CSRC

# Workshop on the Rabi Model, Strong-Light Matter Interactions and Other Quantum Phenomena in CQED Platforms

# Program

December 4 - 9, 2017

Beijing, China

# *Workshop on the Rabi Model, Strong Light-Matter Interactions and Other Quantum Phenomena in CQED Platforms*

*December 4~9, 2017, Beijing, China*

Welcome to the Workshop on the Rabi Model, Strong Light-Matter Interactions and Other Quantum Phenomena in CQED Platforms! The workshop is organized by the Simulation of Physical Systems Division of the Beijing Computational Science Research Center (CSRC) at its Home Building in Zhongguancun Software Park II, during the time period from December 4 to 9, 2017. The organizers also include Prof. Murray Batchelor from Chongqing University and Australian National University.

The workshop will focus on theoretical and experimental aspects related to the Rabi Model, Cavity QED, and Strong Coupling Phenomena, etc. This event will serve as an important platform for exchange of ideas and in-depth discussions on a wide spectrum of forefront topics in this area.

## Organizing Committee

Murray Batchelor, Chongqing University and Australian National University

Stefano Chesi, Beijing Computational Science Research Center

Yong Li (李勇), Beijing Computational Science Research Center

Hai-Qing Lin (林海青), Beijing Computational Science Research Center

Wen Yang (杨文), Beijing Computational Science Research Center

**Workshop Secretary:** Wei Liu (刘薇), weiliu@csrc.ac.cn

☏ 86-10-56981717 (Office); 86-13717776118 (Cellphone); 86-10-56981700 (Fax)

**Workshop Venue:** CSRC Conference Room II, 3rd Floor (中心三层第二会议室)

**Lunch & Dinner Place:** CSRC Canteen, B1 Floor (中心负一层餐厅)

# List of Speakers

(alphabetical order)

| | |
|---|---|
| **Jun-Hong An (安钧鸿)** | Lanzhou University |
| **Murray Batchelor** | Chongqing University and Australian National University |
| **Gang Chen (陈　刚)** | Shanxi University |
| **Qing-Hu Chen (陈庆虎)** | Zhejiang University |
| **Stefano Chesi** | Beijing Computational Science Research Center |
| **Chun-Hua Dong (董春华)** | University of Science and Technology of China |
| **Heng Fan (范　桁)** | Institute of Physics (CAS) |
| **Xue-Dong Hu (胡学东)** | University at Buffalo, SUNY (USA) |
| **Chao-Hong Li (李朝红)** | Sun Yat-Sen University |
| **Tie-Fu Li (李铁夫)** | Tsinghua University |
| **Yong-Chun Liu (刘永椿)** | Tsinghua University |
| **Yu-Xi Liu (刘玉玺)** | Tsinghua University |
| **Xin-You Lv (吕新友)** | Huazhong University of Science and Technology |
| **Jie Peng (彭　杰)** | Xiangtan University |
| **Tao Shi (石　弢)** | Institute of Theoretical Physics (CAS) |
| **Mircea Trif** | Tsinghua University |
| **Yi-Min Wang (王艺敏)** | The Army Engineering University of PLA |
| **Zhi-Hai Wang (王治海)** | Northeast Normal University |
| **Yun-Feng Xiao (肖云峰)** | Peking University |
| **Zhang-Qi Yin (尹璋琦)** | Tsinghua University |
| **Yang Yu (于　扬)** | Nanjing University |
| **Jian-Qi Zhang (张建奇)** | Wuhan Institute of Physics and Mathematics (CAS) |
| **Yu-Yu Zhang (张瑜瑜)** | Chongqing University |
| **Hang Zheng (郑　杭)** | Shanghai Jiao Tong University |

# Useful Information

For your convenience, here are ***Some Important Tips***:

1. CSRC Address:
   - ✧ Beijing Computational Science Research Center (CSRC), Building 9, East Zone, ZPark II, No. 10 Xibeiwang East Road, Haidian District, Beijing 100193, China
   - ✧ 北京市海淀区西北旺东路 10 号院东区 9 号楼中关村软件园二期(100193)

