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Magnonic Charge Pumping via Spin-Orbit Coupling CHIARA CICCARELLI, University of Cambridge, KJETIL HALS, Norwegian University of Science and Technology, University of Copenhagen, ANDREW IRVINE, University of Cambridge, VIT NOVAK, Institute of Physics ASCR, YAROSLAV TSERKOVNYAK, University of California, Los Angeles, HIDEKAZU KUREBAYASHI, University College London, ARNE BRATAAS, Norwegian University of Science and Technology, ANDREW FERGUSON, University of Cambridge — The interplay between spin, charge and orbital degrees of freedom has led to the development of spintronic devices such as spin-torque oscillators and spin-transfer torque MRAM. In this development, spin pumping represents a convenient way to electrically detect magnetization dynamics. The effect originates from direct conversion of low-energy quantized spin waves in the magnet, known as magnons, into a flow of spins from the precessing magnet to adjacent leads. In this case, a secondary spin-charge conversion element, such as heavy metals with large spin Hall angle or multilayer layouts, is required to convert the spin current into a charge signal. Here, we report the observation of charge pumping in which a precessing ferromagnet pumps a charge current, demonstrating direct conversion of magnons into high-frequency currents via spin-orbit interaction. The generated electric current, unlike spin currents generated by spin-pumping, can be directly detected without the need of any additional spin-charge conversion mechanism. The charge-pumping phenomenon is generic and gives a deeper understanding of its reciprocal effect, the spin orbit torque, which is currently attracting interest for their potential in manipulating magnetic information.

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