清华大学高等研究院
Institute for Advanced Study, Tsinghua University
物理学术报告
Physics Seminars (biweekly)

Title: Glass-like dynamics and dimensional crossover in the antiferromagnetic spin-ordered state in a photo-excited Pr0.7Ca0.3MnO3 manganite

Speaker: Prof. Shuyun Zhou

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Time：3:15 pm, Wednesday, Nov. 7, 2012
(2:45~3:15pm, Tea, Coffee, and Cookie)

Venue: Conference Hall 322, Science Building, Tsinghua University

Abstract:

Nanoscale electronic ordering of charges, orbitals and spins are commonly observed in strongly correlated electron systems and they underlie important emergent material properties. Revealing their dynamics across the phase transition is an important scientific challenge. The ultrabright and ultrashort X-ray pulses produced by free electron laser and synchrotron light sources provide new opportunities to probe the dynamic evolution of electronic orderings using laser pump, ultrafast X-ray probe techniques. Here I will present our recent results on the dynamics of antiferromagnetic spin order across the photo-induced phase transition in a colossal magnetoresistance manganite $Pr_{0.7}Ca_{0.3}MnO_3$ using ultrafast time-resolved resonant soft X-ray scattering spectroscopy. In the “melting” process, we observed two time scales associated with electronic and lattice interactions respectively. The recovery process, however, shows exotic behavior that cannot be explained by electronic or lattice driven mechanism. Instead, the recovery of the spin ordering, measured over nearly 12 decades in time (70 ps to tens of seconds), exhibits a stretched-exponential behavior that is a hallmark of glass-like systems. Moreover, a dimensional crossover in the effective interaction from 1D at low pump fluence to 3D at high pump fluence is observed, suggesting that the spin ordering and orbital ordering are transiently decoupled. A microscopic picture consistent with all experimental observations is proposed and the role of spin order in the phase transition will be discussed.

S.Y. Zhou *et al.*, Phys. Rev. Lett. **106**, 186404 (2011).
S.Y. Zhou *et al.*, http://xxx.lanl.gov/abs/1209.3452