

## Research Highlights

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Subject Category: [Nanomagnetism and spintronics](#)

### Magnetic devices: New look for flux diodes

Peter Rodgers

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#### Abstract

Increased control over the motion of magnetic flux quanta in superconductors could lead to a new generation of 'fluxtronic' devices

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#### Introduction

Components that allow current to flow in only one direction — such as diodes in electronic circuits — are important in many applications, and are also of much interest in fundamental research. A number of groups have already demonstrated diodes that can control the motion of quanta of magnetic flux or 'vortices' in superconducting circuits and, in some cases, even reverse the overall direction of the vortex motion. However, these rectifier devices all suffer from limited control or efficiency.

Now Shuichi Ooi of the National Institute for Materials Science in Japan and co-workers<sup>1</sup> have made 'vortex ratchets' that are easier to control and also offer high efficiency. These devices rely on out-of-plane vortices being pinned by a triangular array of holes milled into the superconductor by a focused ion beam. An applied current that consists of two different oscillating frequencies can then be used to push the magnetic quanta to the left or the right by varying the relative phase or frequencies of the two harmonics. Applying an external magnetic field offers a further degree of control. The team also made a rectifier that worked for in-plane flux quanta.

The work could have applications in a new form of 'electronics' called 'fluxtronics', in which devices operate by manipulating vortices rather than electrons.

#### Reference

1. Ooi, S. *et al.* Nonlinear nanodevices using magnetic flux quanta. *Phys. Rev. Lett.* 99, 207003 (2007). | [Article](#) |