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ICTS Statistical Physics and Condensed Matter Seminar

Title : The disordered quantum Ising model with periodic and quasiperiodic driving

Speaker : Felix von Oppen (Freie Universität Berlin, Germany)

Date : Friday, 05 December 2025

Time : 3:30 PM (IST)

Abstract : This year marks the centennial of the publication in which Ernst Ising introduced the model that carries his name. Its quantum version, the transverse field (or quantum) Ising model, is not only important for solving the classical Ising model. It is also pervading large swaths of modern quantum condensed matter physics, quantum information theory, and beyond. Motivated by an experiment on a superconducting quantum processor [1], we study the disordered quantum Ising model with periodic and quasiperiodic driving. When written in terms of Jordan-Wigner fermions, the periodic - or Floquet - quantum Ising model supports Majorana π modes in addition to Majorana zero modes. We show [2] that the robustness against longitudinal disorder is vastly different for Majorana π modes than for Majorana zero modes. While zero pairings in the many-body spectrum are rapidly lifted, the π pairings are even strengthened, up to vastly larger disorder strengths. We explain our results within a self-consistent Floquet perturbation theory and study implications for boundary spin correlations. We show that related ideas allow one to find essentially analytical results for the defining temporal correlation function of Floquet time crystals [3]. We also study a version of the quantum Ising model with quasiperiodic driving and find that its phase diagram evolves in a self-similar manner with increasing simulation time [4].

References

[1] X. Mi et al., Science 378, 785 (2022)

[2] H. Schmid, A.-G. Penner, K. Yang, L.I. Glazman, F. von Oppen, Phys. Rev. Lett. 132, 210401 (2024)

[3] A.-G. Penner, H. Schmid, L.I. Glazman, F. von Oppen, Phys. Rev. B **111**, 184308 (2025)

[4] H. Schmid, Y. Peng, G. Refael, F. von Oppen, Phys. Rev. Lett. **134**, 240404 (2025)

Venue : Chern Lecture Hall

Zoom Link: <https://icts-res-in.zoom.us/j/98822569029?pwd=oVaMTqxIRUTAA3rgWDRo2HZxqGjG8F.1>

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