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A magnetic reconnection model for shock-turbulence interaction

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It is well recognized that several kinds of shock waves such as the Earth's bow shocks, transient shocks produced by solar flares, etc. play very important roles in solar system plasmas. Shocks are also ubiquitous in reconnection situations. It has been considered that shocks are essential to materialize a fast reconnection. In the previous papers [1-3], we considered the effects of turbulence in the fast magnetic reconnection. There we stressed the importance of the interaction between turbulence and mean-field structures as well as the importance of the balance between the transport enhancement and suppression. Considering the importance of shocks, it is required to treat shock–turbulent interaction properly in a turbulent reconnection model. In the context of turbulence theory and modeling, the shock–turbulence interaction is a very challenging problem. With the interactions with a shock, turbulence properties change considerably: (i) The intensity of fluctuations changes in an anisotropic manner; (ii) The vorticity structure is also strongly affected; (iii) The turbulence length scale changes in a complex manner across the shock; and so on. Towards the theory treating these points, in the present work, we propose a turbulence model with the density fluctuation effects incorporated. The inclusion of the density variance leads to a complicated expressions for the turbulent correlations such as the Reynolds (and Maxwell) stresses and the turbulent electromotive force, which leads to deeper understanding of the turbulent transport in shocks. It is expected that a numerical simulation of magnetic reconnection with the present turbulence model will give substantially different results near the shock regions.

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