persistent dust production at or shortly before discovery (i.e., the comet was detected because it 'turned on' at about that time), or the comet's dust-emission activity picked up rapidly in mid-2003, when it was behind the sun. The steeper light curve beginning in August 2003 can support this scenario. In either case, there was no antitail around 2003 Dec. 27 and none is expected to appear around 2004 June 26, the times of the earth's transit across the comet's orbital plane. In the intervening period of time, the position angle of the antitail and the angle it subtends with the prolonged radius vector (i.e., approximately with the plasma tail) are predicted to vary as follows (the first number in each interval refers to an onset time in late June 2003, the second to onset in mid-October 2002): Apr. 15, p.a. 42-45 deg, angle with respect to the radius vector 142-145 deg; 20, 32-37 deg, 137-142 deg; 25, 16-24 deg, 125-133 deg; May 5, 323-334 deg, 80-91 deg; 15, 291-295 deg, 82-86 deg; 20, 274-278 deg, 120-124 deg; 25, 255-262 deg, 130-137 deg; 30, 236-251 deg, 117-132 deg; June 4, 197-232 deg, 80-115 deg; 9, 154-186 deg, 37-69 deg. The angular deviation from the radius vector dropping below 90 deg implies the antitail's disappearance. There are two maxima in this angle, one on Apr. 13, the second on May 21. Unless the dust production terminated early, more recent ejecta fill the entire sector between the antitail and the plasma tail. The visibility of this sector is affected by projection geometry and, to a degree, is anticorrelated with the antitail's prominence. Also, in long- exposure images, which show the antitail to extend further out, its slight curvature may be noticed toward greater position angles (counterclockwise) farther from the comet, although this effect may be concealed by decreasing brightness." [IAUC 8330, 2004 April 23]

Another of Bill Ward's AAT guided images – this one of 2002 T7 taken on May 21.

M. L. Sitko, University of Cincinnati; R. W. Russell and D. L. Kim, Aerospace Corporation; and S. M. Brafford, University of Dayton, report 3-13-micron spectrophotometry of comet C/2002 T7, obtained on May 31.1 UT with the 1.5-m University of Minnesota telescope (+ Aerospace Broadband Array Spectrograph System; 8".5 aperture; 49" chop throw; integration times 10 min on the comet and 20 min on the reference star, beta Gem) at Mt. Lemmon: "A virtually featureless comet continuum was seen to rise from 3.5 to 13 microns, with only a very weak possible silicate emission band superimposed. A blackbody with a temperature of about 300 +/- 10 K was fit to the underlying continuum flux at 5, 8.4, and 12 microns. This grain temperature is about 9 +/- 4 percent higher than that of an equilibrium blackbody at the heliocentric distance of the comet. The silicate-feature-to-continuum ratio, based on the underlying continuum fit, was about 1.03 +/- 0.02. With our aperture, the comet has the following narrowband (about 0.25 micron) magnitudes and combined random errors (due to calibration star and comet, as well as variations due to the presence of real spectral structure): [3.7 microns] = 7.63 +0.44/-0.31, [4.7 microns] = 5.58 +/- 0.09, [5 microns] = 4.79 +0.49/-0.33, [8 microns] = 1.43 +/- 0.16, [10.5 microns] = 0.06 +/- 0.32, and [12 microns] = -0.39 +/- 0.02 (the stated errors are standard deviations of the mean)." [IAUC 8355, 2004 June 16]



Brian Marsden notes on MPEC 2004-K65 [2004 May 29] that The "original" and "future" barycentric values of 1/a from the above orbit are -0.000058 and -0.000697 (+/- 0.000002) AU^-1, respectively. A gravitational solution from the full observed arc is not satisfactory, even when the recent observations are strongly weighted relative to the earlier observations. A nongravitational solution is also not entirely satisfactory. He further notes on MPEC 2004-L38 [2004 June 12] that Non-gravitational parameters A1 = -0.19 +/- 0.02, A2 = +0.3826 +/- 0.0062 from 3825 observations . The "original" value suggests that this is a "new" comet from the Oort cloud. Michael Mattiazzo gives the orbital plane crossing as 2004 December 25.

