Habitable zones

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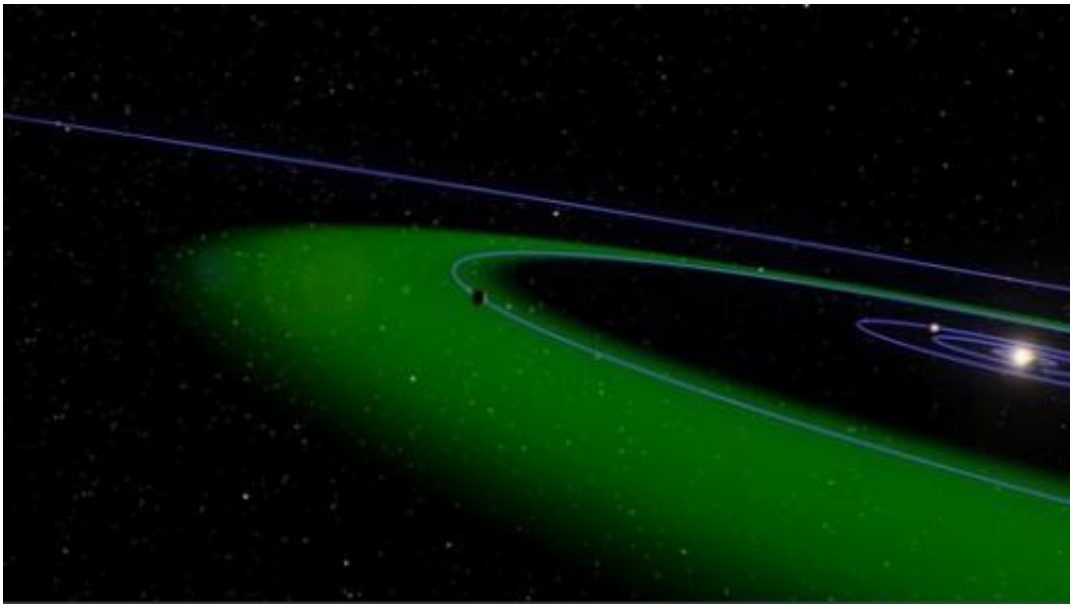

An artist's conception of the habitable zone (green ring) around 55 Cancri, a star known to have a large planet orbiting in this temperature-suitable region where water could be liquid. Credit: NASA/JPL-Caltech

(PhysOrg.com) -- The "habitable zone" is the region around a star where a suitable planet could sustain the conditions necessary for life. Most astronomers take it to be the region where the balance between stellar radiation onto the planet and radiative cooling from the planet allows water on the surface to be a liquid; this definition also presumes the planet has an atmosphere and a solid surface. In our solar system, the Earth is cozily situated in the middle of the habitable zone which, depending on the model, extends roughly from Venus to Mars.

The Kepler satellite has recently announced the detection of 1235 planetary candidates around other stars. How many of these exoplanets lie in their habitable zones and might (at least to this extent) be suitable hosts for life? The original Kepler paper concluded that fifty-four were in their habitable zones.

CfA astronomers Lisa Kaltenegger (now at the Max Planck Institute for Astronomy) and Dimitar Sasselov have explored in more detail the conditions necessary for a planet to lie in its habitable zone. They take into account more carefully five factors: the incident stellar flux and its spectral character, the planet's eccentricity (how its distance from the star differs during its orbit), the planet's reflectivity including the effects of partial cloud cover, the greenhouse gas concentration, and finally, some details of the planet's atmosphere.

With some reasonable assumptions the scientists find that, in the case of the solar system, the habitable zone extends from the orbit of Venus to well beyond the orbit of Mars (nearly to the inner edge of the main asteroid belt). When they apply their models to the 1235 candidates in the current Kepler catalog they find that the original estimate of fifty-four planets was far too high.

A more accurate estimate finds that only six of the Kepler exoplanetary candidates could be in a habitable zone, assuming that they have atmospheres. The results are another important step in refining the search for Earth-like planets (not just Earth-sized planets) around other stars.

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