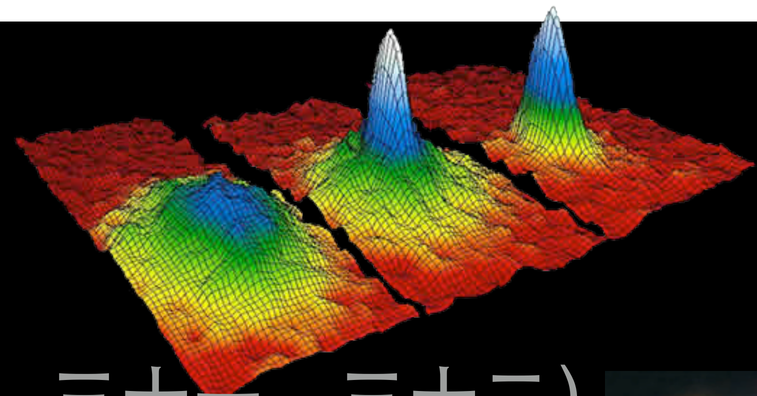
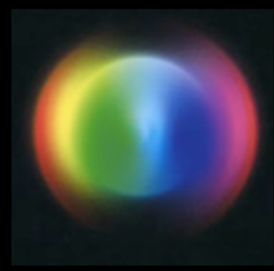
2012年11月22日（星期四）
武汉物数所频标楼3楼报告厅
上午10：00－12：00



理论与交叉学术交流系列报告（三十、三十一、三十二）



Quantum manipulation and nonlinear optics with cold atoms

Synthetic gauge potentials for ultracold neutral atoms （10:00-10:40）

Dr. Yu-Ju Lin
中研院原子分子研究所

Education: Ph.D., Stanford University (Jan, 2007); B.S., National Taiwan University (1999). Experience: Assistant Research Fellow, IAMS, Academia Sinica (2010–); Postdoctoral Research Associate, Joint Quantum Institute, National Institute of Standards and Technology and the University of Maryland (2007–2010). Research interests: Ultracold quantum gases in optical lattices; creation of gauge potentials; Bose-Einstein Condensation; Manipulation of ultracold atoms with a microfabricated chip.

Spinor Bose-Einstein condensates in an all-optical trap （10:40-11:20）

Dr. Ming-Shien Chang
中研院原子分子研究所

Education: Ph.D., Georgia Institute of Technology (2006); M.S., National Taiwan University (1997); B.S., National Taiwan University (1995). Experience: Assistant Research Fellow, IAMS, Academia Sinica (2009–); Postdoctoral Research Fellow, Physics Department and Joint Quantum Institute, University of Maryland (2007–2009); Postdoctoral Research Fellow, Physics Department and FOCUS Center, University of Michigan (2006–2007). Research interests: Atom cooling and trapping, ultracold collisions; Bose-Einstein Condensation, spinor condensates; Trapped ion quantum computation/simulation.

