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The Emergence, Motion, and Disappearance of Magnetic Null Points NICHOLAS MURPHY, Harvard-Smithsonian Center for Astrophysics, CLARE PARNELL, ANDREW HAYNES, University of St Andrews, DAVID PONTIN, University of Dundee — Magnetic reconnection frequently occurs at and around magnetic null points. We derive exact expressions for the motion of a magnetic null point in a smoothly varying magnetic field. We define $\mathbf{x}_n$ as the position of a null, $\mathbf{U} = d\mathbf{x}_n/dt$ as the null's velocity, and $\mathbf{M}$ as the Jacobian matrix of the magnetic field at the null. By evaluating the derivative of the magnetic field following the motion of the null, we find the null velocity to be $\mathbf{U} = -\mathbf{M}^{-1}\partial\mathbf{B}/\partial t$ with all quantities evaluated at the null point. For resistive MHD, this reduces to $\mathbf{U} = \mathbf{V}(\mathbf{x}_n) - \eta\mathbf{M}^{-1}\nabla^2\mathbf{B}$. This expression indicates that any difference between the plasma flow velocity at the null and the velocity of the null itself is due to resistive diffusion of the magnetic field. Null points must diffuse in and out of existence. Null-null pairs first appear (or disappear) as a single degenerate null with singular $\mathbf{M}$, and then instantaneously move apart (together) infinitely fast. An expression describing the motion of separators cannot depend solely on local parameters and must include information on connectivity changes due to reconnection along the entire field line.

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