

Intermittency at Earth's bow shock: Measures of turbulence in quasi-parallel and quasi-perpendicular shocks

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Introduction

The supplementary material provided here includes tests of Taylor's hypothesis for events B and C, example plots of the magnetic spectrum for events A and D, and plots demonstrating the evolution of the spectral index fits, average spectral index, and kurtosis plots for events B and C. The methods used to create the figures are identical to those used for events A and D and are documented in the 'Results' section of the manuscript.

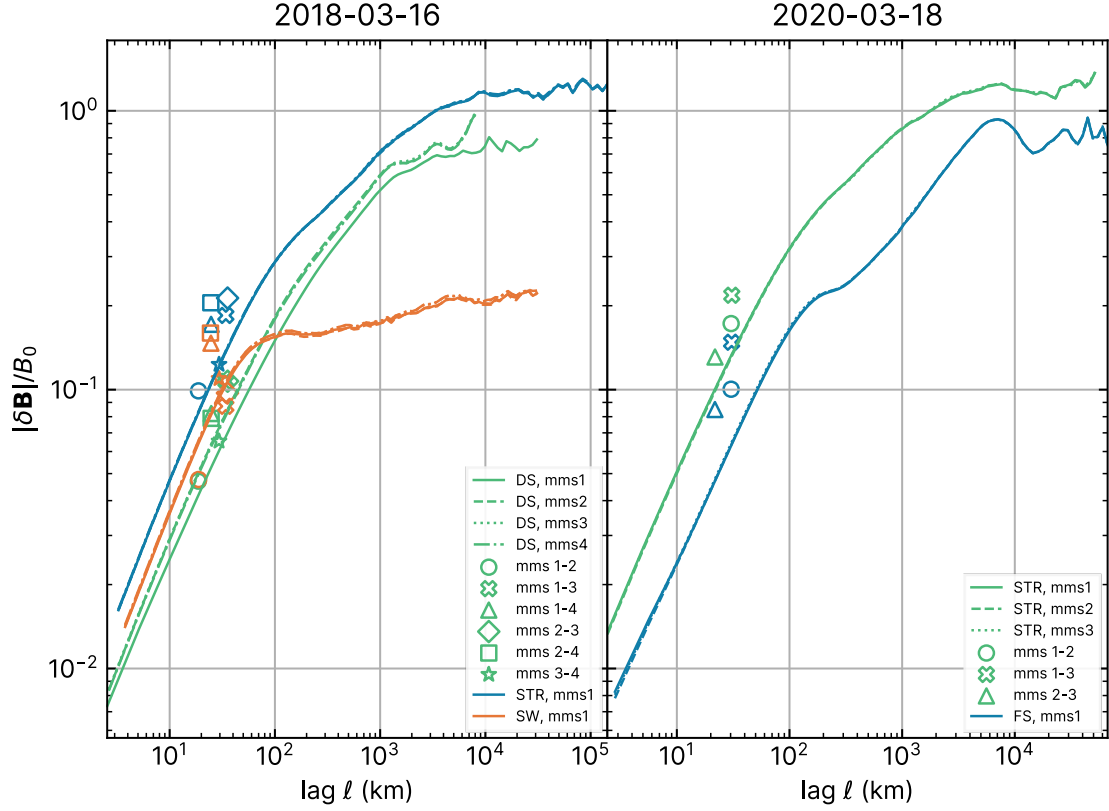


Figure S1: Magnetic fluctuation amplitude normalised to average field strength $|\delta \mathbf{B}|/B_0$ as a function of scale ℓ . *Left:* Event B, *right:* Event C. Fluctuation amplitude obtained using a single spacecraft and assuming Taylor's hypothesis is given by a line, solid for MMS 1, dashed for MMS 2, dotted for MMS 3, and dot-dashed for MMS 4. Colours represent the different regions of each event: Orange for solar wind (SW), blue for shock transition region (STR) or foreshock (FS), and green/red for the magnetosheath (MS). Measurements from the six spacecraft pairs, with ℓ equivalent to the separation scale, are shown by the following markers: Circle for MMS 1-2, cross for 1-3, triangle for 1-4, diamond for 2-3, square for 2-4, and star for 3-4.

