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Can Venus magnetosheath plasma evolve into turbulence?

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The present work aims to understand turbulence properties in planetary magnetosheath regions to obtain physical insight on the energy transfer from the larger to smaller scales, in spirit of searching for power-law behaviors in the spectra which is an indication of the energy cascade and wave-wave interaction. We perform a statistical analysis of energy spectra using the Venus Express spacecraft data in the Venusian magnetosheath. The fluxgate magnetometer data (VEXMAG) calibrated down to 1 Hz as well as plasma data from the ion mass analyzer (ASPERA) aboard the spacecraft are used in the years 2006-2009. Ten-minute intervals in the magnetosheath are selected, which is typical time length of observations of quasi-stationary fluctuations avoiding multiple boundaries crossings. The magnetic field data are transformed into the mean-field-aligned (MFA) coordinate system with respect to the large-scale magnetic field direction and the energy spectra are evaluated using a Welch algorithm in the frequency range between 0.008 Hz and 0.5 Hz for 105 time intervals. The averaged energy spectra show a power law upto 0.3 Hz with the approximate slope of -1, which is flatter than the Kolmogorov slope, -5/3. A slight hump in the spectra is found in the compressive component near 0.3 Hz, which could possibly be realization of mirror mode in the magnetosheath. A spectral break (sudden change in slope) accompanies the spectral hump at 0.4 Hz, above which the spectral curve becomes steeper. The overall spectral shape is reminiscent of turbulence. The low-frequency part with the slope -1 is interpreted as realization of the energy containing range, while the high-frequency part with the steepening is interpreted either as the beginning of energy cascade mediated by mirror mode or as the dissipation range due to wave-particle resonance processes.

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