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Probing singularities of GR with Quantum Fields

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Singularity theorems of Penrose and Hawking are based on geodesic incompleteness. Physically, this criterion refers to the fate of classical test particles. What if one uses quantum fields instead? They would be more fundamental probes. For technical simplicity, I will restrict myself to cosmological singularities and show that one can unambiguously evolve quantum
fields across them in a rigorous sense. Already for test quantum
fields, classical singularities are not absolute boundaries where physics breaks down. I will also discuss the behavior of expectation values of renormalized products of
fields. The overall conclusion
is that singularities of classical GR are tamer when seen from a quantum perspective, and the quantum considerations provide more refined tools to probe their structure. This work is based on joint work with Tommaso De Lorenzo and Marc Schneider, and supported by the NSF grant PHY-1806356 and the Eberly Chair funds of Penn State.

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