Contribution ID: **119** Type: **not specified**

Stellar Flybys are Unlikely under New Constraints from Sednoid Observation

Tuesday 8 July 2025 11:37 (1 minute)

Sednoids are extremely distant Trans-Neptunian Objects (TNOs) with large semi-major axes and large perihelion distances. To date, we have only discovered three Sedniods: (90377) Sedna, 2012 VP113, and (541132) Leleakuhonua. Sednoids are thought to have formed through a combination of early planetary scatterings, which increased their semimajor axes, and additional perturbations beyond the four giant planets, which elevated their perihelion distances. Understanding the formation mechanism of sednoids is of great significance to our understanding of the early dynamical evolution of our solar system. One hypothesis posits that close stellar flybys could have perturbed objects from the primordial scattering disk, generating the sednoid population. In this study, we run 768 N-body simulations with different stellar encounter configurations to explore whether such a close stellar flyby can satisfy new constraints identified from sednoid (and detached extreme TNO) observation, including the low-inclination ($i < 30^\circ$) profile and the primordial orbital alignment. Our results suggest that flybys with field stars are unable to generate a sufficient population, whereas flybys within the birth cluster fail to produce the primordial orbital alignment. To meet the inclination constrain of detached extreme TNOs, flybys have to be either coplanar ($i_\star \sim 0^\circ$) or symmetric about the ecliptic plane ($\omega_\star \sim 0^\circ, i_\star \sim 90^\circ$). After taking into account their occurrence rate at the early stage of the Solar System, we conclude that stellar flybys that satisfy all constraints are unlikely to happen ($<5\%$). Future discoveries of additional sednoids with precise orbital determinations are crucial to confirm the low-inclination tendency and the primordial alignment, and to further constrain models of the Solar System's early dynamical evolution.

Presenter: HU, Qingru (Department of Astronomy, Tsinghua University, Beijing)

Session Classification: Poster Session