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Parameter estimation using the Newman-Penrose scalar and its applications: searching for boson-star mergers in LIGO-Virgo data

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The detection and analysis of gravitational-wave signals relies on the comparison of the gravitational strain observed by the detectors (e.g. LIGO and Virgo) to theoretical templates for strain produced by given sources, e.g. black-hole mergers. Numerical simulations of compact-mergers, however, do not typically output the gravitational strain but a quantity known as the Newman-Penrose (NP) scalar. The obtention of the strain from the NP scalar is subject to well known systematic errors that are not trivial to ease. In this talk I will present a formalism that allows for the comparison of the detector data to the NP templates outputted by numerical simulations, which qualitatively removes a complete layer of errors. As an observational application, I will show a systematic comparison of high-mass events from LIGO and Virgo to numerical simulations of exotic compact objects known as (vector) boson stars, or Proca stars, providing estimates of the mass of the ultra-light bosons building up the stars together with a preliminary population study.

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