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Compact objects in the Generalized SU(2) Proca Theory

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We present compact object solutions in the Generalized SU(2) Proca theory (GSU2P), including boson stars, neutron stars, and black holes. This modified gravity model is a vector-tensor theory, invariant under global SU(2) transformations, and incorporates second-order derivative self-interactions of the vector field, extending beyond the massive Yang-Mills theory. Initially, we investigated two Lagrangian components consisting of four gauge fields minimally coupled to the metric tensor. These components yield an exact Reissner-Nordström black hole solution with two distinct non-Abelian effective charges that depend on the theory's free parameters. We also found soliton solutions, generalizing the particle-like solutions of the Einstein-Yang-Mills equations, which can be interpreted as gauge Proca boson stars. Within certain parameter ranges, these solutions exhibit potential stability. Additionally, we found neutron star solutions, where the baryonic matter is modeled using a piecewise polytropic equation of state. In general, these solutions are more compact compared to those in General Relativity. Specifically, for the same equation of state and central baryonic density, the GSU2P solutions are more massive than those in General Relativity, reaching the mass gap. These results constraint the range of the free parameters of the theory.

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