Hawking radiation and entropy of a black hole in modified gravity from quantum tunneling approach

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We extend the Parikh–Wilczek method from Einstein gravity space-time to modified gravity ones to study the tunneling radiation of particles across the event horizon of a black hole in f(R)、Lovelock-Born-Infeld、Gauss–Bonnet、Hořava–Lifshitz and Massive gravity. The emission rate and the emission spectrum are obtained and shown to take the same form as that for Einstein gravity black hole. That is, the conclusion is universal that the emission spectrum deviates from the purely thermal spectrum but consists with an underlying unitary theory. Compared to the conventional tunneling rate, which is related to the increment of the Bekenstein-Hawking entropy, the entropy of a modified gravity black hole is obtained. Except of massive gravity black hole, the entropy does not obey the area law. But all the entropy satisfies the first law of thermodynamics and is in accordance with the early results.

References

Li G Q, Chinese Physics C, 41(4): 045103 (2017)

Li G Q, Mo J X, Gen. Relativ. Gravit., 49:57 (2017)

Li G Q, Mo J X, Astrophys Space Sci **(2016) 361:251**

Li G Q, OU Y Y, Lin Z T, Lithuanian Journal of Physics, **59** (1): 15 (2019)