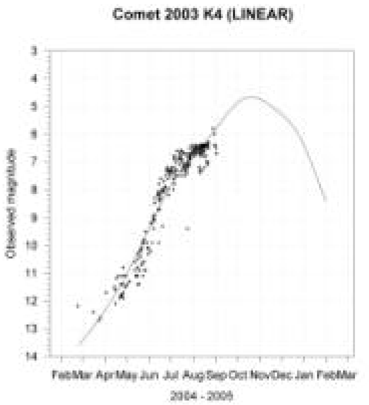
Alexandre Amorim recovered the comet after solar conjunction on April 9.36, estimating it at around 4.6. The comet reached perihelion on 2004 April 23 at 0.61 AU. It reached a peak of around 3rd magnitude in the first half of May. It has faded relatively quickly and by early August was around 11th magnitude.

588 observations give a preliminary corrected light curve of 5.2 + 5 log d + 5.4 log r

2003 K4 (LINEAR) Initially it only brightened slowly and reached 10th magnitude at the end of May. During June it brightened quite rapidly and reached 8th magnitude mid month and was approaching 7th magnitude by the end of the month. It passed its most northerly declination and then headed south. On July 15 Juan José González observing from Leon in Spain reported glimpsing the comet with the naked eye. During the rest of July and up to mid August there was little change in brightness, with the comet remaining at around 6.5. As it got lower in northern skies it become harder to observe, however I managed to make a final observation of it on September 1.9, estimating it at around 6.5.

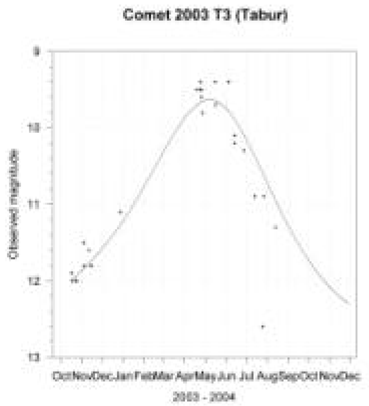
It passed through the SOHO LASCO fields as a 7^m object from 2004 September 27 to 2004 October 13. It reaches perihelion at 1.02 AU on 2004 October 13.7. Southern Hemisphere observers will pick it up at the end of the month and it should remain visible until mid 2005.

Brian Marsden notes on MPEC 2003-R44 [2003 September 9] that the "original" and "future" barycentric values of 1/a are +0.000020 and -0.000199 (+/- 0.000014) AU**-1, respectively, suggesting that this is a "new" comet from the Oort cloud. Such comets often brighten relatively quickly at first, so that we should not necessarily expect a good display at perihelion.

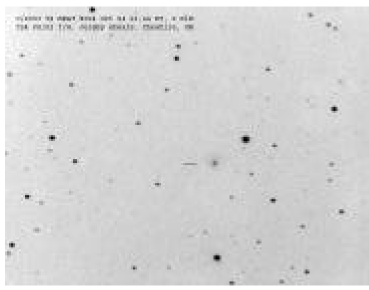


295 observations received so far give a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 3.3 + 5 log d + 11.3 log r which suggests that the comet could reach 5th magnitude at best. There is however some evidence that its absolute magnitude is decreasing as it was only about 7^{th} magnitude when it passed through the SOHO C3 field.

2003 T3 (Tabur) emerged from solar conjunction as a 9th magnitude object in early May, however it was low in the summer twilight and not easy to observe. I glimpsed it in mid June, estimating it at around 10th magnitude. Observers in mid September estimated it at around 11.5. It will slowly fade through to the end of year, but remains in the morning sky.



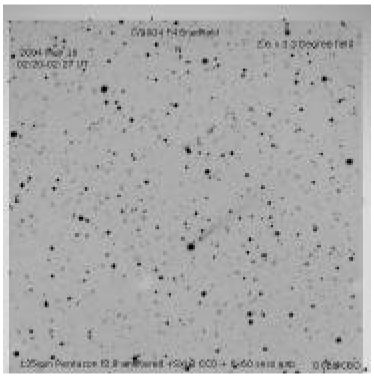
31 observations received so far give a preliminary light curve, not corrected for aperture, but where possible corrected for systematic observer differences of m = 6.6 + 5 log d + 6.9 log r



2003 T4 (LINEAR) The comet could come within visual range in 2004 September and reach binocular visibility in 2005 February. We will loose it in March at 6th magnitude and it will be a southern hemisphere object after perihelion. I tentatively estimated it at 13.4 on September 18.93.

