Polarised emission from interstellar dust clouds

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The emission of interstellar dust grains at far-infrared and radio wavelengths is observed to be polarised. This tells us that the emitting grains are asymmetric and at least partially aligned in the interstellar magnetic fields. The polarisation carries information about the grain properties and the grain alignment mechanisms that are at work in the clouds. Because polarisation is connected to the geometry of the magnetic fields, the observations can also be used to infer the effects that magnetic fields may have on the formation and evolution of interstellar clouds and thus on the star-formation process. The interest in dust polarisation is increasing because of the large amount of polarisation data available from the *Planck* survey [1], balloon-borne experiments, and new ground-based instruments. Part of the interest is connected with the studies of the cosmic microwave background where the emission from interstellar clouds is recognised as a major source of confusion.

I will describe our current work on the interpretation and modelling of the polarised radiation from the interstellar medium. I will concentrate on the analysis of *Planck* observations towards dense molecular clouds. We have studied the objects in the *Planck catalogue of Galactic Cold Clumps* (PGCC) [2]. The clumps are dense and cold (T<14K) regions of interstellar clouds and are believed to represent an early stage in the process leading to the formation of new stars. We confirm a general decrease of the polarisation fraction as a function of the column density. This points to an increasing magnetic field tangling and possibly a partial loss of the grain alignment, which is expected to result from the weak radiation field inside the clumps. We are also investigating the relative orientation of the magnetic fields, which are deduced from the polarisation data, and the density structures, which are traced by higher resolution *Herschel* satellite data. Earlier studies have suggested that low column density structures are aligned with the magnetic field while the dense, star-forming filaments are mainly perpendicular [3]. We are pursuing these studies with a sample of over one hundred fields that were observed at submillimetre wavelengths as part of the *Herschel* open time key programme Galactic Cold Cores [4]. The results on the polarisation fraction and the relative orientation of the density and magnetic field structures are being compared to the predictions from high-resolution magnetohydrodynamic simulations.

[1] Planck Collaboration. Planck intermediate results. XIX. An overview of the polarized thermal emission from Galactic dust, 2015, A&A 576, A104

[2] Planck Collaboration. Planck 2015 results. XXVIII. The Planck Catalogue of Galactic cold clumps, 2016, A&A 594, A28

[3] Planck Collaboration. Planck intermediate results. XXXII. The relative orientation between the magnetic field and structures traced by interstellar dust, 2016, A&A 586, A135

[4] Juvela M., Ristorcelli I., Pagani L., et al., Galactic cold cores III. General cloud properties, 2012, A&A 541, A12