Semiclassical Instability of the Cauchy Horizon in Self-Similar Collapse

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Abstract Generic spherically symmetric self-similar collapse results in strong naked-singularity formation. In this paper we are concerned with particle creation during a naked-singularity formation in spherically symmetric self-similar collapse without specifying the collapsing matter. In the generic case, the power of particle emission is found to be proportional to the inverse square of the remaining time to the Cauchy horizon (CH). The constant of proportion can be arbitrarily large in the limit to marginally naked singularity. Therefore, the unbounded power is especially striking in the case that an event horizon is very close to the CH because the emitted energy can be arbitrarily large in spite of a cutoff expected from quantum gravity. Above results suggest the instability of the CH in spherically symmetric self-similar spacetime from quantum field theory and seem to support the existence of a semiclassical cosmic censor. The divergence of redshifts and blueshifts of emitted particles is found to cause the divergence of power to positive or negative infinity, depending on the coupling manner of scalar fields to gravity. On the other hand, it is found that there is a special class of self-similar spacetimes in which the semiclassical instability of the CH is not efficient. The analyses in this paper are based on the geometric optics approximation, which is justified in two dimensions but needs justification in four dimensions.