Researchers manipulate collective dynamics in magnetic nano-structures

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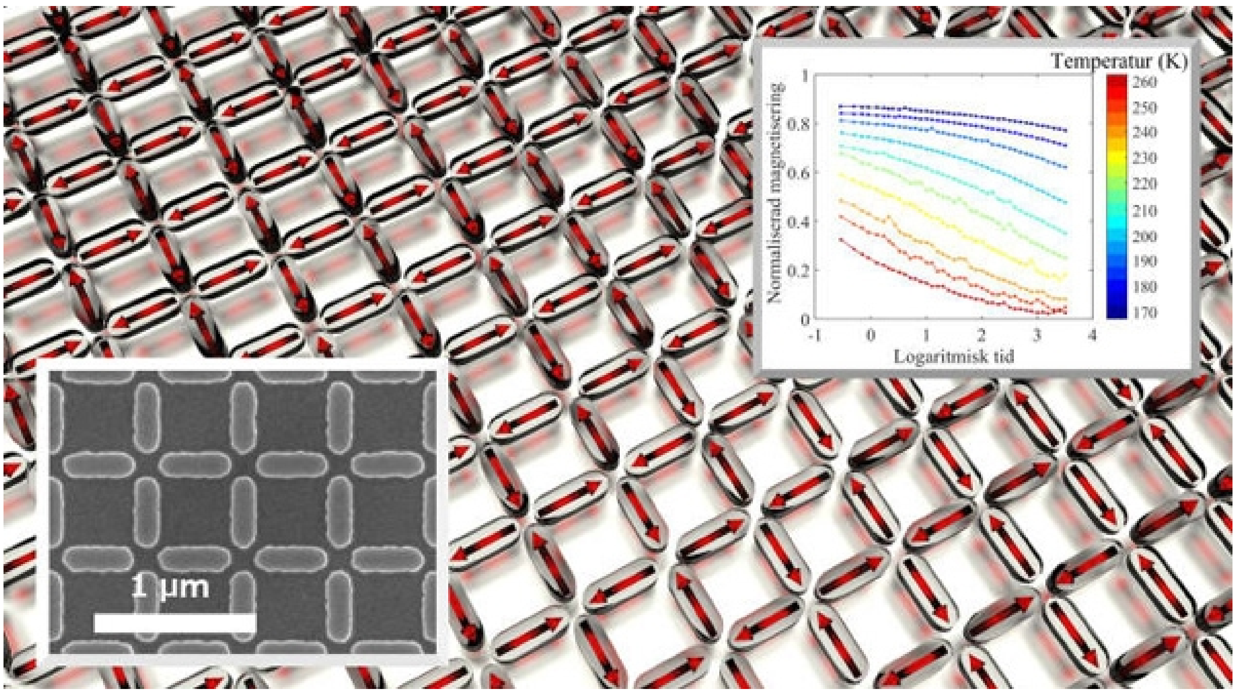

Credit: Vassilios Kapaklis, Mikael Andersson, Henry Stopfel

Researchers at the Division of Solid-State Physics and the Division of Materials Physics at Uppsala University have shown how the collective dynamics in a structure consisting of interacting magnetic nano-islands can be manipulated. Their findings are published in the journal *Scientific Reports*.

With the aid of modern nano-fabrication methods the researchers have imitated nature and created a 2D pattern of small stadium shaped magnetic islands. These small magnets have properties similar to those of magnetic atoms, exhibiting thermal fluctuations. The time and temperature dependence of the magnetisation in a collective of magnetic islands has been studied, using a very sensitive custom build magnetometer, developed in Uppsala.

"One of the advantages of using such magnetic nano-islands instead of magnetic atoms, as our primary building blocks is that the magnetic properties of the islands can be tuned with precision, something otherwise very difficult. To have precise control of your building blocks helps tremendously when analyzing measurements," explains Vassilios Kapaklis, Senior Lecturer in materials physics at Uppsala University.

A collective magnetic state is formed when these magnetic islands are allowed to interact and it is this state, which the researchers studied. The collective can exhibit emergent properties differing strongly compared to those of the single building blocks and that can be controlled by the geometrical placement of the building blocks.

"Out results show that magnetometry can be used to monitor the development of the magnetic collective in real time, while also offering the possibility to study the impact temperature has on this development," says Mikael Andersson, PhD student in solid state physics at Uppsala University.

The understanding of collective effects in magnetic nanostructures is crucial for realising applications such as magnetic logical circuits, which have the advantage of not requiring power to preserve a desired logical state.

More information: M. S. Andersson et al. Thermally induced

magnetic relaxation in square artificial spin ice, *Scientific Reports* (2016).
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