Exact solution of the classical and quantum Heisenberg mean field spin glasses

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While the physics of classical and quantum Ising spin glasses has been understood rather thoroughly, glasses of Heisenberg (vector) spins have remained a difficult and largely unsolved problem, including especially its quantum version, which governs the local moments in randomly doped, strongly correlated materials.
I will present the numerically exact mean field solution of quantum and classical Heisenberg spin glasses, based on the combination of a high precision numerical solution of the Parisi full replica symmetry breaking equations and a continuous time Quantum Monte Carlo.

We find that the Heisenberg (vector) spin glasses have a rougher energy landscape than their Ising analogues, which affects their avalanche response to external stimuli. The (short time) quantum dynamics and collective excitations exhibit a surprisingly slow temperature evolution, that, at asymptotically low temperatures, tend to the superuniversal form found so far in all insulating mean field glasses.

We extend our analysis to the doped, metallic Heisenberg spin glass, which displays an unexpectedly slow spin dynamics reflecting the proximity to the melting quantum critical point and its associated Sachdev-Ye-Kitaev Planckian dynamics.

I will discuss open questions and relations to quantum electron glasses and localization.

Ref: N. Kavokine, M. Müller, A. Georges, and O. Parcollet, Phys. Rev. Lett. **133**, 016501 (2024).