Where Have the Other Asteroid Belts Gone?

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Abstract: Observationally we find few asteroids or comets in the outer solar system which are not on planet-crossing orbits, and which could be considered stable over long time periods. Is this a result of observational bias, or an indication that the outer solar system interior to Neptune truly is depleted of planetesimal meterial? Using our highly-accurate high-order modified Störmer numerical integration technique, coupled with roundoff error mininimizing methods, we integrate the trajectories of ten thousand massless test particles - many more than in previous studies - for 1 billion years in a search for stable niches in the Saturn/Uranus and Uranus/Neptune zones. The increase in numbers of test particles facilitates robust statistical inference, and comparison with analytic results derived from statistical mechanics and kinetic theory. We also examine the role that resonant effects had on the evolution of these systems. We find that most planetesimals are removed on the order of 10^7 year time scales, but a few inhabited regions persist for 10^8 years. Few planetesimals survive the entire 1 billion year integration.

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