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Energetic Particle Propagation in Critically Balanced Turbulence

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Observations and modelling suggest that the fluctuations in magnetised plasmas exhibit scale-dependent anisotropy, with more energy in the fluctuations perpendicular to the mean magnetic field than in the parallel fluctuations and this anisotropy increasing at smaller scales. We study the influence of this scale-dependence on cosmic rays by constructing a model of critically balanced turbulence, as suggested by Goldreich & Sridhar (1995), and calculating energetic particle diffusion coefficients using full-orbit simulations. The model uses an enveloped turbulence approach, where each 2-dimensional wave mode with wavenumber $k_\perp$ is packed into envelopes of length L following the critical balance condition, $L \propto k_\perp^{-2/3}$, with the wave phase coherence broken from envelope to envelope. We find that the scale-dependence of the turbulence increases the spatial cosmic ray diffusion coefficients. We discuss the implications of the findings on cosmic ray anisotropies.