Understanding non-thermal particle energization and turbulent dissipation in the terrestrial magnetosheath

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Heliospheric plasma is characterized by the presence of highly non-maxwellian particle distributions. As energy transfer is dominated by collisionless processes, non-linear kinetic dynamics can generate significant non-thermal plasma populations. These processes are central in the evolution of the heliosphere and the interaction of planetary environments with the solar wind. However, understanding this non-maxwellian energization, requires both high-resolution multi-point measurements as well as new theoretical frameworks that can describe the kinetic physics that control energy transfer processes in collsisonless plasma. We present results obtained by the Magnetospheric MultiScale mission, focusing on a dedicated campaign that involved an extensive high-resolution sampling of the terrestrial magnetosheath. This unique dataset allows us to conduct a comprehensive survey of the dynamics and evolution of this region. We examine the evolution of the turbulent energy transfer, the properties of the turbulent dissipation, as well as the role of intermittent structures in plasma heating and non-thermal particle acceleration. The high-resolution multi-point plasma measurements allow for a direct investigation of non-maxwellian features of the particle distribution functions, and the application of kappa distributions and Hermite decomposition, that can in turn provide novel insights into the pathways of collisionless energy transfer and particle energization. This work contributes to our understanding of the multi-scale processes of this turbulent system and how they respond to a wide range of upstream parameters, as the highly variable solar wind conditions drive this system during a very active part of the solar cycle.