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In search of Quantum Spin Liquids

Magnetic systems are characterised by microscopic interaction strengths that couple magnetic moments of different atomic sites. Depending on the magnitudes, signs and ranges of these interactions, various magnetic ground states can be realised, the simplest examples being various collinear magnetic arrangements. In simple systems exhibiting transitions from paramagnetic to ordered (ferro- or antiferro-) magnetic states with the lowering of temperature, one may obtain an estimate of the net interaction strength from the temperature-intercept (Θ_{CW}) of the inverse-susceptibility plot as a function of the temperature via the Curie-Weiss Law. This magnitude of Θ_{CW} is often a good indication of the transition temperature. However, there are many systems where the magnetic ordering temperature is significantly suppressed compared to Θ_{CW} due to frustrations in the magnetic interactions. Alternatively, such frustrated interactions can give rise to a magnetically frozen or glassy state. In some unusual cases, no magnetic ordering or freezing is found down to the lowest temperature probed despite a sizable value of Θ_{CW}, prompting one to believe that such systems have an exotic ground state, known as quantum spin liquid state. We have been probing several new systems that are improbable candidates of this class of compounds but finding experimental features to suggest unusual ground states akin to the quantum spin liquid state. I shall discuss some of these systems in my presentation.

D. D. Sarma obtained a 5-year Integrated MSc degree in Physics from the Indian Institute of Technology, Kanpur, in 1977 and a Ph.D. Degree in 1982 from Indian Institute of Science (IISc), Bengaluru. He worked in Kernforschungsanlage (later renamed as Forschungszentrum), Jülich, Germany, as a Visiting Scientist during 1984-1986. He was a faculty member at Solid State and Structural Chemistry Unit of IISc during 1986-2021 and was the first holder of the J. N. Tata Chair of IISc during 2017-2020. He also held the positions of MLS Chair Professor at Indian Association for the Cultivation of Science, Kolkata during 2006-2009 and Distinguished Scientist of CSIR during 2011-2016. He is now serving as an Honorary Professor (2021-2026) at IISc. His research interest spans the science of strongly correlated electron systems, primarily based on transition metal compounds, semiconductor nanocrystals and energy materialsusing a wide range of experimental and theoretical tools.