Curriculum Vitae

Ite A. Yu

余怡德

Education

Ph.D. in Physics, Massachusetts Institute of Technology (1993).

B.S. in Physics, National Tsing Hua University (1984).

Employment

2015-present	Distinguished Professor, National Tsing Hua University.
2005-2015	Professor of Physics, National Tsing Hua University.
2000-2005	Associate Professor, National Tsing Hua University.
1995-2000	Associate Professor (tenure track), National Tsing Hua University.
1993-1995	Postdoctral Researcher, Harvard-Smithsonian Center for Astrophysics.

Honors and Awards

- Outstanding Research Award, the Ministry of Science and Technology (2016/8~2019/7).
- Outstanding Scholar Award, Foundation for the Advancement of Outstanding Scholarship (2016/8~2019/7).
- Tsing Hua Distinguished Professor, National Tsing Hua University since 2015.
- Fellow of the Physical Society of R. O. C. Taiwan since 2014.
- Outstanding Scholar Award, Foundation for the Advancement of Outstanding Scholarship (2013/8~2016/7).
- Outstanding Research Award, the Ministry of Science and Technology (2012/8~2015/7).
- National Tsing Hua University Outstanding Mentor Award (2009).

Services for Major International Conferences

- The Conference on Lasers and Electro-Optics (CLEO) 2017, FS 1: Quantum Optics of Atoms, Molecules and Solids, San Jose, U. S. A. (2017/5). [Program Committee Member]
- CLEO 2017: Special Symposium on Sources of Nonclassical Light and their Scalability, San Jose, U. S. A. (2017/5). [Organizer]
- The 16th Asian Quantum Information Science Conference (AQIS), Taipei, Taiwan (2016/8). [Organizing Committee Member]
- The Conference on Lasers and Electro-Optics (CLEO) 2016, FS 1: Quantum Optics of Atoms, Molecules and Solids, San Jose, U. S. A. (2016/6). [Program Committee Member]

- The 11th Conference on Lasers and Electro-Optics Pacific Rim (CLEO-PR), Busan, Korea (2015/8). [Short Course Lecturer of "Slow, Stored, and Stationary Light in Cold Atoms"] The most important conference in the fields of lasers and electro-optics in the Asia-Pacific region. 3 short courses on the research topics of current interests were offered in this conference.
- The Conference on Lasers and Electro-Optics (CLEO) 2015, FS 1: Quantum Optics of Atoms, Molecules and Solids, San Jose, U. S. A. (2015/6). [Program Committee Member]

Professional Service

- Deputy Director of Personnel Office, National Tsing Hua University (2016/8-present).
- Executive Editor, Chinese Journal of Physics (2016/1-2016/12).
- Editor, Chinese Journal of Physics (2006/1-present).
- Director of the Division of Academy, the Physical Society of R. O. C. Taiwan (2014/2-2016/1).
- Executive Board Member, the Physical Society of R. O. C. Taiwan (2014/2-2016/1).
- Convener of the Physics Panel, the Ministry of Science and Technology, Taiwan (2011/1~2013/12).
- Physics Panel Member, the Ministry of Science and Technology, Taiwan (2008/1-2010/12).
- Director of the Division of International and Continuing Education, National Tsing Hua University (2006/3-2007/8).

Professional Memberships

- The Physical Society of R. O. C. Taiwan
- APS
- OSA

Research Interests

Slow light, storage of light, low-light-level nonlinear optics, quantum memory, quantum optics, quantum information manipulation, and cold atoms.

Representative Publications

*: corresponding author; ǂ: research team leader; [*Times Cited*] provided by Google Scholar.

[1] Z. Y. Liu, Y. H. Chen, Y. C. Chen, H. Y. Lo, P. J. Tsai, I. A. Yu,*ǂ Y. C. Chen, and Y. F. Chen,* "Large Cross-Phase Modulations at the Few-Photon Level," **Phys. Rev. Lett.** 117, 203601 (2016). [*Times Cited: 3*] Editors' Suggestion; Selected for a Viewpoint in *Physics*.

