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Electron density and magnetic field turbulence spectra in the very local interstellar medium in-situ measured by Voyager 1

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We present the turbulence spectra of magnetic and electron density fluctuations in-situ measured by Voyager 1 in the local interstellar medium from 2012 to 2019. The magnetic spectrum shows a Kolmogorov power law with a one-dimensional power law index -5/3 at $mk \leq 10^{-8.8}$, where k is a wavenumber and m is the unit meter. On the other hand, the electron density spectrum also shows a Kolmogorov power law with a one-dimensional power law index -5/3 in the inertial range. Based on the observational data, the relations between the outer scale of the turbulent system and the powers of electron density and magnetic fluctuations are obtained. We then calculate the spectra locally for six individual time periods, within which the electron density and magnetic fluctuations are simultaneously observed. It is found that the power of perpendicular magnetic fluctuations is usually higher than that of parallel magnetic fluctuations, indicating the dominance of Alfvén waves in turbulence spectrum. Part of the observed turbulence spectra reveal that the normalized parallel magnetic power exhibits a much higher intensity than the normalized electron density power in the local interstellar medium of low to moderate plasma beta (0.1-0.8). Such dominance in the parallel magnetic power cannot be explained by the linear magnetohydrodynamic modes alone and may be associated with the arc/spherically polarized Alfvén mode.

References

K. H. Lee and L. C. Lee, Interstellar turbulence spectrum from in situ observations of Voyager 1, Nature Astronomy 3, 154-159 (2019)
K. H. Lee and L. C. Lee, Turbulence Spectra of Electron Density and Magnetic Field Fluctuations in the Local Interstellar Medium, ApJ 904, 66 (2020)