

# Using an analytical model of the sweeping $\nu_6$ resonance to constrain the rate of giant planet migration

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Minton & Malhotra (2009) showed that the dynamically stable regions of the asteroid belt are not uniformly filled with asteroids, and that the observed pattern of depletion is diagnostic of sweeping resonances (both secular and mean motion) due to the migration of Jupiter and Saturn that is presumed to have occurred early in the solar system's history.

The powerful  $\nu_6$  secular resonance may have been largely responsible for the majority of the depletion of the asteroid belt, especially in the inner belt between  $\sim 2.0$ - $2.8$  AU, during

the giant planet migration epoch.

Here we develop an analytical model of the sweeping  $\nu_6$  resonance and use it as a constraint on the rate of semimajor axis migration of Saturn, and hence as a constraint on the rate of planet migration.

We also show that features of the observed large asteroid eccentricity distribution are consistent with the sweeping of the  $\nu_6$  resonance and further constrain the rate of Saturn's migration.

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## Finding Order in Kuiper Belt Chaos

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