Ion acceleration at filamentary structures downstream of the earth’ s bow shock: MMS and wind observations

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The Earth’s bow shock is the place where most of the solar wind’s kinetic energy is partitioned into wave energy, particle acceleration, and heating. Very recent publications provide strong evidence that current sheets at the shock ramp region and downstream may participate in the thermalization of the solar wind plasma. Their occurrence varies from single to multiple current sheets, reconnecting or not reconnecting, as well as filamentary structures. These structures are often associated with turbulence mediating particle distributions. We investigated several quasi-parallel/quasi-perpendicular bow shock crossings by the MMS spacecraft with its sophisticated instrumentation, characterizing and quantifying the occurrence of filamentary structures, current sheets, the associated magnetic field wave turbulence, and ion acceleration downstream of the shock. The associated turbulence is likely a mediator for energy partition. These MMS observation indicate that current sheets and field gradients are associated with ion acceleration. The associated turbulence is likely a mediator for energy partition. During some traversals the shock location was changing due to variable upstream solar wind conditions. This happened during times of increasing Mach number/dynamic pressure. At these times we observe higher wave activity and broader distribution functions with suprathermal tails. Much less suprathermal ions downstream of the shock are observed at shock crossings during decreasing upstream Mach numbers. It is known that with increasing Mach numbers, the bow shock moves away from the Sun and compresses the magnetosheath that would favour reconnection of currents sheets, stronger electric field gradients and thus ion acceleration. At periods of decreasing upstream Mach numbers, the bow shock moves towards the Sun, becomes blunter, and the sheath region relaxes, making reconnecting current sheets less likely and smoothens field gradients resulting in less acceleration. Other possible acceleration mechanisms will also be discussed in the context of this presentation. The shape of and the power law of the observed distribution function with suprathermal tails. These tails and the power law index will provide us important information on the processes that cause acceleration.