UNIVERSITÀ
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Colloquia

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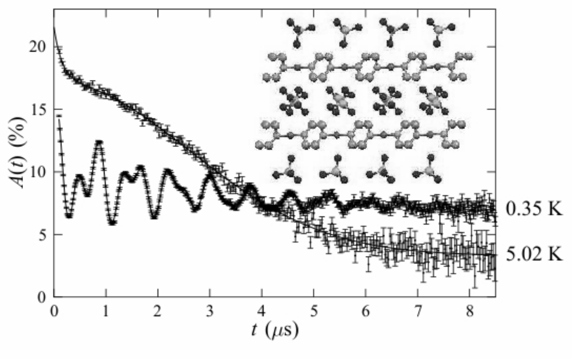
Low dimensional and topological states in molecular magnets and beyond

Low-dimensional quantum magnetism continues to be of great theoretical and experimental interest, as reduced dimensionality supports strong quantum fluctuations that can result in novel excitations and critical behaviour. Of particular recent importance is the understanding the physics in reduced dimensions using notions from topology. Examples include topological objects such as walls, vortices and skyrmions, which exist in the spin textures of a range of magnetic systems, and one-dimensional spin chain systems, where topological considerations are key in elucidating the possible ground states and excitation spectra. Here we discuss our recent results in this area, with an emphasis on the use of muon-spin relaxation as a sensitive probe of emergent magnetism in spin chains and ladders. Muons have repeatedly been shown to be sensitive to long-range magnetic order in these systems, which is often very difficult to observe using other techniques, and also to low-energy dynamics. We present the results of measurements on a series of materials, including: (i) $\mathrm{Cu(pyz)(gly)ClO_4}$ which is based on spin dimers; (ii) the spin ladder material $\mathrm{(Hpip)_2CuBr_4}$ where similar physics governs the phase diagram; and (iii) the chiral spin chain $\mathrm{[Cu(pym)(H_2O)_4]SiF_6.H_2O}$ [3]. We use our muon spectra to identify the regions of the phase diagram and crucially, we show that density functional theory can be used to explain how perturbations to a material caused by the presence of the charged muon impurity, allow the muon to probe the system. We also present new results on a S=1 molecule-based magnet which is a successful realization of a Haldane spin chain [4]. By applying magnetic fields we are able to close the Haldane spin gap, driving the system through a quantum critical point. We discuss the prospects for gaining control over such molecule-based systems via chemical engineering, with an aim to promote exotic ground states.



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