Regularized micromagnetic theory for Bloch points

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Magnetic singularities, known as Bloch points, pose a significant challenge for the micromagnetic theory due to the divergence of the effective field at these points. In this talk, we present a recently developed regularized micromagnetic model that does not assume a fixed magnetization length, but treats magnetization as an order parameter on the $\mathbb{S}^3$ sphere, thus allowing it to vary in length from zero up to a threshold value [1]. Such an extension of micromagnetics respects the fundamental properties of local spin expectation values in quantum systems. Relying on the $\mathbb{S}^3$ order parameter, we derive Landau-Lifshitz-Gilbert and Thiele equations and apply them to the dynamics of several spin textures: domain walls in nanowires, chiral bobbers, and magnetic dipole strings [2,3]. The results demonstrate how the extended formalism accounts for the dynamics of Bloch points observed experimentally and open up prospects for modeling complex spin structures, including the nucleation and annihilation of topological states such as skyrmions and hopfions.

References:

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