Now That we Have Found Them: Characterizing Planets Around Other Stars

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The field of planets around other stars ("exoplanets") is one of the most exciting in astronomy. The number of detected planets now numbers over 300. But detection is merely the starting point towards answering the question of "What are these planets like?" The planets that are currently the easiest to study are those that transit as seen from Earth, meaning they periodically pass directly in front of and behind their parent star, like an eclipse. Transits are powerful because we can then measure planetary radii and estimate bulk composition. When a planet passes in front of its star we can also measure the tiny fraction of light that passes through the planet's atmosphere, imprinting its absorption spectrum on this stellar light. This allows us to measure the abundances of molecules in the atmospheres of planets that are over 100 light years away. Transits are more likely to occur when planets are close to their parent star, and hence, are hot. When a hot planet passes behind its parent star, we can see the planet's thermal infrared emission disappear. The amount of this emission drop tells us the planetary temperature. In all these studies, complex planetary structure and planetary atmosphere models are needed to interpret the incoming data. Those exoplanets that are easiest to find are the large gas giants, similar to Jupiter. Exotically, these transiting "hot Jupiters" orbit at distances much closer than even Mercury does to the Sun. This same path of transiting planet characterization is now being used for smaller planets, similar to Neptune, and will eventually be done for exo-Earths (sooner than you think!).