SECULAR LIGHT CURVES OF COMETS:
85P/Boethin

Ignacio Ferrín,
Center for Fundamental Physics,
University of the Andes,
Mérida, Venezuela.

**Orbit.** This comet has been selected as the new target of the Deep Impact mission (A'Hearn et al., 2005; Tytell, 2005).

The comet has close encounters with Jupiter. In 1985 it approached to Jupiter at 0.718 AU, in 1995 it approached at 0.63 AU and in June of 2007 will be at only 0.44 AU. Due to the 1985 perturbation the perihelion distance increased from q=1.0935 AU in 1975 to 1.1143 AU in 1986 (Belyaev et al., 1986; Marsden and Williams, 2005). It will approach Earth at 0.87 AU in December 23rd, 2008.

The aphelion distance of this comet is 8.91 AU, thus this must be a Saturn Family comet, perturbed into the inner solar system by this planet. At the beginning we did not attach much significance to this fact, but later on we show that the SLC presents four peculiarities that might be explained if Saturn Family comets were different from Jupiter Family comets.

**Data sets.** In the recovery observation by Gilmore and Kilmartin (IAUC 4121) the comet already had a coma at R= -1.71 AU before perihelion. There are very few observations of this comet. Kamel (1992) has compiled the 1975 and 1986 return. The 1997 return was missed because the comet was on the other side of the sun. We used his uncorrected magnitudes in accord with our procedures outlined in Paper I (Ferrín, 2005). Although we do not use photographic observations, so little information is available on this comet that we had no other choice. Five faint observations by Roemer appear in Kamel's compilation and were converted to visual using V-PG = -0.7 mag (Sekanina et al., 1996).

**Secular Light Curve** The log plot is shown in Figure 1 and the time plot in Figure 2. The turn on of this comet is at only R_{ON}= -1.82±0.05 AU, while R_{OFF}= +1.69±0.05 AU. The SLC requires two power laws before perihelion, the first one at turn on with a slope of n= +28, and changing to slope n= +8.0 at R_{BP}= -1.44 AU from the sun, where R_{BP} is the break point.

The time plot (Figure 2) allows the determination of the turn on and turn off points, T_{ON}= -107±4 d and T_{OFF}= +91±6 d. Thus the total active time is rather small, T_{active}= 198±7 d.
**Photometric and Time-Age** An age can be calculated from the log and the time plots, independently. We find P-AGE= 46±4 cy, and T-AGE= 51±4 cy. Thus this is a middle age comet.

**Nucleus Diameter** Of the five observational points by Roemer, two fulfill our definition of a nuclear magnitude, following a $R^{-2}$ power law. We find for the absolute nuclear magnitude, $V_N(1,1,0)= 14.3±0.3$, and assuming a geometric albedo of $p_v= 0.04$ we find $D_{EFFE}= 6.3±0.6$ km.

**Peculiarities of the SLC** A first peculiarity of this comet is the large $n=+28$ value quite different from the Jupiter Family comets, which typically exhibit $n$~ 8 to 12 (confirmation Paper I). Maybe the light curve is incomplete, originating this large slope, but four tight observational points near turn on, suggest that the slope may be right.

A second peculiarity of this comet is that its perihelion distance increased from $q=1.0935$ AU in 1975 to $q= 1.1143$ AU in 1986, thus receiving less solar radiation. All the 1986 observations lie above the 1975 measurements, thus contrary to expected, the comet increased its absolute magnitude to $m_V(1,1) = 5.4±0.2$ mag.

A third peculiarity of this SLC is the odd shape after perihelion. It seems to be described again by two power laws. And 1975 observations do not seem to agree very well with 1986 observations.

A fourth peculiarity of this comet is that according to other JF comets, a middle age comet should exhibit a larger turn off distance due to thermal propagation inside the nucleus. This is not shown, and in fact the turn off distance is smaller than the turn on distance, giving for the asymmetry parameters $R_{OFF} / R_{ON} = 0.89$ and $T_{OFF} / T_{ON} = 0.9$. Values smaller than 1.0 do not occur in JF comets.

Perhaps all these four peculiarities might be explained by the fact that this is a *Saturn Family* comet. Although the SLC seems to be rather complete, the coming apparition will decide if the observed features are real or not.

**REFERENCES**
85P/Boethin

- \( q = 1.11 \) AU
- \( Q = 8.91 \) AU
- \( \log Q = 0.95 \)
- \( R_{\text{ON}} = 1.82 \pm 0.05 \) AU
- \( R_{\text{OFF}} = 1.69 \pm 0.05 \) AU
- \( V_{\text{ON}} = 15.6 \pm 0.1 \)
- \( V_{\text{OFF}} = 15.4 \pm 0.1 \)
- \( m_{v} (1,1) = 5.4 \pm 0.2 \)
- \( R_{\text{BP}} = -1.44 \pm 0.05 \) AU
- \( m_{\text{BP}} = 8.6 \pm 0.1 \)

Nucleus:
- \( V_{\text{NUC-TW}} = 14.3 \pm 0.3 \)
- \( A_{\text{SEC}} = 8.95 \pm 0.08 \)
- \( D_{\text{EFFE}} = 6.3 \pm 0.6 \) km
- \( P-\text{AGE} = 46 \pm 4 \) cy

Perihelions:
- \( \bigcirc \) 19750106
  - \( q = 1.0935 \) AU
- \( \triangle \) 19860116
  - \( q = 1.1143 \) AU
- \( \bigtriangleup \) Nuclear

Nuclear Phase

Figure 1
FIGURE CAPTIONS

Figure 1. Secular light curve of comet 85P/Boethin, Log plot. The most significant feature of this light curve, is the break in the power law before perihelion, and the very steep slope n=28 not found in any previous comet. Other puzzling fact is that the comet increased its perihelion distance to the sun, thus receiving less energy. Surprisingly the comet increased in absolute brightness. See text for additional

Figure 2. Secular light curve of comet 85P/Boethin, Time plot. The photometric age calculated from the previous plot is P-AGE= 46±4 comet years. From this plot a time-age can be calculated and results in T-AGE= 51±4 comet years in good agreement with the previous one. The comet is a middle age comet.