6th Asia-Pacific Conference on Plasma Physics, 9-14 Oct, 2022, Remote e-conference

Phase space transport in the interaction between shocks and plasma turbulence

S. Servidio[1], D. Trotta[2] and F. Valentini[1]
[1] Dipartimento di Fisica, Università della Calabria, Italy[1]
[2] The Blackett Laboratory, Imperial College London, London
e-mail (speaker):sergio.servidio@fis.unical.it

The interaction between collisionless shocks and plasma turbulence is a key ingredient for the understanding of many astrophysical phenomena [1, 2]. Such an interaction has been of growing interest in recent literature, involving theoretical [3], numerical [4, 5], and observational [6] efforts.

Shocks and turbulence are therefore spectacular, ubiquitous phenomena. We investigate, by kinetic simulations, the interaction between a supercritical shock and fully developed plasma turbulence [7]. In Figure 1 we show hoe the turbulence level influences the dynamics and the topology of the shock.

We demonstrate how turbulence changes the phase space transport due to a complex interaction. Two main findings are presented: 1) a paradigm for modeling the shocks, including a natural interaction with surrounding turbulence, and 2) an analysis method, based on coarse-grained Vlasov-kinetic equations, able to characterize (and simplify) the transport processes.

These results are relevant for a variety of systems, ranging from the Earth's bow shock interacting with solar wind turbulence [8] to supernovae explosions propagating through the interstellar turbulent medium.

References
[1] A. M. Bykov *et al*, Space Sci. Rev. **215**, 14 (2019)
[2] F. Guo et al, Frontiers in Astronomy and Space Sciences **8**, 27 (2021)
[3] G. P. Zank *et al*, Phys. Fluids **14**, 3766 (2002)
[4] Y. Matsumoto *et al*, Schience **347**, 6225 (2015)
[5] J. Giacalone and J. R. Jokipii, JGR **101**, 11095 (1996)
[6] S. Perri and G. Zimbardo, APJ **815**, 75 (2015)
[7] D. Trotta *et al*, PNAS **118**, e2026764118 (2021)
[8] D. Trotta *et al*, APJ, in press (2022)

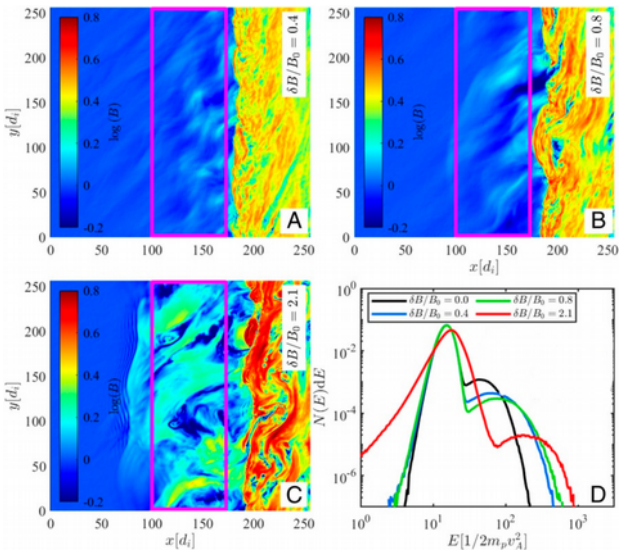

Figure 1. (A) The 2D color maps of magnetic field magnitude B for the perturbed shocks and with different upstream turbulence strengths (A–C). (D) Upstream energy spectra collected in the regions highlighted by the magenta boxes.