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Temperature intermittent structures in the solar wind

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In the solar wind turbulence, proton temperature fluctuations are highly intermittent, especially at small scales in the inertial range. This phenomenon may contain information about solar wind intermittent heating. However, the physical nature of the temperature intermittency is not yet clear. Based on the measurements from Solar Orbiter, we identify temperature intermittent structures in the fast and slow solar wind, respectively. We investigate the dependence of the nature and kinetic effects of the intermittent structures on the flow velocity. According to the variations of proton temperature and magnetic field configuration together with other plasma properties when the intermittency occurs, we classify the temperature intermittency in the fast wind into the following five categories: (1) 20% of the cases are linear magnetic holes (LMH) with local temperature enhancement, and a majority of them are unstable to mirror-mode instability. (2) 18% are related to current sheets (CS) also with local temperature enhancement. (3) 9% are tangential discontinuities with a temperature interface (Step), which could separate two different parcels of plasma. (4) 15% of the cases are accompanies by local temperature decrease (Dip) that may be also due to MM instability. (5) 25% of the cases show a chain of magnetic field variations (Chain) probably related to compressive vortex-like structures or the mixture of LMHs and CSs. Figure 1 shows the superposed epoch analysis for different types of temperature intermittent structures on the fluctuations of Tp, Np, $T_\perp/T_{//}$, $\beta_{//}$, and |B|. Figure 2 gives the normalized 2D distribution of the data points related to different types of temperature intermittency in the $T_\perp/T_{//} - \beta_{//}$ plane. In the slow wind, the situation is different. The temperature intermittent structures are mainly associated with firehose instability. These results will help to further understand the intermittent dissipation process in the solar wind turbulence.

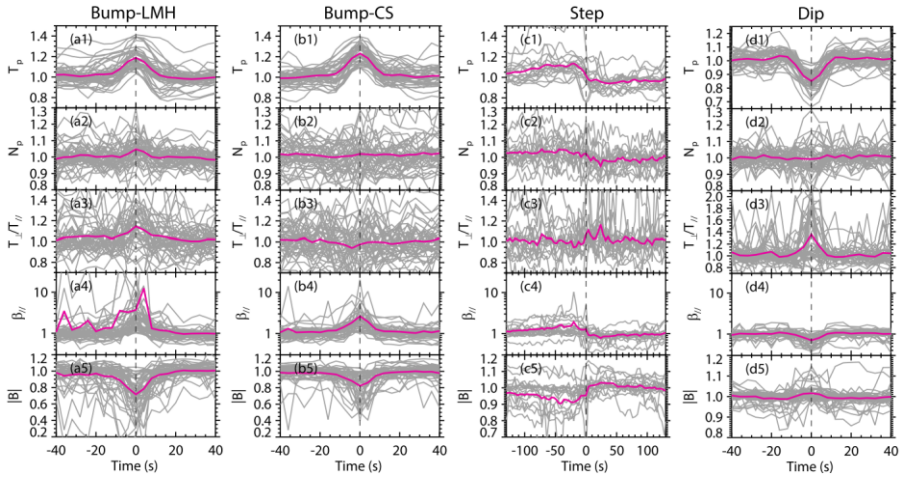

Figure 1. Superposed epoch analysis on the fluctuations of Tp, Np, $T_\perp/T_{//}$, $\beta_{//}$, and |B| for different types of temperature intermittent structures (from left to right: LMH, CS, Step, and Dip).

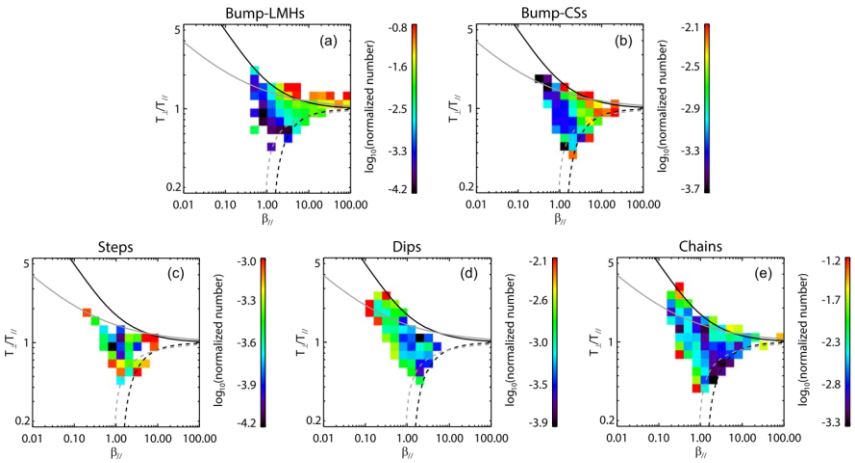

Figure 2. Normalized 2D distribution of the data points related to different types of temperature intermittency in the $T_\perp/T_{//} - \beta_{//}$ plane.