Contribution ID: **226** Contribution code: **O-2** Type: **Oral**

Studying spin diffusion and quantum entanglement with LF-μSR

Monday, 29 August 2022 11:00 (20 minutes)

LF-μSR studies of spin diffusion started with mobile solitons [1] and polarons [2] in conducting polymers. Spin 1/2 antiferromagnetic chains can also support diffusive spin excitations in a certain parameter range of the XXZ model [3], showing either diffusive [4] or ballistic transport [5]. Recent LF-μSR studies of layered triangular lattice quantum spin liquid materials such as 1T-TaS_2 [6] and $YbZnGaO_4$ [7] have shown spin dynamics that is extremely well described by a 2D spin diffusion model, fitting much better than previously proposed models for spin correlations. In $YbZnGaO_4$ the diffusion rate shows a clear crossover between classical and quantum regimes as T falls below the exchange coupling J. That the spin diffusion approach works well in the high T classical region might be expected, but it is found that it also works equally well in the low T quantum region. This allows a T dependent length scale to be derived from the data that can be assigned to a quantum entanglement length ξ. Another entanglement measure, the Quantum Fisher Information F_Q [8] can also be obtained from the LF-μSR data and compared with ξ.

[1] K. Nagamine et al, Phys. Rev. Lett. 53, 1763 (1984); [2] F.L. Pratt et al, Phys. Rev. Lett. 79, 2855 (1997); F.L. Pratt et al, Physica B 326, 34 (2003); [3] B. Bertini et al, Rev. Mod. Phys. 93, 025003 (2021); [4] F.L. Pratt et al, Phys. Rev. Lett. 96, 247203 (2006); F. Xiao et al, Phys. Rev. B 91, 144417 (2015); [5] T. Lancaster et al, Phys. Rev. B 85, 184404 (2012); B.M. Huddart et al, Phys. Rev. B 103, L060405 (2021); [6] S. Manas-Valero et al, npj Quantum Mater. 6, 69 (2021); [7] F.L. Pratt et al, Phys. Rev. B 106, L060401 (2022); [8] P. Hauke et al, Nat. Phys. 12, 778 (2016).

Primary author: Dr PRATT, Francis (STFC)

Co-authors: HUDDART, Benjamin (Durham University); LANCASTER, Tom (Durham University); MANAS-VALERO, Samuel (University of Valencia); CORONADO, Eugenio (University of Valencia); LANG, Franz (STFC); BLUNDELL, Stephen (University of Oxford); HARAVIFARD, Sara (Duke University); STEINHARDT, William (Duke University)

Presenter: Dr PRATT, Francis (STFC)

Session Classification: Oral contributions

Track Classification: Spin liquids and related phenomena