Nonlinear optics with cold atoms （11:20-12:00）

Dr. Ying-Cheng Chen
中研院原子分子研究所

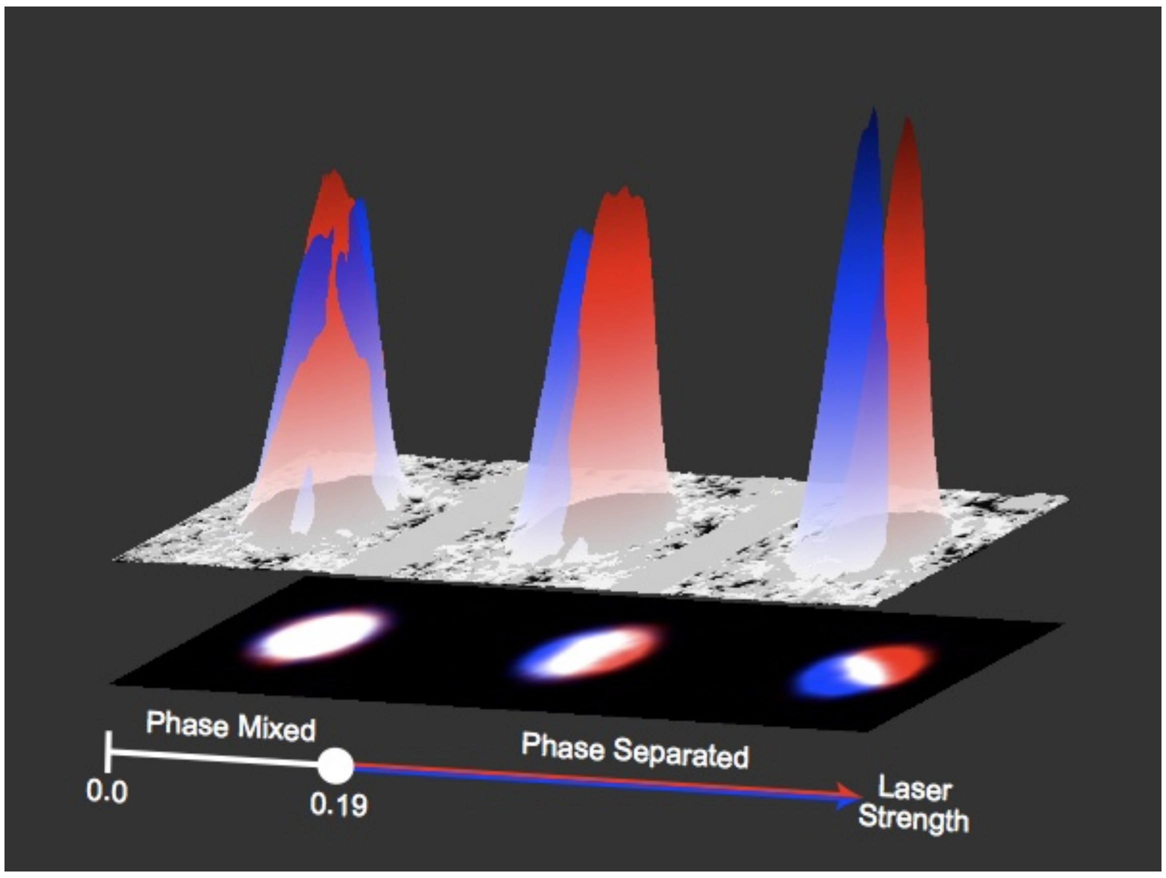
Education: B.S., National Tsing Hua University (1993); M.S., National Tsing Hua University (1995); Ph.D., National Tsing Hua University (2002). Experience: Postdoctoral Research Fellow, Rice University (2002–2004); Assistant Research Fellow, IAMS, Academia Sinica (2005–); Joint Appointment Assistant Professor, Department of Physics, National Tsing Hua University (2007–). Research interests: Development of general molecule cooling and trapping techniques; Studies of further molecule cooling schemes such as sympathetic cooling and evaporative cooling to reach ultracold regime (sub-uK); Studies of ultracold molecule collisions and reactions; Studies of condensed-matter physics with dipolar, molecular gases in ultracold regime.

Title: Synthetic gauge potentials for ultracold neutral atoms

Speaker : Yu-Ju Lin (林育如)

Abstract:

Ultracold atoms hold great promise in simulating essential models in condensed matter physics. One apparent limitation is the charge neutrality of the atoms, preventing access to important physics such as electrons in magnetic fields. We have circumvented this limitation by generating an effective vector gauge potential with an optical coupling between internal states of the atoms. We have made synthetic magnetic fields for ultracold neutral atoms through spatial variation of the vector gauge potential. In our system, we use a two-photon Raman coupling to dress a rubidium 87 Bose-Einstein condensate (BEC), where the dressed atoms have a modified energy-momentum dispersion, leading to the effective vector potential. Our created synthetic magnetic field is stable in the laboratory frame, which also allows for adding optical lattices with ease. Our optical approach is not subject to the limitations of rotating systems; with a suitable lattice configuration, it should be able to create sufficiently large synthetic magnetic fields in the quantum-Hall regime. Furthermore, in the weak optical coupling limit the vector gauge potentials are spin-dependent, equivalent to a spin-orbit coupling for neutral atoms. This can be generalized to those leading to non-abelian gauge potentials and realization of topological insulators.



Y.–J. Lin, K. Jimenez-Garcia and I. B. Spielman, “Spin-orbit Coupled Bose-Einstein Condensates”, *Nature* **v471**, 83 (2011).

