MP 10: Operator Algebras

Time: Thursday 14:00–15:30   Location: ZHG001

Invited Talk   MP 10.1   Thu 14:00   ZHG001
Quantum field theory, quantum reference frames and the type of local algebras — •Christopher Fewster — Department of Mathematics, University of York, York, UK

This talk will be a more technically-oriented discussion of the material presented as a plenary talk with the same title during the conference.

QFT assigns local algebras of type III_1 to bounded open spacetime regions. However it has been argued that in some gravitational situations one must include an observer. This happens in particular for the static patch of de Sitter spacetime. Further, the physical observables should be joint observables of the combined QFT-observer system that are invariant under the joint time-evolution of the static patch and observer Hamiltonian. This algebra turns out to be of type II_1 [1]. In this talk, I will describe some of the details of a recent generalisation [2] which places the discussion of [1] on a more operational basis using QFT measurement schemes [3] and by reinterpreting the observer as a quantum reference frame.

[1] V. Chandrasekaran, R. Longo, G. Penington, and E. Witten, An algebra of observables for de Sitter space. JHEP 2023(2) 1-56.

[2] C.J. Fewster, D.W. Janssen, L.D. Loveridge, K. Rejzner and J. Waldron, Quantum Reference Frames, Measurement Schemes and the Type of Local Algebras in Quantum Field Theory, Comm. Math. Phys., 406 (2025) 19:1-87

[3] C.J. Fewster and R. Verch, Quantum fields and local measurements, Comm. Math. Phys. 378 (2020) 851-889

MP 10.2   Thu 14:30   ZHG001
Black Hole Microstates and the Factorisation puzzle — •Jonathan Karl, Souvik Banerjee, and Johanna Erdmenger — Julius-Maximilians-Universität Würzburg

In holography, two manifestations of the black hole information paradox are given by the non-isometric nature of the bulk-boundary map and by the factorisation puzzle. By considering time-shifted microstates of the eternal black hole, we demonstrate that both these puzzles may be simultaneously resolved by taking into account non-local quantum corrections that correspond to wormholes arising from state averaging. This is achieved by showing, using a resolvent technique, that the resulting Hilbert space for an eternal black hole in Anti-de Sitter space is finite-dimensional with a discrete energy spectrum. The latter gives rise to a transition to a type I von Neumann algebra.

MP 10.3   Thu 14:50   ZHG001
Local Structure of Twisted Araki-Woods Algebras — •Ricardo Correa da Silva and Gandalf Lechner — Department of Mathematics, FAU Erlangen-Nürnberg, Erlangen, Germany

Finding models for local nets of von Neumann algebras and understanding the relative commutant $\mathcal{M} \cap \mathcal{N}'$ for the inclusion $\mathcal{N} \subset \mathcal{M}$ is a central problem in Algebraic Quantum Field Theory.

In this talk, a family of von Neumann algebras $\mathcal{L}_T(H)$ with respect to a twist T and a standard subspace H will be introduced and it will be discussed that the Fock vacuum is separating for these algebras if, and only if, the twist T satisfies two physically motivated conditions: crossing-symmetry and the Young-Baxter equation. Furthermore, some properties of the relative commutant of the inclusion $\mathcal{L}_T(K) \subset \mathcal{L}_T(H)$ will be presented.

MP 10.4   Thu 15:10   ZHG001
Finite Temperature States on Crossed Product Algebras — •Johannes Grosse, Ricardo Correa da Silva, and Gandalf Lechner — FAU Erlangen-Nürnberg, Department Mathematik

In this work, we study the finite temperature behaviour of a $(1+1)$-dimensional fermionic quantum field theory of two particle types. As the thermal equilibrium behaviour of one particle type is well-known, the main work focuses on extending thermal equilibrium states from a theory consisting of one particle type to that of two particle types. The issue of extending thermal equilibrium states can be naturally framed in the language of Tomita-Takesaki modular theory and crossed product algebras.