Gravitational Geometry and Dynamics (GGD) Group Seminar

Non-linear dynamics of spinning bosonic stars: formation and stability

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Spherical boson and Proca stars have been extensively studied in the non-linear regime, but no numerical simulations of rotating bosonic stars have been performed. We present the first fully non-linear numerical evolutions of the fully non-linear Einstein-(complex, massive) Klein-Gordon and Einstein--(complex) Proca systems, to assess the formation and stability of spinning bosonic stars. In the formation scenario, starting with constraint-obeying initial data, describing a dilute, axisymmetric cloud of spinning scalar/Proca field, gravitational collapse towards a spinning star occurs, via gravitational cooling. In the scalar case the formation is transient; a non-axisymmetric instability always develops ejecting all the angular momentum from the scalar star. In the Proca case, by contrast, no instability is observed and the evolutions are compatible with the formation of a spinning Proca star. Secondly, we address the stability of an existing star, a stationary solution of the field equations. In the scalar case, a non-axisymmetric perturbation develops collapsing the star to a spinning black hole. No such instability is found in the Proca case, where the star survives large amplitude perturbations. Our analysis suggests bosonic stars have different stability properties in the scalar/vector case, which we tentatively relate to their toroidal/spheroidal morphology.

Wednesday, October 9th 2019, 14H30 || Sala 11.3.21, Departamento de Matemática da UA

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