Ground state selection and dynamical crossover in the quantum pyrochlore magnet $Yb_2Ti_2O_7$

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The pyrochlore magnet $Yb_2Ti_2O_7$ is a promising quantum spin ice candidate as it possesses both an effective S = 1/2 spin, thanks to the well isolated crystal field Kramers doublet ground-state appropriate to Yb^{3+}, and strong quantum fluctuations brought by anisotropic exchange interactions and an XY g-tensor [1]. However, the magnetic properties of $Yb_2Ti_2O_7$ at low temperature have eluded a global understanding, notably because of the presence of extra Yb^{3+} on the B (non-magnetic) pyrochlore site, that clearly impact on its physical properties [2]. By combining neutron diffraction and muon spin relaxation (µSR) techniques, we establish the pressure-temperature phase diagram of $Yb_2Ti_2O_7$ and further evidence a magnetic transition from a disordered, non magnetically ordered, ground state at ambient pressure to a splayed ferromagnetic ground state under hydrostatic pressure [3]. We use applied pressure to counterbalance the effect of negative chemical pressure induced by Yb^{3+}/Ti^{4+} anti-site occupation. Furthermore, we have recently achieved controlled isovalent substitutions of Zr on the Ti site that allowed us to apply chemical pressure in the series $Yb_2(Ti_{1-x}Zr_x)_2O_7$, and explore in more details the quantum crossover regime between the fluctuating and the ferromagnetic regions of the phase diagram at low temperatures.

[1] K. A. Ross, L. Savary, B. D. Gaulin and L. Balents, Phys. Rev. X 1, 021002 (2011)
[2] K. E. Arpino, B. A. Trump, A. O. Scheie, T. M. McQueen, *et al.*, Phys. Rev. B 95, 094407 (2017)
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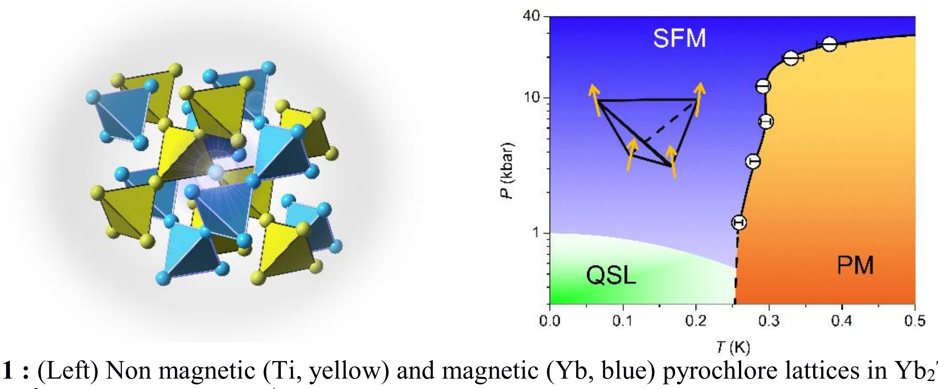

Figure 1 : (Left) Non magnetic (Ti, yellow) and magnetic (Yb, blue) pyrochlore lattices in $Yb_2Ti_2O_7$. Excess Yb^{3+} ion can occupy a Ti^{4+} site and create a local defect. (Right) Pressure-temperature phase diagram of $Yb_2Ti_2O_7$ established by µSR (black circles) highlighting the existence of a non magnetically ordered region (QSL), a splayed ferromagnetic region (SFM) and a collective paramagnetic (PM) region. Line is a guide to the eye.