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Spin superfluidity and long-range transport in thin-film ferromagnets HANS SKARSVÅG, CECILIA HOLMQVIST, ARNE BRATAAS, Norwegian University of Science and Technology (NTNU) — In ferromagnets, magnons may condense into a single quantum state. Analogous to superconductors, this quantum state may support transport without dissipation. Recent works suggest that longitudinal spin transport through a thin-film ferromagnet is an example of spin superfluidity. Although intriguing, this tantalizing concept ignores long-range dipole interactions; here, we demonstrate that such interactions dramatically affect spin transport.[1] In single-film ferromagnets, "spin superfluidity" only exists at length scales (a few hundred nanometers in yttrium iron garnet) somewhat larger than the exchange length. Over longer distances, dipolar interactions destroy spin superfluidity. Nevertheless, we predict the re-emergence of spin superfluidity in tri-layer ferromagnet–normal metal–ferromagnet films that are $\sim 1\,\mu$m in size. Such systems also exhibit other types of long-range spin transport in samples that are several micrometers in size.

[1]H. Skarsvåg, C. Holmqvist and A. Brataas, arXiv:1506.06029

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