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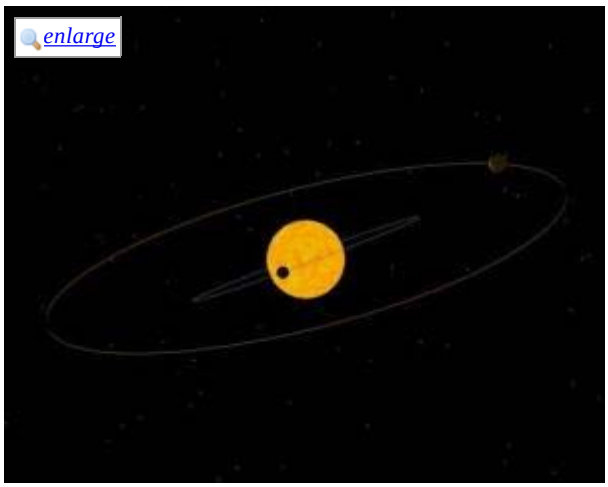
Study On Extrasolar Planet Orbits Suggests That Planetary Systems Like Our Solar System Is the Norm

ScienceDaily (Apr. 11, 2012) — Recently, the HARPS spectrograph and the Kepler satellite made a census of the planetary population around stars like our own, revealing a bounty of planetary systems. A follow-up study led by members of the EXOEarths team (Centro de Astrofísica da Universidade do Porto -- CAUP), in collaboration with Geneva University, did a joint analysis of the data which showed that the planetary orbits in a system are strongly aligned, like in a disk, just as we have in our own solar system.



Exoplanets with non co-planar orbits. (Credit: Ricardo Reis (CAUP))

The two most effective methods for detecting extrasolar planets are the radial-velocity method and the transit method. The radial-velocity method detects planets through the reflex motion induced by the planet on the star's velocity on the radial direction (hence the name). This velocity variation is detected through the Doppler effect, the same that leads to a pitch change in the sound of an traveling train. On the other hand, a planetary transit is akin to a mini-eclipse. As a planet travels around the star, its orbit can locate it in front of the star, and the light we collect from the star is reduced because the planet blocks part of it (even though we cannot image the planet).

There is a significant difference when these two methods are applied to planetary system. A planet can be detected in radial velocity even when the orbit's plane direction is tilted relative to the line of sight, and the same is true for a system of planets. However, for a planet to transit, the plane of its orbit has to be almost perfectly aligned with our line-of-sight, and the same is true for a system of two (or more planets) to transit. This means that if several planets in a system transit they necessarily form a very small angle between them.

Researchers simulated planetary systems with frequencies as reported by HARPS survey (that detects basically all the systems, independently of their inclination angle), and attributed to them different relative inclinations. The frequency of transiting systems was calculated and compared with the values reported by Kepler. Researchers showed that a match can be obtained for double-transiting systems only if they are very strongly aligned with a common plane (the system's plane). This alignment has to be close to 1 degree, and only reaches 5 degrees on very extreme cases (extreme on the sense of the assumption on how a planetary mass translates to a radius).

These results show consistently that the planets' orbits are predominantly aligned, reinforcing the idea that planets form on a disk and suggesting for the first time that violent encounters between planets are not frequent. This provides a very important clue about the formation and evolution of exoplanets, a domain in which several open questions remain. This study shows that the high degree of alignment of our system

might well be the norm for planetary systems.

Pedro Figueira (CAUP), the article's first author said: "These results show us that the way our solar system formed must be common. Its structure is the same as the other planetary systems we studied, with all planets orbiting roughly in the same plane."

Story Source:

The above story is reprinted from materials provided by **Centro de Astrofísica da Universidade do Porto**, via AlphaGalileo.

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Journal Reference:

1. P. Figueira, M. Marmier, G. Boué, C. Lovis, N. C. Santos, M. Montalto, S. Udry, F. Pepe, M. Mayor. **Comparing HARPS and Kepler surveys: On the alignment of multiple-planet systems**. *Astronomy & Astrophysics*, 2012 (accepted)