SOHO comets. Over 70 more SOHO comets have been discovered in the last six months. The majority of these were Kreutz group members. Most were real time, but there were a further three from the archives. Virtually all the SOHO comets have been given designations and we are now as close to real time as is reasonable to get. The non Kreutz group members were: **2004 H4, H5, T2** and **U3** which were Meyer group comets and **2004 J4, J12, J13, J15, J16, J17, J18** and **L10** which were Kracht group comets. There are now 844 SOHO comets with designations and a total of 855 confirmed discoveries.

2004 F4 (Bradfield) was impressive as it passed through the SOHO field in mid April.

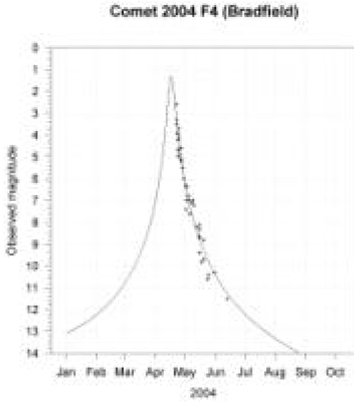


Z. Sekanina, Jet Propulsion Laboratory, writes: "The comet's peculiar shape in the SOHO's C3 coronagraphic images is caused by two effects. The gradual coma broadening in a direction nearly perpendicular to the apparent motion, beginning before Apr. 18.8 UT, is caused by a rapid development of the comet's post-perihelion dust tail, which points to the southwest from the nucleus in the images taken around Apr. 19.5 and to the west in the more recent C3 images. The increasingly rugged boundary of the tail on its antisolar side, especially well pronounced after Apr. 18.8, is due to discrete features protruding through the tail's smooth leading edge. These protrusions are either streamers -- i.e., synchronic formations that are products of recurring events of briefly elevated dust emission (outbursts) -- or striae (i.e., pseudosynchronic formations of a more complex nature). If they are streamers (perhaps a more likely case, judging from their appearance in the images just before the comet's head left the C3 field-of-view), their sequence suggests fairly consistently an outburst recurrence period of about 0.5 day, which might indicate the comet's rotation period. For example, in the image of Apr. 19.496, one can identify at least seven features, whose position angles are estimated at between 150 deg and 240 deg, with the corresponding calculated event times between 2.4 days before perihelion and 0.6 day after perihelion. The peak radiation-pressure accelerations on the particles in the features are estimated at about 2-3 times the sun's gravitational acceleration." [IAUC 8326, 2004 April 20]

2004 F4 imaged by Tony Scarmato on April 28th.

Brian Marsden notes on MPEC 2004-N32 [2004 July 12] that the "original" and "future" barycentric values of 1/a are +0.005164 and +0.004248 (+/- 0.000019) AU^-1, respectively. The original value suggests that this is not a "new" comet from the Oort cloud.

After a spell of cloudy weather I was able to observe it again on May 6.1, estimating it at 7.6 in 20x80B with a 0.3 degree tail. The coma was still highly condensed. It appeared to fade quite slowly, with reports in mid June suggesting that it was still 11th magnitude.



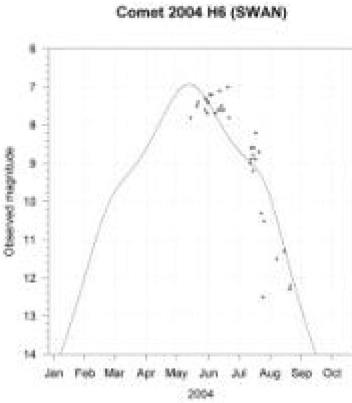
40 observations received so far suggest a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 8.0 + 5 log d + 8.1 log r

2004 H6 (SWAN) This comet was visible in the SOHO SWAN comet movies for a couple of weeks before it was announced in the IAUC. I was informed about a possible comet at the BAA meeting on May 26 by Andrew Pearce, who had confirmed it visually. I immediately spotted the comet (and three others) when I looked at the movie sequence the next day. The IAUC followed later that evening. I was unable to see it in 25x100B on August 12, but Carlos Labordena reported it at 11.3 on August 14.89 in his 23.5cm SC.

On May 13, the Central Bureau was informed apparently independently by X.-m. Zhou, K. Cernis, and M. Mattiazzo of the existence of a possible unknown comet on the low-resolution ultraviolet SWAN images taken from the SOHO spacecraft. As there have been numerous never-confirmed reports to the Central Bureau of such objects over the last couple of years, despite a great exertion of effort to have them confirmed by ground-based observers, we proceeded with caution to try and get solid confirming evidence of a real comet. Reports trickled in (as can be seen from the table below), but successive attempts to produce search ephemerides met with some negative results that indicated some of the early positions were apparently not of the new comet. [IAUC 8346, 2004 May 27]

2002 H6 imaged by Pepe Manteca on August 10.

The orbit shows that it was at perihelion at 0.78 AU on May 12.7.



