

Stability, bifurcation and subcritical behavior of an extended disk dynamo model: implications for the past Martian dynamo

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We have conducted stability analysis and numerical modeling of an extended disk dynamo model incorporating resistive drag and enhanced magnetic feedback. Bifurcation and subcritical behavior of the dynamo are examined. It is found that subcritical dynamo regime, where bistability of self-sustaining and decaying dynamos are observed, emerges by introducing a strong magnetic feedback into the system. Moreover, in the subcritical regime, the final state of a dynamo strongly depends on the initial condition. A strong initial electric current far from the equilibrium state causes large fluctuations in rotation of the disk, which deteriorates a dynamo action and consequently results in a decaying dynamo. The present results demonstrate that a strong magnetic feedback to the flow yields the subcritical dynamo regime. Some implications for the subcritical behavior of the past Martian dynamo are derived.