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The Scaling of Electron Heating in Low-beta Reconnection Exhausts with Kinetic Reconnection Simulations

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Particle heating in reconnection is essential to understand the heating in the solar corona, solar flares and the magnetotail. It plays an important role distributing magnetic energy into different species and between thermal and nonthermal components. Previous observational and theoretical studies on electron heating in reconnection exhausts within the beta~1 regime suggest a simple linear scaling where the electron heating is proportional to the magnetic energy per particle. Using kinetic reconnection simulations in the low-beta regime (with beta down to 0.005), we demonstrate that electron heating follows a sub-linear scaling below beta~0.01, with or without guide fields. As a result, the maximum heating is limited to only ~5 times of upstream electron temperature. This electron heating scaling may be testable by MMS observations at the magnetotail. This new finding has strong implications for the efficiency of electron heating in reconnection at low-beta environments throughout heliosphysics.

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