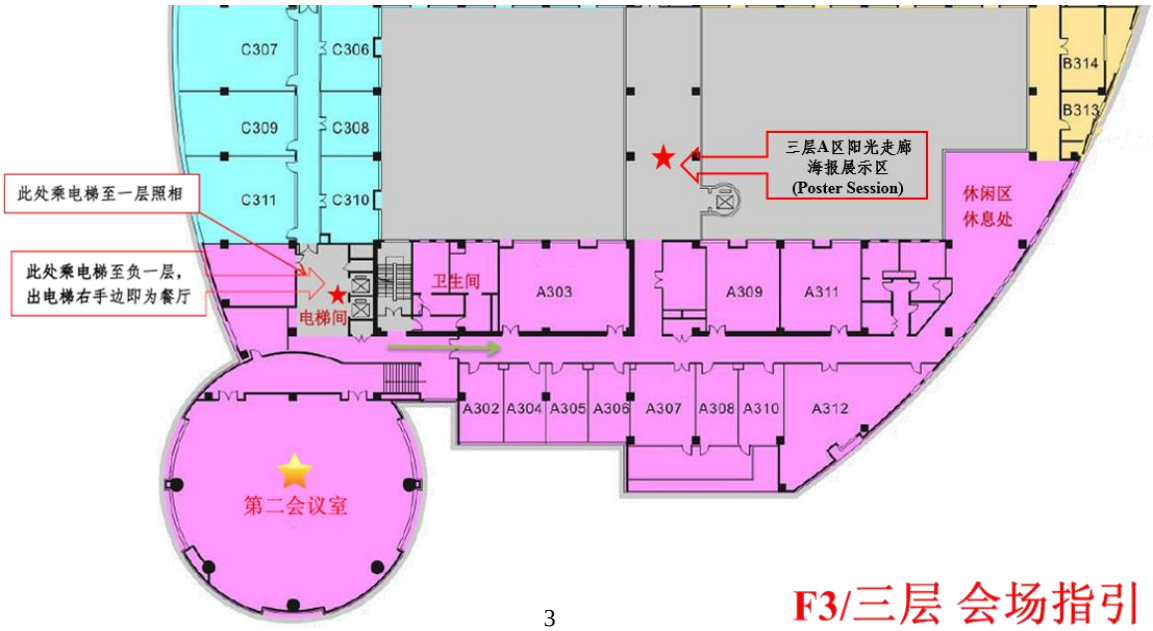
2. Onsite Registration:
   - ✧ 09:00~17:00 (December 4, 2017), CSRC Room A312, 3rd Floor
   - ✧ 08:15~17:00 (December 5~6, 2017), Outside the CSRC Conference Room II

Please put the **Nametag** on to enter the **Conference Room II** and bring your **Meal Tickets** to the **Canteen**.

3. Free Wi-Fi: csrc_guest, password: csrc20150308

4. Poster Session:
   - ✧ Date&Time: 15:00~17:30 (Dec. 8, 2017)
   - ✧ Place: Corridor-A Area, 3rd Floor (中心三层 A 区阳光走廊)
   - ✧ Required Poster Size: **120cm Height * 90cm Width**
   - ✧ Poster Set-Up: 09:00~14:00 (Dec. 8, 2017)

5. How to get invoice (注册费发票领取):
   - ✧ Time: Dec. 7 (Thursday), 15:30~16:00, Dec. 8 (Friday), 15:00~17:30
   - ✧ Place: Outside the CSRC Conference Room II




F3/三层 会场指引

## Recommended Route


**Taxi:**

1) From Capital International Airport (首都国际机场): The cost is about 130 RMB (50mins).
2) From Beijing Railway Station (北京站): The cost is about 100 RMB (80 mins).
3) From Beijing West Railway Station (北京西站): The cost is about 70 RMB (60mins).
4) From Beijing South Railway Station (北京南站): The cost is about 105 RMB (90mins).

**Local Bus:**

Bus #205 (Software Park West Stop/软件园西区站)

Bus #333 (Houchangcun East Stop/后厂村东站)

Bus #963/#982 (Dongbeiwang West Road North Stop/东北旺西路北口站)

**Subway:**

Take Subway Line 13 to "SHANG DI Station(上地站)", take Exit A to catch Bus #205 to "Software Park West Stop(软件园西区站)". Enter the park and proceed toward in the north direction, CSRC will be to your right in 400 meters.

## Recommended Hotel

◆ Yitel 和颐酒店(软件园 5 号路) ***The Nearest Hotel (about 20 minutes' walk)**

Address: ZPark Building 9, No. 8 West Dongbeiwang Road, Haidian District, Beijing

北京市海淀区东北旺西路 8 号中关村软件园 9 号楼 (中关村软件园南门)