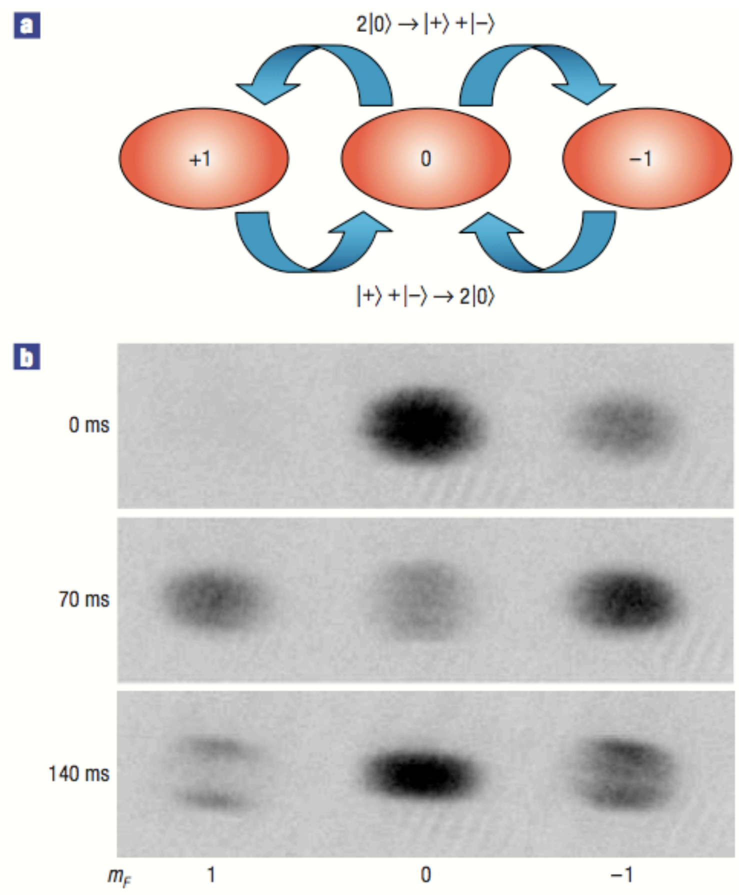
Y.–J. Lin, R. L. Compton, K. Jimenez-Garcia, J. V. Porto and I. B. Spielman, “Synthetic Magnetic Fields for Ultracold Neutral Atoms”, *Nature* ***v462***, 628 (2009).

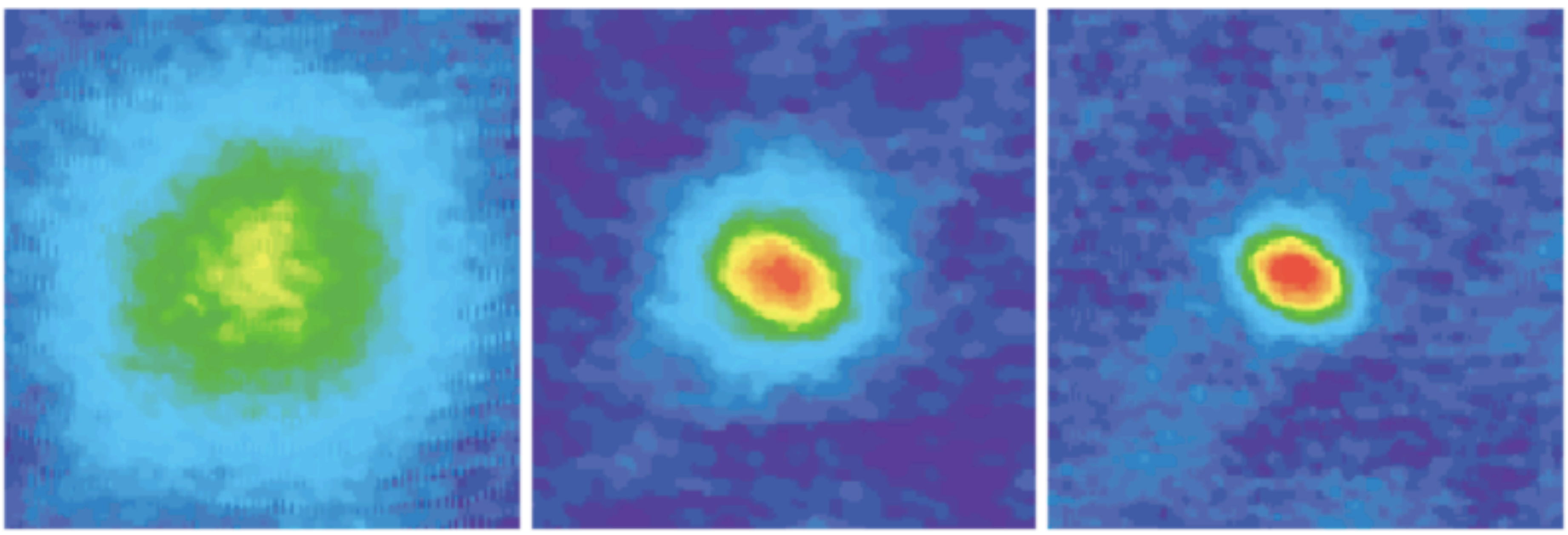
Title: Spinor Bose-Einstein condensates in an all-optical trap

Speaker: Ming-Shien Chang (張銘顯)

Abstract :

Atomic Bose-Einstein condensates with internal atomic spins, so called spinor condensates, possess very rich internal and external quantum structures. It is our goal to investigate the ground state structures as well as the quantum dynamics of spinor condensates in optical trapping potentials, including single potential and optical lattices. We are also interested in preparing quantum many-body states through controlled atomic interactions. In this talk we will report our most recent experimental results toward studies of spinor condensates.





