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Convection in Rotating Spherical Fluid Shells and its Dynamo Action

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by F. H. Busse

Convection in rotating spherical fluid shells is characterized by the relative orientation of gravity and rotation vector. Outside the virtual cylinder touching the inner boundary at its equator convection assumes the form of thermal Rossby waves which are particularly suitable for the generation of magnetic fields. Without magnetic field the shear generated by the thermal Rossby waves tends to destroy them. Only localized convection or intermittent convection may survive the shearing action. Dipolar, quadrupolar and hemispherical dynamos can be realized. Lorentz forces counteract the shearing action of the differential rotation and thus permit an efficient heat transport. Of particular interest are regimes of bistability where depending on initial conditions either dynamos with strong mean magnetic fields or dynamos with highly fluctuating magnetic fields are realized. In systems like the Earth's core aperiodic reversals of the poloidal field may occur in connection with periodic toroidal dynamo waves.