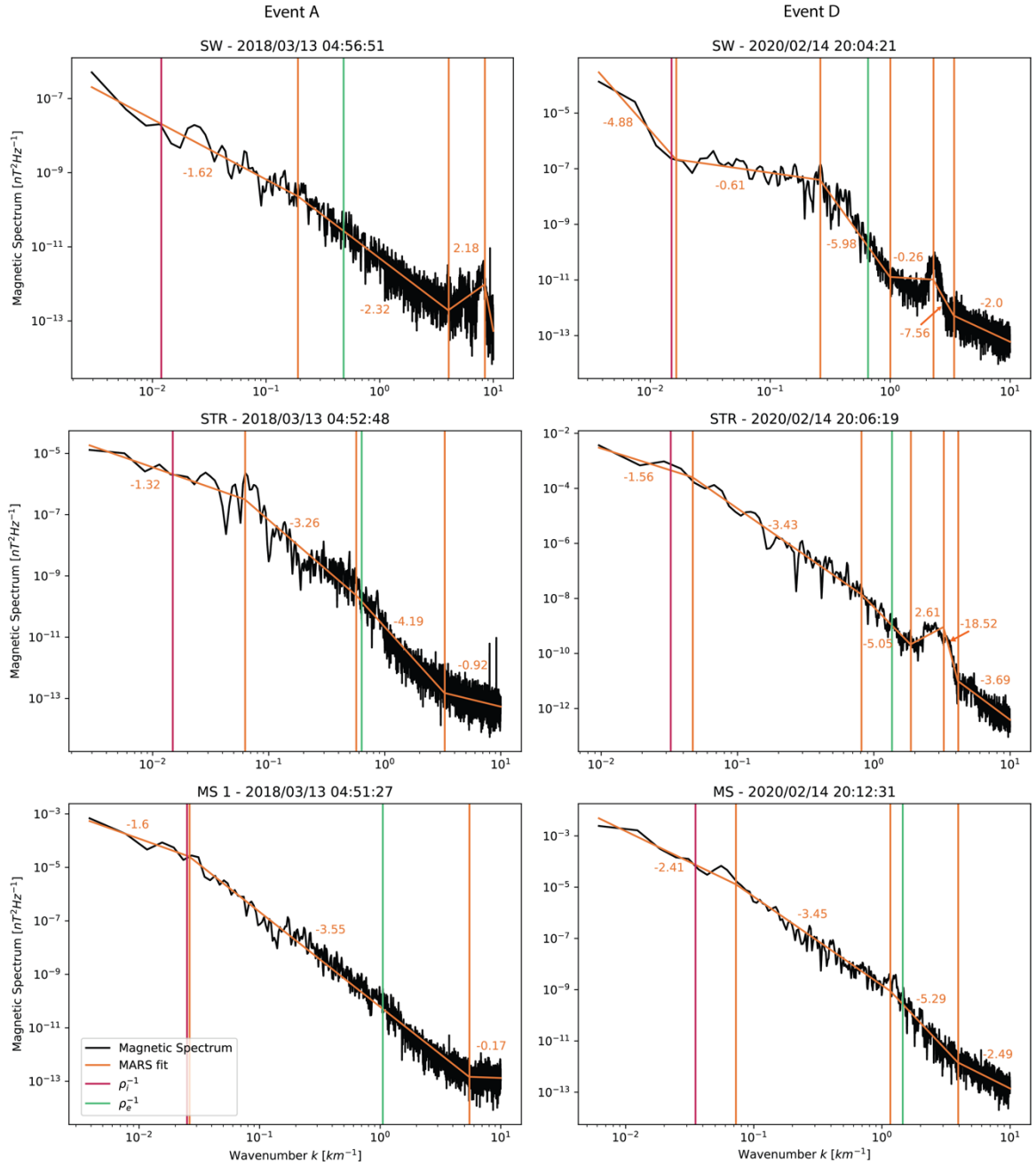


Figure S2: Example magnetic spectra, using the same format as figure 3 in the main manuscript. *Left column:* Event A. *Right column:* Event D. *Top row:* Windows (6s) in the solar wind (SW). *Middle Row:* Windows in the shock transition region (STR). *Bottom row:* Windows in the magnetosheath. The magnetic spectrum is shown in black. The MARS fit is shown in orange, with break points indicated by vertical orange lines at the break point location. For each slope the spectral index is noted in orange text. Ion and electron limits shown by red and green vertical lines, respectively.

