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A scenario for critical scalar field collapse in AdS₃

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We present a family of exact solutions, depending on two parameters α and b (related to the scalar field strength), to the three-dimensional Einstein-scalar field equations with negative cosmological constant.

For $b = 0$ these solutions reduce to the static BTZ family of vacuum solutions, with mass $M = -\alpha$. For nonvanishing b , the solutions become dynamical and develop a strong spacelike central singularity.

The $\alpha < 0$ solutions are black-hole like, with a global structure topologically similar to that of the BTZ black holes, and a finite effective mass.

We show that the near-singularity behavior of the solutions with $\alpha > 0$ agrees qualitatively with that observed in numerical simulations of subcritical collapse.

We analyze the linear perturbations of the threshold solution, $\alpha = 0$, in the $\Lambda = 0$ approximation, and find that it has only one unstable growing mode, which qualifies it as a candidate critical solution for scalar field collapse.

Summary

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