Contribution ID: **331** Type: **not specified**

Generalized Black Hole Entropy as von Neumann Entropy

Friday 29 September 2023 10:20 (40 minutes)

It was recently shown that the von Neumann algebras of observables gravitationally dressed to the mass of a Schwarzschild-AdS black hole or an observer in de Sitter spacetime are Type II, and thus admit well-defined traces. The von Neumann entropies of "semi-classical" states was then found to be equal to the generalized entropy. We present a general framework for obtaining the algebra of dressed observables for linear fields on any spacetime with a Killing horizon. We prove, assuming the existence of a stationary (but not necessarily KMS) state and suitable asymptotic decay of solutions, that the algebra of dressed observables exterior to the Killing horizon always contains a Type II factor of observables "localized" on the horizon. Applying our general framework to the algebra of observables in the exterior of an asymptotically flat Kerr black hole, where the fields are dressed to the black hole mass and angular momentum, we find that the algebra is the product of a Type II$_\infty$ algebra on the horizon and a Type I$_\infty$ algebra at past null infinity. In Schwarzschild-de Sitter, despite the fact that the spacetime is spatially closed, the quantum field observables are dressed to the perturbed areas of the black hole and cosmological horizons yielding a product of Type II$_\infty$ algebras on each horizon. Our results suggest that in all cases where there exists additional "boundary structure" (e.g., an asymptotic boundary or another Killing horizon) the algebra of observables is Type II$_\infty$ and in the absence of such structures (e.g., de Sitter) the algebra is Type II$_1$.

Primary author: LEUTHEUSSER, S. (Princeton)

Presenter: LEUTHEUSSER, S. (Princeton)

Session Classification: Plenary Sessions Friday