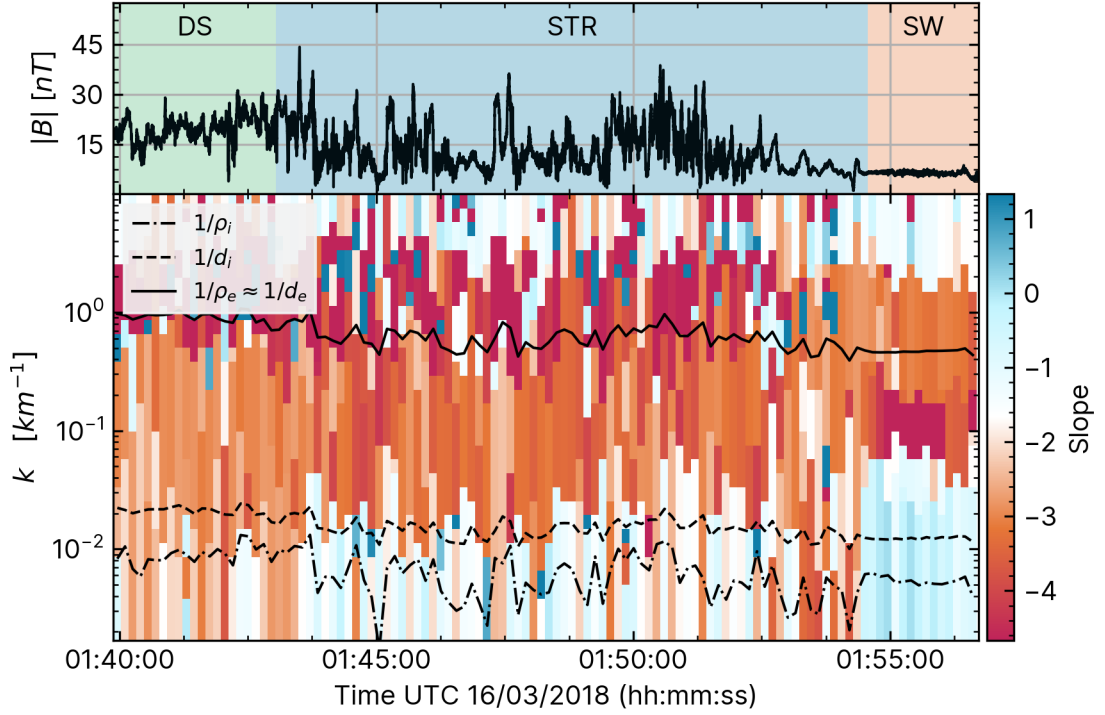


Figure S3. Evolution of spectral slopes as a function of time for event B. *Top:* Magnetic field strength, B . Colours refer to downstream (DS) in green, shock transition region (STR) in blue and solar wind (SW) in orange. *Bottom:* Evolution of spectral indices from MARS fit. Note that this does not always split the spectrum into three regions. The colour represents the slope of the power-law fit. Red indicates steeper than $-5/3$, while blue is shallower than $-5/3$. Breakpoints are indicated by a change in colour. Electron scales, $\rho_e \approx d_e$ are shown as a solid black line, and ion scales d_i and ρ_i are dashed and dot-dashed black lines.

