RevMexAA (Serie de Conferencias), **42**, 101–101 (2013)

AO IMAGING AND INFRARED SPECTROSCOPY OF EXOPLANET HOST STARS

I. Skillen[1] and D. Pollacco[2]

The telescopes of the ORM, La Palma have gained a worldwide reputation in the discovery and characterisation of exoplanets, which demonstrates the powerful synergy that exists between small, mid-size and large facilities such as SuperWASP, the WHT and GTC, in this rapidly evolving field. We outline a WHT programme of near-infrared adaptive optics imaging with NAOMI/INGRID, and near-infrared spectroscopy with LIRIS, of exoplanet host stars to search for associated stellar and brown dwarf companions.

The Wide Angle Search for Planets (WASP) project (Pollacco et al. 2006) has been extraordinarily successful in discovering transiting exoplanets, having identified ∼40% of the confirmed systems at the time of writing. Most of these transiting planets have Jupiter-like masses and orbit very close to their host stars in orbits with semi-major axes $\lesssim$0.1 AU and periods $\lesssim$5 days. It's widely accepted that these 'hot Jupiters' do not form *in situ* due to the effects of strong irradiation by their host stars and Keplerian shear in the proto-planetary disc. In the standard model they form much farther out in the proto-planetary disc beyond the 'snow line' at distances $\gtrsim$3 AU from the host star where solid material is abundant, and undergo a secular migration to smaller orbital semi-major axes by angular momentum exchange between the planet and the gas-disc within which it is embedded.

As more transiting systems have been discovered and studied in detail, a picture of significant diversity in exoplanet densities, atmospheres and orbital geometries has emerged. In particular, measurements of the anomalous Doppler shift caused by a planet eclipsing part of the rotating stellar disc throughout transit (the Rossiter-Mclaughlin effect) demonstrate that the projected angle between the stellar spin and planet orbital axes is such that a significant fraction of massive planets orbit their host star in strongly misaligned, and even in retrograde orbits. This poses a challenge to the standard model which would tend to favour circular and aligned orbits, unless of course protoplanetary discs themselves can be misaligned.

Mechanisms such as planet-planet scattering and interaction with a distant stellar companion (the Kozai mechanism), both generate inward migration and lead to a range of orbital configurations, and may therefore play a role in the formation and evolution of hot Jupiters.

We very recently (July/August 2011) initiated a programme of high resolution, near-infrared imaging with the WHT's adaptive optics (AO) system to discover on spatial scales of ∼0.1″–10″, and to compare the frequency of, binary companions around the aligned and misaligned systems in our sample as an explicit test of the Kozai mechanism's influence on the dynamical history of the hot Jupiters.

Our very preliminary, single-epoch results indicate detections of putative companions to more than one-third of our sample, but these appear not to favour exclusively those systems which are known to be misaligned. Of course second-epoch observations are needed to confirm if these companions are dynamically associated with the exoplanet system.

AO imaging on the WHT is insensitive to companions within ∼0.1″ of the exoplanet host star, and to explore this region we are using near-infrared spectroscopy with the WHT and VLT to search for spectral signatures of low-mass stellar and substellar objects. This combination of AO imaging and near-infrared spectroscopy is a powerful tool for exploring the environments of exoplanet hosts on all spatial scales.

Clearly, very high resolution imaging and spectroscopy play an important role in the confirmation and characterisation of exoplanetary systems, and we anticipate eagerly the advent of the AO imager and integral field spectrograph, FRIDA, and the AO lucky imager, AOLI, on GTC, which together can exploit its near-infrared and optical diffraction limits to better understand the environments of exoplanet host stars at the highest spatial resolutions.

[1]Isaac Newton Group of Telescopes, Apartado de Correos 321, E-38700 Santa Cruz de La Palma, Tenerife, Spain (wji@ing.iac.es).

[2]Astrophysics Research Centre, School of Mathematics and Physics, Queen's University Belfast, University Road, Belfast BT7 1NN, United Kingdom.

REFERENCES

Pollacco, D., et al. 2006, PASP, 118, 1407