

N 9 1 - 2 5 9 9 6

1990 MB: THE FIRST MARS TROJAN

Kimmo A. Innanen (York University), Seppo Mikkola (University of Turku), Edward Bowell (Lowell Observatory), Karri Muinonen (Lowell Observatory), Eugene M. Shoemaker (U.S. Geological Survey, Flagstaff)

Asteroid 1990 MB was discovered by D. H. Levy and H. E. Holt on 20 June 1990 during the course of the Mars and Earth-Crossing Asteroid and Comet Survey conducted by E. M. and C. S. Shoemaker. An orbit based on a 9-day arc and the asteroid's location near Mars' L5 (trailing Lagrangean) longitude led E. Bowell to speculate that it might be in 1:1 resonance with Mars, analogous to the Trojan asteroids of Jupiter. Subsequent observations strengthened the possibility (IAUC 5067), and later calculations by M. Yoshikawa and B. G. Marsden (IAUC 5075) confirmed it. Thus 1990 MB is the first known asteroid in 1:1 resonance with a planet other than Jupiter. The most recent orbit, from observations in 1979 and 1990, shows that the asteroid's semimajor axis (1.5235591 ± 0.0000003 AU, epoch 10 December 1990) is very similar to that of Mars (1.5235830 AU, same epoch).

The existence of 1990 MB—a small body most likely between 2 and 4 km in diameter—provides remarkable confirmation of computer simulations performed by S. Mikkola and K. A. Innanen (IAU Colloquium 123, in press). Their self-consistent n-body simulations have demonstrated just this sort of stability for Trojans of all the terrestrial planets over at least a 2-million-year time base. In the case of Mars Trojans, it was initially thought that stable-looking orbits must have semimajor axes that depart from Mars' by less than $\Delta a/a = 0.003$ and angular excursions from L5 that are less than 2° . Such a small region of stability led Bowell *et al.* (*Bull. Amer. Astron. Soc.* **22**, 1357, 1990) to speculate that 1990 MB was captured from a free orbit fairly late in solar system history, since it is not likely to have survived the heavy bombardment known to have occurred in the region of the terrestrial planets. Additional evidence came from the existence of (3800) Karayusuf, an asteroid having a semimajor axis of 1.578 AU, which suggests that multiple encounters with Mars could lead to orbits rather close to the 1:1 resonance. However, more recent integrations of the motion of 1990 MB by Mikkola and Innanen show that stable excursions about L5 as large as 80° occur on timescales of millions of years. Thus, the question of whether 1990 MB is a primeval Mars Trojan remains open. Clearly, it is desirable to investigate the size and nature of the region of Mars-Trojan stability, and to examine possible implantation mechanisms.

The discovery of 1990 MB suggests that others of similar or smaller diameter may be found. Using hypothetical populations of Mars Trojans, we have modeled their possible sky-plane distributions as a first step in undertaking a systematic observational search of Mars' L4 and L5 libration regions.

Research supported, in part, by NASA grant NAGW-1470.

DUST EMISSION FROM 2060 CHIRON

W.-H. Ip, Max-Planck-Institut fuer Aeronomie, D-3411 Katlenburg-Lindau, Germany

Recent photometric observations of (2060) Chiron have shown that a coma of submicrom dust particles is developed around this distant object. In the present report we shall consider the volatile sublimation process on Chiron's surface and the resultant ejection of small dust particles via gas drag. The dependence of the morphology of the dust cloud on the surface gravity and nucleus rotation will also be investigated. The merits of other possible dust emission mechanisms such as electrostatic charging will be compared with the gas sublimation effect.

THE PRODUCTION OF HOT IONS AND ENERGETIC NEUTRAL ATOMS IN COMETARY COMAS.

W.-H. Ip, Max-Planck-Institut fuer Aeronomie, D-3411 Katlenburg-Lindau, Germany

A burst of hot ions with energies up to a few hundred eV was observed by the Giotto probe as it passed through the contact surface of the cometary ionosphere. The origin of these hot ions in the inner coma has not been satisfactorily explained. The collisional re-ionization of energetic neutral atoms created in the outer coma was found to be problematic, for example. In the present report we shall assess the possible contribution of particle acceleration by reconnection process in the ion tail. The potential "internal" ionization effect from such auroral process will be estimated as well.

