

# Advances in Quantum Simulation and Sensing with Ultracold Gases

813. WE-Heraeus-Seminar

24 Jun - 28 Jun 2024  
at the Physikzentrum Bad Honnef/Germany

The WE-Heraeus Foundation supports research and education in science, especially in physics.  
The Foundation is Germany's most important private institution funding physics.

**WILHELM UND ELSE  
HERAEUS-STIFTUNG**



# Program

## Sunday, June 23, 2024

- 17:00 – 21:00    Registration
- 18:00 – 21:00    *BUFFETT SUPPER / Informal get together*
- 21:00 –            *Switzerland-Germany (2024 UEFA European Football Championship)*

## Monday, June 24, 2024

- 07:40 – 08:40    *BREAKFAST*
- 08:40 – 09:00    Carlos Sá de Melo            **Opening and welcome**

### **Session 1: Quantum Sensing I**

- 09:00 – 09:45    Alice Sinatra            **Nonlocal correlations and sensing with cold atoms in optical lattices**
- 09:45 – 10:30    Li You            **Quantum enhanced sensing with spinor atomic condensates in linear and nonlinear interferometries**
- 10:30 – 11:00    *COFFEE BREAK*

### **Session 2: Quantum Simulation I**

- 11:00 – 11:45    Yoshiro Takahashi            **Quantum simulation and sensing with ultracold ytterbium atoms**
- 11:45 – 12:30    Zhen-Sheng Yuan            **Microscopic study on simulating lattice gauge theory with ultracold atoms**
- 12:30 – 14:00    *LUNCH*

# Program

**Monday, June 24, 2024**

## **Session 3: Contributed Talks I**

- |               |  |   |
|---------------|--|---|
| 14:00 – 14:30 | Andrea Bergschneider   | <b>Enhancing pair tunneling with Floquet engineering</b>  |
| 14:30 – 15:00 | Johannes Hofmann   | <b>Scale and conformal invariance in rotating few-fermion systems</b>   |
| 15:00 – 15:30 | Aurélien Fabre   | <b>Universal self-organization dynamics in strongly-interacting fermions with long-range photon-mediated interactions</b> |
| 15:30 – 16:00 | <i>COFFEE BREAK</i>  |   |
| 16:00 – 16:15 | Stefan Jorda   | <b>About the Wilhelm and Else Heraeus Foundation</b>  |
| 16:15 – 18:45 | <b>Plenary Poster Flash Presentations</b>  |   |
| 18:45 – 20:15 | <i>HERAEUS DINNER at the Physikzentrum<br/>(cold and warm buffet, with complimentary drinks)</i> |   |
| 20:15 – 21:45 | <b>Poster Session I</b>  |   |

# Program

**Tuesday, June 25, 2024**

08:00 – 09:00 *BREAKFAST*

## **Session 4: Quantum Sensing II**

09:00 – 09:45 Kai Bongs **Disruptive applications enabled by quantum sensors and clocks**

09:45 – 10:30 Susanne Yelin **Sensing and QED with cooperative atom arrays**

10:30 – 11:00 *COFFEE BREAK*

## **Session 5: Different Dimensions**

11:00 – 11:45 Henning Moritz **Fermionic superfluids in two and three dimensions**

11:45 – 12:30 Franco Dalfovo **BEC and BKT transitions in a Bose gas in the 2D-3D dimensional crossover**

12:30 – 14:00 *LUNCH*

## **Session 6: Molecules**

14:00 – 14:45 Andreas Schindewolf **From microwave shielding to field-linked molecules**

14:45 – 15:30 Sebastian Will **Creating and exploring Bose-Einstein condensates of dipolar molecules**

15:30 – 16:00 *COFFEE BREAK*

16:00 – 17:00 **Group Discussions I**

17:00 – 18:30 **Poster Session II**

18:30 – 20:00 *DINNER*

20:00 – **Socializing**

# Program

Wednesday, June 26, 2024

08:00 – 09:00 *BREAKFAST*

## Session 7: Rydberg Atoms

09:00 – 09:45 Florian Meinert **Circular Rydberg atoms for quantum simulations**

09:45 – 10:30 Michael Fleischhauer **Non-equilibrium physics with Rydberg atoms: Epidemic dynamics, self-organized criticality and anomalous directed percolation**

10:30 – 11:00 *COFFEE BREAK*

## Session 8: Vortices

11:00 – 11:45 Andrea Richaud **Inertial effects in superfluid vortex dynamics**

11:45 – 12:30 Giacomo Roati **Vortex matter in strongly-correlated superfluids**

12:30 – 14:00 *LUNCH*

14:00 – 14:10 **Conference photo** (in front of the main entrance)

14:10 – 18:30 **Excursion**  
**Leisurely hike to the Drachenfels (Dragon's rock)**

18:30 – 20:00 *DINNER*

## Evening Talk

20:00 – 21:00 Masahito Ueda **Beyond-hermitian quantum physics**

21:00 – **Socializing**

# Program

Thursday, June 27, 2024

08:00 – 09:00 *BREAKFAST*

## Session 9: Light and Matter

09:00 – 09:45 Corinna Kollath

**Controlling the dynamics of atomic correlations via the coupling to a dissipative cavity**

09:45 – 10:30 Thomas Pohl

**Quantum states of light from lattices of ultracold**

10:30 – 11:00 *COFFEE BREAK*

## Session 10: Fermions

11:00 – 11:45 Joseph Thywissen

**Emergent s-wave interactions between identical fermions via orbital-singlet pair wavefunctions**

11:45 – 12:30 Tarik Yefsah

**Quantum gas microscopy of fermionic matter in continuous space**

12:30 – 14:00 *LUNCH*

## Session 11: Quantum Simulation II

14:00 – 14:45 Markus Greiner  
(remote access)

**Hubbard quantum simulations - from dipolar quantum solids to kinetic magnetism**

14:45 – 15:30 Selim Jochim

**How close is  $4\pi$  to infinity?**

15:30 – 16:00 *COFFEE BREAK*

# Program

Thursday, June 27, 2024

## Session 12: Contributed Talks II

16:00 – 16:30	Niels Kjaergaard	Rydberg atomic polarimetry of THz fields
16:30 – 17:00	Rukmani Bai	Miscible-immiscible transition in the strongly interacting bosonic mixtures
17:00 – 17:30	Hans Keßler	Route to chaos in an atom-cavity system
17:30 – 18:30	<b>Group Discussions II</b>	
18:30 – 20:00	<i>DINNER</i>	
20:00 – 21:30	<b>Poster Session III</b>	

# Program

**Friday, June 28, 2024**

08:00 – 09:00 *BREAKFAST*

## **Session 13: Non-Equilibrium Dynamics**

09:00 – 09:45 Lucia Hackermüller **Non-equilibrium molecule association as a shortcut to adiabaticity and 3D-printing for quantum technologies**

09:45 – 10:30 Matthias Weidemüller **Rydberg spin glas**

10:30 – 11:00 *COFFEE BREAK*

## **Session 14: Quantum Simulation III**

11:00 – 11:45 Robert Smith **Explorations with Erbium**

11:45 – 12:30 Hendrik Weimer **Quantum simulation of open quantum systems**

12:30 – 12:40 Axel Pelster **Poster Awards and Concluding Remarks**

12:40 – 14:00 *LUNCH*

***End of seminar and departure***