Brian Marsden notes on MPEC 2004-N33 [2004 July 12] that the "original" and "future" barycentric values of 1/a are -0.000124 and -0.000099 (+/- 0.000048) AU^-1, respectively. The original value suggests that this is a "new" comet from the Oort cloud.

37 observations received so far suggest a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 7.2 + 5 log d + 13.5 log r

2004 K1 (Catalina) The Catalina sky survey discovered a 19th magnitude asteroidal object on May 21.41 which on further observation showed a slight coma. It is a distant object at perihelion at 3.4 AU in early July 2005, when it might reach 14th magnitude. An apparently asteroidal object reported by the Catalina Sky Survey, and posted on the NEO Confirmation Page, has been found by T. Spahr to show a weak coma with a possible very faint extension to the west on CCD images obtained by J. B. Battat and himself (Mt. Hopkins 1.2-m reflector) on May 24.4 UT; the FWHM of the comet image is 20 percent larger than other stars of similar brightness in the field. R. Stoss reports that CCD images taken by S. Sanchez, J. Nomen, and himself on May 24.1 (0.30-m reflector, Mallorca) shows the object to have a softer image than surrounding field stars. [IAUC 8343, 2004 May 24]

Brian Marsden notes on MPEC 2004-Q64 [2004 August 30] that the "original" and "future" barycentric values of 1/a are +0.000952 and +0.000683 (+/- 0.000043) AU^-1, respectively. The original value suggests that this is probably not a "new" comet from the Oort cloud.

2004 K2 (P/McNaught) Rob McNaught discovered a faint comet on CCD images taken with the 0.5-m Uppsala Schmidt at Siding Spring on May 20.80 during patrols for the Siding Spring Survey, the southern counterpart of the Catalina Sky Survey. SSS is jointly operated by the University of Arizona and the Australian National University, with funding from NASA. The comet is periodic, with a period of 5.5 years. It reached perihelion at 1.55 AU in mid June. A comet has been discovered by R. H. McNaught on CCD images obtained with the 0.5-m Uppsala Schmidt telescope at Siding Spring. Following posting on the NEO Confirmation Page, J. Young reported that CCD images obtained with the 0.6-m reflector at Table Mountain on May 25.5 UT show an 8"-10" coma with no apparent central condensation and a straight, narrow tail 20"-30" long in p.a. 252 deg. CCD images taken by A. C. Gilmore and P. M. Kilmartin with the 0.6-m reflector at Mount John on May 25.7 show a circular 5" coma and no tail. [IAUC 8348, 2004 May 28]

2004 K3 (LINEAR) A 19th magnitude suspicious object found by LINEAR on May 29.35 and put on the NEOCP has been found to show cometary activity by Peter Birtwhistle and others. It reached perihelion at the end of June at 1.1 AU, but is intrinsically faint and receding from the earth and is now fading.
An apparently asteroidal object reported by LINEAR, and posted on the NEO Confirmation Page, has been found to have cometary appearance on CCD images taken by P. Birtwhistle (Great Shefford, U.K.; coma diameter 12" with a hint of a 9"-wide extension emanating from a 3" central condensation for approximately 20" in p.a. 90 deg) and by P. Holvorcem and M. Schwartz (Tenagra Observatories, Nogales, AZ; 0.81-m f/7 reflector; 5" coma). [IAUC 8350, 2004 June 11]

2004 L1 (LINEAR) An 18th magnitude object found by LINEAR on June 12.28 and put on the NEOCP has been found to show cometary activity. It reaches perihelion at the end of March 2005 at 2.1 AU. It may brighten to 14th magnitude around the time of perihelion.
An apparently asteroidal object discovered by the LINEAR project, and posted on the 'NEO Confirmation Page', has been found to show cometary appearance (5" round coma without condensation) by J. Young (0.6-m reflector, Table Mountain) on CCD images taken on June 14.3-14.4 UT. [IAUC 8352, 2004 June 14]

Brian Marsden notes on MPEC 2004-Q66 [2004 August 30] that the "original" and "future" barycentric values of 1/a are +0.001441 and +0.001415 (+/- 0.000128) AU^-1, respectively. The original value suggests that this is probably not a "new" comet from the Oort cloud.