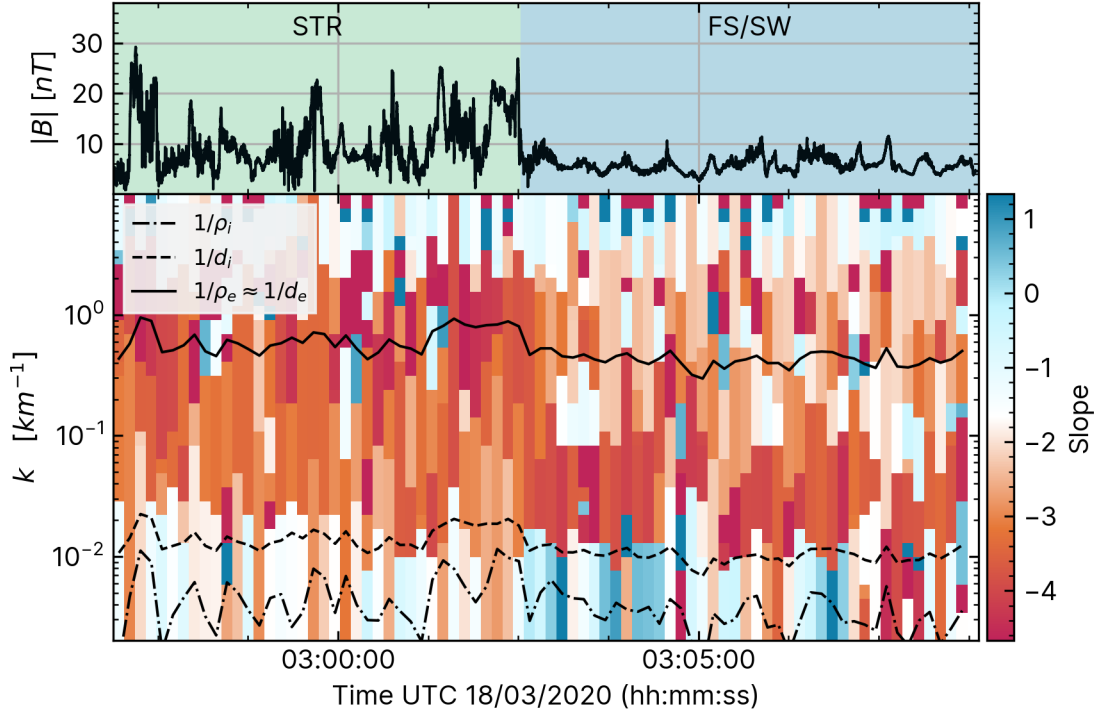


Figure S4. Evolution of spectral slopes as a function of time for event C. *Top:* Magnetic field strength, B . Colours refer to shock transition region (STR) in green and foreshock/solar wind (FS/SW) in blue. *Bottom:* Evolution of spectral indices from MARS fit. Note that this does not always split the spectrum into three regions. The colour represents the slope of the power-law fit. Red indicates steeper than $-5/3$, while blue is shallower than $-5/3$. Breakpoints are indicated by a change in colour. Electron scales, $\rho_e \approx d_e$ are shown as a solid black line, and ion scales d_i and ρ_i are dashed and dot-dashed black lines.

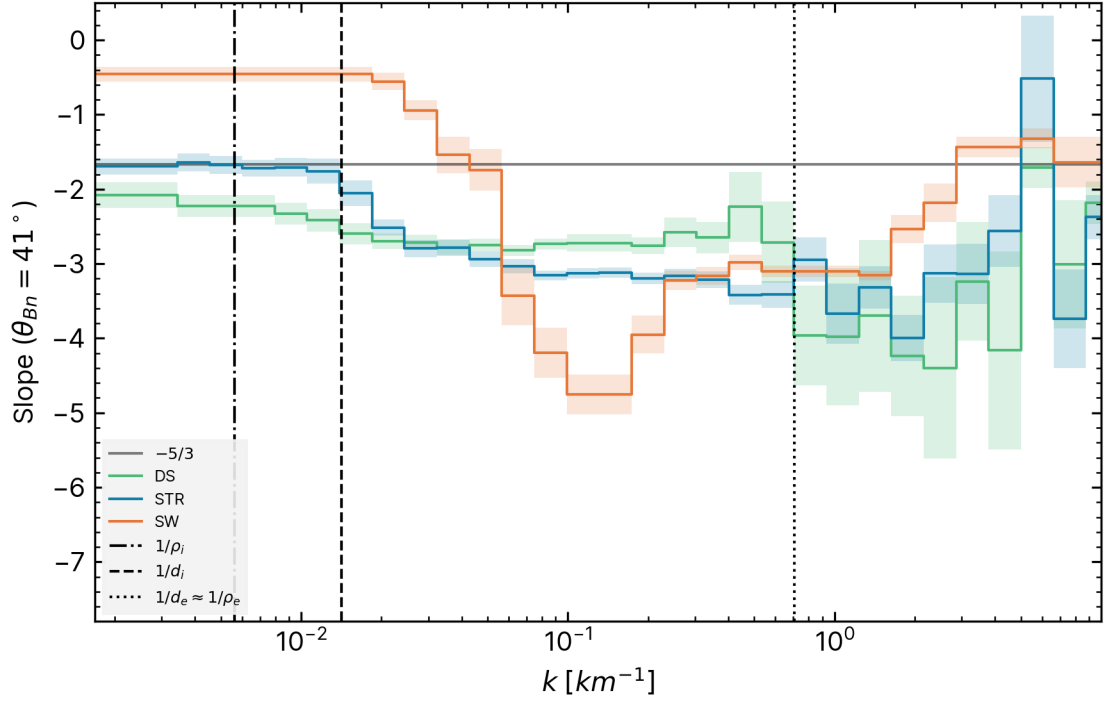


Figure S5. Average slope as a function of scale for event B. Each line represents a subsection of the entire interval. Downstream (DS) in green, shock transition region (STR) in blue, and solar wind (SW) in orange. The average ion gyroradius ρ_i and inertial length d_i are shown as dot-dashed and dashed lines respectively. The average electron gyroradius ρ_e and inertial length d_e are shown as a single dotted line. The Kolmogorov $-5/3$ slope is shown as a horizontal solid black line.

