

Spin-piston problem for a ferromagnetic thin film: Shock waves and solitons

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Abstract

The Landau-Lifshitz PDE for a thin-film, easy-plane ferromagnet is analogous to the equations of fluid dynamics when expressed in Hamiltonian form in terms of a spin density and a magnetic fluid velocity. In this talk, this hydrodynamic interpretation will be leveraged to analytically and computationally study the dynamics of the initial-boundary value problem (IBVP) for a ferromagnetic channel subject to an effective spin piston at one end and a uniform, perpendicular applied field. A full classification of nonlinear wave solutions on sufficiently short timescales is provided using Whitham modulation theory by identifying two key aspects of the fluid-like dynamics: subsonic/supersonic conditions and convex/non-convex hydrodynamic flux.