



Seminar

Observation of Exceptional point in a chaotic exciton polariton billiard

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Time: 10:00am, December 22, 2015 (Tuesday)

时间: 2015年12月22日 (周二) 上午10:00

Venue: Room W563, Physics Building, Peking University

地点: 北京大学物理学院, 西楼563会议室

Abstract

Exciton-polaritons are hybrid light-matter quasiparticles formed by strongly interacting photons and excitons (electron-hole pairs) in semiconductor microcavities. They have emerged as a robust solid-state platform for next-generation optoelectronic applications as well as for fundamental studies of quantum many-body physics. Importantly, exciton-polaritons are a profoundly open (that is, non-Hermitian) quantum system, which requires constant pumping of energy and continuously decays, releasing coherent radiation. Thus, the exciton-polaritons always exist in a balanced potential landscape of gain and loss. However, the inherent non-Hermitian nature of this potential has so far been largely ignored in exciton-polariton physics. In this talk, I will demonstrate that non-Hermiticity dramatically modifies the structure of modes and spectral degeneracies in exciton-polariton systems, and, therefore, will affect their quantum transport, localization and dynamical properties. Using a spatially structured optical pump, we create a chaotic exciton-polariton billiard. Eigenmodes of this billiard exhibit multiple non-Hermitian spectral degeneracies, known as exceptional points. Such points can cause remarkable wave phenomena, such as unidirectional transport, anomalous lasing/absorption and chiral modes. By varying parameters of the billiard, we observe crossing and anti-crossing of energy levels and reveal the non-trivial topological modal structure exclusive to non-Hermitian systems. I will also show mode switching and a topological Berry phase for a parameter loop encircling the exceptional point. Our findings pave the way to studies of non-Hermitian quantum dynamics of exciton-polaritons, which may uncover novel operating principles for polariton-based devices.

Reference:

- [1] Observation of non-Hermitian degeneracies in a chaotic exciton-polariton billiard
T. Gao, E. Estrecho, K.Y. Bliokh, T.C.H. Liew, M.D. Fraser, S. Brodbeck, M. Kamp, C. Schneider, S. Höfling, Y. Yamamoto, F. Nori, Y.S. Kivshar, A. Truscott, R. Dall, E.A. Ostrovskaya, *Nature* 526,554(2015)
- [2] Kasprzak, J. et al. Bose-Einstein condensation of exciton polaritons. *Nature* 443,409-414 (2006).
- [3] Dembowski, C. et al. Encircling an exceptional point. *Phys. Rev. E* 69, 056216(2004).

About the Speaker

高廷阁分别在2005年2008年分别获得北京师范大学学士学位, 北京大学硕士学位。2014年在希腊克里特大学获得博士学位。博士项目从属于欧盟玛丽居里Clermont4。从2014年到现在在国立澳大利亚大学从事博士后研究。高廷阁一直从事砷化镓半导体微腔激子极化激元的研究。研究内容包括激子极化激元凝聚体的光学(自旋)调控, 非厄米哈密顿量物理以及自发产生的激子极化激元凝聚体四波混频现象等。