



Seminar

Phase transition in a spin-orbital-angular-momentum coupled Bose-Einstein condensate

江开军

中科院武汉物理与数学研究所



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Venue: Room W563, Physics building, Peking University

地点: 北京大学物理楼, 西563会议室

Abstract

Coupling between particle's spin and orbital motion (linear momentum or orbital angular momentum) is ubiquitous in atoms, photons, solid materials and many other systems. It contributes to the topological properties like quantum-Hall effect in solid materials and electronic fine structure in atoms. Ultracold atoms with a high tunability provides an ideal platform to study spin-orbit (SO) coupling. Spin-linear-momentum (SLM) coupling has been observed in quantum gases and subsequently a variety of exotic quantum states have been explored. While the experimental study on the other kind of SO coupling, namely the spin-orbital-angular-momentum (SOAM) coupling, is still lacking.

In this talk, I will report the experimental observation of the ground-state phase diagram of the SOAM coupled Bose-Einstein condensate. By inducing a Raman transition using a pair of Gaussian and Laguerre-Gaussian (LG) laser beams, we realize SOAM coupling of ultracold atoms. We observe phase transitions when the two-photon Raman coupling strength or detuning approaches the critical value. The phase transitions are classified as the first order, which feature a discontinuous jump of the angular momentum (OAM) and the spin polarization. We demonstrate the hysteresis loop across the first-order phase transition. The role of interatomic interaction on the phase transition is also elucidated.

[1] D. Zhang, T. Gao, P. Zou, L. Kong, R. Li, X. Shen, X. Chen, S. Peng, M. Zhan, H. Pu, and K. Jiang, Phys. Rev. Lett. 122, 110402 (2019)

[2] T. Gao, J. Pan, D. Zhang, L. Kong, R. Li, X. Shen, X. Chen, S. Peng, M. Zhan, W. V. Liu, and K. Jiang, arXiv: 1805.04727 (2018)

[3] T. Gao, D. Zhang, L. Kong, R. Li, K. Jiang, Chin. Phys. Lett. 35, 086701 (2018)

About the speaker

江开军, 男, 研究员, 博士生导师, 2010年获中科院“百人计划”支持。1994~1998, 武汉大学获学士学位; 1999~2005, 中科院武汉物理与数学研究所(WIPM)获博士学位; 2005~2008, 美国国家标准与技术研究院(NIST)从事博士后研究; 2008~2010, 法国巴黎高等师范学院(ENS)从事博士后研究; 2010~至今, 中科院武汉物理与数学研究所任研究员。从事超冷原子物理研究, 发表SCI论文30余篇, 包括1篇Nature和5篇PRL。现主要研究方向: 简并费米气体中的少体和多体相互作用; 具有球对称玻色凝聚体的集体行为和自旋-轨道角动量耦合玻色气体的新奇量子态。