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The dynamical architecture and habitable zones of the planetary system 55 Cancri

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Abstract. We performed numerical simulations to study the secular orbital evolution and dynamical structure of the quintuplet planetary system 55 Cancri using the self-consistent orbital solutions of Fischer *et al.* (2008).

The nearby star 55 Cancri is of spectral type K0/G8V with a mass of $0.92 \pm 0.05\,M_{\odot}$. Two giant planets are reported to be trapped in a 3:1 orbital resonance and Fischer *et al.* (2008) revealed a fifth planet in this system. Herein, we report on simulations of the secular evolution and dynamical structure of this system.

We show that this system can be stable for at least 10^8 yr. In addition, we extensively studied the planetary configuration of four outer companions with one terrestrial planet in the wide region 0.790–5.900 AU to examine the existence of a potential asteroidal structure and Habitable Zones (HZs). We find that there are unstable regions for the orbits about 4:1, 3:1 and 5:2 mean motion resonances (MMRs) with the outermost planet in the system, and several stable orbits can remain at 3:2 and 1:1 MMRs, a configuration which bears some resemblance with the asteroidal belt in the solar system.

From a dynamical point of view, candidate HZs for the existence of more potential terrestrial planets reside in the range between 1.0 AU and 2.3 AU for relatively low eccentricities. Moreover, our numerical simulations suggest that additional Earth-like planets can coexist with the five known planets in this system over secular timescale. This result suggests that abundant measurements and space missions (e.g. SIM Lite) should focus on this system in the future. The detailed results of this work may be found in Ji *et al.* (2009).

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