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Re-assessing how much parallel and perpendicular electric fields accelerate electrons during magnetic reconnection NAOKI BESSHO, LI-JEN CHEN, KAI GERMASCHEWSKI, The University of New Hampshire, AMITAVA BHATTACHARJEE, Princeton Plasma Physics Laboratory, Princeton University
— By means of 2-D PIC simulations applicable to reconnection in the Earth's magnetotail, we show that the parallel electric field accelerates electrons only up to 40 keV, and further acceleration above that energy in fact comes from the perpendicular electric field, which can explain observations of energetic electrons with energies greater than 100 keV. We show that the parallel potential, which is the integral of the parallel electric field along the field line, is proportional to $(\omega_{pe}/\Omega_e)^{-2}$, and also to $(n_b/n_0)^{-1/2}$, where ω_{pe}/Ω_e is the ratio of the plasma frequency to the electron cyclotron frequency, and n_b/n_0 is the ratio of the lobe density to the density of the current sheet. Applying the parameters in the Earth's magnetotail to the above relations, we demonstrate that the parallel potential is not more than 40 keV. In addition to pitch angle scattering from the parallel to the perpendicular velocity for electron beams along magnetic field, which was suggested in previous studies, energetic electrons accelerated by the perpendicular electric field experience pitch angle scattering from the perpendicular to the parallel velocity, which can isotropize plasma in the exhaust.

Naoki Bessho
The University of New Hampshire

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