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Shadow of black holes at cosmological distances

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Abstract

We analytically investigate the influence of a cosmic expansion on the angular size of black hole shadow observed by a comoving observer. We have found: 1) exact solution for the shadow size in case when expansion is driven by cosmological constant only (Schwarzschild-de Sitter); 2) approximate solution for general case of multicomponent universe (with matter, radiation, and dark energy) obtained by using of angular size redshift relation with effective linear size of the shadow; 3) numerical solution for general case obtained by numerical integration of geodesics in McVittie spacetime. Remarkably, it is shown that supermassive black holes at large cosmological distances in the Universe with matter may give a shadow size approaching the shadow size of the black hole in the center of our Galaxy, and present sensitivity limits.

Based on works:

Perlick, Tsupko and Bisnovatyi-Kogan, *Physical Review D*, 97, 104062 (2018)

Bisnovatyi-Kogan and Tsupko, *Physical Review D*, 98, 084020 (2018)