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Controlling superconducting spin flow with a single homogeneous ferromagnet: interference, torque and spin-flip immunity[1] SOL JACOBSEN, IRYNA KULAGINA, JACOB LINDER, Norwegian University of Science and Technology (NTNU) — Superconducting spintronics has the potential to overcome the Joule heating and short decay lengths of electron transport by harnessing the dissipationless spin currents of superconductors in thin-film devices. Using conventional singlet superconductive sources, such dissipationless currents have only been demonstrated experimentally using intricate magnetically inhomogeneous multilayers, which can be difficult to construct, control and measure. Here we present analytic and numerical results proving the possibility of both generating and controlling a long-ranged spin supercurrent using only one single homogeneous magnetic element (arXiv:1510.02488). The spin supercurrent generated in this way does not decay spatially, in stark contrast to normal spin currents that remain polarized only up to the spin relaxation length. Through a novel interference term between long-ranged and short-ranged Cooper pairs, we expose the existence of a superconductivity-mediated torque even without magnetic inhomogeneities, showing that the different components of the spin supercurrent polarization respond fundamentally differently to a change in the superconducting phase difference. This establishes a mechanism for tuning dissipationless spin and charge flow separately via superconductors.

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