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Helical Ion Beams from Fluctuating Shock Structures

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Heliospheric shocks are well-known accelerators of particles, responsible for the creation of gradual solar energetic particle events. While the fact that particle beams are formed in shock interactions is firmly established, many open questions remain in regard to the microphysics of the acceleration process and the shape of the resulting beam distribution.

The standard analytic assumption for the distribution functions of shock-accelerated particle beams is that of a gyrotropic loss-cone distribution. However, using two independent simulation methods (test-particle simulations and hybrid-Vlasov simulations) we have identified situations in which the presence of foreshock waves leads to the formation of beams with distribution functions departing significantly from this prediction.

In particular, helical, highly non-gyrotropic beam structures in velocity space appear upstream of fluctuating shock structures.

We identify the origins of these helix structures at the shock, analyze the instability behaviour of these beams and discuss observational signatures from synthetic observations.

Collaboration

– not specified –

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