Polarized thermal dust emission as seen by *Planck* : A comparison with MHD simulations and lessons from a toy model

F. Levrier[1] on behalf of the *Planck* collaboration and J. Neveu[1]

[1]LERMA, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universités,
UPMC Univ. Paris 06, École Normale Supérieure, F-75005, Paris, France
email: `francois.levrier@ens.fr`

Abstract. The *Planck* satellite has mapped the polarized microwave sky (from 30 GHz to 353 GHz) with unprecedented sensitivity and angular resolution. This wealth of data yields the first complete map of polarized thermal emission from dust in our own Galaxy, shedding new light on the formation of dense cold structures within which new stars and planetary systems are born, under the combined effects of gravity, turbulence and magnetic fields. We present a statistical analysis of this polarized emission from nearby molecular clouds, with an emphasis on the evolution of the maximum polarization fraction observed as a function of column density, and on the anti-correlation between the polarization fraction and the local dispersion of polarization angles. To interpret this data, numerical simulations of anisotropic MHD turbulence underline the essential role played by the topology of the interstellar magnetic field, in particular its large-scale component. Indeed, the polarization of dust thermal emission at the scales observed by Planck is essentially related to the geometry of the magnetic field. Polarization fractions anti-correlate with column densities, which may be due to a succession of variously polarized structures on the line of sight. They also anti-correlate with the local dispersion of polarization angles. These features are well reproduced by MHD simulations of the diffuse ISM, with comparable correlation coefficients. As an extension to this work published in Planck Intermediate Results XX (A&A, 576, 105, 2015), the statistical properties of the random component of the interstellar magnetic field are explored using a toy model of the turbulent magnetized ISM based on fractional Brownian motion (fBm) fields. A least-squares analysis to retrieve the statistical properties of the interstellar magnetic field from Planck observations is pursued. Application of this method on the toy model shows good promise, and we are currently working towards its application on *Planck* data.

References

Fromang, S., Hennebelle, P., & Teyssier, R. 2006, *A&A*, 457, 371
Hennebelle, P., Banerjee,R., Vazquez-Semadeni, E., Klessen, R. S., & Audit, E. 2008, *A&A*, 486, L43
Planck 2013 Results XI 2004, *A&A*, 571, 11
Planck 2015 Results I 2015, *A&A*, submitted
Planck Intermediate Results XIX 2015, *A&A*, 576, 104
Planck Intermediate Results XX 2015, *A&A*, 576, 105
Teyssier, R. 2002, *A&A*, 385, 337