[2] M. J. Lee, J. Ruseckas, C. Y. Lee, V. Kudriašov, K. F. Chang, H. W. Cho, G. Juzeliūnas,

and I. A. Yu,*‡ "Experimental demonstration of spinor slow light," **Nature Commun.** 5, 5542 (2014). [*Times Cited: 13*]

[3] Y. H. Chen, M. J. Lee, I. C. Wang, S. Du, Y. F. Chen, Y. C. Chen, and I. A. Yu,*‡ "Coherent Optical Memory with High Storage Efficiency and Large Fractional Delay" **Phys. Rev. Lett.** 110, 083601 (2013). [*Times Cited: 94*] The 2013 May issue of Aisa Pacific Physics Newsletter reports this work in *research highlights*.

[4] Y. H. Chen, M. J. Lee, W. Hung, Y. C. Chen, Y. F. Chen, and I. A. Yu,*‡ "Demonstration of the Interaction between Two Stopped Light Pulses," **Phys. Rev. Lett.** 108, 173603 (2012). [*Times Cited: 46*] The 2012 April issue of Nature Physics reports this work in *research highlights* with the title of "Frozen light switch".

[5] C. Belthangady,* C. S. Chuu, I. A. Yu, G. Y. Yin, J. M. Kahn, and S. E. Harris,‡ "Hiding Single Photons with Spread Spectrum Technology," **Phys. Rev. Lett.** 104, 223601 (2010). [*Times Cited: 26*] The 2010 June issue of Nature Physics reports this work in *research highlights* with the title of "Photon in a haystack".

[6] Y. W. Lin, W. T. Liao, T. Peters, H. C. Chou, J. S. Wang, H. W. Cho, P. C. Kuan, and I. A. Yu,*‡ "Stationary Light Pulses in Cold Atomic Media and without Bragg Gratings," **Phys. Rev. Lett.** 102, 213601 (2009). [*Times Cited: 88*]

[7] Y. F. Chen, C. Y. Wang, S. H. Wang, and I. A. Yu,*‡ "Low-Light-Level Cross-Phase-Modulation Based on Stored Light Pulses," **Phys. Rev. Lett.** 96, 043603 (2006). [*Times Cited: 145*]

[8] Y. C. Chen, Y. A. Liao, H. Y. Chiu, J. J. Su, and I. A. Yu,*‡ "Observation of the quantum interference phenomenon induced by interacting dark resonances," **Phys. Rev. A** 64, 053806 (2001). [*Times Cited: 98*]

Research Summary

In 1997, I established the first experiment of cold atoms in Taiwan. Observation of Bose-Einstein condensation (BEC) had been my research goal since I was a PhD student in M. I. T. In 2006, the BEC of ^{87}Rb atoms was realized in my own group. Many of my former master-degree students pursued their PhD degrees in U. S. A. or Europe, and participated in the studies of quantum fluids, trapped ions, or other AMO physics during the last 20 years. Nowadays, young researchers including my former PhD students (Dr. Ying-Cheng Chen in Academia Sinica and Prof. Yong-Fan Chen in National Cheng Kung University) have made the research fields of cold atoms booming in Taiwan.

Since 2000, employing laser-cooled atoms my group has mostly studied the phenomenon of electromagnetically induced transparency (EIT) and its applications in low-light-level nonlinear optics and quantum memory. Light is an ideal carrier of information and hardly interacts with the environment, an important feature in quantum communication. Based on the EIT effect, slow as well as stationary light greatly enhances the interaction time between light and matters, and can make nonlinear optical processes achieve significant efficiencies even at

single-photon level. Storage of light arising from the EIT effect provides the method of coherent transfer of wave functions between photons and atoms, and can lead to the application of quantum memory. These developments have made great impacts on quantum information manipulation.

My research team is one of the earliest groups in the world that utilized cold atoms in the EIT/slow light experiments. For example, we publsihed an EIT paper in PRA 64, 053806 (2001), and at that time there were a few published papers reporting the EIT or slow light experiments with cold atoms. The EIT physics can work in any of 3-level or 4-level systems made by all kinds of atoms and molecules, room-temperature or heated atomic vapors, solids, quantum wells/dots, superconducting rings, etc. The media of cold atoms can greatly reduce the Doppler broadening, thermal noise, collisional perturbation, and other temperature-related nuisances. The results with cold atoms from our group serve as the prototypes for other media.