Telephone: +86-10-82826677


Zoom in

# Workshop on the Rabi Model, Strong Light-Matter Interactions and Other Quantum Phenomena in CQED Platforms

**CSRC Conference Room II, F3 | December 5-9, 2017**

| Tuesday, December 5, 2017 | |
|---|---|
| 08:15 – 17:00 | **Registration** |
| 08:50 – 09:00 | **Welcoming Address** |
| **Morning Session, Chair: Stefano Chesi** | |
| 09:00 – 09:45 (45 minutes) | Yun-Feng Xiao, Peking University<br>***LECTURE****-Cavity QED in Composite Optical Systems* |
| 09:45 – 10:00 | Q&A, Break |
| 10:00 – 10:45 (45 minutes) | Yun-Feng Xiao, Peking University<br>***LECTURE****-Cavity Optomechanical Cooling beyond the Resolved Sideband Limit* |
| 10:45 – 11:00 | Q&A, Break |
| 11:00 – 11:45 (45 minutes) | Mircea Trif, Tsinghua University<br>***LECTURE****-Cavity Quantum Electrodynamics with Quantum Transport* |
| 11:45 – 12:00 | Q&A, Break |
| 12:00 – 14:00 | *Lunch & Rest* |
| **Afternoon Session I, Chair: Hong-Gang Luo** | |
| 14:00 – 14:30 (30 minutes) | Gang Chen, Shanxi University<br>*Hidden Continuous Symmetry in Two-Mode Cavities* |
| 14:30 – 15:00 (30 minutes) | Mircea Trif, Tsinghua University<br>*Majorana Fermions Signatures in a Cavity QED Setup* |
| 15:00 – 15:30 (30 minutes) | Tie-Fu Li, Tsinghua University<br>*Single-Photon Driven High-Order Sideband Transitions in an Ultrastrongly Coupled Circuit Quantum Electrodynamics System* |
| 15:30 – 16:00 | *Coffee Break* |
| **Afternoon Session II, Chair: Hang Zheng** | |
| 16:00 – 16:30 (30 minutes) | Tao Shi, Institute of Theoretical Physics (CAS)<br>*Variational Study of Fermionic and Bosonic Systems with Non-Gaussian States: Theory and Applications* |
| 16:30 – 17:00 (30 minutes) | Jian-Qi Zhang, Wuhan Institute of Physics and Mathematics (CAS)<br>*Force-Induced Transparency and Conversion between Slow and Fast Light in Optomechanics* |
| 17:00 – 17:30 (30 minutes) | Chao-Hong Li (Jia-Hao Huang), Sun Yat-Sen University<br>*Asymmetric Sequential Landau-Zener Dynamics of Bose-Condensed Atoms in a Cavity* |
| 17:30 – 18:30 | *Dinner* |

| Wednesday, December 6, 2017 | |
|---|---|
| 08:15 – 17:00 | **Registration** |
| **Morning Session, Chair: Murray Batchelor** | |
| 09:00 – 09:45<br>(45 minutes) | Hong-Gang Luo, Lanzhou University<br>***LECTURE****-Polaron Picture for the Quantum Rabi Model* |
| 09:45 – 10:00 | Q&A, Break |
| 10:00 – 10:45<br>(45 minutes) | Hong-Gang Luo, Lanzhou University<br>***LECTURE****-Polaron Picture for the Two-Photon Quantum Rabi Model* |
| 10:45 – 11:00 | Q&A, Break |
| 11:00 – 11:45<br>(45 minutes) | Hang Zheng, Shanghai Jiao Tong University<br>***LECTURE****-Counter-Rotating Interaction in Rabi Lattice: Non-Conservation of Polariton Number and Its Effect on Quantum Phase Transition* |
| 11:45 – 12:00 | Q&A, Break |
| 12:00 – 14:00 | *Lunch & Rest* |
| **Afternoon Session I, Chair: Gang Chen** | |
| 14:00 – 14:45<br>(45 minutes) | Hang Zheng, Shanghai Jiao Tong University<br>***LECTURE****-Rabi Model and Bloch-Siegert Shift* |
| 14:45 – 15:00 | Q&A, Break |
| 15:00 – 15:30<br>(30 minutes) | Heng Fan, Institute of Physics (CAS)<br>*Anisotropic Rabi Model* |
| 15:30 – 16:00<br>(30 minutes) | Xin-You Lv, Huazhong University of Science and Technology<br>*Rabi Model in the Weak and Ultrastrong Coupling Regimes* |
| 16:00 – 16:30 | *Coffee Break* |
| **Afternoon Session II, Chair: Wen Yang** | |
| 16:30 – 17:00<br>(30 minutes) | Yu-Yu Zhang, Chongqing University<br>*Analytical Solution to the Finite-Qubit Quantum Rabi Model: A Squeezed-Coherent Approach and a Coherent Approach* |
| 17:00 – 17:30<br>(30 minutes) | Stefano Chesi, Beijing Computational Science Research Center<br>*Quantum Phase Transition in the Anisotropic Quantum Rabi Model* |
| 17:30 – 18:30 | *Dinner* |

