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Electron firehose instability: kinetic linear theory and 2D Particle-in-Cell simulations

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The kinetic Electron Firehose Instability (EFI) is thought to be a crucial mechanism for constraining the electron anisotropy in the expanding solar wind, within the small observed values. The EFI arises in a bi-Maxwellian plasma when the parallel temperature is greater than the perpendicular one, and its effect is to reduce the anisotropy. We study this mechanism via kinetic linear theory, extending and refining previously known results, and by new 2D Particle-in-Cell simulations. The results of PIC simulations show under which terms the EFI can indeed be regarded as a constraint for the electron distribution function. The detailed electron physics near marginal stability condition is analyzed, with emphasis on the competition between growing and damping modes. The results indicate a possible observational signature of this process, namely the appearance of low-frequency, quasi-perpendicular whistler/electron-cyclotron waves.