

Simulation of Mercury dynamo

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Magnetic field measurements during two fly-bys of the Mariner 10 showed that Mercury possesses its intrinsic magnetic field. The estimated strength of an internal dipole is about three orders of magnitude smaller than the Earth's dipole moment. Possible sources of the Mercury's weak magnetic field are crustal magnetization due to an ancient dynamo, an active dynamo, or their combination. Thermal evolution models predict the existence of a thin liquid portion of the metallic core with small fraction of light alloying elements even at present, suggesting the presence of an active dynamo. However, it is still unclear whether or not the present Mercury's magnetic field is, in fact generated by dynamo action. Determination of the origin and generation mechanism of Mercury's magnetic field would provide constraints on the interior structure and evolution of Mercury. Numerical models of Mercury dynamo show that dynamo action in a thin shell geometry is capable of sustaining the magnetic field.

Moreover, dipole moments comparable with the observed value are obtained in dynamo models, suggesting that the principal source of Mercury's magnetic field is an active dynamo working in a thin shell geometry. It is also found that there are two dynamo branches in parameter space. Difference between them can be found in the distribution of the magnetic field at the core surface. Non-dipole component is larger at high-latitude in one branch, while dipole configuration prevails in the other. It is thus, very important to measure non-dipole field in order to clarify where Mercury dynamo lies in parameter space. In this sense, it is possible to carry out magnetic field measurements at altitudes where non-dipole field does not decay very much due to large core size of Mercury. Combining numerical dynamo models and magnetic field measurements which will be carried out by MESSENGER and BepiColombo missions, significant constraints on Mercury dynamo, and the interior structure and evolution of this mysterious planet would be obtained.

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