

Black Holes in the Generalized Proca Theory

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ABSTRACT

We investigate static and spherically symmetric black hole solutions in the generalized Proca theory which corresponds to the generalization of the shift-symmetric scalar-tensor Horndeski theory to the vector-tensor theory [1]. Any solution obtained in this paper possesses a constant spacetime norm of the vector field, $X := -\frac{1}{2}g^{\mu\nu}A_\mu A_\nu = X_0 = \text{constant}$. The solutions in the theory with generalized quartic coupling $G_4(X)$ generalize the stealth Schwarzschild [2] and the Schwarzschild- (anti-) de Sitter [3] solutions obtained in the theory with the nonminimal coupling to the Einstein tensor $G^{\mu\nu}A_\mu A_\nu$. While in the vector-tensor theory with the coupling $G^{\mu\nu}A_\mu A_\nu$ the electric charge does not explicitly affect the spacetime geometry, in more general cases with nonzero $G_{4XX}(X_0) \neq 0$ this property does not hold in general. The solutions in the theory with generalized cubic coupling $G_3(X)$ are given by the Schwarzschild- (anti-) de Sitter spacetime, where the dependence on $G_3(X)$ does not appear in the metric function.

References

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