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Opportunities in magnetic ground state discovery using annealers and beyond

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The knowledge of the ground states, the phase diagram and the critical properties of quantum magnets, especially those which can yield interesting and unconventional phases, is essential to enable future quantum spintronics technologies. Dynamic susceptibility experiments, such as neutron scattering, heat capacity, and magnetic susceptibility, performed on materials often show a variety of ground and excited states, which are often difficult to understand. On the other hand, spin systems are straightordedly embedded in quantum computers. Ising quantum annealers, quantum-inspired parallel tempering machines and certain universal ion-trap-based devices performing analog simulations have started to reach the level of maturity required to be useful tools for solving these problems without having to retort to conventional monte-carlo routines. In this talk, we describe the solution to the frustrated Ising Shastry-Sutherland Hamiltonian using three different backends - D-Wave [1], Fujitsu [2] and Honeywell [3]. The Hamiltonian is arguably expressed in several rare-earth magnets, such as Holmium tetraborides which provides a physics motivation to solving this problem. We showcase that each backend has its opportunities and drawbacks which if used appropriately, can be a powerful tool to access a variety of phases, phase transitions, as well as their (quantum) critical behaviour.

Biography

Arnab Banerjee has completed his PhD from University of Chicago and postdoctoral studies from the Quantum Condensed Matter Division at the Oak Ridge National Laboratory, followed by the position of a scientist in the same organization for 3 more years.He is currently the assistant professor at the Department of Physics and Astronomy at the Purdue University at West Lafayette, Indiana, and Guest Scientist at the Oak Ridge National Laboratory, Quantum Computing Institute. He is also the Steering Committee member of the Center for Quantum Technologies at Purdue. He has published more than 35 papers in reputed journals..