

ICAM Workshop report

WORKSHOP INFORMATION

Workshop title: “Correlations in novel quantum materials (CNQM2023)”

Workshop dates: July 24 - 28 2023

Workshop location: Max-Planck-Institute for Solid State Research, Stuttgart, Germany

ORGANIZERS' INFORMATION

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I. OUTCOME OF THE WORKSHOP

A. Description of the event and covered scientific topics

Materials with strongly correlated quantum particles are at the forefront of present solid state research. Understanding the experimental properties of novel quantum materials crucially relies on the exchange between experiment and theory, as well as on the application of cutting-edge analytical and numerical tools on the theory side. This workshop aimed at bringing together world-leading experts in the study of strong correlations to advance the current perspective on important questions of the field: What are the signatures of quantum order in newly synthesized experimental setups? What is the nature of phase transitions between these novel states of matter? Which aspects of quantum materials can be described on the model level? What are the computational and algorithmic boundaries hindering the solution of the many-body problem?

To this end, we invited established experts as well as aspiring scientist from the analytical and numerical realm of theoretical condensed matter physics on the one hand, and experimental physicists with a broad range of techniques on the other hand, for giving a talk at the MPI-FKF:

Keynote speakers

- Andrey Chubukov (U Minnesota)
- Piers Coleman (Rutgers U)
- Antoine Georges (CCQ Flatiron)
- Roderich Moessner (MPI Dresden)

- Dimitry Abanin (University of Geneva)
- Roser Valentí (University of Frankfurt)
- Andrei Bernevig (Princeton University)
- Pablo Jarillo-Herrero (MIT)

Invited Speakers

- Felix Baumberger (University of Geneva)
- Erez Berg (Weizmann Institute of Science)
- Igor Boettcher (University of Alberta)
- Silke Bühler-Paschen (TU Wien)
- Massimo Capone (SISSA, Trieste)
- Premala Chandra (Rutgers University)
- Luca de' Medici (ESCPI Paris)
- Emanuel Gull (University of Michigan-Ann Arbor)
- Matthieu Le Tacon (Karlsruhe IT)
- Alexander Levchenko (University of Wisconsin-Madison)
- Peter P. Orth (Saarland University)
- Srinivas Raghu (Stanford University)
- Johannes Reuther (FU Berlin)
- Lucia Reining (École Polytechnique)
- Anna Seiler (University of Göttingen)
- Alessandro Toschi (TU Wien)
- Alexei Tsvelik (Brookhaven National Laboratory)
- Jan von Delft (LMU Munich)
- Mengxing Ye (University of Utah)

Contributed Speakers

- Lorenzo Crippa (University of Würzburg)

- Anushree Datta (LPS, CNRS)
- Valentin Leeb (TUM)
- Yashar Komijani (University of Cincinnati)
- Mireia Tolosa Simeón (RUB)

The talks were grouped into **eight sessions**

- Unconventional Superconductors and Intertwined Phases,
- Emergent Quasiparticles: Yes or no?,
- Strong Correlations: from Models to Materials,
- Multiorbital Effects in Strongly Correlated Systems,
- Quantum Information and Dynamics,
- Mott is Different,
- Topology and Correlations,
- Twistronics

all of which are at the forefront of contemporary condensed matter physics.

Each session consisted of one keynote talk (35 minutes talk and 10 minutes discussion) and three invited talks (25 minutes talk and 5 minutes discussion). To facilitate the involvement of young scientists a poster session and poster prize was organized with 64 contributed posters in total. Furthermore, long **discussion times** were arranged for. Including the participants from the institute, the **event hosted about 110 attendees**.

The workshop also hosted an **interdisciplinary outreach event** about “The Future of Solid State Research”. The panel discussion brought together experts from theoretical and experimental physics and chemistry to discuss the possible future research topics and strategies with the general public: Prof. Dr. Bettina Lotsch (MPI-FKF), Prof. Dr. Piers Coleman, and Prof. Dr. Antoine Georges, and Prof. Dr. Martin Dressel (University of Stuttgart).

In order to expose the participants to the local Swabian culture we arranged for a guided town tour in Esslingen, a tour through the Kessler sparkling wine production and a **conference dinner** with traditional Swabian delights.

More information can be found on our **conference webpage** <https://www.fkf.mpg.de/cnqm2023>.

B. Impact of the meeting

Due to the pandemic hitting the scientific community and the entire world population in 2020 and 2021 (and still today) the feeling for the necessity of personal scientific exchange grew enormously lately. Hence, the timing of the event has been perfect to revive long-sought personal discussions among experts in their respective fields. The feedback from the attendees has been overwhelmingly positive and their wish to organize the workshop as an annual event has been placed many times to the organizers.

C. Emergence of potential research collaborations

Bringing together scientist from the different sub-fields of strongly correlated systems already proved immensely interesting during the workshop. For the first time this year, we successfully included experimental talks in the conference program in addition to the theoretical contributions and topics. Especially during the discussions at the end of the talks and in the dedicated discussion slots, researchers from both disciplines have been connecting and have exchanged ideas. But also within the two sub-disciplines of analytical and numerical theory, long-needed communication on scientific topics has been fostered. Finally, our meeting generated new scientific interaction between our home-institute, the ICAM node Max-Planck-Institute for Solid State research, and the external attendees of our workshop. Therefore, we believe, that, in the long-term perspective, research collaborations will emerge from our event.

II. RECORDINGS/VIDEOS

All the talks of this conference have been recorded. However, due to European law, we have to collect a declaration of consent that these talks may be made public. We distributed the declarations among the speakers and will collect them in the upcoming weeks. Afterwards, the raw videos will be cut and edited and made accessible to ICAM and on the YouTube channel of the MPI-FKF. Attached you can find the conference photo and a picture taken at the conference excursion.