

Long-Term Stability of Planets in the Alpha Centauri System

The alpha Centauri system is billions of years old, so planets are only expected to be found in regions where their orbits are long-lived. We evaluate the extent of the regions within the alpha Centauri AB star system where small planets are able to orbit for billion-year timescales, and we map the positions in the sky plane where planets on stable orbits about either stellar component may appear. We confirm the qualitative results of Wiegert & Holman (Astron. J. 113, 1445, 1997) regarding the approximate size of the regions of stable orbits of a single planet, which are larger for retrograde orbits relative to the binary than for pro-grade orbits. Additionally, we find that mean motion resonances with the binary orbit leave an imprint on the limits of orbital stability, and the effects of the Lidov-Kozai mechanism are also readily apparent. Overall, orbits of a single planet in the habitable zones near the plane of the binary are stable, whereas high-inclination orbits are short-lived. However, even well within regions where single planets are stable, multiple planet systems must be significantly more widely-spaced than they need to be around an isolated star in order to be long-lived.