Nonlocal analysis of energies in Micromagnetics

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In this talk we provide conditions in order to formally justify a nonlocal analysis of energies in Micromagnetics. Specifically, we first consider a nonlocal-to-local approximation of exchange energy functionals, extending the well-known Bourgain-Brezis-Mironescu formula to encompass the scenario where antisymmetric contributions are encoded. The key points are a pointwise convergence result and a Γ-convergence argument. After the nonlocal approximation, we investigate the existence and qualitative properties of minimizers, focusing on the competition between a nonlocal symmetric exchange interaction, which penalizes spatial variations in magnetization, and a magnetostatic self-energy term that accounts for long-range dipolar interactions. For spherical domains, we generalize Brown's fundamental results by identifying critical radii such that uniform magnetizations are preferable for the small-body regime, while non-uniform magnetization configurations become dominant in the large-body regime.

This is joint work with E. Davoli, G. Di Fratta and L. Lombardini.