Habitable Planets, and Water-Delivery in Binary Star Systems

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Current models of planet formation explain how planets are formed around single stars. However, binary stars are the most common outcome of the star formation process. There is considerable evidence for protoplanetary disks in young multiple star systems, and observations show that initial conditions for planet formation exist in binary systems, as well. A survey of all currently known extrasolar planets indicates that close to 25% of their hosting stars are members of binary systems. Almost all of these binaries are wide with separations ranging from 250 to 1000 AU. At these separations, the effect of the binary companion on the formation and dynamical evolution of planets around the other star is negligible. However, in close binary systems, such as Gamma Cephei (separation of 21 AU) where a Jupiter-like planet revolves the primary at a distance of 2.13 AU, the gravitational perturbation of the companion can have considerable effects on the structure of the circumstellar disk, formation of planetesimals and protoplanets, and ultimately on the formation of habitable planets, and water-delivery mechanisms. In this paper, I will discuss habitability in binary systems and the effects of the companion on the formation of Earth-like planets in the system's habitable zone. Within the context of habitability, I will present the results of a large survey of the parameter space of binary-planetary systems in search of regions where habitable planets can have long-term stable orbits, and will discuss the effect of the companion on mechanisms of delivery of water to such planets.