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Multiple observations of electron diffusion regions by the electric field experiments on Polar and Cluster

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The necessary conditions for an electron diffusion region within the magnetopause are that the parallel electric field be non-zero, that $\mathbf{j}_{perp}\cdot\mathbf{E}_{perp}$ be large, and that the scale size of the region be the order of the electron skin depth, c/ω_{pe} ($\sim$2 km at the sub-solar magnetopause), where ω_{pe} is the electron plasma frequency. The first observations of such regions (*Phys. Rev. Lett.*, **91(24)**, doi:10.1103/PhysRevLett.91.245002, 2003) exhibited these characteristics inside filamentary current structures. These observations are extended by analyses of hundreds of additional events on Polar and the four Cluster spacecraft to conclude that electron diffusion regions are numerous within the magnetopause and that they are stable over distances of hundreds of kilometers and many seconds of time. This non-conventional view of a filamentary magnetopause is supported by computer simulations.