



## Weekly Seminar

# Quantum many-body sensors

**Prof. Abolfazl Bayat**

*University of Electronic Science and Technology of China*

**Time: 3:00pm, July. 12, 2021 (Monday)**

**时间: 2021年7月12日 (周一) 下午3:00**

**Venue: Room W563, Physics building, Peking University**

**地点: 北京大学物理楼, 西563会议室**

### 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. We show that for partial accessibility the sensing capacity of a block in the ground state reduces to sub-Heisenberg limit. To compensate this, we drive the system periodically and use 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 origin of this precision enhancement is found to be the closing of the Floquet gap. This is in close correspondence with the role of the vanishing energy gap at criticality for quantum enhanced ground state sensing with global accessibility. The proposal is general to all integrable models and can be implemented on existing quantum devices.

In addition, we show that the same quantum many-body system can be used for AC-field sensing. Due to periodicity of the dynamics, any local block of the system saturates to a steady state which allows achieving sensing precision well beyond classical limit, almost reaching the Heisenberg bound. We associate the enhanced quantum precision to closing of Floquet gap, resembling the features of quantum sensing in the ground state of critical systems. We show that the proposed protocol can also be realized in near-term quantum simulators, e.g. ion-traps, with limited number of qubits. We show that in such systems a simple block magnetization measurement and a Bayesian inference estimator can achieve very high precision AC field sensing.

### About the speaker

Abolfazl Bayat is a professor of Physics at the Institute of Fundamental and Frontier Sciences in University of Electronic Science and Technology of China in Chengdu. After completing his PhD in 2008 from Sharif University of Technology in Iran, he did his postdocs at University College London (2008-2011 and 2013-2017) and University of Ulm in Germany (2011-2013). The research interest of Prof. Bayat includes: quantum simulation, quantum sensing and many-body physics.