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# Structure of magnetic turbulence at 1 AU

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Analysis of turbulence data

## Summary

Ab initio cosmic-ray modulation models require turbulence spectra as input for the diffusion tensor. If one assumes a composite slab/2D structure for the turbulence, the so-called slab ratio - which is the ratio of the energy density in the slab spectrum compared with the total energy density - is required. Bieber et al. (1996, JGR, 101) describe two methods for calculating this ratio; Saur and Bieber (1999, JGR, 104) add a third method. After a brief introduction to the partial variance technique, we apply it in a preliminary study of the slab ratio for both the inertial- and the energy range of magnetic turbulence observed at 1 AU, using ACE data for 1998 to 2015. We use only the so-called ratio test of Bieber et al., which is based on fitting data to the ratio of the two theoretical spectrum components perpendicular to the mean magnetic field, denoted by Pyy/Pxx. Here the y-direction is perpendicular to the plane containing the mean magnetic field and the radial direction, and the x-direction is in that plane. Saur and Bieber tested both the radial and the mean field direction as candidate symmetry axes for turbulence in the energy range; here we test this only for the slab component but for both the energy- and the inertial range. For the inertial range we find an average slab fraction of 0.29 for the whole data set, which is in good agreement with values reported in other studies using the ratio test. Our analysis suggests that the slab turbulence in this high-frequency regime is symmetric with respect to the mean magnetic field, and not the radial direction. However, for the energy range, we find that at low frequencies the radial direction is the symmetry axis for the slab turbulence, in agreement with Saur and Bieber. We find an average slab fraction of 0.31 for the energy range, which is smaller than the value of 0.36 reported by these authors. We cannot as yet rule out that the slab fraction is the same in these two energy regimes when error margins are taken into account. We also show that the slab fraction can vary by as much as a factor of four during the course of a solar activity cycle. This implies that the parallel mean free path could vary by the same factor. In non-linear theories for perpendicular diffusion, this would also affect the perpendicular mean free path, and most probably also the drift scale. The consequences of a slab fraction that is different for the energy- and for the inertial range, and that varies with solar activity, have yet to be studied in ab initio modulation models.

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No

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N/A

## Would you like to <br> submit a short paper <br> for the Conference <br> Proceedings (Yes / No)?

No

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