In the research fields of quantum optics and quantum information manipulation, my major contributions are listed below:

(i) I proposed the idea of photon-photon interaction via stored light, and my group made the first experimental demonstration of the idea with classical light [see PRL 96, 043603 (2006)]. Single-photon cross-phase modulation (XPM) refers to the phase of a photon modulated by another. A phase shift of π in single-photon XPM is the classic example in the textbooks of quantum optics and quantum information, and can lead to the applications in quantum nondemolition measurements and quantum phase gates. However, the theoretical works in PRA 73, 062305 (2006) by J. H. Shapiro and PRA 81, 043823 (2010) by J. Gea-Banacloche suggested that the phase shift of π with single photons is either not useful or not possible. These works considered moving light pulses, and fortunately their results do not apply to our scheme which utilizes stored light. Recently, the experimental works of G. Rempe and S. Dürr's group [Sci. Adv. 2, e1600036 (2016)] and V. Vuletić's group [Proc. Natl. Acad. Sci. U. S. A. 113, 9740 (2016)] utilized the scheme of stored light to demonstrate a XPM shift on the order of π per photon. As the scheme of photon-photon interaction via stored light has become a key technique for quantum information manipulation with photons, I am the pioneer of this scheme.

(ii) Quantum memory for photons with high storage efficiency (SE) and long storage time is key to the successful operation of long-distance quantum communication. Previous experiments with EIT media revealed that a maximum SE is only about 50%. These results seemingly excluded the EIT medium as an efficient quantum memory. My research team demonstrated that as long as the optical density of an EIT medium is high and the decoherence rate is low, the SE can be well above 50% and even approach 100%. See PRL 110, 083601 (2013) and arXiv:1605.08519 for details. As photons are the ideal carriers in quantum communication, the works on the EIT memory led by me made the important contribution to quantum information technology.

(iii) My research team is one of the leading groups in the study of photon-photon interatcion. Quoted from S. Parkinsy's "Optical Quantum Logic at the Ultimate Limit," in Physics 9, 129 (2016), "*… the authors of the recent studies [1–3] have employed to force the interaction between weak light pulses propagating through a cold-atom medium, and thereby circumvent the fundamental limit on phase shifts. ... Finally, Ite Yu from the National Tsing Hua University, Taiwan, and colleagues [3] made two pulses—each containing, on average, eight photons—propagate slowly and simultaneously through a cold-atom cloud in which two EIT configurations overlapped. … The shift is equivalent to 26° per photon, with the prospect of further improvement.*" A series of the experiments on cross-phase modulation and all-optical switching led by me advanced the research of photon-photon interatcion for quantum information manipulation.

Invited Talks in International Conferences or Workshops Since 2013

- SPIE Photonic West 2016, San Francisco, U. S. A. (2016/2). [Invited Talk]
- The 11th Conference on Lasers and Electro-Optics Pacific Rim (CLEO-PR), Busan, Korea (2015/8). [Invited Talk]
- The 8th Asia-Pacific Conference and Workshop on Quantum Information Sciences (APCWQIS 2014), Tainan, Taiwan (2014/12). [Invited Talk]
- The 11th Asian International Conference on Atomic and Molecular Sciences (AISAMP 11), Sendai, Japan (2014/10). [Invited Talk]
- SPIE Photonic West 2014, San Francisco, U. S. A. (2014/2). [Invited Talk]
- The 4th International Meeting on Frontiers of Physics (IMFP), Pahang, Malaysia (2013/8). [Plenary Talk]
- Workshop on Coherent Control of Complex Quantum System (C3QS), Okinawa Institute of Science and Technology, Okinawa, Japan (2013/5). [Invited Talk]

