Precision Galactic magnetometry from dust polarization

R. Skalidis[1,2#*], K. Tassis[1,2], V. Pavlidou[1,2], J. R. Beattie[4] and J. Sternberg[3]

[1] Dept. of Physics & ITCP, University of Crete, 70013, Heraklion, Greece

[2] Institute of Astrophysics, FORTH, 70013, Heraklion, Greece

[3] Ph. Dept., Ecole Normale Sup., Université PSL, 24, Paris, France

[4] Research School of Astronomy and Astrophysics, ANU, Canberra, Australia

Presenting author: R. Skalidis, email: rskalidis@physics.uoc.gr

* Corresponding author: R. Skalidis, email: rskalidis@physics.uoc.gr

ABSTRACT

Dust polarization is used to probe the magnetic field properties in the interstellar medium (ISM), but it does not provide a direct measurement of its strength. Various methods have been developed employing dust polarization and spectroscopic data in order to infer the magnetic field strength. All of these methods rely on the assumption that the observed linewidths of the emission spectra and the spread in the distribution of the polarization angle is due to the propagation of Alfven waves, e.g., Chandrasekhar & Fermi 1953. Observations, however, indicate that non-Alfvenic (compressible) waves may be important in the ISM kinematics. We relaxed the incompressibility assumption and developed a new method which takes into account the compressible modes in the estimation of the magnetic field strength (Skalidis & Tassis 2021). We created synthetic observations from 3D MHD turbulent simulations in order to assess the accuracy of our method. We found that with our new method we can estimate the magnetic field strength with a relative deviation from the true value always smaller than 50% (Skalidis et al. 2021). On the other hand, the previous methods which omit the compressible modes produced estimates which systematically deviate more than a factor of two from the true value. The accuracy of our method allows us for the first time to enter the Era of Precision Astrophysics for ISM magnetic fields.

REFERENCES

[1] Chandrasekhar, S., Fermi E., 1953, ApJ, 118, 113

[2] Skalidis R., Tassis K., 2021, A&A, 647, 186

[3] Skalidis R., Sternberg J., et al. 2021, A&A, 656, 118