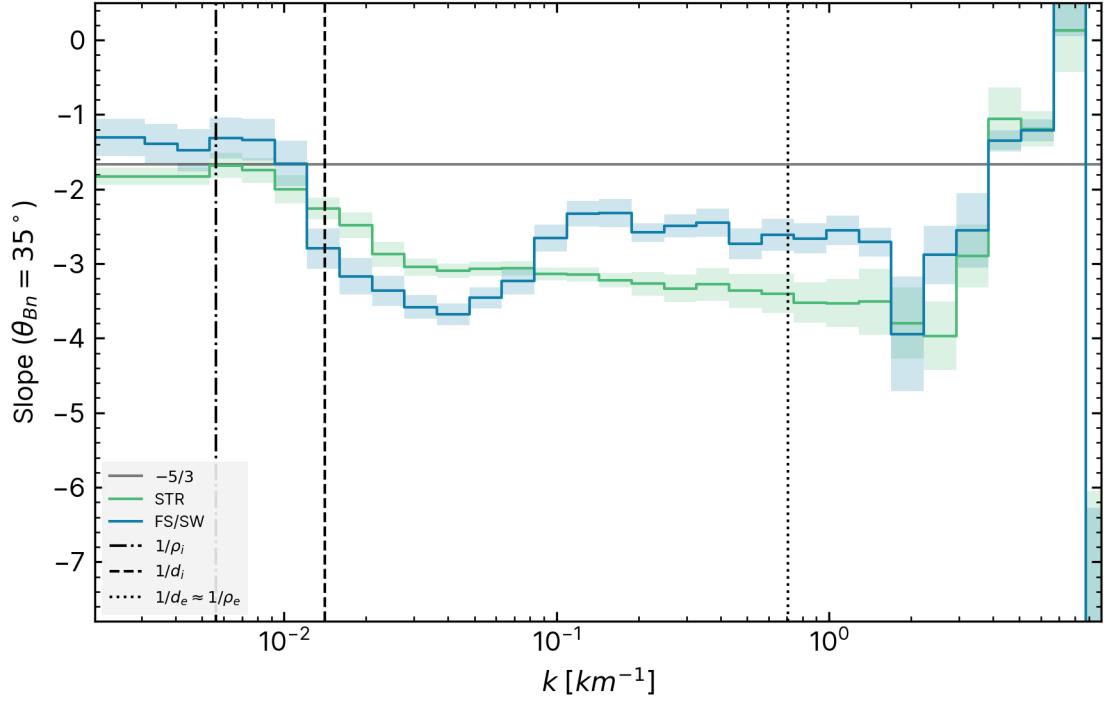


Figure S6. Average slope as a function of scale for event C. Each line represents a subsection of the entire interval. The shock transition region (STR) is shown in green, and the foreshock/solar wind (FS/SW) region is shown in blue. The average ion gyroradius ρ_i and inertial length d_i are shown as dot-dashed and dashed lines respectively. The average electron gyroradius ρ_e and inertial length d_e are shown as a single dotted line. The Kolmogorov $-5/3$ slope is shown as a horizontal solid black line.

