Neptune's Migration into a Hot Kuiper Belt

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The abundance of Kuiper Belt Objects (KBOs) at Neptune's 3:2 resonance has been interpreted as evidence of Neptune's outward migration. However recent reports of several KBOs inhabiting Neptune's more distant higher order resonances, namely, the 7:3 and 5:2 (which are located at 53 and 55 AU) represent something of a puzzle because previous simulations of Neptune's migration into a dynamically cold Kuiper Belt did not reveal any resonance capture at the 7:3 and 5:2. One possible explanation for these objects is given in Chiang et al (2003), who show that capture by the 5:2 is indeed possible when Neptune migrates into a previously stirred-up, or "hot" Kuiper Belt. We have investigated this scenario further by performing a suite of simulations of Neptune's migration into a hot Kuiper Belt. These simulations obtain endstates that resemble the observed Kuiper Belt if the KBO's have initial eccentricities and sin(i) of ~ 0.1 prior to the onset of planet migration. In this case, the high capture probabilities of the familiar 2:1 and 3:2 resonances are reduced by only a factor of ~ 2, while the more distant high-order resonances such as the 9:4, 7:3, 5:2, and the 3:1, become effective at capturing KBOs and pumping their eccentricities up to $e \sim 0.4$. Note that these latter resonances are located at semimajor axes $52 < a < 64$ AU, and that resonance capture inserts many of these eccentric KBOs into the domain of the Scattered Disk. Consequently, resonance capture by these weak resonances might also account for many members of the so-called 'extended Scattered Disk' (described by Gladman et al 2002) comprised of distant, eccentric KBOs having high perihelion distances exceeding 38 AU.

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