Publications in the Recent 10 Years

1. J. Ruseckas, I. A. Yu, and G. Juzeliūnas, "Creation of two-photon states via interaction between Rydberg atoms during the light storage," Phys. Rev. A 95, 023807 (2017). Editors' Suggestion.
2. Z. Y. Liu, Y. H. Chen, Y. C. Chen, H. Y. Lo, P. J. Tsai, I. A. Yu, Y. C. Chen, and Y. F. Chen,* "Large Cross-Phase Modulations at the Few-Photon Level," Phys. Rev. Lett. 117, 203601 (2016). Editors' Suggestion; Selected for a Viewpoint in *Physics*.
3. C. Y. Lee, B. H. Wu, G. Wang, Y. F. Chen, Y. C. Chen, and I. A. Yu, "High conversion efficiency in resonant four-wave mixing processes," Opt. Express 24, 1008 (2016).
4. Y. L. Chuang, I. A. Yu, and R. K. Lee, "Quantum theory for pulse propagation in electromagnetically-induced-transparency media beyond the adiabatic approximation,"

Phys. Rev. A 91, 063818 (2015).

5. Y. L. Chuang, I. A. Yu, and R. K. Lee, "Non-separated states from squeezed dark-state polaritons in electromagnetically-induced-transparency media," J. Opt. Soc. Am. B 32, 1384 (2015).
6. W. Hung, P. Huang, F. C. Wu, M. Bruvelis, H. Y. Xiao, A. Ekers, and I. A. Yu, "Storage time of cold Rb atoms in an optical dipole trap formed by a multimode fiber laser," J. Opt. Soc. Am. B 32, B32-B36 (2015).
7. M. J. Lee, J. Ruseckas, C. Y. Lee, V. Kudriašov, K. F. Chang, H. W. Cho, G. Juzeliūnas, and I. A. Yu, "Experimental demonstration of spinor slow light," Nature Commun. 5, 5542 (2014).
8. Y. F. Hsiao, P. J. Tsai, C. C. Lin, Y. F. Chen, I. A. Yu, and Y. C. Chen, "Coherence properties of amplified slow light by four-wave mixing," Opt. Lett. 39, 3394 (2014).
9. C. K. Chiu, Y. H. Chen, Y. C. Chen, I. A. Yu, Y. C. Chen, Y. F. Chen, "Low-light-level four-wave mixing by quantum interference," Phys. Rev. A 89, 023839 (2014).
10. H. H. Jen, B. Xiong, I. A. Yu, and D. W. Wang, "Electromagnetically induced transparency and slow light in quantum degenerate atomic gases," J. Opt. Soc. Am. B 30, 2855 (2013).
11. Y. H. Chen, M. J. Lee, I. C. Wang, and I. A. Yu, "Fidelity of the electromagnetically-induced-transparency-based optical memory," Phys. Rev. A 88, 023805 (2013).
12. W. M. Hsu, Y. H. Chen, J. S. Wang, and I. A. Yu, "Slow and stored light pulses in the presence of magnetic fields," J. Opt. Soc. Am. B 30, 2123 (2013).
13. J. Ruseckas, V. Kudrišov, I. A. Yu, and G. Juzeliūnas, "Transfer of orbital angular momentum of light using two component slow light," Phys. Rev. A 87, 053840 (2013).
14. Y. H. Chen, M. J. Lee, I. C. Wang, S. Du, Y. F. Chen, Y. C. Chen, and I. A. Yu, "Coherent Optical Memory with High Storage Efficiency and Large Fractional Delay," Phys. Rev. Lett. 110, 083601 (2013).
15. C. C. Lin, M. C. Wu, B. W. Shiau, Y. H. Chen, I. A. Yu, Y. F. Chen, and Y. C. Chen, "Enhanced all-optical switching with double slow light pulses," Phys. Rev. A 86, 063836 (2012).
16. M. J. Lee, Y. H. Chen, I. C. Wang, and I. A. Yu, "EIT-based all-optical switching and cross-phase modulation under the influence of four-wave mixing," Opt. Express 20, 11057 (2012).
17. Y. H. Chen, M. J. Lee, W. Hung, Y. C. Chen, Y. F. Chen, and I. A. Yu, "Demonstration of the Interaction between Two Stopped Light Pulses," Phys. Rev. Lett. 108, 173603 (2012).
18. T. Peters, S. W. Su, Y. H. Chen, J. S. Wang, S. C. Gou, I. A. Yu, "Formation of stationary light in a medium of non-stationary atoms," Phys. Rev. A 85, 023838 (2012).
19. S. W. Su, Y. H. Chen, S. C. Gou, and I. A. Yu, "An effective thermal-parametrization

theory for the slow-light dynamics in a Doppler-broadened electromagnetically induced transparency medium," J. Phys. B 44, 165504 (2011).

