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Control and Local Measurement of the Spin Chemical Potential in a Magnetic Insulator CHUNHUI DU, TOENO VAN DER SAR, TONY ZHOU, Department of Physics, Harvard University, PRAMEY UPADHYAYA, Department of Physics and Astronomy, University of California, Los Angeles, FRANCESCO CASOLA, HUILIANG ZHANG, Harvard-Smithsonian Center for Astrophysics, MEHMET ONBASLI, CAROLINE ROSS, Department of Materials Science and Engineering, Massachusetts Institute of Technology, RONALD WALSWORTH, Harvard-Smithsonian Center for Astrophysics, YAROSLAV TSERKOVNYAK, Department of Physics and Astronomy, University of California, Los Angeles, AMIR YACOBY, Department of Physics, Harvard University — In recent decades, a large scientific effort has focused on harnessing spin transport for providing insights into novel materials and low-dissipation information processing. We introduce single spin magnetometry based on nitrogen-vacancy (NV) centers in diamond as a new and generic platform to locally probe spin chemical potential which essentially determines the flow of spin currents. We use this platform to investigate magnons in a magnetic insulator yttrium iron garnet (YIG) on a 100 nanometer length scale. We demonstrate that the local magnon chemical potential can be systematically controlled through both ferromagnetic resonance and electrical spin excitations, which agrees well with the theoretical analysis of the underlying multi-magnon processes. Our results open up new possibilities for nanoscale imaging and manipulation of spin-related phenomena in condensed matter systems.

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