| Thursday, December 7, 2017 | |
|---|---|
| **Morning Session, Chair: Qing-Hu Chen** | |
| 09:00 – 09:45<br>(45 minutes) | Yang Yu, Nanjing University<br>***LECTURE****-Quantum Simulation of the General Semi-Classical Rabi Model in Regimes of Arbitrarily Strong Driving* |
| 09:45 – 10:00 | Q&A, Break |
| 10:00 – 10:45<br>(45 minutes) | Yang Yu, Nanjing University<br>***LECTURE****-Simulating Topological Semimetal Bands with Superconducting Circuits* |
| 10:45 – 11:00 | Q&A, Break **(Group Photo)** |
| 11:00 – 11:45<br>(45 minutes) | Chun-Hua Dong, University of Science and Technology of China<br>***LECTURE****-Optomechanically Induced Non-Reciprocity* |
| 11:45 – 12:00 | Q&A, Break |
| 12:00 – 14:00 | *Lunch & Rest* |
| **Afternoon Session I, Chair: Heng Fan** | |
| 14:00 – 14:30<br>(30 minutes) | Jun-Hong An, Lanzhou University<br>*Suppressed Dissipation of a Quantum Emitter Coupled to Surface Plasmon Polaritons* |
| 14:30 – 15:00<br>(30 minutes) | Yong-Chun Liu, Tsinghua University<br>*Strong Coupling Assisted by Coupled Cavities* |
| 15:00 – 15:30<br>(30 minutes) | Zhang-Qi Yin, Tsinghua University<br>*Quantum Simulation and Dynamics of the Lipkin-Meshkov-Glick Models* |
| 15:30 – 16:00 | *Coffee Break* |
| **Afternoon Session II, Chair: Yu-Xi Liu** | |
| 16:00 – 16:30<br>(30 minutes) | Zhi-Hai Wang, Northeast Normal University<br>*Single-Photon Scattering in Coupled Cavity Array with Ultra-Strong Coupling* |
| 16:30 – 17:00<br>(30 minutes) | Yi-Min Wang, The Army Engineering University of PLA<br>*Holomonic Quantum Computation in Rabi Model Described Circuit QED Systems* |
| 17:00 – 17:30<br>(30 minutes) | Jie Peng, Xiangtan University<br>*Peculiarities of the Dark-Like States and Its Possible Application* |
| 17:30 – 18:30 | *Dinner* |

| Friday, December 8, 2017 | |
|---|---|
| **Morning Session, Chair: Xue-Dong Hu** | |
| 09:00 – 09:45 (45 minutes) | Yu-Xi Liu, Tsinghua University<br>***LECTURE****-Interaction between Microwave Fields and Superconducting Quantum Circuits from Jaynes-Cumming to Generalized Rabi Model (I)* |
| 09:45 – 10:00 | Q&A, Break |
| 10:00 – 10:45 (45 minutes) | Yu-Xi Liu, Tsinghua University<br>***LECTURE****-Interaction between Microwave Fields and Superconducting Quantum Circuits from Jaynes-Cumming to Generalized Rabi Model (II)* |
| 10:45 – 11:00 | Q&A, Break |
| 11:00 – 11:45 (45 minutes) | Qing-Hu Chen, Zhejiang University<br>***LECTURE****-Solutions to Quantum Rabi Model and Its Several Variants Using Bogoliubov Operators* |
| 11:45 – 12:00 | Q&A, Break |
| 12:00 – 14:00 | *Lunch & Rest* |
| **Afternoon Session, Chair: Yong Li** | |
| 14:00 – 14:45 (45 minutes) | Qing-Hu Chen, Zhejiang University<br>***LECTURE****-Quantum Phase Transitions and Dynamics of the Dicke and Spin-Boson Models with Extended Coherent States* |
| 14:45 – 15:00 | Q&A, Break |
| 15:00 – 17:30 | Poster Session, Discussion |
| 17:30 – 20:00 | *Banquet* |
| **Saturday, December 9, 2017** | |
| **Morning Session, Chair: Hai-Qing Lin** | |
| 09:00 – 09:45 (45 minutes) | Xue-Dong Hu, University at Buffalo, SUNY (USA)<br>***LECTURE****-How to Couple Spins with Electric Field* |
| 09:45 – 10:00 | Q&A, Break |
| 10:00 – 10:45 (45 minutes) | Xue-Dong Hu, University at Buffalo, SUNY (USA)<br>***LECTURE****-Strong Spin-Photon Coupling in Semiconductor Nanostructures* |
| 10:45 – 11:00 | Q&A, Break |
| 11:00 – 11:45 (45 minutes) | Murray Batchelor, Chongqing University and Australian National University<br>***LECTURE****-The Eigenspectrum of the Asymmetric Quantum Rabi Model* |
| 11:45 – 12:00 | Q&A, Break |
| 12:00 – 12:10 | Closing Remarks |
| 12:10 – | *Lunch, Departure* |