20. H. Y. Lo, Y. C. Chen, P. C. Su, H. C. Chen, J. X. Chen, Y. C. Chen, I. A. Yu, and Y. F. Chen, "Electromagnetically induced transparency based cross-phase modulation at attojoule levels," Phys. Rev. A 83, 041804(R) (2011).
21. S. W. Su, Y. H. Chen, S. C. Gou, T. L. Horng, and I. A. Yu, "Dynamics of slow light and light storage in a Doppler-broadened electromagnetically-induced-transparency medium: A numerical approach," Phys. Rev. A 83, 013827 (2011).
22. C. Belthangady, C. S. Chuu, I. A. Yu, G. Y. Yin, J. M. Kahn, and S. E. Harris, "Hiding Single Photons with Spread Spectrum Technology," Phys. Rev. Lett. 104, 223601 (2010).
23. T. Peters, Y. H. Chen, J. S. Wang, Y. W. Lin, and I. A. Yu, "Observation of phase variation within stationary light pulses inside a cold atomic medium," Opt. Lett. 35, 151 (2010).
24. W. T. Liao, T. Peters, E. C. Shen, and I. A. Yu, "Propagation, broadening, and energy decay of quasi-stationary light pulses in thermal atoms," Chinese J. Phys. 47, 817 (2009).
25. Y. W. Lin, W. T. Liao, T. Peters, H. C. Chou, J. S. Wang, H. W. Cho, P. C. Kuan, and I. A. Yu, "Stationary Light Pulses in Cold Atomic Media and without Bragg Gratings," Phys. Rev. Lett. 102, 213601 (2009).
26. T. Peters, Y. H. Chen, J. S. Wang, Y. W. Lin, and I. A. Yu, "Optimizing the retrieval efficiency of stored light pulses," Opt. Express 17, 6665 (2009).
27. W. H. Lin, W. T. Liao, C. Y. Wang, Y. F. Lee, and I. A. Yu, "Low-light-level all-optical switching based on stored light pulses," Phys. Rev. A 78, 033807 (2008).
28. Y. W. Lin, H. C. Chou, P. P. Dwivedi, Y. C. Chen, and I. A. Yu, "Using a pair of rectangular coils in the MOT for the production of cold atom clouds with large optical density," Opt. Express 16, 3753 (2008).
29. H. W. Cho, Y. C. He, T. Peters, Y. H. Chen, H. C. Chen, S. C. Lin, Y. C. Lee, and I. A. Yu, "Direct measurement of the atom number in a Bose condensate," Opt. Express 15, 12114 (2007).
30. P. C. Guan and I. A. Yu, "Simplification of the electromagnetically induced transparency system with degenerate Zeeman states," Phys. Rev. A 76, 033817 (2007).
31. P. C. Guan, Y. F. Chen, and I. A. Yu, "Role of degenerate Zeeman states in the storage and retrieval of light pulses," Phys. Rev. A 75, 013812 (2007).
32. Y. F. Chen, Y. M. Kao, W. H. Lin, and I. A. Yu, "Phase variation and shape distortion of light pulses in electromagnetically induced transparency media," Phys. Rev. A 74, 063807 (2006).
33. Y. F. Chen, P. C. Kuan, S. H. Wang, C. Y. Wang, and I. A. Yu, "Manipulating the

retrieved frequency and polarization of stored light pulses," Opt. Lett. 31, 3511 (2006).

34. C. Y. Wang, Y. F. Chen, S. C. Lin, W. H. Lin, P. C. Kuan, and I. A. Yu, "Low-light-level all-optical switching," Opt. Lett. 31, 2350 (2006).
35. Y. F. Chen, C. Y. Wang, S. H. Wang, and I. A. Yu, "Low-Light-Level Cross-Phase-Modulation Based on Stored Light Pulses," Phys. Rev. Lett. 96, 043603 (2006).