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Reconnection Simulations of Impulsive Flare Events in the presence of Helium-3 and Helium-4

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Observations of impulsive solar energetic particle events occasionally show enhancements of helium-3 up to ~104 greater than coronal abundances. Fisk (1978) and Temerin and Roth (1992) proposed that these enhancements could be caused by ion cyclotron waves and that helium-3 would be preferentially heated due to its unique cyclotron frequency. In order to test this theory, we have run kinetic simulations of magnetic reconnection in the corona using the particle-in-cell code p3d. Initial parameters were set to coronal values: 5% helium-4 number density, β equal to 0.1, and the guide field equal to 0.5 times the reconnecting field. Initial results showed instabilities develop along the separatrices of the reconnection outflows, though temperature anisotropies associated with ion cyclotron waves were not present. Fourier transforms in time of the parallel electric field at multiple locations along the separatrices showed frequencies between 1.2 and 1.6 times the proton cyclotron frequency. A second simulation with the same parameters including helium-3 as test particles is being performed to investigate the effects on helium-3.

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