2004 L2 (LINEAR) A 19th magnitude object found by LINEAR on June 11.35 and put on the NEOCP has been found to show cometary activity. It reaches perihelion in mid November 2005 at 3.8 AU. It will be a few magnitudes brighter at perihelion, but will not become a visual object.
An apparently asteroidal object reported by LINEAR, and posted on the 'NEO Confirmation Page', has been found to show cometary appearance on CCD images taken by G. Masi (Las Campanas, 0.35-m reflector, June 17.2 UT; round coma with diameter 6"-8") and by J. E. McGaha (Tucson, AZ, 0.62-m reflector, June 17.3; 5-min exposure shows a 10" coma and a 15" fan-shaped tail in p.a. 300 deg). [IAUC 8356, 2004 June 17]

A/2004 MA8 [Siding Spring Survey] was discovered on July 14 and initially appeared unremarkable. It has however been linked to an object seen in 1992 and the orbit shows that it is a possible candidate for an extinct cometary nucleus. It reached perihelion in late January at 1.43 AU and has a period of 5.81 years. It can make moderately close approaches to Jupiter and encounters in the 18th century pushed q out to 1.61 AU. Further encounters at the end of the 19th century pulled it back to 1.40 AU, whilst future encounters will again push it out to 1.60 AU. The closest recent encounter with Jupiter was 1.37 AU in 1881.

2004 NL21 (160P/LINEAR) This object originally designated as an asteroid has been found to show cometary characteristics. It was found on July 15 by LINEAR. Currently around 16th magnitude it will fade. It reaches perihelion at 2.08 AU in mid October and has a period of 7.9 years. Following discovery it was linked to an object seen in 1996 NEAT images and this confirms the orbital details.

Maik Meyer provides the following information on the linkage with the NEAT images:

It came right after my little son went to bed and I was preparing for a comet observing session, so I had time without family duties. I quickly checked for earlier images of this comet and SkyMorph indicated two days in 1996 in NEAT data with an asteroidal brightness of 18 mag. I was not very hopeful but almost fell off my seat when I saw the bright 16-mag. comet with a coma and a tiny tail on my screen.
I quickly measured the two days, composed the message to the MPC, and, when I came back from my comet observing, MPEC 2004-S18 had been issued containing the observations and updated orbits for the 1996 and 2004 apparitions. I still wonder why this one slipped through NEAT's detection, because it is so obvious. Now this comet will become numbered - my second precovery which leads to a permanent numbering after 159P/LONEOS.

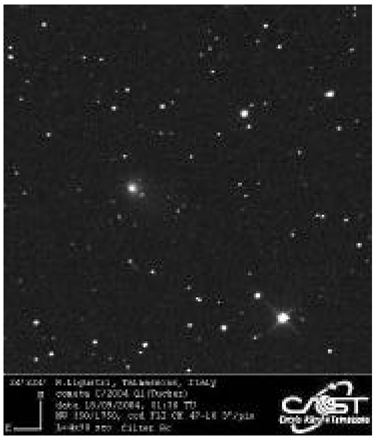
A/2004 NN8 [Siding Spring Survey] The Siding Spring Survey has discovered an unusual asteroid in a retrograde orbit that is (probably) still approaching perihelion. Gareth Williams notes on MPEC 2004-O09 [2004 July 17] While the retrograde nature of the orbit of 2004 NN8 is certain, the size of the orbit is very poorly constrained. At one extreme, the orbit could be parabolic (or even hyperbolic). At the other, orbits with semi-major axes smaller than 4 AU are not excluded by the currently available observations. The solution above is based on the assumption that 2004 NN8 is similar to objects such as 1999 LE31 and (20461) Dioretsa. Further observations are very much desired, as are observations with large-aperture instruments to clarify the physical nature of this object. The difference in plane-of-sky between the above solution and a parabolic solution on Aug. 17 amounts to -0m.23 in R.A. and -1'.1 in Decl. The object is expected to fade after early August as its distance from Earth increases.

2004 P1 (NEAT) A faint diffuse comet was found by NEAT on August 5.32. Currently around 20th magnitude it was at perihelion at 6.0 AU in August 2003 and will fade.

