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Experimental Studies of Planetary Core Convection and Dynamo Processes

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The magnetic fields of the terrestrial planets are generated by convectively-driven dynamo processes occurring within the electrically-conductive fluid regions of planetary cores. Present experimental approaches are focusing on two complementary methods for understanding core dynamo processes: mechanically-driven dynamo experiments and buoyancy-driven convection experiments. In the mechanically-driven experiments, energy is pumped into the velocity field via impellers or pumps. Although the flows produced are not necessarily geophysically accurate, dynamo action may result, thereby producing a system of both physical and geophysical interest. In buoyancy-driven rotating magnetoconvection experiments, energy is pumped predominantly into the externally-imposed magnetic field. The buoyancy-driven flows, acted upon by strong Coriolis and Lorentz forces, are interesting analogues to core convection; the velocities, however, are far too small to generate dynamo action. Here we will review the latest mechanically-driven dynamo experiments and then discuss the results of buoyancy-driven rotating magnetoconvection experiments relevant to core convective processes.

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