UNIVERSAL RECONNECTION IN MAGNETIC FIELDS

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ABSTRACT

Magnetic reconnection takes place across current sheets, i.e. layers of intense shear in **B**, in most large-scale equilibrium magnetic fields. Neglecting gradients in the plasma pressure, the equilibrium field is described by $\nabla \times \mathbf{B} = \alpha \mathbf{B}$. This partial differential equation has the unusual property of mixed characteristic (two families of complex characteristics and one family of real characteristics), with the result that almost all magnetic field topologies develop internal surfaces of tangential discontinuity (current sheets) as the field relaxes to equilibrium. That is to say, most of the deformed magnetic fields in the astronomical universe develop internal reconnection sites as they approach static equilibrium. The bipolar magnetic fields of active regions on the Sun¸ the magnetic fields whisked from the sunward magnetopause into the geotail, and probably the magnetic fields of the galactic halo are continually swirled andd mixed so that the internal winding and interweaving of the field lines leads to formation of surfaces of tangential discontinuity and reconnection.