NIR Imaging Spectroscopy of Extrasolar Planets

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The search for exoplanets and their characteristics has become a fast-growing field in astrophysics. Most of the about 150 known exoplanets have been found indirectly [Marcy 1995] via dynamical effects (Doppler-shift of stellar Lines). Several so called transiting exoplanets have been detected due to variations in the stellar light curves [Henry 2000, OGLE and TrES surveys]. First direct detection of infrared light from an extrasolar planet was recently demonstrated [Deming 2005, Charbonneau 2005] and also the direct imaging of an extrasolar planet deems possible [Neuhäuser 2004, Chauvin 2005]. Although imaging of extrasolar planets already provides valuable information, the important step is obtaining spectra of exoplanets.

Detailed models of contrast and expected signal to noise ratio show that the subgroup of transiting exoplanets is already observable with near infrared integral field spectroscopy from large ground based telescopes. These exoplanets have their orbits inclined so that they move across the stellar disk during inferior conjunction and disappear behind the host star during superior conjunction.

The best of these candidates so far is the transiting 'Hot Jupiter' exoplanet HD 209458b since its orbit has been determined with sufficient accuracy and its orbital period of about 3.5 days provides frequently recurring conjunctions.

However, observing opportunities are rare (only about 3 nights per year and observatory) because transit has to occur during culmination and because enough observing time under stable atmospheric conditions is needed to build a adequate S/N-ratio on the star alone in SC. Each conjunction lasts about 2 hours between 2nd and 3rd contact, requiring about 7 hours for optimal observation. Therefore, a careful investigation of the timing of the secondary eclipse and its duration.
is absolutely necessary to optimize integration time and to correlate the data. It can be shown that despite many error afflicted parameters (e.g. eccentricity and inclination of the orbit)[Cody 2002], the SC and its duration can meanwhile be determined to within a few minutes.

Our group has observed HD 209458b before and during its secondary eclipse using the VLT-SINFONI instrument in August 2005 and using the OSIRIS instrument at Keck on September 11th, 2005.

References:
Marcy, G. W.; Butler, R. P. 1995, 187th AAS Meeting, 70.04; Bulletin of the AAS, Vol. 27, p.1379

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