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Spectral shape and anisotropy of solar wind magnetic fluctuations at electron scales

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The shape of the spectrum of the magnetic fluctuations in the solar wind is studied in a high frequency range, where the electron dissipation can play a part. The STAFF-SA experiment on Cluster measures the intensity and the polarisation of these fluctuations between 9 Hz and more than 300 Hz: with the Taylor hypothesis, this frequency range corresponds to scales $kc/\omega_{pe} \simeq 0.1$ to 10. We consider the "free" solar wind, i.e. not magnetically connected to the Earth's bow shock, during five intervals lasting 2 to 4 hours. Two kinds of fluctuations are observed, with different polarisations: (i) Whistler waves with a right-handed polarisation are sometimes observed, with a broad spectral peak around $0.2 f_{ce}$. (ii) Fluctuations with a linear polarisation are always observed; their spectrum is a power law below $kc/\omega_{pe} \simeq 0.1$, and displays an exponential cut-off above $kc/\omega_{pe} \simeq 0.3$. The power law spectrum below $kc/\omega_{pe} \simeq 0.1$ merges with the power law spectrum obtained at larger scales with the FGM and the STAFF-SC data. In order to analyse the anisotropy of the magnetic fluctuations at electron scales, we consider the intensity of the STAFF-SA fluctuations along 3 directions, along B, $B \times V$ and $B \times (B \times V)$. This coordinate system is based on the magnetic field B and the flow velocity V, and redefined every 4 s. Around 10 Hz, the medians of the intensity ratios $I_{B\times V}/I_{B\times B\times V}$ for the five intervals are between 1.4 and 2.2, while the medians of $I_{B\times B\times V}/I_B$ are between 0.8 and 1.3. The magnetic fluctuations are thus not completely isotropic: the $B \times V$ direction appears to be the privileged

direction for the magnetic fluctuations at this electron scale ($kc/\omega_{pe} \simeq 0.3$).