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Dark sirens number counts with the Einstein Telescope: cosmological forecasts and astrophysical modelling

The present generation of interferometers has demonstrated that gravitational-wave observations, even in the absence of electromagnetic counterparts, i.e. dark sirens, can serve as an independent method to investigate the Hubble tension. However, while the proposed designs for the Einstein Telescope (ET) can produce astonishingly precise H_0 measurements, it has been shown that incorrect astrophysical modeling in dark sirens methods can bias our estimates, hence effort must be put into studying the star binaries population properties as progenitors of these events.

In this talk, I will introduce a number counts technique to derive H_0 solely from gravitational-wave data, bypassing assumptions about black hole masses or external galaxy catalogs. By comparing the expected number of dark sirens to those actually detected, we gain a powerful handle on cosmic expansion, particularly in view of ET's projected capabilities, expected to significantly increase the gravitational-wave event sample.

I will discuss our refined models on merger rate evolution, star formation histories, and binary population synthesis (via the SEVN code) and then highlight the importance of the common envelope (CE) phase and its effects on our astrophysical models and on H_0 constraints. I will showcase results for the ET with number counts only and in different CE models and compare the results for the triangular vs. 2L design sensitivities.

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