ASTEROID-TYPE ORBIT EVOLUTION NEAR THE 5:2 RESONANCE. S.I. Ipatov, M.V. Keldysh Institute of Applied Mathematics, Moscow, USSR

In the case of the 5:2 commensurability with the motion of Jupiter the asteroid can reach the orbits of Mars, Earth and Venus when eccentricity e is greater than 0.41, 0.65 and 0.74, respectively. For individual fictitious asteroids Ipatov [1] obtained the growth of e from 0.15 to 0.74–0.76. Rates of changes of orbital orientations are different for Mars, Earth, Venus and asteroid. Therefore, for corresponding values of e the asteroid could encounter these planets and leave the gap due to those encounters. In order to investigate this hypothesis of the 5:2 Kirkwood gap formation Ipatov [2] studied the regions of initial data for which the eccentricities of asteroids located near the 5:2 commensurability exceeded 0.41 during evolution. The orbit evolution for 500 fictitious asteroids was investigated by numerical integration of the complete (unaveraged) equations of motion for the three-body problem (Sun–Jupiter–asteroid). Variations in e for most of these asteroids were quasiperiodic. The equations of motion were integrated in the time interval $\Delta t \geq 5 \cdot 10^3 t_J$ (t_J is the heliocentric orbital period of Jupiter) in the two-dimensional case and $\Delta t \geq 10^4 t_J$ in the three-dimensional case. Various initial orientations of the orbit of the asteroid and its location in orbit were considered in the case when initial value of asteroidal semimajor axis a was equal to the resonance value. For the initial asteroidal eccentricity $e_0 = 0.15$ it was obtained that maximum value of asteroidal eccentricity exceeded 0.41 for 2/3 of all investigated asteroids. We defined the maximum region of the initial values of a and e for which fictitious asteroids penetrated within the orbit of Mars during their evolution. It was shown that the outer boundaries of this region coincided with the boundaries of the 5:2 Kirkwood gap. For $e_0 \leq 0.2$ and initial inclination $i_0 \leq 20^\circ$ the regions of initial data for which fictitious asteroids reached the orbits of Earth and Mars are close to each other. Asteroids reached the orbits of Mars and Venus as a rule for certain types of relationships between variations in eccentricity and longitude of perihelium. For $e_0 \leq 0.15$ and $5^\circ \leq i_0 \leq 10^\circ$ resonant relationships were obtained in some cases between the periods of variations in eccentricity, inclination i , argument of perihelium and longitude of the ascending node. In the case $i_0 = 40^\circ$ the equations of motion were integrated in a time interval equal to $5 \cdot 10^4 t_J$ or $10^5 t_J$ because in this case for the majority of runs maximum values of e and i were reached in the time $\Delta t > 2 \cdot 10^4 t_J$. When $i_0 = 40^\circ$ and $e_0 = 0.15$ it was obtained for all investigated asteroids that the maximum values of eccentricity $e_{\max} > 0.6$, and for most of the asteroids $e_{\max} > 0.99$ while the maximum value of inclination $i_{\max} \geq 89^\circ$.

References: [1] Ipatov S.I. (1988) *Kinematics Phys. Celest. Bodies*, 4, N 4, 49. [2] Ipatov S.I. (1989) *Sov. Astron. Lett.* 15, 324

PHOTOMETRY OF COMET AUSTIN AROUND CN O-O BAND

V. Ivanova, B. Komitov,
S. Vladimirov and V. Shkodrov

Department of Astronomy, Bulgarian Academy
of Sciences, 1784 Sofia, 72 Lenin blvd.

Photographic observations of Comet Austin 1989c1 were taken with the 50/70cm Schmidt telescope of the Bulgarian National Observatory - Rozhen through an interference filter transmitting the CN band around 382nm. The observations were carried out on 18 and 27 of May 1990, when the comet has been at heliocentric distances $r=1\text{AU}$ and $r=1.2\text{AU}$ and geocentric distances of 0.28AU and 0.24AU respectively.

The radial profiles of relative intensities are derived. For the both observations they are very similar. In the both cases the CN O-O emission is generated by photodissociative excitation during the decomposition of CN parent molecules. The possible parent compounds are discussed.