武汉物数所理论交叉学术交流系列报告 （第一九七期）

Space-time Crystal and Quantum Spin Dynamics of Bethe Strings

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About the speaker:

Congjun Wu received his Ph.D. in physics from Stanford University in 2005, and did his postdoctoral research at the Kavli Institute for Theoretical Physics, University of California, Santa Barbara, from 2005 to 2007. He became an assistant professor in the Department of Physics at the University of California, San Diego (UCSD) in 2007, an associate professor at UCSD in 2011, and a professor at UCSD in 2017. His research interests include quantum magnetism, superconductivity, orbital physics, and topological states in condensed-matter and cold-atom systems.

Abstract:

Real-time dynamics reveals rich information of quantum many-body systems, and the interplay between dynamics and correlation is a long-standing problem of condensed matter physics. In this talk, we present our efforts on two fundamental aspects of quantum dynamics – symmetry and strong correlations.

A solid state textbook typically starts with crystals – static periodical structures in space. We generalize this concept to dynamic systems with intertwined space-time symmetry and dub it "space-time" crystal. The static crystal and the Floquet lattice are its special cases in which space and time periodicities decouple. A new mathematic concept of "space-time" group is proposed to describe the symmetries of a space-time crystal, which augments space group with non-symmorphic operations involving fractional translations along the time domain: "time-screw rotation" and "time-glide reflection". Classifications on the 1+1 D and 2+1D space-time crystals (groups) are completed, and applications of space-time crystals to dynamic condensed matter systems will be discussed. We have also studied the real frequency response at high energy in strongly correlated systems, which is a hardcore problem of condensed matter physics. The Bethe string states, originally proposed by Bethe as 2-body magnon bound states, are solved in its quantum many-body version in the anisotropic antiferromagnetic XXZ chains. The dominant role of Bethe strings in quantum dynamics is identified when spin chains are close to the field-tuned criticality. These states have been observed for the first time in the electron-spin-resonance spectroscopy measurement on SrCo2V2O8, and we identified their appearance as a series of characteristic spectra lines.

Reference:

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3. Z. Wang, J. Wu, W. Yang, A. K. Bera, D. Kamenskyi, A.T.M. N. Islam, S. Xu, J. M. Law, B. Lake, C. Wu, A. Loidl, Nature 554, 219 (2018).

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