A/2004 PB27 (LINEAR) is an asteroid, of 19th magnitude, discovered by LINEAR on 2004 August 8.25. It is in a 9.1 year orbit, with perihelion at 2.0 AU and an eccentricity of 0.54. It is at perihelion in September, but is receding from the Earth and will fade. [MPEC 2004-P39, 2004 August 11, 3-day orbit]

A/2004 PY42 [CINEOS] The Campo Imperatore-CINEOS discovered a 20th mag unusual asteroid on August 10.87. It is in an indeterminate orbit, which is distant, but the orbit may be parabolic [MPEC 2004-P48, 2004 August 12]

2004 Q1 (Tucker) Roy Tucker discovered a 15th magnitude comet on CCD images taken with his 0.35-m reflector on August 23.46. The comet will brighten to 13th magnitude and should come within visual range during September. It reaches perihelion at 2.0 AU in early December. Some observations suggest that it was 12th magnitude in early September. I was able to observe it with the N'land refractor on September 18.99, when it was a fairly easy object at 12.5; other observers are estimating it a little brighter. By mid October it was a very easy object of 11th magnitude.



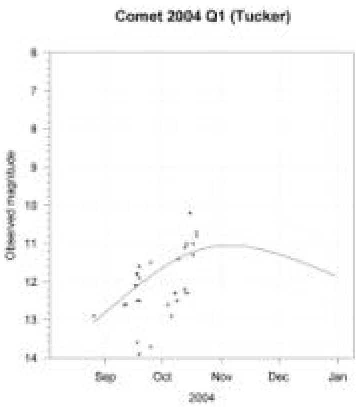
Roy Tucker provides the following discovery information:

With my system at Goodricke-Pigott Observatory, I do an all-night scan-mode image of a strip of sky 48 arcminutes wide centered at declination +02 degrees, 5 minutes with three 35-centimeter aperture f/5 Newtonian telescopes with 1K-squared CCDs at the foci. The telescopes are spread in the east-west direction so that they image the same sky but separated in time by about twenty minutes. Their aiming is centered about 40 minutes to the east of the meridian. During data acquisition, the scan is chopped into 1024x1024-pixel FITS images, each covering about 0.64 square degrees. Imaging begins in the evening twilight and continues until morning twilight. Summer is not prime observing time in Tucson, Arizona. We have a seasonal monsoon from early July until mid-September like clockwork. I haven't seen Perseid meteors here in years. My first bit of luck was that I got four consecutive clear nights from the 20th through the 23rd of August. The object announced yesterday in MPEC 2004-Q43 as comet C/2004 Q1 (Tucker) was actually recorded on the morning of the 22nd, but in an image triplet just a few fields from the end. After looking at blinking images for a couple of hours, I sometimes get a little eager to finish up. I actually did report a faint asteroid in another part of the field, but I was so fixated on looking for faint moving objects that I missed the big moose wallowing across the field.

Fortunately, the 23rd was clear and the comet was well positioned near the middle of the field of view (in the cropped frame seen above). When I got to that image triplet, I immediately noticed it, but didn't think too much about it. I see known comets pass through my field fairly often and, indeed, had seen comet 53P/Van Biesbroeck pass through on the 20th and the 21st. I went to the Minor Planet Center's Web site and used the MPChecker function to find out what the object was. When it reported no known objects in that area, I became very interested. I immediately composed an astrometry report for those observations and Emailed them to the Minor Planet Center with the heading "comet" and inquired if this was a known object. After a bit of time, Kyle Smalley responded that this appeared to be an unknown object and requested a physical description. During the wait for this response, I realized that I should have recorded it the previous night. A short search revealed the previous images and I sent those astrometric measures to the MPC. So, although the formal discovery image was recorded on the 23rd of August, I was actually able to provide observations for the previous night within a short time. The object was then posted on the NEO Confirmation Page and other observers quickly verified it.

So, I was lucky three ways. 1) I had good weather at just the right time, 2) nobody else saw it between my observations of the 22nd and the 23rd, and 3) the other surveys were working mostly to the west. Of course, it helps to look at large numbers of images. Each clear night provides me 500 to 700 images to examine, depending upon season. I'll get perhaps 190 clear, dark nights per year, which means a little over 100,000 images per year. Although the discovery was very exciting, the operation that produced it is very routine. MOTESS is a "discovery machine"; photons go in and discoveries come out. I don't actually do much except look at a lot of images. I go to bed pretty early and rise early to shut down the instrument and begin processing the data. It's a pleasant change from the usual astronomical observing in that I can get a good night's sleep and go to a day job refreshed.

