been suggested. Seiichi Yoshida finds a good fit with m1 = 6.8 + 5 log Δ + 10 log r. If we take the archetypal active evolved object, 1P/Halley, the brightening rate at r < 1.7AU was found by Daniel Fischer to be 9.1 log r. C/1995 O1 (Hale-Bopp), also an active multiple-return object, brightened at 7.5 log r for most of its inbound passage. C/2002 C1 is brightening slightly faster than these comets, but not spectacularly so. Even so, it seems to be an unusually gassy object.

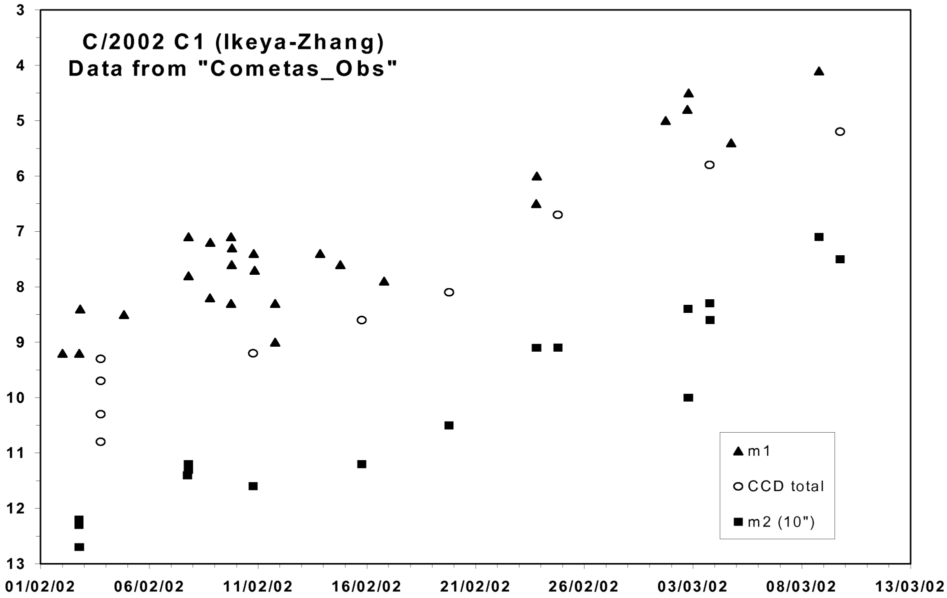

Figure 1: Comet C/2002 C1 (Ikeya-Zhang) data from 'Cometas Obs'

ON THE PAST ORBIT OF COMET C/2002 C1 (IKEYA-ZHANG) **Graeme Waddington**

As Mark has pointed out, there is a remarkable similarity between the orbits of C/1532 R1, C/1661 C1 and C/2002 C1. The possibility of a connection between the comets of 1532 and 1661 seems first to have been appreciated by Halley, in his "A Synopsis of the Astronomy of Comets" of 1705, who suggested that they were, in fact, one and the same comet. Current orbital solutions of C/2002 C1 favour an identity with C/1661 C1. Indeed, on February 21 and 25 Nakano produced two separate orbital solutions linking the observations of 1661 and 2002. But what then of the initially favoured identification with C/1532 R1? Could the comet of 1532 and the 1661-2002 comet be fragments that split from each other in the distant past? The similarity of the orbital elements seems to suggest so.

Nakano's 2002 Feb 25 solution incorporates 304 observations from 2002 together with 7 from 1661 and he specifies the osculating orbital elements for epochs in both 2002 and 1661. Using the RADAU integrator to follow the orbit back in time from 2002 leads to the following sequence of perihelion passages: 2002 Mar 18.98, 1661 Jan 28.6, 1273 May 2, 878 Nov 18, 429 July 14, 91 June 7. At this stage this sequence must be regarded as being still somewhat negotiable. Even so, it does not stop us using it to look into the possible connection of 1532 and 1661-2002 as separate components of a once single cometary nucleus.

In this sequence the largest change in z = 1/a is from 0.0205 to 0.0170, which occurs during the 429 apparition. This jump occurs as a result of an approach to within 0.52au of Jupiter in 430 July. If at this time the comet consisted of two separate entities following the same basic orbit (but with different perihelion passage times) then the difference in the timing of their respective Jovian encounters could well have been responsible for the large separation in time of subsequent passages of the inner solar system. This is not to say that any nuclear splitting actually occurred at the 429 encounter - far from it, since the required separation in perihelion passages in 429 is indicative of a splitting at an earlier apparition.

Based on the integrated elements at epoch 1877960.5 (429 July 30), by unilaterally changing the perihelion passage time by 25 days (to 429 June 19) and integrating forward we get the following sequence of subsequent perihelion passages: 977 July 8, 1528 July 2, 2093 Oct 29.

Indeed, by changing the time of perihelion passage by between 25.025 and 25.030 days we can get a perihelion passage in the year 1532 itself. Of course, it is still early days but this at least shows that a common ancestor comet to C/1532 R1 and C/1661 C1 (== C/2002 C1) is a distinct possibility. (As an aside, a difference in the perihelion passage times of around twenty days would tend to indicate that the actual splitting of the parent nucleus would most likely have occurred during the previous apparition.)

Now for the obligatory disclaimer. The integration from Nakano's 2002 epoch elements gives rise to a 0.3-day difference in the time of 1661 perihelion passage and that given by Nakano directly from his orbit solution. There are many possible reasons for this, such as difference in integration methods etc. Although the discrepancy is small it can have a large effect on the long-term integration - the error being magnified with each subsequent Jovian encounter. To see this we can start the backward integration at the 1661 epoch using Nakano's given elements; this results in the sequence of perihelion passages: 1661 Jan 28.9, 1273 Apr 24, 879 Jan 22, 425 Feb 10, -41 July 19 .

Plainly, specification to the month, let alone the day, is unwarranted and our 429 apparition has moved by four years thus altering considerably the circumstances of the Jovian encounter that we were relying on to separate the fragments of the parent comet! All is not lost, however, since the fact that the comet's descending node is located so close to the orbit of Jupiter gives ample opportunity for fragment-separating encounters.

So far all this speculation has been based on a solution (Nakano's) that is based on an *a priori* linkage of the 1661 and 2002 apparitions. What then of the current solutions of just the 2002 astrometric data? At the time of writing, (March 11) there are two separate solutions encompassing the available astrometric arc of Feb 1 to March 8. These are from JPL (orbit solution number 8, using 369 observations) and MPC (MPEC 2002-E22 solution, using 365 observations). Integrating these backwards in time yields the following sequences of perihelion passages:
JPL :: 1659 Aug 4.7, 1298 Jan 2, 944 Oct, 630 Sept, 187 Apr.
MPC :: 1659 Sept 25.3, 1296 Jan. 1, 942 Dec, 606 June, 212 July
(MPEC 2002-E22 lists a previous perihelion passage of 1659.7 +-0.8). In these two sequences the seventh century apparition provides the closest Jovian encounter, and hence the one most useful in terms of producing a large subsequent separation between hypothetical nuclear fragments. The differences between the sequences, however, once again cautions as to reading too much into this. Even so, the fact that we have been able to tie down so much about this comet (albeit in rather speculative terms) in the brief time that it has been observed at the current apparition bodes well for the resolution of the 1532 + 1661 + 2002 connection in the not too distant future.
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