EFFECTS OF CLOUDS ON REFLECTION PROPERTIES OF HOT JUPITERS. N. Afram[1] and S. V. Berdyugina[1,2], [1]Kiepenheuer Institut für Sonnenphysik, Freiburg, Email: afram@kis.uni-freiburg.de, [2]NASA Astrobiology Institute, Institute for Astronomy, University of Hawaii, USA.

Introduction: Polarimetry is capable to directly detect reflected light from an exoplanetary atmosphere even if the planet is spatially unresolved from the star and does not transit it. This technique has led to the first detection of the reflected light from an exoplanetary atmosphere and first measurement of its geometrical albedo [1],[2]. Because of the strong dependence of the polarization signal on the composition of the atmosphere [3], the dominance of Rayleigh scattering on dust condensates, molecules, and other species was shown to lead to the blue color of the planet.

In this work we will present how polarimetric techniques are applied to characterize atmospheres of hot Jupiters that contain clouds.

Clouds represent the main opacity source in the atmosphere of an exoplanet. The presence of clouds and the chemical composition of the atmosphere can be studied with polarimetric methods which are independent of planet transits in front of their host stars. Various molecules (H2O, CO, CO2, CH4) in the atmosphere of hot Jupiters (the type of exoplanet that is similar to Jupiter but with higher surface temperatures due to a closer orbit to their parent star) were detected with differential spectroscopy. However, this method can only be applied to transiting planets.

Here, we present the theory to model molecular polarization due to scattering in selected molecular bands for a range of parameters of hot Jupiter atmospheres. We model various scenarios of different atmospheres with varying temperature/pressure profiles including clouds. We study how the polarization signal of the light reflected by the planet's atmosphere that contains cloud is changed due to scattering in molecular lines that are dominant in the atmospheres of hot Jupiters (e.g. WASP_19_b) as dust or in the gas phase (such as H2O, OH, H2, CO, CO2, CH4, NH3, MgO, MgSiO3, Mg2SiO4, Al2O3).

This method represents a powerful tool for detecting molecules in exoplanets (and other objects) and shows how decoding polarimetric signals in a spectrum of an exoplanet can reveal its orbit, mass, and chemical composition.

This study will help planning observations of exoplanets based on theoretical predictions.

References:

[1] Berdyugina, S.V., Berdyugin, A.V., Fluri, D.M., Piirola, V., 2008, ApJ Lett., 673, L83. [2] Berdyugina, S.V., Berdyugin, A.V., Fluri, D.M., Piirola, V., 2011, ApJ Lett., 728, L6. [3] Stam, D.M., Hovenier, J.W., Waters, L.B.F.M., 2004, A&A, 428, 663.