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Energy Dissipation at Filamentary Structures Downstream of the Earth's Parallel Bow Shock

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While the Earth's bow shock marks the location at which the solar wind is thermalized, recent publications provided evidence that filamentary structures such as reconnecting current sheets at the shock ramp region may participate in the thermalization process. Small scale filamentary structures are distinct features that are abundant at the shock and inside the magnetosheath. These structures are not limited to current sheets but include electric and magnetic field enhancements. They may consist of a single or multiple filaments. They originate from energy dissipation at and downstream of the bow shock, in particular the parallel bow shock.

We have studied several crossings of the magnetosheath made by the MMS spacecraft, characterising and quantifying the occurrence and consequences of current sheets and field enhancements in terms of local plasma heating and ion acceleration far downstream of the shock. These observations suggest that a combination of current sheet formation, and electric field and magnetic field gradients can contribute to local downstream ion acceleration, and heating. The associated turbulence is likely a consequence of solar wind input parameters. These observations provide evidence that under certain plasma conditions these filamentary structures can play a significant role in thermalizing of the magnetosheath plasma as it propagates further downstream toward the magnetopause, thus augmenting the effect due to the bow shock itself.