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## Black hole parameters and estimation of the Hubble constant from observations: a GR approach

We extract the Hubble law by the frequency shift considerations of test particles revolving a Kerr black hole in asymptotically de Sitter spacetime. To this end, we consider massive geodesic particles circularly orbiting a Kerr-de Sitter black hole that emit redshifted photons towards a distant observer which is moving away from the emitter–black hole system. We further obtain an expression for the redshift in terms of spacetime parameters such as mass, rotation parameter and the cosmological constant. Then, we express the frequency shift of photons in terms of the Hubble constant with the help of some reasonable physically motivated approximations. Finally, some exact formulas for the Schwarzschild black hole mass and the Hubble constant in terms of the observational redshift of massive bodies circularly orbiting the black hole are extracted. Our results pave the way to develop a new independent general relativistic approach to estimating the late-time Hubble constant in terms of observable astrophysical quantities.

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