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Simulating cosmic ray diffusion coefficients in synthetic compressive magnetic turbulence

In order to reliably estimate cosmic ray (CR) transport effects due to turbulence in the heliospheric magnetic field (HMF), and to validate existing diffusion theories (see, e.g., Engelbrecht et al., 2022, for a review), direct simulations, which involve solving the Newton-Lorentz equation numerically, may be employed (e.g., Els and Engelbrecht, 2024). Prior work, guided by turbulence conditions observed in the inner heliosphere, has largely focused on CR transport due to turbulence transverse to the background magnetic field. However, CR transport in the outer heliosphere, including in the heliosheath (HS), where HMF turbulence has been observed to have a compressive component (e.g., Fraternale et al., 2019), has, to date, received comparatively little attention. In this work, an approach to modelling HMF turbulence with an arbitrary compressive component, based on the synthetic turbulence model of Tautz and Dosch (2013), is suggested. Furthermore, turbulence parameters which may be expected in the HS are inferred from available analyses (e.g., Fraternale et al., 2019; Zhao et al., 2024). These parameters are then used as inputs for the particle pusher code detailed by Els and Engelbrecht (2024), modified so as to account for the presence of compressive turbulence, from which estimates for CR transport coefficients due to HMF turbulence conditions in the HS are calculated.

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