

International Workshop on Condensed Matter Physics and AdS/CFT

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In 1997, a new duality between quantum field theories and gravity called the “gauge/string duality” (AdS/CFT correspondence) originated from string theory. It was quickly realized that this duality captures apparently universal features of certain strongly coupled systems. While first successfully applied to QCD, recent research started to apply this duality to strongly coupled and correlated states of condensed matter such as e.g. the electronic states present in high temperature superconductors. Conversely, real-world systems might be used to model gravity and in particular black holes, an approach dubbed “analogue gravity”. These results have been very promising and keep attracting the interest of string theorists, condensed matter physicists and the gravitational community. The goal of this joint workshop with the Institute for Solid State Physics (ISSP), the University of Tokyo held at the Kavli IPMU on May 25-29, 2015, organized by René Meyer (Kavli IPMU), Shin Nakamura (Chuo U./ISSP), Hiroshi Ooguri (Caltech/Kavli IPMU), Masaki Oshikawa (ISSP), Masahito Yamazaki (Kavli IPMU), and Hongbao Zhang (VUB Brussels), was to bring together key members from these three communities to foster exchange in this direction and ignite further collaboration.

The program of the workshop consisted of 20 hour-long talks by internationally recognized experts, who gave excellent overviews over their respective topics and at the same time presented cutting-edge research. In total 122 participants (80 from Japan) attended the workshop. 33 researchers from Japan and abroad used the opportunity to present their work in the gong show and poster presentation. The workshop focused on three topics: (1) AdS/CFT, non-Fermi liquid phenomenology and high temperature superconductivity, (2) non-equilibrium physics and AdS/CFT, and (3) topological states of matter and entanglement entropy. Concerning (1), the discussion largely revolved around the question of which aspects of the physics of high temperature superconductors are relevant for AdS/CFT, and what gravity theories can describe them. A very

interesting insight of (2) was that black holes in AdS/CFT share many features of non-equilibrium dynamics known from condensed matter systems. Finally, as regarding (3), entanglement entropy was discussed both as a tool to characterize topological states of matter and gauge theories, and as a way to better understand gauge/gravity duality in general.

This workshop was one of the key meetings in the field in this year. It was unique in bringing together condensed matter physicists and string theorists nearly in a half-half ratio, as well as gravitational theorists, which made it very successful. This workshop was financially supported by the Kavli IPMU, ISSP, and the EU ESF HoloGrav network. We are grateful to the administrative staff of the Kavli IPMU and ISSP for their hard work, as well as to the volunteers from ISSP for their help.

