Stable Slivan states in the inner main belt?

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Slivan (2002) derived spin states for ten asteroids in the Koronis family residing in the outer main belt. Surprisingly, all four asteroids with prograde sense of rotation were shown to have spin axes nearly parallel in the inertial space. All asteroids with retrograde sense of rotation had large obliquities and rotation periods either short or long. Vokrouhlický et al. (2003) developed a model capable to explain this peculiar setup. Its key element was a capture in spin- orbital resonance (Cassini state 2) with planetary frequency s_6 assisted by evolution due to the Yarkovsky-O'Keefe-Radzievskii-Paddack (YORP) effect. These resonant configurations were dubbed "Slivan states". In this work, we analyze whether Slivan states can exist elsewhere in the main belt, focusing on its inner part (heliocentric distance < 2.5 au).

We find that long-term stable Slivan states can indeed exist in this part of the main belt provided that the orbital inclination is low enough. This is because the low inclination allows for the separation of the Cassini zones associated with the proper frequency s and the planetary frequency s_6. As an example, the spin state of (20) Massalia may be located inside, or very close, to a Slivan state. On the other hand, the orbital inclination of the members in the Flora family, or the region nearby, exceeds a critical value to maintain long-term stability of the Slivan states. For that reason, the spin states recently determined by Kryszczyńska (2013) for a couple of asteroids in this innermost part of the main belt are not similar to the Slivan states in the Koronis family. Still, their proximity to the Cassini state of the s_6 frequency may require an explanation.

References: Slivan, S. M. (2002). Spin vector alignment of Koronis family asteroids. Nature, 419, 49; Vokrouhlický, D., Nesvorný, D., & Bottke, W. F. (2003). The vector alignments of asteroid spins by thermal torques. Nature, 425, 147; Kryszczyńska, A. (2013). Do Slivan states exist in the Flora family?. II. Fingerprints of the Yarkovsky and YORP effects. A&A, 551, A102.