Ordering of magnetic properties run hot and cold

Given how much information we regularly store in magnetic form on everything from computer hard disks to credit card strips, researchers are increasingly interested in the stability of magnetic properties in materials. Mary Anne White, a chemist at Dalhousie University, and Bruce Gaulin of McMaster University's Brockhouse Institute for Materials Research, combined their facilities and expertise to explore how heat affects the magnetic properties of a metal oxide.

The pair examined a pyrochlore, erbium titanate [$Er_2Ti_2O_7$], which normally loses its magnetic qualities at just a few degrees above absolute zero. The McMaster lab grew pure crystals of this material so that it could be analyzed by the Dalhousie group, which specializes in thermal property measurements. The resulting data on magnetic entropy revealed that samples retained some magnetic ordering over an unexpectedly high temperature range. "What we found is that although the magnets ordered at quite low temperatures — 1.2 K (-272 C) — we had to go to really high temperatures — 200 K (-73 C) — to completely disorder the magnetism," says White. "That represents a nearly 200-fold difference in the amount of thermal energy."

The pair's findings, published in *Proceedings of the Royal Society A*, indicate how difficult it can be to fully scramble magnet properties, an observation that will be of greater interest as scientists look for even better ways of using such materials. "This is fodder for theoreticians who are studying magnetic spins in different environments and how we can control them," White adds.