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Optical analog of the Schwarzschild-Planck metric

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Recently, a new metric has been proposed by Good and Linder [1] following the trajectory of a moving mirror in flat space. This trajectory can be considered as a regularized version of the Schwarzschild metric with a new length scale related with the microscopic nature of space time that can be considered of the order of the Planck scale. This has been called the Schwarzschild-Planck metric.

In analog gravity phenomena usually related with gravity is studied in a different system, the analog system. A successful implementation of this analogy has been implemented in the laboratory using photonic crystal fibers and intense light pulses [2].

In this work, we present an optical analog of the Schwarzschid-Planck metric. Here, the new scale is not the Planck scale, but a more reachable scale related with the microscopic nature of the analog space, in this case, the material of the optical fiber. The curvature of the system is obtained by the shape of the optical pulse.

We study the differences on the spectrum of the analog Hawking radiation emitted by the analog metric on the original Schwarzschild metric and the modified one with a physical scale factor.

[1] M. Good, E. V. Linder, Modified Schwarzschild metric from a unitary accelerating mirror analog, New Journal of Physics. 23 043007 (2021)
[2] J. Drori, Y. Rosenberg, D. Bermudez, Y. Silberberg, U. Leonhardt, Observation of stimulated Hawking radiation in an optical analogue, Physical Review Letters 122 10404 (2019)

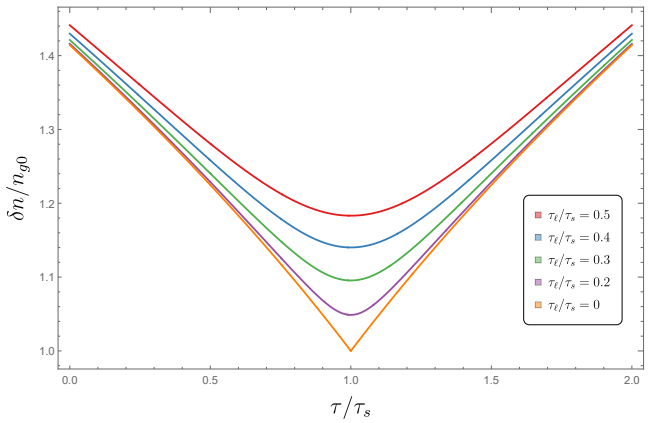

Figure 1 : Pulse shape that recreates the Schwarzschild-Plank metric with different values of τ_l/τ_s, distance is in units of horizon τ_s.