Spontaneous scalarization of black holes

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It has recently been shown that nontrivial couplings between a scalar field and the Gauss-Bonnet invariant can give rise to black hole spontaneous scalarization. Theories that exhibit this phenomenon are among the leading candidates for testing gravity with upcoming black hole observations. These theories admit both the classic black hole solutions predicted by general relativity as well as novel hairy black hole solutions. We present the general assumptions for the generation of black hole scalarization within a class of theories supplemented with a scalar field coupled with the Gauss-Bonnet term. These theories are usually labeled scalar-Gauss-Bonnet gravity and englobe the Einstein-dilaton-Gauss-Bonnet as a particular case. We also show the steps towards placing the spontaneous scalarization of black holes on a more robust theoretical footing - from the EFT point of view - by considering the leading-order scalar self-interactions as well as the scalar-Gauss-Bonnet coupling. We demonstrate that, while the quadratic terms control the onset of the tachyonic instability that gives rise to the black hole hair, the higher-order terms control the nonlinearities that quench that instability, and hence also control the stability of the hairy black hole solutions. This poses a window of theories that could be phenomenologically probed within strong-field tests of gravity.