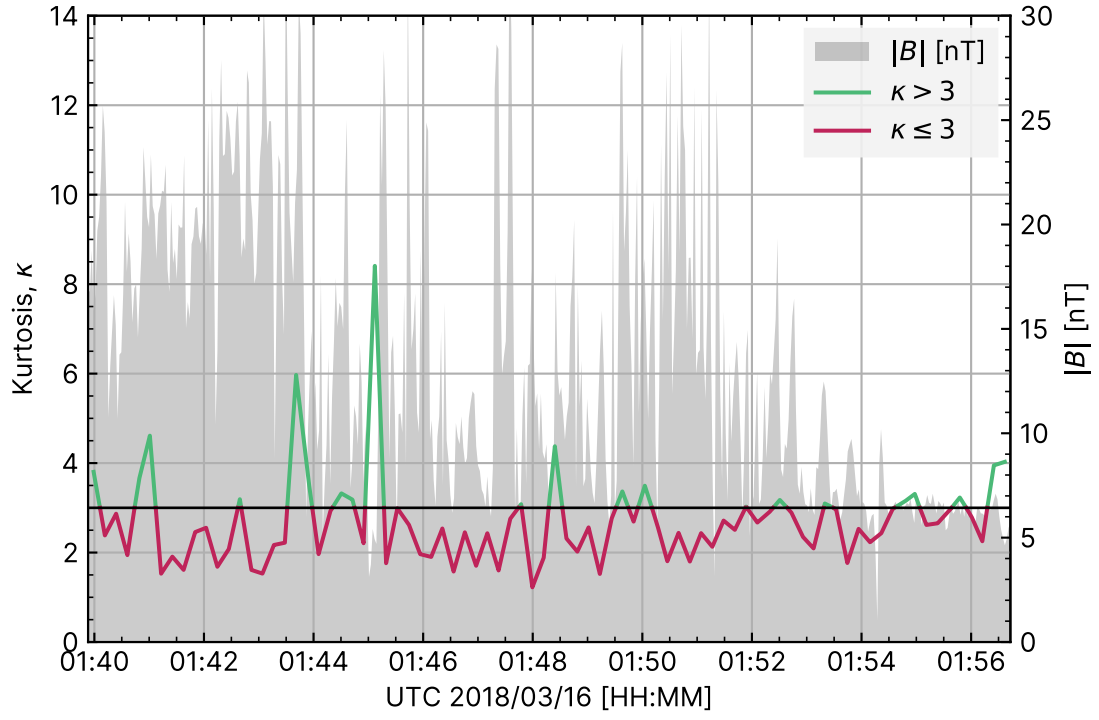


Figure S7. Kurtosis examined for event B. $\kappa > 3$ is shown green, and $\kappa \leq 3$ is red. A horizontal black line highlights $\kappa = 3$. $|B|$ is displayed for reference as a grey shaded background, with the vertical scale on the right.

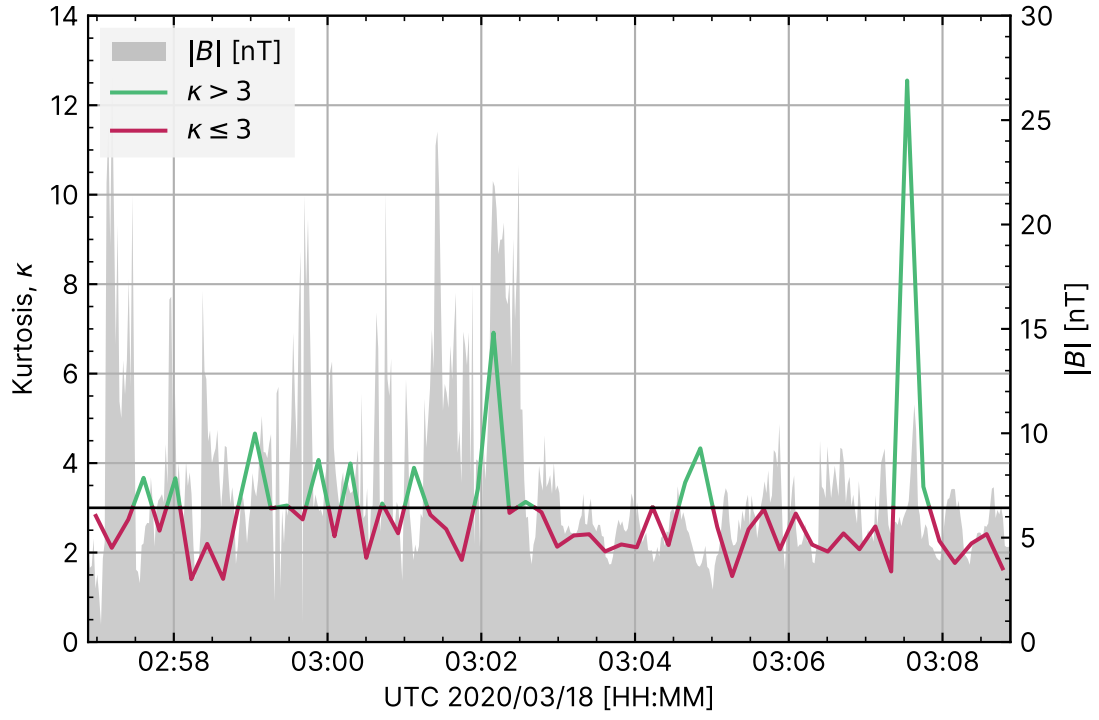


Figure S8. Kurtosis examined for event C. $\kappa > 3$ is shown green, and $\kappa \leq 3$ is red. A horizontal black line highlights $\kappa = 3$. $|B|$ is displayed for reference as a grey shaded background, with the vertical scale on the right.