

Characteristic Hadamard states and semi-classical gravitational collapse

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To study the influence of quantum fields on the formation of a black hole, we show how locally covariant renormalization schemes for the stress-energy tensor for linear scalar fields can be adapted to a characteristic (i.e. null-cone) treatment of the semi-classical Einstein equations. Key to this approach is understanding the singularities of Hadamard parametrices restricted to null-cones. We show that for conformally coupled fields on spherically symmetric space-times the renormalization freedom of this stress-energy tensor can be reduced by conditions on the required initial data. Furthermore, we show how this approach provides hints that due to local quantum effects during gravitational collapse the (averaged) null energy condition may be violated, potentially implying that formation of a trapped surface (i.e. apparent horizon) need not lead to the formation of a black hole singularity.

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