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Photon sphere and shadow of dynamical Kottler black hole

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Abstract

In this paper, we analyze the shadow of a black hole immersed in a dynamic background reflecting the expansion of the universe due to the presence of dark energy. Using a time-dependent metric (the dynamic Kottler metric), we obtain the null (lightlike) geodesics of spacetime and calculate the effective potential for light rays. Our results show that the expansion of the universe causes the radius of the photon sphere, and consequently the black hole shadow, to decrease gradually over time. This phenomenon can be a way to determine cosmological parameters.

Keywords: Kottler black hole, Photon sphere, Black hole shadow.

For full article, refer to the Persian section