

Executive Summary of the Virtual Workshop on “Gravity and Emergent Gauge Fields in Condensed and Synthetic Matter”

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Goals of the workshop: To explain experiments and to develop theoretical physics, it is becoming increasingly necessary to blend distant disciplines in an unprecedented level of understanding. New experimental realizations of quantum anomalies in condensed matter systems, non-abelian gauge fields in ultra-cold atomic gasses, and black-hole-horizon analogues, as well as theoretical developments such as newly discovered quantum field theory dualities, or the study of Sachdev-Ye-Kitaev models are important examples. However, this requirement often slides through conferences that are not focused on blending these disciplines, despite the strong interest from researchers in several fields.

To drive progress in these topics it is necessary to bring together condensed matter and high-energy theorists in an atmosphere that encourages discussions. This is the goal of this two week workshop at the Mainz Institute for Theoretical Physics, where practitioners of both fields can present new and ongoing developments on these fields, sparking discussion to catalyse new breakthroughs.

We expect this workshop to:

- Establish a fruitful dialogue between communities that are typically decoupled
- Isolate timely common open problems.
- Trigger otherwise unlikely collaborations that can develop solutions and new theoretical approaches to theoretical problems transcending specific fields.

Workshop program: While the workshop was intended to be organized offline, the ongoing covid-19 pandemic forced it to be held online. To make this online format manageable, a relaxed program was made consisting of two talks per day for the two weeks of the duration of the workshop. In total there were 21 invited speakers spanning themes as diverse as Weyl physics and anomalies, analogue gravity, SYK and related strongly-interacting physics, and cold atoms and QCD. Rather than grouping the speakers by topic, it was decided to mix the various topics as much as possible, thereby encouraging the participants to go to talks outside their own discipline.

Diversity: While inviting speakers, the organizers paid special attention to gender balance. This partially succeeded: 20% of the invited speakers were female. While this is roughly in line with amount of female PhD graduates in physics, we would set ourselves a more ambitious goal in the event a follow-up to this workshop would be organized by us. During the discussions sessions, however, the female participants played an active role, as was positively reflected upon by one of the female speakers.

Workshop results: Given that this is one of the first workshops that blends high- and low-energy physics, the main success of the workshop should be measured by the amount of interactions and discussions that were held at the workshop. While hard to stimulate in the online environment, a couple of steps were taken to encourage discussions: i) speakers were explicitly asked to give provocative talks, ii) talks were scheduled for 30 minutes with 15 minutes for discussion, and iii) a slack channel was set up where speakers posted their slides and where discussions could be continued. At this slack channel, there was room for posting contributions by participants, such as posters. Many of the talks were followed by a lively discussions among the participants, that was often continued at the slack channel. In this respect we consider this workshop a success, despite the limitations of the online environment.

Outlook: Many participants continued discussions amongst each other after the plenary sessions, and it was often remarked that such discussions should take place offline. We noticed that the general feeling among the participants was that the workshop filled an open and timely niche, and that they would strongly support a follow-up workshop in an offline setting.