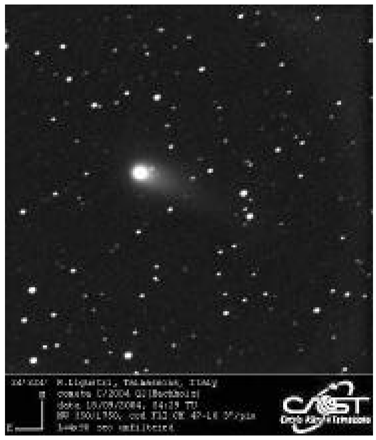
Roy Tucker's day job is CCD engineer at the University of Arizona. MOTESS is short for "Moving Object and Transient Event Search System," a project that received a 2002 Planetary Society Eugene Shoemaker Grant (update). His other discoveries include NEA 2003 UY12 and PHA 2004 MP7.



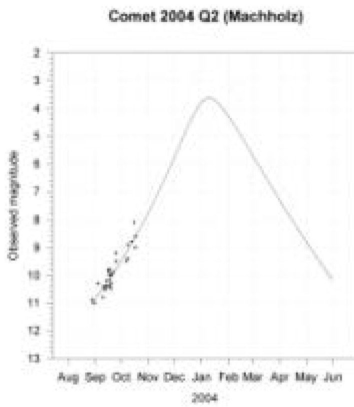
22 observations received so far suggest a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 4.2 + 5 log d + [20] log r

2004 Q2 (Machholz) Don Machholz made a visual discovery of an 11th magnitude comet on August 27.47 with his 0.15-m f8 reflector x30. The orbit shows the comet brightening and moving south, so that initially it will not be visible from the UK. We should however be able to pick it up in December, by which time it may be 5th magnitude, creating a record number of naked eye comets during the year. It reaches perihelion at 1.20 AU in late January 2005 and will be well placed for viewing after Christmas. Pre-discovery images taken in May by Michael Jaeger and Vello Tabur suggest that the orbit may be a long period ellipse, and also that there is nothing unusual about the magnitude evolution of the comet.

Don Machholz provides the following discovery information: I began comet hunting on Jan 1, 1975, and for nearly 30 years now I've done some comet hunting each and every month. At the time I found this comet I had searched 7046 hours, 1457 since my previous find, in 1994, when I found three comets in four months (go figure!) When I found this latest one I was on my back deck, using my 6" (15cm) Criterion Dynascope (purchased in 1968). I used a 2" OD eyepiece pressed over the focussing tube, yielding 30x and a field of view of about 2 degrees. This is the same setup I use for my Messier Marathons, and I used it last March to find all 110 objects by memory in one night. I'm very comfortable with it. I use it on my back deck from time to time to compliment the 10" reflector and 5" homemade binoculars I have in my observatory 30 meters from my house. With the 6" in the deck I can see down to -45 degrees declination. I had covered some of the southern sky on Aug 25, then went back out on Aug 27 to cover more sky, working my way eastward after each N-S sweep.



There were some early suggestions that the orbit is periodic and links with comet 1532 R1. If so this would be an interesting link given suggested linkage of this comet with a progenitor of 2002 C1 (Ikeya-Zhang). The pre-discovery observations however rule out this possibility.



Observations in mid September put the comet at around 10th magnitude and it had brightened to 8th magnitude by mid October. The latest observation by Alexandre Amorim put the comet at 8.0 in 20x80 binoculars on October 29.05.

30 observations received so far suggest a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 4.3 + 5 log d + 10.9 log r, which suggests that it might reach 4th magnitude at the end of the year.

A/2004 QB17 [Steward] is an asteroid, of 20th magnitude, discovered at the Steward Observatory, Kitt Peak on 2004 August 25.31. It is in a 5.1 year orbit, with perihelion at 0.99 AU and an eccentricity of 0.67. It is at perihelion in late December, but will only get a little brighter. It is a potentially hazardous object, passing 0.007 AU from the Earth's orbit at the ascending node. [MPEC 2004-Q51, 2004 August 26, 1-day orbit] The orbit is typical of a short period comet and it can pass within 0.5 AU of Jupiter.

2004 R1 (P/McNaught) Rob McNaught discovered an 18th magnitude comet on CCD images taken by himself with the 0.5-m Uppsala Schmidt at Siding Spring on September 2.42. Sadly although the NEO confirmation page asking for further observations suggested that the object was -0.4, this was not the case! Further observations show that the object is a short period comet, with perihelion at 1.0 AU in late August. The period is 5.4 years.

