MP 3: Quantum Field Theory I: Axiomatic, Probabilistic, Algebraic, Conformal

Time: Tuesday 16:15–18:15 Location: KH 02.013

Invited Talk MP 3.1 Tue 16:15 KH 02.013

Osterwalder-Schrader axioms for a class of unitary 2D Conformal Field Theories — •Maria Stella Adamo[1], Yuto Moriwaki[2], and Yoh Tanimoto[3] — [1]Department Mathematik, Friedrich-Alexander-Universität Erlangen-Nürnberg, Cauerstrasse 11, 91058 Erlangen, Germany — [2]Interdisciplinary Theoretical and Mathematical Science Program (iTHEMS) Wako, Saitama 351-0198, Japan — [3]Dipartimento di Matematica, Università di Roma "Tor Vergata", Via della Ricerca Scientifica 1, I-00133 Roma, Italy

We provide a brief overview of axiomatic frameworks for quantum field theory in the case where the spacetime is 2-dimensional and the theory is invariant under conformal transformations, with a particular focus on the Wightman formalism of quantum fields.

For a general quantum field theory, the reconstruction theorem by Osterwalder-Schrader provides conditions to be verified by correlation functions in the Euclidean space to produce a quantum field theory in the Wightman formalism. In our work, for a reasonable class of unitary full Vertex Operator Algebras describing a class of unitary 2D conformal field theories, we construct Euclidean correlation functions that verify a conformal version of the Osterwalder-Schrader axioms.

Invited Talk MP 3.2 Tue 16:45 KH 02.013

Schwarzian Field Theory for Probabilists — •Peter Wildemann — University of Geneva

What does Liouville field theory, the SYK random matrix model and JT quantum gravity have in common? If you'd ask a physicist in recent years, they would be quick to point out that the low-energy behaviour of all these models should be described by the Schwarzian field theory. In itself, the latter can be understood as a probability measure on a quotient of the group of circle-diffeomorphisms Diff(T)/PSL(2,R). We discuss a rigorous approach constructing the measure in terms of a non-linear transformation of Brownian bridges, following ideas by Belokurov–Shavgulidze. Furthermore, we present new results that uniquely characterise the measure in terms of an appropriate change-of-variables formula, which can be seen as an analogue of the Cameron–Martin theorem on the space of circle diffeomorphisms. As a byproduct, we also obtain a short proof for the calculation of the measure's partition function (i.e. total mass), confirming a prediction by Stanford–Witten. This talk is based on joint work with Roland Bauerschmidt and Ilya Losev.

Invited Talk MP 3.3 Tue 17:15 KH 02.013

Local topological order and boundary algebras — Corey Jones[1], •Pieter Naaijkens[2], David Penneys[3], and Daniel Wallick[3] — [1]North Carolina State University, Raleigh, NC, USA — [2]Cardiff University, Cardiff, UK — [3]The Ohio State University, Columbus, OH, USA

Topologically ordered phases of matter have interesting features, such as the existence of quasi-particles with braid statistics. These quasi-particles can be studied using an AQFT-inspired approach along the lines of the celebrated Doplicher-Haag-Roberts programme on superselection sectors. In this talk I will introduce an axiomatisation, called *local topological order*, of such quantum models. These axioms are defined in terms of nets of (ground state) projections satisfying certain conditions. They allow us to define a physical boundary algebra, and I will outline how in concrete models (such as Kitaev's toric code or Levin-Wen models) the bulk superselection sector ("DHR") category can be recovered from the boundary algebra, giving a mathematical framework for *topological holography.* If time permits, I will explain how these axioms can be extended to included models with *topological* boundaries, and outline how this can be used to study, for example, Walker-Wang bulk-boundary systems.

MP 3.4 Tue 17:45 KH 02.013

Applications of the Lax-Phillips Theorem in Algebraic Quantum Field Theory — •Jonas Schober — Brigham Young University, Provo, Utah, USA

Algebraic quantum field theory is one of the main attempts to provide a formal mathematical framework for quantum field theory. Its core idea is to assign to every space-time region a von Neumann algebra of local observables, subject to the Haag-Kastler axioms, which encode locality, covariance, and causality. Translating the Haag-Kastler axioms from von Neumann algebras to the simpler setting of so-called standard subspaces leads to the investigation of one-parameter semigroups of unitary endomorphisms of standard subspaces. In this talk, we show how a real version of the classical Lax-Phillips Theorem, originally developed in the context of scattering theory, can be used to represent these endomorphism semigroups in an L^2-space over the real line. We also outline how this concrete realization allows one to obtain structural results about the semigroups.

MP 3.5 Tue 18:00 KH 02.013

Operator statistics from a simple approximate CFT — Alexander Altland[1], Julian Sonner[2], and •Konstantin Weisenberger[1] — [1]Institute for Theoretical Physics, University of Cologne, 50937 Cologne, Germany — [2]Départment de Physique Théorique, Université de Genève, CH-1211 Genève 4, Switzerland

Recently, in the context of the AdS3/CFT2 correspondence, the notion of ensembles of $2d$ quantum field theories specified by distributions of OPE-coefficients and conformal dimensions $\{C_{ijk}, h_i, \bar{h}_i\}$ has been introduced (Belin et al, *JHEP09(2024)163*). These ensembles, dubbed 'approximate CFTs' (aCFTs), are expected to be conformally invariant on average while also exhibiting signatures of quantum chaos. We give the first explicit construction of such an ensemble: N_c colors of Dirac fermions in the presence of quenched gauge-field disorder. For $N_c = 1$, we present prescriptions for the calculation of moments of OPE coefficients and conformal dimensions, and use them to reconstruct all associated probability distributions of the theory. For $N_c > 1$, we apply the same methods to find the variance of OPE coefficients of bilinear fields. Finally, we also demonstrate the emergence of random matrix statistics upon perturbing the system by a mass operator.