

Pattern Formation Dynamics in a Spinor Dipolar Bose-Einstein Condensate

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We study the spin dynamics of a ferromagnetic Bose-Einstein condensate with magnetic dipole-dipole interaction (MDDI). Using the Gross-Pitaevskii and Bogoliubov theories, we find that various magnetic structures such as checkerboards and stripes emerge in the course of the dynamics due to the combined effects of spin-exchange interaction, MDDI, quadratic Zeeman and finite-size effects, and nonstationary initial conditions.¹ We also introduce the hydrodynamic equations of motion for the spin and superfluid current for the above system.² The equation of motion for the spin has the same form as an extended Landau-Lifshitz-Gilbert equation, which describes the magnetization dynamics of solid-state ferromagnets, except for the term including the superfluid current. We discuss the effect of the superfluid current on the spin dynamics.³

¹Y. Kawaguchi, K. Kudo, H. Saito, and M. Ueda, Phys. Rev. A **82**, 043627 (2010).

²K. Kudo and Y. Kawaguchi, Phys. Rev. A **82**, 053614 (2010).

³K. Kudo and Y. Kawaguchi, in preparation.