Spacecraft observations of a Maxwell Demon coating the separatrix of asymmetric magnetic reconnection with crescent-shaped electron distributions

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During asymmetric magnetic reconnection in the dayside magnetopause in situ spacecraft measurements show that electrons from the high density inflow penetrate some distance into the low density inflow. Supported by a kinetic simulation, we present a general derivation of an exclusion energy parameter, which provides a lower kinetic energy bound for an electron to jump across the reconnection region from one inflow region to the other. As by a Maxwell Demon, only high energy electrons are permitted to cross the inner reconnection region, strongly impacting the form of the electron distribution function observed along the low density side separatrix. The dynamics produce two distinct flavors of crescent-shaped electron distributions in a thin boundary layer along the separatrix between the magnetospheric inflow and the reconnection exhaust. The analytical model presented relates these salient details of the distribution function to the electron dynamics in the inner reconnection region.

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