

Hyperfine-enhancement as a route to persistent spin dynamics in singlet-state systems

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Many magnetically frustrated systems exhibit what is known as persistent spin dynamics (PSD) in μ SR experiments, the origin of which has remained mysterious since their discovery in the 1990s. As the temperature is lowered, the muon-spin relaxation rate rises (as would be expected for the slowing-down of spin fluctuations) but this rate then saturates at low temperature, the low-temperature fluctuations being interpreted as PSD. To explain this phenomenon, we describe how muons can couple to singlet states and illustrate this with experimental data taken on Tm₂Ti₂O₇. The key idea is that the hyperfine interaction, usually neglected in treatments of electronic magnetism, provides a route in which excited states can be mixed into the ground state, and this new state can couple to the "quantum muon" [1]. This mechanism lies behind the effect found in some quantum spin ice compounds [2], but here it is not based on the distortion effects surrounding the muon [3,4]. We will show how this idea can be extended to understand the way muons couple to a variety of systems exhibiting highly frustrated magnetism [5], as well as to dynamical problems more generally [3].

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