

清华大学高等研究院

Institute for Advanced Study, Tsinghua University

学术报告

Title:	Using optical atomic clock to study SU(N) -symmetric interactions in Sr orbital magnetism
Speaker:	Dr. Xibo Zhang JILA, University of Colorado at Boulder
Time:	3:00pm, Friday, September 5, 2014
Venue:	Conference Hall 322, Science Building, Tsinghua University

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($N \le 10$) symmetry in 87Sr with I=9/2 [3] on the basis of the unprecedented measurement precision of an optical lattice clock. By encoding a pseudo-spin $\frac{1}{2}$ 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).

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