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Spin wave dynamics in solid nanowire of circular cross section in crossover dipolar-exchange regime

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The increase of the interest on spin wave propagation in cylindrical nanowires arises both from the development of fabrication methods, experimental techniques used for characterization of spin wave dynamics and numerical tools.

In this work we report about spin wave dynamics in uniform Ni nanowire of circular cross section. Solution for spectrum of the spin waves propagating along the wire axis was obtained in semi-analytical form and compared with numerical computation based on finite element method to find spin wave eigenmodes using the Landau-Lifshitz equation. We described spin wave spectrum in dipolar regime, exchange regime and crossover dipolar-exchange regime.

Spin wave spectrum has form of the set of dispersion branches. We showed that the branches (and crossings/anticrossings between them) can be analyzed and classified by: calculating the contribution of exchange and dipolar energies, investigation of spatial profiles of spin wave amplitudes (or magnetostatic potential) and computing the overlap integral between the branches. We discussed also the influence of magnetization pinning (applied at the external surface of the wire) on the spin wave spectrum.

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