Dynamical stability of extrasolar terrestrial planets

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Many terrestrial planets could exist in the extrasolar planetary systems. We have investigated the condition for the planet to be habitable from the viewpoint of planet's dynamical stability.

Organisms which we are familiar with on the Earth require liquid water during at least part of their life cycle. In order for life to emerge on a terrestrial planet, it is necessary that their orbits remain confined in the habitable zone (the range of distance from the star allowing the existence of liquid water at the sueface of a terrestrial planet) (e.g., Kasting et al. 1993). Many of the giant planets so far discovered possess different orbital properties from the planets of Solar System. Most extrasolar planetary systems so far found are comprised of short-period giant planet or eccentric planet. We have investigated the effect of such giant planets on the orbital stability of the terrestrial planets in extrasolar planetary systems.

In addition, moderate climate may be required in order for land-based life to evolve and survive on a terrestrial planet. Variation of planetary obliquity is one of the important causes to affect the climate. Since orbital properities of the planets which affect the planet's obliquity are different from those which make their orbits unstable, obliquity may suffer large variation even if their orbits are stable. However, retrograde spin, or a large and/or close satellite might reduce such large obliquity variation(Atobe et al. 2004, Icarus, in press).

We investigated the dynamical stability of planet and its effect on the planetary habitability, introducing the numerical simulation of the motion of orbit and obliquity. The probability of the existence of habitable planets in extrasolar planetary systems is also discussed.