M.-S. Chang, Q. Qin, W. Zhang, L. You, and M.S. Chapman, “Coherent spinor dynamics in a spin-1 Bose condensate,” *Nature Physics* **v1**, 111 (2005).

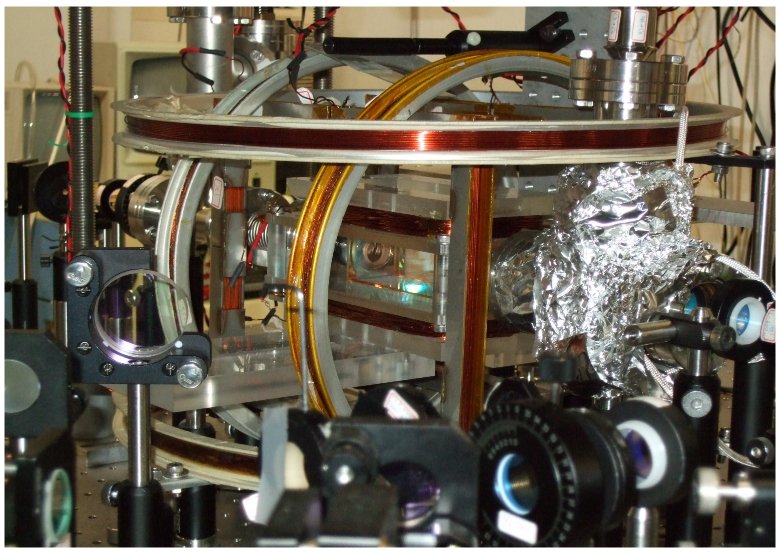
M.-S. Chang, C.D. Hamley, M.D. Barrett, J.A. Sauer, K.M. Fortier, W. Zhang, L. You, and M.S. Chapman, “Observation of Spinor Dynamics in Optically Trapped 87Rb Bose-Einstein Condensates,” *Phys. Rev. Lett.* **v92**, 140403 (2004).

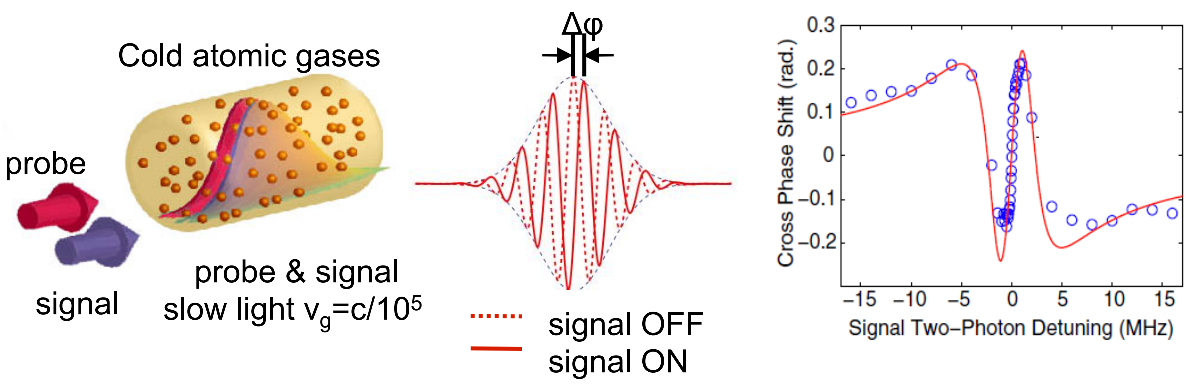
Title: Nonlinear optics with cold atoms

Speaker: Ying-Cheng Chen (陳應誠)

Abstract:

Electromagnetically induced transparency (EIT) provides avenues to implement nonlinear optical processes such as cross-phase modulation, all-optical switching, and four-wave mixing. Based on the EIT effect, the recent developments of slow light, storage of light and stationary light attract great attention. The slow light as well as the stationary light pulse greatly enhances the interaction time between light and matter and makes nonlinear optical processes achieve significant efficiency even at low-light or even single-photon level, leading to photon-photon interactions or operations among quantum bits. The studies of slow light, storage of light, and stationary light has made the great impact to quantum information science and can lead to the applications in quantum information processing. We report our low-light-level experiments to use optically dense cold atomic samples and the slow light or stationary light to enhance the efficiency of nonlinear optical processes. The future improvements towards the single-photon level will be discussed.





B. W. Shiau, M. C. Wu, C. C. Lin, Y. C. Chen, Low-light-level cross-phase modulation with double slow light pulses, Phys. Rev. Lett. **v106**, 193006 (2011)

Y. H. Chen, M. J. Lee, W. L. Hung, Y. C. Chen, I. A. Yu, Demonstration of the interaction between two stopped light pulses, Phy. Rev. Lett. **v108**, 173603 (2012).