# Following elementary excitations to finite temperatures at the pressure-induced quantum phase transition in $TlCuCl_3$

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We control the ground state and elementary excitations of the quantum antiferromagnet $TlCuCl_3$ by the application of pressure and temperature. The magnetically ordered phase is "melted" by both quantum and thermal fluctuations, and we map the behaviour of the triplet excitations across the quantum critical regime by inelastic neutron scattering. We use a bond-operator formalism with hard-core boson statistics to describe the evolution of the finite-temperature spectrum from spin waves into gapped magnons.
Because the quantum disordered and finite-temperature disordered phases are continuously connected, quantum and thermal fluctuations show very similar effects in opening a gap. One degenerate magnon mode of the disordered phase becomes the longitudinal excitation of the ordered phase.[1] We measure the linewidth of this critically damped mode across the phase transition and show within our model how the universal behaviour governed by the pressure parameter is altered due to thermal broadening.

[1]Ch. Rüegg *et al.*, Phys. Rev. Lett. **100**, 205701 (2008).