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Head-on collisions of ℓ-boson stars

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We will present results on fully non-linear numerical evolutions of the Einstein-(multi)–Klein-Gordon equations to describe head-on collisions of ℓ-boson stars. Despite being spherically symmetric, ℓ-boson stars have a (hidden) frame of reference, used in defining their individual multipolar fields. To assess the impact of their relative orientation, we perform simulations with different angles between the axes of the two colliding stars. Additionally, two scenarios are considered for the colliding stars: that they are composites of either the same or different scalar fields. Despite some model-specific behaviours, the simulations generically indicate that: 1) the collision of two sufficiently (and equally) massive stars leads to black hole formation; 2) below a certain mass threshold the end result of the evolution is a bound state of the composite scalar fields, that neither disperses nor collapses into a black hole within the simulation time; 3) this end product (generically) deviates from spherical symmetry and the equipartition of the number of bosonic particles between the different scalar fields composing the initial boson stars is lost, albeit not dramatically. This last observation indicates, albeit without being conclusive, that the end result of these collisions belongs to the previously reported larger family of equilibrium multi-field boson stars, generically non-spherical, and of which ℓ-boson stars are a symmetry enhanced point. We also extract and discuss the waveforms from the collisions studied.

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