Collapsing radiation shells in Einstein-Gauss-Bonnet gravity

B.P. Brassel*, S.D. Maharaj* and R. Goswami*

University of KwaZulu-Natal
Astrophysics and Cosmology Research Unit, School of Mathematics, Statistics and Computer Science, Private Bag X54001, Durban 4000, South Africa
drbrasselint@gmail.com

We investigate the continual gravitational contraction of a spherically symmetric radiation shell in five-dimensional Einstein-Gauss-Bonnet gravity. We show that the final fate of such a collapse is an extended and weak curvature naked conical singularity at the centre, which then subsequently becomes covered by an apparent and event horizon. This process is completely different from the five-dimensional general relativity counterpart, where a strong curvature singularity develops at the centre. Since the singularity in the case of Einstein-Gauss-Bonnet gravity is sufficiently weak, we argue that the spacetime can be extended through it, which gives us an elegant way of constructing regular black holes in higher dimensions without violating any energy conditions. We also extend our study to spacetimes with null and string fluids, which are the counterpart of generalised Vaidya spacetimes in general relativity. We show that similar end states are also possible in those cases. Furthermore, we show that in higher dimensions, a strong curvature singularity forms upon the cessation of the collapse, and that this singularity can never be naked; cosmic cencorship is never violated for dimensions higher than five in Einstein-Gauss-Bonnet gravity.

References

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