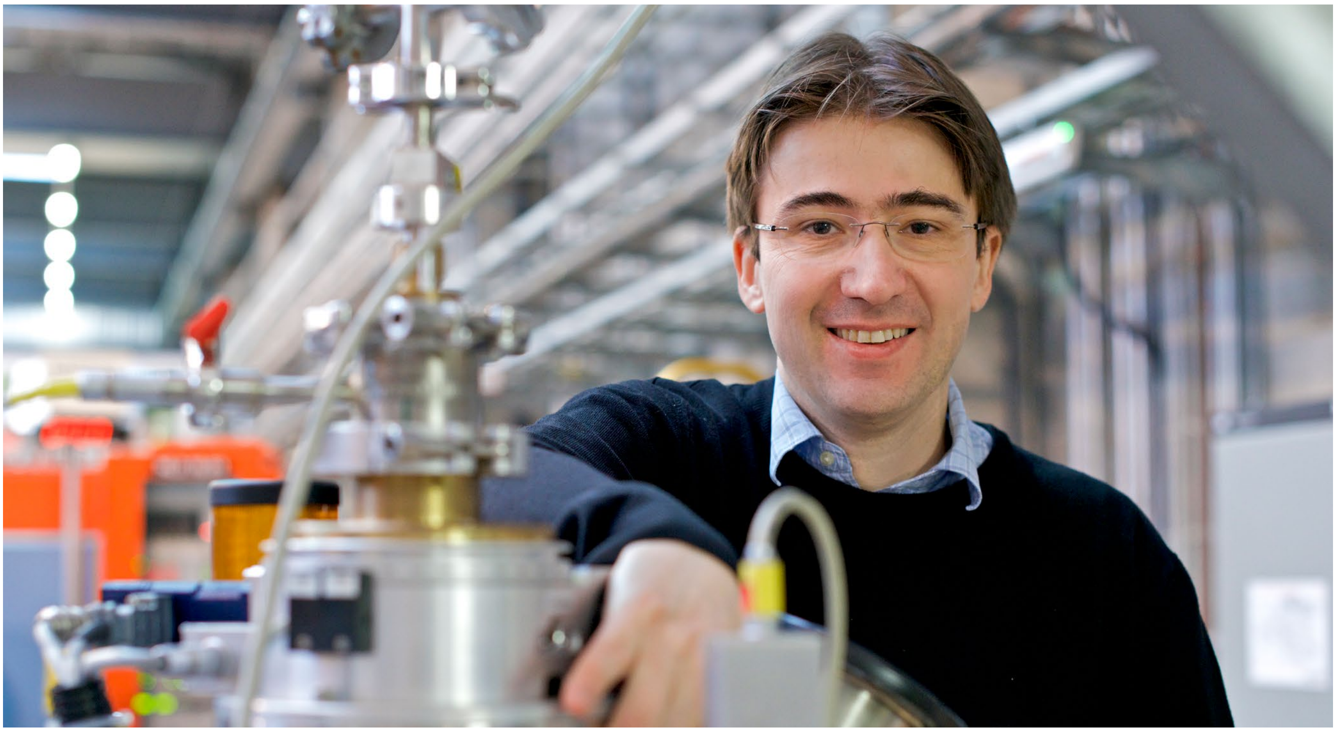
Michel Kenzelmann researches materials with unusual magnetic properties

Professor Michel Kenzelmann leads the Laboratory for Neutron Scattering and Imaging at the Paul Scherrer Institute and teaches as a titular professor at the University of Basel's Department of Physics. He analyses materials whose magnetic properties differ significantly from those of the bar magnets we know from school. For example, he studies a material known as quantum spin ice, which may be suitable for use in future quantum computers, among other applications.



Michel Kenzelmann leads the Laboratory for Neutron Scattering and Imaging at the PSI and teaches as a titular professor at the University of Basel's Department of Physics. (Image: Paul Scherrer Institute)

Spin ice is of particular interest

Quantum spin ices are crystalline materials in which the intrinsic angular momenta (spins) of the electrons in the various ions highly fluctuate even at very low temperatures close to absolute zero. Spin ice is of particular interest to scientists because it allows the observation of unusual phenomena, such as the formation of magnetic monopoles. These do not have north and south poles, as in a bar magnet, but rather a single pole resulting from interactions between a large number of spins. Based on theoretical calculations, the existence of magnetic monopoles was predicted many decades ago, but they were only realized experimentally in recent years.

Quantum mechanical effects

In 2018, in addition to the magnetic monopoles, Michel Kenzelmann's group also successfully demonstrated quantum mechanical spin ice effects in crystals of praseodymium hafnium oxide in collaboration with colleagues from the United Kingdom and Japan.

Quantum effects in the spin ice lead to new types of electric fields that are coupled with the magnetic monopoles and that fluctuate together. The resulting electromagnetic fields have similar properties to those of light and allow the formation of quantum-coherent states in which distant spins remain entangled with one another. The discovery is a step toward identifying novel materials that could pave the way for a new generation of quantum electronics.