EJECTION OF PARTICLES FROM COMET LEXELL: THE GRAVITATIONAL INFLUENCE OF JUPITER

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The orbital evolution of comet P/Lexell has been characterized by a sequence of three close planetary encounters within 12 years; the first of these encounters was with Jupiter, 1767, and lead to a reduction of the perihelion distance from 2.9 AU to 0.67 AU. Then the comet encountered the Earth at a distance of 0.015 AU, in 1770, and was discovered. The final, very close encounter with Jupiter, in 1779, removed the comet from observability, sending it into an orbit of perihelion distance in excess of 5 AU (Kazimirchak-Polonskaya, 1967).

We have investigated the orbital evolution of the comet, and of an associated stream of particles, between 14.0 August 1770 and 20.0 March 1782 (JD 2367764.5 - JD 2372000.5), thus covering the second encounter with Jupiter (Carusi, Kresáková, and Valsecchi, Astron. Astrophys., in press). The computations have taken into account the perturbations of the planets from Venus to Neptune, and the n-body integrator is based on Greenspan's Discrete Mechanics.

The aim of the work has been to check if a sufficient fraction of the particles ejected from P/Lexell at the two perihelion passages in 1770 and 1776 could escape far enough from the parent body to avoid being removed from their Earth crossing orbits by jovian perturbations in 1779. Note that P/Lexell is the only known case for which we know the exact time of particle release, and that this time coincided with the only period of appreciable cometary activity (Kresáková, 1980).

Our fictitious stream is composed by 44 particles, eje-

V. V. Markellos and Y. Kozai (eds.), Dynamical Trapping and Evolution in the Solar System, 105–106.

cted at the starting date at tangential velocities V between -50 and +50 m/s relative to the comet. More specifically, the spacing in V is 5 m/s between -50 and -10, 1 m/s between -10 and +20, and again 5 m/s between +20 and +50. The motion of the comet has also been integrated for comparison.

The trajectories of the particles at the close encounter turn out to be very interesting and rather surprising. A great part of the stream is very strongly perturbed, and only the particles farthest from the comet remain in orbits resembling the initial ones. The central part of the stream is practically unchanged until immediately before the encounter; then the particles are deflected in all the directions, so that, looking at them in a frame centred on Jupiter, the resulting stream looks like an expanding circle. Plotting the individual trajectories in three dimensions reveals that the paths of the most perturbed particles are nearly coplanar, and that the plane of the motion contains the position of Jupiter at the time of the encounter, but not that of the Sun.

The spatial density of particles in the vicinity of the comet drops dramatically after the encounter. Jupiter removes from Earth crossing orbits not only the comet, but also the particles ejected in 1770 with V comprised between -3.5 and 14.5 m/s; moreover, an analogous stream ejected at the perihelion passage of 1776 would suffer much stronger depletions, due to the shorter time available for the dispersion along the orbit.

REFERENCES

Kazimirchak-Polonskaya, E.I.: 1967, Sov. Astron. - A.J. 11, pp. 349-365.

Kresáková, M.: 1980, Bull. Astron. Inst. Czechosl. 31, pp. 193-206.