Resonance and Capture of Jupitor Comets

W. S. Koon, M.W. Lo, J. E. Marsden and S. D. Ross

A number of Jupiter family comets such as *Oterma* and *Gehrels 3* make a rapid transition from heliocentric orbits outside the orbit of Jupiter to heliocentric orbits inside the orbit of Jupiter and vice versa. During this transition, the comet can be captured temporarily by Jupiter for one to several orbits around Jupiter. The interior heliocentric orbit is typically close to the 3:2 resonance while the exterior heliocentric orbit is near the 2:3 resonance. An important feature of the dynamics of these comets is that during the transition, the orbit passes close to the libration points L_1 and L_2, two of the equilibrium points for the restricted three-body problem for the Sun-Jupiter system. Studying the libration point invariant manifold structures for L_1 and L_2 is a starting point for understanding the capture and resonance transition of these comets. For example, the recently discovered heteroclinic connection between pairs of unstable periodic orbits (one around the L_1 and the other around L_2) implies a complicated dynamics for comets in a certain energy range. Furthermore, the stable and unstable invariant manifold 'tubes' associated to libration point periodic orbits, of which the heteroclinic connections are a part, are phase space conduits transporting material to and from Jupiter and between the interior and exterior of Jupiter's orbit.