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Spectropolarimetry of the 3.4 μm Band in the Quintuplet

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Abstract. We present spectropolarimetry of the 3.4μm solid hydrocarbon absorption feature arising in the ISM toward the Quintuplet member GCS3-II, permitting for the first time a comparison of the hydrocarbon and silicate polarizations in the same line of sight. The hydrocarbon band is not measurably polarized, strengthening our previous conclusion that the silicates and carbonaceous grains form distinct populations.

1. Introduction

The formation and physical properties of the organic grain component in the diffuse interstellar medium (DISM) are controversial. Two production routes for interstellar aliphatic hydrocarbons have been proposed. Firstly, if organic refractory material is produced in the DISM by UV processing of ice mantles originating in dense clouds, silicate cores should be coated with a hydrocarbon mantle (e.g. Greenberg & Li 1996). Alternatively, if production occurs in situ in the diffuse ISM via hydrogen-bombardment of pre-existing carbon particles (Mennella et al. 2002), hydrocarbons and silicates would be separate grain populations. In the first of these pictures, the 3.4μm (hydrocarbon) feature should share the polarization properties of the 9.7μm (silicate) absorption feature. Adamson et al. (1999) showed that the 3.4μm feature observed toward GC-IRS7 is not polarized, but the predicted polarization of the hydrocarbon feature was based on the observed polarization of the silicate feature toward GC-IRS3, a (slightly) different line of sight. It is important to obtain spectropolarimetry of the hydrocarbon and silicate features along the same line of sight.

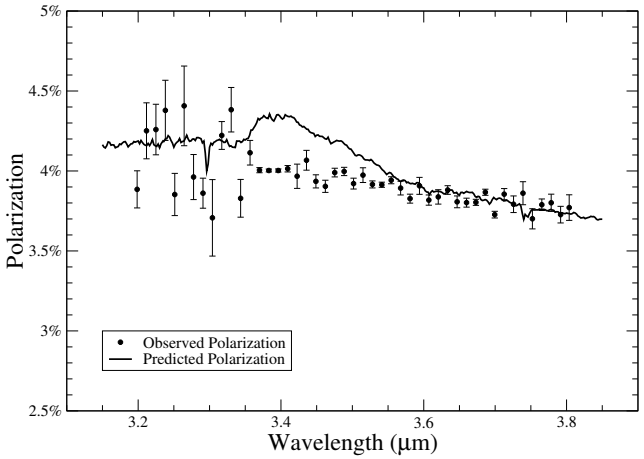

Figure 1. Polarization spectrum of GCS 3-II. Predicted and observed polarization measurements are shown.

2. Spectropolarimetry of the Quintuplet Member GCS 3-II

There is good evidence that both the silicate and hydrocarbon features observed toward the Quintuplet cluster member GCS3-II are in the foreground. The polarization position angle is essentially constant across the silicate band, is similar to the interstellar value, and the polarization spectrum is consistent with pure absorption (Smith et al. 2000). The 3.4μm hydrocarbon absorption is invariant across the cluster (Chiar, Adamson, & Pendleton, in preparation). The polarization of the silicate feature implies, in the core-mantle model, a 3.4μm feature polarized with Δp between 0.36 and 0.41%.

Using CGS4 on UKIRT, we have obtained 3-μm spectropolarimetry of the line of sight toward GCS 3-II. Complimentary data for the line of sight toward GCS 3-IV were also obtained and will be presented in a future journal article. Although reduction is at a preliminary stage and all systematics have not yet been investigated, the results for GCS 3-II suggest an upper limit excess of order 0.1% at the peak of the hydrocarbon feature (Figure 1). This is consistent with an origin of the hydrocarbon feature in a grain population which is physically separate from the silicates in this line of sight, and which does not respond to the alignment mechanism that polarizes the silicates.

References

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