Department of Theoretical Physics

THE QUANTUM SPACETIME SEMINAR SERIES

Von Neumann algebras and black holes

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Zoom link shall be shared separately

We will first review von Neumann algebras, their Type classification and discuss algebras related to QFT in proper subregions of spacetime. Then, we discuss the crossed product by the modular automorphism group, which changes the type of a von Neumann algebra. We apply these results to the algebra of quantum fields in a black hole exterior in semiclassical gravity, and review how inclusion of gravity implements the crossed product by the modular automorphism group. This can be used to define a statistical quantity, `the entropy of the algebra' which turns out to be the generalized entropy apart from a constant. We showed this generalizes to arbitrary diffeomorphism invariant theories of gravity, where the generalized entropy now contains the Wald entropy. We then discuss a recent proposal that seeks to generalize these results to subregions of arbitrary spacetimes. Further, we show that this construction can be used to prove the generalized second law (GSL) for asymptotically flat (Schwarzschild and Kerr) and asymptotically AdS black holes. Finally, we discuss our recent results on the causal structure of higher curvature gravity. Specifically, we discuss their connection to proposals for a boundary algebraic diagnostic for stringy horizons in the bulk at finite t'Hooft coupling. We end with future directions on applications of von Neumann algebras to black holes.

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