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Quantum Field Vacuum Effects on Causality, Focusing and the Penrose-Hawking Singularity Theorem to One Loop ERIC STEINFELDS, KEITH ANDREW, THAD ROBERTS, Western Kentucky University — Quantum field interactions alter the structure of spacetime through vacuum polarization effects in such a way that the changes can often be modeled with an effective spacetime index of refraction. This index couples directly to the scalar and Ricci curvatures of the manifold and will alter the null geodesic structure of the spacetime manifold and thereby the causal structure of events. This is manifested through the action of conjugate points and the energy conditions resulting in changes in the focusing of null rays and the formation of closed trapped surfaces. However, the underlying focusing structure is a critical ingredient in order for the Penrose-Hawking singularity theorems to apply. Here we use the results of Hollowood and Shore with the Drummond-Hathell action applied to a scalar field coupled to gravity to examine the ingredients of the singularity theorems including the vacuum effects at the one loop level within the context of a static elliptical Reissner-Nordstrom electric and magnetic monopole charged black hole metric. We find the expression for the change in null ray paths for a closed trapped surface for this metric and express this as changes in the causal structure as it impacts the event horizon and Cauchy horizon for this metric.

Keith Andrew
Western Kentucky University

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