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Probing the Imprint of Dark Sector Dynamics on Evolution of Black Hole

One of the feasible theoretical explanations for the currently observed accelerated expansion of the Universe is the inclusion of the dark sector in the standard cosmological model. Further extension of this idea can't be an exaggeration, if we thought the interaction between dark energy and matter contents of the universe. In this work, we investigate the cosmological evolution in a dynamical dark sector and its influence on the mass evolution of Schwarzschild black holes devoid of any charge and rotation. We analyze the cosmic expansion through relevant cosmological parameters like scale factor, Hubble parameter, deceleration parameter, redshift and the type of dark energy during transition and present time. Our focus also attributes to study black-hole mass dynamics governed by the competing effects of Hawking radiation and accretion of the surrounding cosmic medium. Our results show that the black hole mass increases significantly during the radiation-dominated era, remains nearly constant for an intermediate period, and eventually decreases during the matter-dominated era, ultimately leading to complete evaporation depending on the accretion efficiency and initial formation mass. We further examine the population of such black holes in connections with constraints arise from several astrophysical phenomena like the present matter density, photon spectrum, CMB spectral distortions, and Big Bang nucleosynthesis. Within the framework of the interacting dark sector, we evaluated these constraints and found that they are more flexible than standard cosmology and Brans-Dicke theory counterparts.

Primary author: Mr SAHU, Debasis (Research Scholar (Ph.D.), P.G. Department of Physics, Fakir Mohan University, Baleshwar, India)

Co-author: Dr NAYAK, Bibekananda (Assistant Professor, P.G. Department of Physics, Fakir Mohan University, Baleshwar, India)