Quantum many-body

Abstract
Ground state criticality of many-body systems is a resource for quantum enhanced sensing, namely Heisenberg precision limit, provided that one has access to the whole system. Indeed, for partially accessible probes the sensing capacity in the ground state reduces to sub-Heisenberg limit. To compensate this, we drive the system periodically and use the local steady state for quantum sensing. Remarkably, the steady state sensing shows a significant enhancement in its precision in comparison with the ground state and even shows super-Heisenberg scaling for a certain range of frequencies. The same setup can also be used for sensing AC fields. The precision in partially accessible systems may also be compensated through a sequence of measurements which are performed after a period of free evolution. We show that as the length of measurement sequence increases the precision surpasses the standard limit and asymptotically reaches Heisenberg scaling. While most of many-body quantum sensors achieve enhanced sensitivity within a very narrow region, known as local sensing, one may need a probe to measure an unknown parameter over a large interval. To address this issue, we formulate the notion of global sensing and establish a systematic method to optimize quantum many-body probes to achieve the best possible precision when the parameters of interest vary over arbitrarily large intervals.

References:
[1] V. Montenegro, U. Mishra, A. Bayat, Phys. Rev. Lett. 126, 200501 (2021)
[2] U. Mishra, A. Bayat, Phys. Rev. Lett. 127, 080504 (2021)
[3] V. Montenegro, G. S. Jones, S. Bose, A. Bayat, Phys. Rev. Lett. 129, 120503 (2022)