Stability of Hairy Black Holes with scalar or Proca hair

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We present some preliminary results about the stability of the Kerr Black Holes with Scalar Hair (KBHsSH) introduced by Herdeiro and Radu in 2014. These black holes admit a scalar hair, minimally coupled to gravity and solution to the massive Klein-Gordon equation, which has a harmonic dependence in time and in the azimuthal angle. This allows the metric sector to be stationary and axisymmetric. The KBHsSH can coexist with traditional Kerr Black Holes in a region of the parameter space, and should be entropically favored. On the other hand, spinning scalar Boson Stars have been shown to be unstable dynamically (Sanchis-Gual et al. 2019), which begs the question of the stability of the KBHsSH close to that limit. We thus perform fully non-linear 3D numerical evolutions to test the stability of KBHsSH, using the Einstein Toolkit numerical suite. We will present the first results that we obtained in both parts of the parameter space mentioned previously. Motivated by the qualitatively different behavior between spinning scalar and Proca Boson Stars, an ongoing line of work aims at performing similar numerical evolutions for Kerr Black Holes with Proca Hair (Herdeiro, Radu, Rúnarsson 2016).