Frustration and spin liquid physics in $Ca_{10}Cr_7O_{28}$

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Abstract:

In certain insulating materials, despite reasonably strong antiferromagnetic or mixed interactions between the spins of neighbouring ions, no magnetic ordering transition is observed down to the lowest measured temperatures. Although there has been significant progress over the past couple of decades, the complete description and classification of such 'spin liquids' remains an open problem.

In this talk, I will discuss a recent example: $Ca_{10}Cr_7O_{28}$, in which - rather unusually - most of the Cr ions have charge +5, and thus S=1/2 spins, making it likely that this material is a quantum spin liquid. I will review the available experimental data, and discuss the theoretical model used to date in the literature: the breathing bilayer kagome (BBK) model. I will argue that this model cannot reproduce the measured specific heat capacity of $Ca_{10}Cr_7O_{28}$ [1]; thus, while it does appear to show spin liquid behaviour, the relevance of that to $Ca_{10}Cr_7O_{28}$is doubtful. I will conclude by speculating on what extra physics might be needed to make the model fit the material better.

[1] J. A. Crossley and CAH, arXiv:2309.13987 (2023).