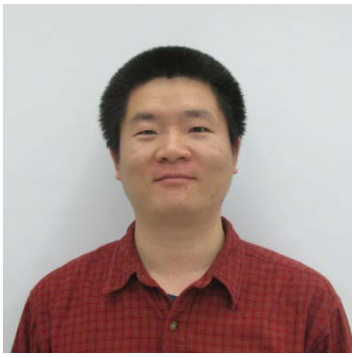
北京大学量子材料科学中心
International Center for Quantum Materials, PKU

Weekly Seminar

Using optical atomic clock to study SU(*N*)-symmetric interactions in Sr orbital magnetism



Dr. Xibo Zhang

University of Colorado

Time: 4:00pm, Sept. 10, 2014 (Wednesday)
时间：2014年9月10日（周三）下午4:00
Venue: Room 607, Science Building 5
地点：理科五号楼607会议室

Abstract

Inter-atomic interactions have been a key source of systematic uncertainty for the world's best atomic clocks in the past six years. Thanks to the development of ultrastable lasers with 1×10^{-16} instability, these interactions are now characterized to very high precision, which not only allows our single clock ("JILA SrII") to achieve the best performance in two key ingredients necessary for a primary standard – stability and accuracy, both at the 10^{-18} level [1], but also enables our first-generation system ("JILA SrI") to realize a powerful laboratory to study a many-body spin system with strongly interacting, open, and driven dynamics [2]. Here we report a spectroscopic observation of SU($N \leq 10$) symmetry in ^{87}Sr with I=9/2 [3] on the basis of the unprecedented measurement precision of an optical lattice clock. By encoding a pseudo-spin ½ degree of freedom in the two clock states, while keeping the system open to all 10 nuclear spin sublevels, we probe the non-equilibrium two-orbital SU(*N*) magnetism via Ramsey spectroscopy of atoms confined in an array of two-dimensional optical traps. We study the spin-orbital quantum dynamics and determine the relevant interaction parameters. This work lays the groundwork for using alkaline-earth atoms as test-beds for important orbital models, as well as realizing exotic quantum systems that have no counterparts in nature.

[1] *A New Generation of Atomic Clocks: Accuracy and Stability at the 10^{-18} Level*.
B. J. Bloom, T. L. Nicholson, J. R. Williams, S. L. Campbell, M. Bishof, X. Zhang, W. Zhang, S. L. Bromley, and J. Ye, Nature **506**, 71-75 (2014).
[2] *A quantum many-body spin system in an optical lattice clock*.
M. J. Martin, M. Bishof, M. D. Swallows, X. Zhang, C. Benko, J. von-Stecher, A. V. Gorshkov, A. M. Rey, and J. Ye, Science **341**, 632-636 (2013).
[3] *Spectroscopic observation of SU(N)-symmetric interactions in Sr orbital magnetism*.
X. Zhang, M. Bishof, S. L. Bromley, C.V. Kraus, M. Safronova, P. Zoller, A. M. Rey, and J. Ye, Science, 21 August 2014 (10.1126/science.1254978).

About the Speaker

Xibo Zhang is a postdoctoral research associate at JILA, University of Colorado at Boulder. Dr. Zhang received his B.Sc. from Peking University in 2005, and his Ph.D. from the University of Chicago in 2012. His current interests include using ultracold quantum degenerate gases to study many-body physics ("cold quantum simulator") and using optical atomic clocks to study quantum physics at non-degenerate, relatively high temperatures ("warm quantum simulator") on the basis of the unprecedented measurement precision made possible by the latest development of ultra-stable laser spectroscopy.