Highly inflated Jupiters

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The HATNet telescopes at the Fred L. Whipple Observatory in Arizona. The telescopes have detected three exceptionally large extra-solar planets, dubbed highly inflated Jupiters.

There are currently 851 confirmed extra-solar planets. Of these, 289 were detected because their orbits (as seen from Earth) take them across the face of their host star, dimming the star's light in a transit event. The Kepler satellite has provided the largest set of transiting extra-solar planets and, if the list is expanded to include candidate planets (that is, planets spotted but not yet confirmed), it contains several thousand objects. Of the 289 confirmed transiting planets though, 194 were found with ground-based telescopes.

"Hot Jupiters" are those extra-solar planets whose masses are about the same as Jupiter's, but whose orbits are so close to their stars that (unlike Jupiter in our solar system) their atmospheres are very hot, in some cases over 2000K, and correspondingly swollen to as much as twice the diameter of Jupiter. The large diameters and small orbits (frequent transits) of hot Jupiters make them a particularly good class for ground-based telescopes to identify via their transits.

Scientists who model planetary atmospheres calculate that the diameters of hot Jupiters should be inflated, but they cannot yet adequately explain the measured sizes. For that matter, scientists are not sure why hot Jupiters should exist at all, nor how they formed and evolved. Astronomers trying to understand how the Earth formed and how it ended up orbiting the Sun at a distance just right for temperatures conducive to life are therefore very interested in the lessons to be learned from hot Jupiters.

These same characteristics of transiting hot Jupiters make them particularly good candidates for ground-based observations. CfA astronomers have pioneered a new technique for discovering and studying extrasolar planets using a system of six small, automated ground-based telescopes (diameters between about 6 and 11 centimeters) that take digital, optical images of the sky nightly, looking for intensity variations in each star's light. Because the telescope diameters are small,

the field of view of each telescope in the sky is large, and many thousands of stars are simultaneously monitored. The cameras use multi-megapixel CCDs to obtain tens of thousands of exposures that the software then scans looking for variability that signals planetary transits. The telescopes, which are currently located at the Fred L. Whipple Observatory in Arizona and the Submillimeter Array in Mauna Kea, Hawaii, are collectively called the HATNet. So far, HATNet has discovered 42 of the 289 known transiting planets.

CfA astronomers Bence Beky, Torres Guillermo, Dave Latham, Bob Noyes, Gilbert Esquerdo, Allyson Bieryla, Dimitar Sasselov, Gabor Furesz, and Robert Stefanik, and their colleagues, using HATNet have published their discovery of three new hot Jupiters—and in so doing have identified a new subclass of extra-solar planets, dubbed "highly inflated Jupiters."

The three new planets each has an orbital period of just a few days, a mass slightly smaller than that of Jupiter (by about 20%), and a radius 50%-70% larger than Jupiter's. Combining their results with statistics of previously known hot Jupiters, the scientists realized that hot Jupiters like these three, with radii over 50% larger than Jupiter's, form a distinct subset of exoplanets with highly inflated atmospheres. Although the reasons for their existence remain a topic of research, as with all the hot Jupiters, the new results demonstrate how important it is for astronomers to collect detailed information on large numbers of objects. One might perhaps think that the thousands of known or suspected extra-solar planets comprise a large enough set for a thorough understanding of planets, but the discovery of this distinct subset of highly-inflated Jupiters demonstrates the need for ongoing research.

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