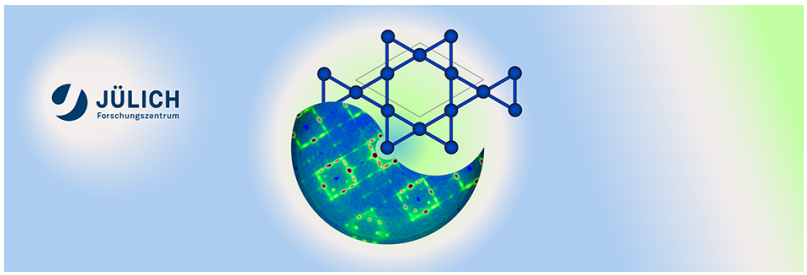

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Single-crystal growth and low-temperature physical properties of novel frustrated quantum magnets

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Frustrated magnets have competing interactions that prevent spins from aligning in a simple order, leading to highly degenerate ground states. To pursue the rich physics and exotic phenomena involved, a variety of geometrically frustrated materials have been uncovered, providing intriguing platforms for the manipulation of complex degrees of freedom [1].
Pyrochlore-structure frustrated magnets with the general formula R2B2O7 (where R represents magnetic 4f rare-earth ions and B is a non-magnetic cation) consist of a three-dimensional network of corner-sharing tetrahedra. This 3D geometry gives rise to a richer landscape of magnetic interactions and spin configurations compared to their 2D counterparts, such as triangular or kagome lattices. The nature of the magnetic anisotropy depends on the specific rare-earth ion: for instance, in Nd2Zr2O7, the Nd3+ ions exhibit local ⟨111⟩ Ising anisotropy, leading to an all-in–all-out antiferromagnetic ground state [2]. In contrast, Yb2Ti2O7 hosts XY-like spins with moments confined to planes perpendicular to the local ⟨111⟩ axes [3].
In this work, we introduce partial substitution of Nd3+ into Yb2Ti2O7, aiming to perturb the pure XY anisotropy of Yb^{3+} with Ising-like contributions from Nd3+. This allows us to explore the interplay between different types of magnetic anisotropy within the geometrically frustrated pyrochlore framework. High-quality single crystals of YbNdTi2O7 were successfully grown using the optical floating-zone method. Subsequently, axis-dependent magnetic susceptibility measurements were performed to probe the anisotropy of the system. Building on the high-quality single crystal obtained, future neutron scattering studies on YbNdTi2O7 are expected to provide valuable insights into the anisotropic spin correlations and potential emergent quantum phenomena arising from the interplay of Ising and XY interactions.

[1] L. Balents, Nature, 464, 199-208 (2010).
[2] E. Lhotel, S. Petit, S. Guitteny, et al., Physical Review Letters, 115, 197202 (2015).
[3] J. Gaudet, K. A. Ross, E. Kermarrec, et al., Physical Review B, 93, 064406 (2016).

Autor: Dr. ZHU, Yinghao (Jülich Centre for Neutron Science JCNS at MLZ, Forschungszentrum Jülich)

Co-Autoren: Herr PERSSON, Jörg (FZJ, DE); Dr. SU, Yixi (Jülich Centre for Neutron Science (JCNS) at MLZ, Forschungszentrum Jülich GmbH)

Vortragende(r): Dr. ZHU, Yinghao (Jülich Centre for Neutron Science JCNS at MLZ, Forschungszentrum Jülich)

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