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The Kinetic Plasma Physics of Cosmic Ray Streaming Instabilities: Hybrid Simulations of the Nonlinear Growth COLBY HAGGERTY, University of Hawaii, DAMIANO CAPRIOLI, University of Chicago, ELLEN ZWEIBEL, University of Wisconsin, Madison — Cosmic Rays (CRs) are believed to amplify magnetic fields and heat thermal plasma throughout the galaxy via streaming instability. Both theoretical and numerical models of galaxy formation are sensitive to small changes in these plasma parameters, however most of the scientific understanding of the effects of CR streaming instabilities comes from analytical linear theory. We detail the linear and nonlinear effects of both the resonant and nonresonant (Bell) streaming instability using the relativistic kinetic hybrid code, dHybridR. "Undriven" simulations (i.e., where CRs are not continuously supplied) agree well with linear theory for a range of wave numbers but with several novel nonlinear features. Additionally, we examine the "driven" case (sustained CR injection) in which nonlinear effects are important as the background plasma begins to be heated and pushed, leading to the saturation of the instability. Finally, we extract from the simulations heating rates and self-generated diffusion coefficients, which can be implemented into galaxy formation models.

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