Exploring Planet Migration and Resonance Chain in Formation of the Kepler-80 Planetary System

Hadiseh Nabavi Nejad[1], Yousef Sadeghi [2], Sareh Ataiee [3]

Department of Physics, School of Sciences, Ferdowsi University of Mashhad, Mashhad, Iran

Abstract

This study presents a comprehensive examination of the formation mechanisms and dynamical evolution of a tightly packed planetary system. Specifically, we investigate the Kepler-80 system, a K-dwarf star hosting six super-Earths. Our investigation delves into both migration I and no-gap migration regimes, analyzing the system's behavior under different disk parameters and exploring the stability provided by resonance chains. We explore how variations in the disk's parameters and surface density influence the orbital configurations and long-term stability of the system. Our simulations indicate that the presence of a gap at the inner edge of the disk introduces instability, necessitating consideration of unsaturated torques. The findings indicate that planetary systems similar to Kepler-80, usually form with an aspect ratio of about 0.03. However in our simulation, stability increased when the aspect ratio was adjusted to 0.05, and due to the flaring of the disk, its value reached 0.03. Our research underscores the importance of Lindblad torque in reducing planetary migration rates, thereby allowing sufficient time for establishing stable resonance chains. The simulations reveal that all planets in the Kepler-80 system are locked into both two-body and complex three-body resonances.

[1]hadisehnabavi@gmail.com
[2]yousefsadeghi2001@gmail.com
[3]sarehataiee@um.ac.ir