How many spin liquids are there in $Ca_{10}Cr_7O_{28}$?

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$Ca_{10}Cr_7O_{28}$ is an exotic new magnetic insulator, in which spin-1/2 Cr^{5+} ions form bilayers of a breathingKagome lattice. Exchange interactions in $Ca_{10}Cr_7O_{28}$ are confined to bilayers and predominantly ferromagnetic, with a Curie temperature of 2.35 K [1, 2]. None the less, no magnetic order is observed down to 19 mK, making $Ca_{10}Cr_7O_{28}$ an unusual example of two-dimensional quantum spin liquid [1].

In this talk we explore the nature and origin of the spin liquid observed in $Ca_{10}Cr_7O_{28}$, starting from the microscopic model of magnetic interactions proposed by Balz *et al.* [1, 2]. Using semi-classical molecular-dynamics simulations, we characterise the evolution of spin dynamics in $Ca_{10}Cr_7O_{28}$ in applied magnetic field, making explicit comparison with published inelastic neutron scattering data.

To our surprise, we find that excitations encode not one, but two distinct types of spin liquid, a “spiral spin liquid” similar to that studied in square-lattice frustrated ferromagnets [3], and a coulombic spin liquid previously observed in the Kagome-lattice antiferromagnet [4]. We argue that the zero-field quantum spin-liquid ground state in $Ca_{10}Cr_7O_{28}$ is born out of the “spiral spin liquid”, and interpret scattering at finite energy in terms of the pinch-points of the coulombic spin liquid. We also offer a simple explanation of the spiral spin liquid behaviour, through a mapping onto an effective spin-3/2 honeycomb lattice model [5].

References

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