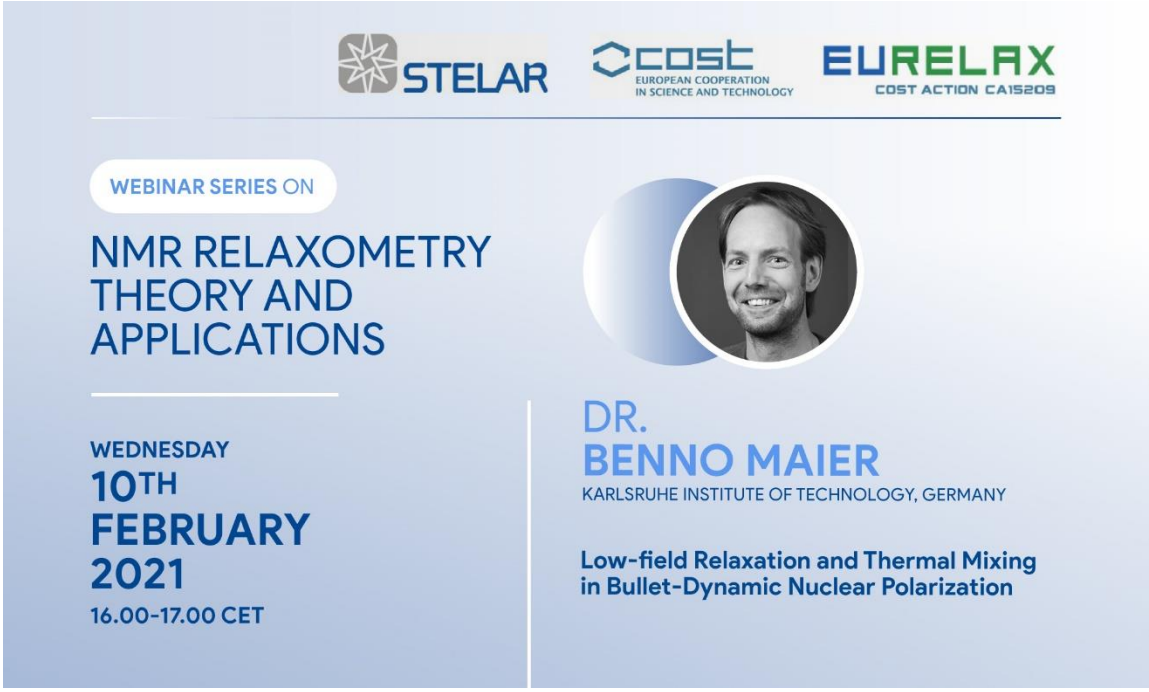

Abstract

Low-field Relaxation and Thermal Mixing in Bullet-Dynamic Nuclear Polarization

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In dissolution-dynamic nuclear polarization (D-DNP), nuclear spins are first polarized at low temperatures using dynamic nuclear polarization. The sample is then dissolved with a jet of hot solvent, and the solution is transferred to a secondary magnet, where strongly enhanced NMR signals can be recorded. It may be beneficial to reverse the order of transfer and dissolution, i.e. to first transfer the hyperpolarized solid, and then dissolve it only upon arrival in the secondary magnet. This scheme, called bullet-DNP, offers fast transfer times, and scalability towards small sample volumes. The transfer of a hyperpolarized solid also may also enable hetero-nuclear polarization transfer via thermal mixing. However, these potential advantages can only be put to use without modification if radical-induced low-field relaxation can be controlled.

Here we present a study of low-field relaxation and low-field thermal mixing in pyruvic acid in the presence of trityl radical OX063. We suggest an interpretation of the observed behaviour in terms of a flow of energy from the nuclear Zeeman reservoirs to the lattice, via the electron non-Zeeman reservoir. We also provide a brief update on the status of bullet-DNP experiments in our lab.

Author Biography

Benno Meier received his PhD in Physics from Leipzig University in 2012, supervised by Jürgen Haase. Benno then joined the lab of Malcolm Levitt in Southampton where he worked on quantum rotors and long-lived states. He was promoted to Senior Research Fellow in 2015 and received an EPSRC fellowship to develop bullet DNP in 2018. He was awarded a Helmholtz Young Investigator Group in 2019 and relocated to Karlsruhe Institute of Technology in 2019. Benno is co-founder and director of HyperSpin Scientific UG.