Radiative Transfer Modeling to Interpret Photopolarimetric Measurements of Brown Dwarf Emissions

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We present a novel radiative transfer scheme for computing the disc-resolved and disc-integrated polarized infrared emission of an oblate brown dwarf (BD) or planet. Using this capability, we model oblate cloud-bearing brown dwarfs at different orientations relative to the observer.

The dependence of the photo-polarimetric signal on cloud optical thickness and droplet size, stellar oblateness and inclination are examined qualitatively.

Knowledge of the oblateness and the projected inclination of the stellar axis in the viewing plane together allow the determination of the exact orientation in space of the stellar rotation axis, for both uniform and patchy brown dwarfs. Polarization measurements are most sensitive to the stellar limb, thus providing information complementary to photometric measurements which are susceptible to limb darkening. Information content analysis reveals that polarization can contribute significantly to the quality of the retrieval, especially when measurements can be made with high accuracy.

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