zbMATH Open
THE FIRST RESOURCE FOR MATHEMATICS

Chen, Jingrun; **Sun, Zhiwei**; **Wang, Yun**; **Yang, Lei**

A spin-wave solution to the Landau-Lifshitz-Gilbert equation. (English) Zbl 1479.35188

Commun. Math. Sci. 19, No. 1, 193-204 (2021).

Summary: Magnetic materials possess the intrinsic spin order, whose disturbance leads to spin waves. From the mathematical perspective, a spin wave is known as a traveling wave, which is often seen in wave and transport equations. The dynamics of intrinsic spin order is modeled by the Landau-Lifshitz-Gilbert equation, a nonlinear parabolic system of equations with a pointwise length constraint. In this paper, a spin wave for this equation is obtained based on the assumption that the spin wave maintains its periodicity in space when propagating at a varying velocity. In the absence of magnetic field, an explicit form of spin wave is provided. When a magnetic field is applied, the spin wave does not have such an explicit form but its stability is justified rigorously. Moreover, an approximate explicit solution is constructed with approximation error depending quadratically on the strength of magnetic field and being uniform in time.

MSC:

35C07 Traveling wave solutions
34E10 Perturbations, asymptotics of solutions to ordinary differential equations
35B40 Asymptotic behavior of solutions to PDEs
35C20 Asymptotic expansions of solutions to PDEs
35K45 Initial value problems for second-order parabolic systems
35K55 Nonlinear parabolic equations
35Q81 PDEs in connection with semiconductor devices

Keywords:

Landau-Lifshitz-Gilbert equation; spin wave; asympotic analysis

Full Text: DOI

Edited by FIZ Karlsruhe, the European Mathematical Society and the Heidelberg Academy of Sciences and Humanities
© 2022 FIZ Karlsruhe GmbH