Models show one nearby star system could host Earth-like planet

July 24 2006

The steady discovery of giant planets orbiting stars other than our sun has heightened speculation that there could be Earth-type worlds in nearby planetary systems capable of sustaining life. Now researchers running computer simulations for four nearby systems that contain giant planets about the size of Jupiter have found one that could have formed an Earth-like planet with the right conditions to support life.

A second system is likely to have a belt of rocky bodies the size of Mars or smaller. The other two, the models show, do not have the proper conditions to form an Earth-size planet. Each system lies within 250 light years of Earth (a light year is about 5.88 trillion miles). Astronomers already have found evidence that each system contains at least two giant planets about the mass of Jupiter, which have migrated close to their stars, perhaps as close as Mercury is to the sun.

For each of the four systems, the researchers conducted 10 computerized simulations that placed small planet embryos, or protoplanets, in the system to see if they are able to gather more material and form a true planet the size of Earth. Each simulation assumed the same conditions in the planetary system except that the position and mass of each protoplanet was altered slightly, said Sean Raymond, a postdoctoral researcher at the University of Colorado, who took part in the work while he was an astronomy doctoral student at the University of Washington.

Raymond is lead author of a paper describing the research published in

June in the Astrophysical Journal. Co-authors are Rory Barnes, a postdoctoral researcher at the University of Arizona who also took part in the work while a UW astronomy doctoral student, and Nathan Kaib, a UW doctoral student in astronomy. The work was funded by the National Aeronautics and Space Administration, NASA's Astrobiology Institute and the National Science Foundation.

"It's exciting that our models show a habitable planet, a planet with mass, temperature and water content similar to Earth's, could have formed in one of the first extrasolar multi-planet systems detected," Barnes said.

Recent studies show many known extrasolar planetary systems have regions stable enough to support planets ranging from the mass of Earth to that of Saturn. The UW models tested planet formation in systems called 55 Cancri, HD 38529, HD 37124 and HD 74156. The researchers assumed the systems are complete and the orbits of their giant planets are well established. They also assumed conditions that might allow formation of small bodies that could develop into rocky, Earth-like planets.

In the models, the scientists placed moon-sized planet embryos between giant planets and allowed them to evolve for 100 million years. With those assumptions, they found terrestrial planets formed readily in 55 Cancri, sometimes with substantial water and orbits in the system's habitable zone. They found HD 38529 is likely to support an asteroid belt and Mars-sized or smaller bodies but no notable terrestrial planets. No planets formed in HD 37124 and HD 74156.

"What surprised me the most was to see the system that only formed planets the size of Mars or smaller," Raymond said. "Anything that grew too big would be unstable, so there was an accumulation of a lot of smaller protoplanets maybe one-tenth the size of Earth."

It was significant, Kaib said, that the models showed conditions could remain stable enough for 100 million years so that a planetary embryo would have a chance to gather more substance and develop into a body the size of the moon or Mars. "In our early system, that's probably what our inner solar system looked like, with hundreds of bodies that size," he said.

Extrasolar planets have been discovered with increasing frequency in recent years because of techniques that detect giant planets by their gravitational effect on their parent stars. It is uncertain how the giant planets evolve, but they are thought to form far away from their host stars and then migrate inward, pushed by the gas discs from which they formed. If the migration occurs late in the system's development, the giant planets might destroy most of the materials needed to build Earth-like planets, Raymond said. He noted that while the presence of giant planets is fairly well established, it will be some time before it is possible to detect much smaller Earth-sized planets around other stars.

For another recent paper, Raymond ran more than 450 computer simulations to map giant planet orbits that allow Earth-like planets to form. If a giant planet is too close it will prevent rocky material from amassing into an Earth-sized planet. That study showed that only about 5 percent of the known giant-planet systems are likely to have Earth-like planets. But because of long observation times and sensitive equipment needed to detect planets the size of Saturn and Jupiter, it is possible there could be many planetary systems such as ours in this galaxy, he said.

Source: University of Washington

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