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Large scale electron acceleration by parallel electric fields during magnetic reconnection[1] J. EGEDAL, A. LE, MIT, PSFC, W. DAUGHTON, LANL — Magnetic reconnection is an ubiquitous phenomenon in plasmas. It permits an explosive release of energy through changes in the magnetic field line topology. In the Earth's magnetotail, reconnection energizes electrons up to hundreds of keV and solar flares events can channel up to 50% of the magnetic energy into the electrons resulting in superthermal populations. Electron energization is also fundamentally important to astrophysical applications, where X-rays generated by relativistic electrons provide a unique window into the extreme environments. Here we show that during reconnection powerful energization of electrons by $E_\parallel$ can occur over spatial scales which hugely exceed what previously thought possible. Thus, our results are contrary to a fundamental assumption that a hot plasma – a highly conducting medium for electrical current – cannot support any significant $E_\parallel$ over length scales large compared to the small electron inertial length $d_e = c/\omega_{pe}$. In our model $E_\parallel$ is supported by strongly anisotropic features in the electron distributions not permitted in standard fluid formulations, but routinely observed by spacecraft in the Earth's magnetosphere. This allows for electron energization in spatial regions that exceed the regular d_e scale electron diffusion region by at least three orders of magnitude.

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