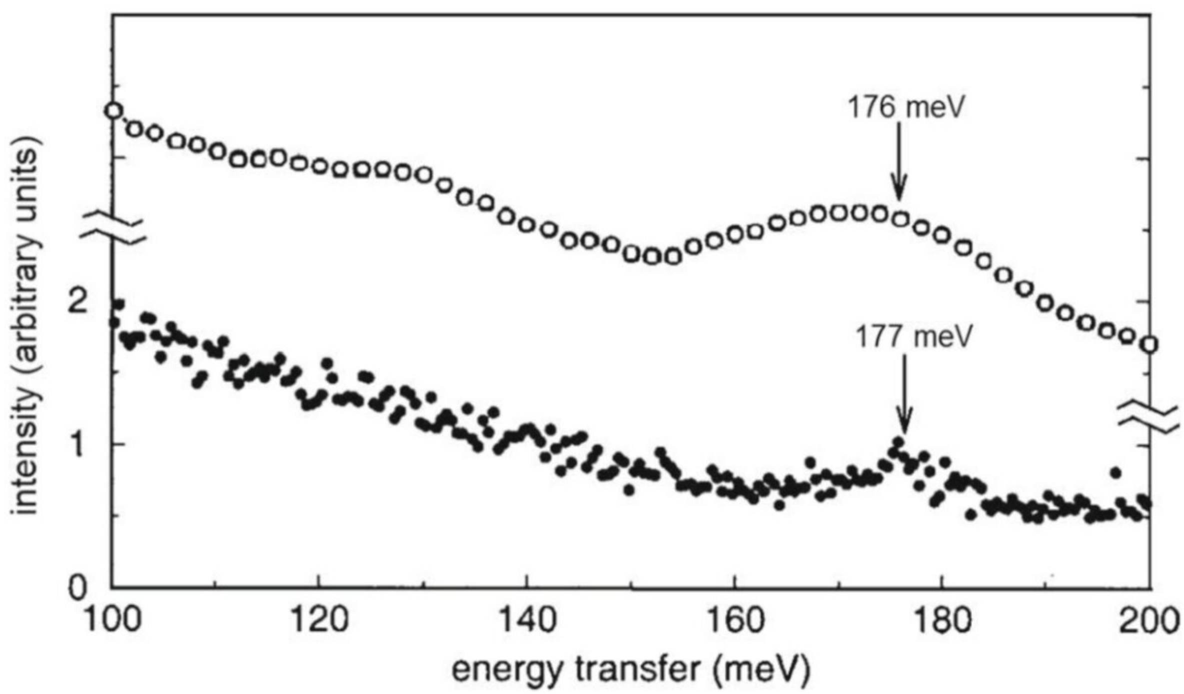
Study offers correction for better calculations for the magnetic properties of neodymium compounds

December 6 2023, by Samuel Jarman



INS spectra of $Sm_2 Fe_{17}$ from Refs. [129] (upper curve) and [23] (lower curve). Credit: *The European Physical Journal Plus* (2023). DOI: 10.1140/epjp/s13360-023-04449-5

High-energy neutron scattering is a powerful tool in spectroscopy, allowing researchers to probe the physical and chemical properties of many different materials.

It is especially well suited for studying the dense and complex structures of lanthanide-iron intermetallic compounds, such as the celebrated $Nd_2Fe_{14}B$. So far, however, researchers still haven't figured out how to probe the material's valuable magnetic properties using neutron scattering.

In a new study published in *The European Physical Journal Plus*, Michael Kuz'min at Aix-Marseille University, together with Manuel Richter at Leibniz IFW Dresden, present a correction to the technique which could be used to determine the 'exchange field' of Nd: an important indicator of its magnetic properties.

The duo's approach could help researchers to better understand the origins of neodymium compounds' high resistance to demagnetization, which is crucial for their use as permanent magnets, which are indispensable for wind turbines, electric cars, and robots.

A metal's exchange field measures the degree of alignment between the quantum spins of its neighboring atoms, which is strongly tied to the strength of its magnetism. It can be determined by measuring the difference between two key quantities.

The first of these is the transition energy required for orbiting electrons to move between 'multiplets': closely spaced energy levels associated with the electronic structures of Nd atoms. Secondly, spin-orbit splitting describes the interaction between the regular angular momenta of the electrons' spin, and their orbit around their atoms.

For measurements of the Nd exchange field, challenges emerge since both of these quantities are affected by electric fields generated by the arrangement of ions surrounding Nd atoms in the crystal lattice, which interferes with mutual interactions between their orbiting electrons.

In their study, Kuz'min and Richter propose a new set of formulas to correct for the influence of this electric field. By applying these corrections to their observations, the duo hopes that researchers in future experiments could be better placed to explore and exploit the metal's magnetic properties using neutron spectroscopy.

More information: Michael D. Kuz'min et al, Lanthanide exchange fields and intermultiplet transitions in permanent-magnet materials, *The European Physical Journal Plus* (2023). DOI: 10.1140/epjp/s13360-023-04449-5

Provided by Springer

Citation: Study offers correction for better calculations for the magnetic properties of neodymium compounds (2023, December 6) retrieved 27 April 2024 from https://phys.org/news/2023-12-magnetic-properties-neodymium-compounds.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.