# Dynamical formation of Proca stars and quasi-stationary solitonic objects

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We perform fully non-linear numerical simulations within the spherically symmetric Einstein-(complex)Proca system. Starting with Proca field distributions that obey the Hamiltonian, momentum and Gaussian constraints, we show that the self-gravity of the system induces the formation of compact objects, which, for appropriate initial conditions, asymptotically approach stationary soliton-like solutions known as Proca stars. The excess energy of the system is dissipated by the mechanism of *gravitational cooling* in analogy to what occurs in the dynamical formation of scalar boson stars. We investigate the dependence of this process on the phase difference between the real and imaginary parts of the Proca field, as well as on their relative amplitudes. Within the timescales probed by our numerical simulations the process is qualitatively insensitive to either choice: the phase difference and the amplitude ratio are conserved during the evolution. Thus, whereas a truly stationary object is expected to be approached only in the particular case of equal amplitudes and opposite phases, quasi-stationary compact solitonic objects are, nevertheless, formed in the general case.

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