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Hairy Black Holes & Boson Stars: From shift-symmetry to spontaneous scalarization

Abstract

I will discuss compact solutions (namely black holes and boson stars) in scalar-tensor theory of gravity where a single complex scalar field is non-minimally coupled to Einstein's Gravity by means of a curvature invariant - here, the Gauss-Bonnet term.

The coupling function $f(\phi)$ is chosen as a general quadratic polynomial in the scalar field which, restricting to a real field, allows for large families of hairy black holes to exist. This particular choice allows to find a connection between two type of solutions: shift-symmetric (where the model is invariant under a shift of the scalar) and spontaneously scalarized black holes (where hairy solutions only exists for a sufficiently high value of the coupling parameter). I will discuss the pattern of solution in the general quadratic case and show how both shift-symmetric and spontaneously scalarized black holes appear as limiting cases.

Endowed with a suitable potential, the model also possess non-topological solitons: boson stars. If time permits, I will show how the non-minimal coupling can drastically influence their domain of existence and classical stability.