Cluster of Excellence Precision Physics, Fundamental Interactions and Structure of Matter
PRISMA

Mainz Institute for Theoretical Physics

From Kinematic Space to Bootstrap: Modern Techniques for CFT and AdS

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Conformal field theories (CFTs) are a cornerstone of modern physics;. They are a basic tool for all condensed matter theorists and many particle physicists. The last two decades have revealed that certain CFTs have a fascinating bonus application. Under the holographic duality (the AdS/CFT correspondence), they encode the quantum dynamics of gravitational systems, enabling the study of quantum gravity and the unitary of black holes in controlled settings. At the same time, the structure of CFTs is so tightly constrained that it is possible to derive many facts about them from self-consistency and unitarity alone. The attendant effort to characterize and classify all CFTs is known as the bootstrap program. Until recently, the bootstrap program and the AdS/CFT correspondence have mostly developed as two independent and complementary fields. Luckily, this has changed in the last few years – in part because these research enterprises made sufficient progress to establish contact and in part because there were several breakthrough insights. The goal of scientific program was to nurture the current convergence of the bootstrap program and the AdS/CFT correspondence, to use insights from one to foster progress in the other, and develop new joint tools for exploiting conformal symmetry. An example for such a tool is the kinematic space, a formalism invented by two of the organizers which clarifies the manipulations carried out in bootstrap calculations, but which also provides an efficient description of the gravitational dynamics of the dual anti-de Sitter (AdS) spacetime.

The scientific program “Modern Techniques for CFT and From Kinematic Space to Bootstrap” was a productive meeting with engaged participants, productive discussions, and excellent talks. Participants appreciated the relaxed schedule that included plenty of time for discussions (two talks per day), the young age of the participants (many postdocs) and the lively and creative atmosphere.

There were four major topics or classes of questions: (i) kinematic space, (ii) black holes from bootstrap, (iii) the question of the general character of holography, and (iv) locality in AdS. A majority of the talks spanned several if not all of these topics. This includes Jan de Boer’s “The Interior Geometry of a Typical Microstate,” Alejandra Castro’s “Wilson Lines in AdS3,” Henry Maxfield’s “A view of the bulk from the worldline,” Lampros Lamprou’s “Entanglement Holonomies,” Gilad Lifschytz’s “A new perspective on bulk reconstruction,” and Felix Haehl’s “Gravity and Entanglement from Entanglement.” Several other talks were more focused: Nele Callebeaut’s “The Gravitational Dynamics of Kinematic Space,” Charles Melby-Thompson’s “Double Trace Interfaces,” Charles

Rabideau's "Higher-dimensional DifferenJal Entropy: Toward the Reconstruction of Surface Areas" and Claire Zukowski's "What is the structure of phase space in holography?", Micha Berkooz's "Chord Diagrams, Exact Correlators in Spin Glasses and Black Hole Bulk ReconstrucJon" and Moshe Rozali's "Fine Grained Chaos in AdS2 Gravity" and Hengyu Chen's "Aspects of Spinning Wiien Diagrams, from Geodesic to Mellin". Alessandro Vichi did an excellent job delivering a talk "Informal Introduction to Modern Conformal Bootstrap" which set the subjects covered elsewhere in the scientific program against the background of the bootstrap program, with emphasis on its modern elements. The participants could be seen at white boards, busily discussing and planning future projects, way into the evenings and past the official closing hours of MITP.