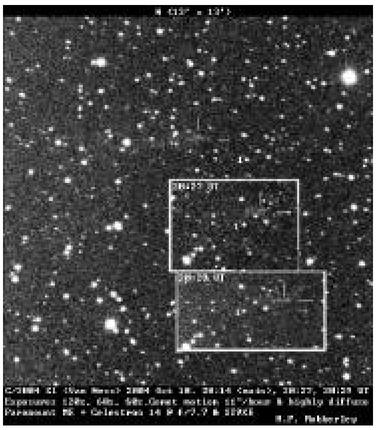
2004 R2 (ASAS) On September 8 Grzegorz Pojmanski released an alert on a possible cometary object of about 12th magnitude found on the Polish "All Sky Automated Survey" (ASAS) images taken on September 3 and confirmed that morning. This was posted on the comet mailing list, and initial orbits by Kobayashi, Sato and Bouma suggested a faint sun-approaching object. Later that day it was posted on the NEOCP and confirmed as a comet on September 9. It was poorly placed for observation from the UK, and passed through the SOHO LASCO C3 coronagraph from October 5 to 10 where it looked to be becoming more diffuse and elongated. It was at perihelion at 0.11 AU on October 7.9. Although it should have been observable post perihelion, no observations had been received by the end of October, and it looks as if it did not survive.

Stuart Rae estimated the comet at 9.7 on September 10, a little brighter than the ephemeris estimate. By September 15 it had brightened to 8.4 and had become more condensed.

The 8 observations received so far suggest a preliminary light curve, corrected for aperture and where possible for systematic observer differences of m = 9.3 + 5 log d + 6.5 log r. This suggested that it might reach 1st magnitude in early October, however it was only 7th magnitude when it passed through the SOHO field.

2004 R3 (LINEAR-NEAT) An object found by LINEAR and NEAT has been confirmed as a periodic comet. The rather short arc suggests that it is some four months past perihelion, which was at 2.1 AU and has a period of around 7.5 years.

A/2004 RT109 (KLENOT) is an asteroid, of 19th magnitude, discovered at the Klet Observatory with the KLENOT telescope on 2004 September 10.99. It is in a 7.0 year orbit, with perihelion at 1.68 AU and an eccentricity of 0.54. It is at perihelion in mid October, but will not get significantly brighter. [MPEC 2004-R62, 2004 September 12, 1-day orbit] The orbit is typical of a short period comet and it can pass within 0.2 AU of Jupiter.



2004 S1 (Van Ness) M E Van Ness discovered an 18th magnitude comet on images taken with the LONEOS 0.59m Schmidt at Lowell Observatory on September 26.26. The preliminary orbit gives it a perihelion distance of 0.68 AU in early December, however with an absolute magnitude of 16.5 it is unlikely to become brighter than 15th magnitude and it will fade after mid October.

2004 T1 (P/LINEAR-NEAT) NEAT reported a comet discovered on October 5.44, which had been reported as asteroidal by LINEAR on October 5.27. Other observers, including Peter Birtwhistle, confirmed the cometary nature of the object. It reaches perihelion in early November at 1.71 AU and has a period of 6.5 years. Although LINEAR reported it as 18th magnitude, NEAT gave 15th magnitude. Michael Mattiazzo reports that it was observed visually at 13.8 on October 9.62. It will begin to fade as the distance from Earth is increasing.

2004 T2 (SOHO) This, the 50th member of the Meyer group, was discovered by Rainer Kracht on October 12 in C2 images from October 8 and 9.

2004 T3 (Siding Spring) Rob McNaught noted a 19th magnitude object on images from the Siding Spring 0.5-m Uppsala Schmidt on October 12.69, that has been confirmed as cometary. The orbit is still rather uncertain, and currently suggests that the object was at perihelion in 2003 April at 8.9 AU.

2004 U1 (LINEAR) An asteroidal object reported by LINEAR on October 19.42 has been shown to have a faint coma and tail, by amongst others Peter Birtwhistle. The 19th magnitude object is perhaps a month from perihelion at 2.7 AU.

2004 U2 (SOHO) This was a non-group comet, discovered by Heiner Otterstedt on October 16 in C3 images from the same day. It may be observable from the ground, however it seemed to burst into activity, reaching 7th magnitude and then fade.

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

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