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Measuring neutron star tidal deformability with Advanced LIGO: a Bayesian analysis of neutron star - black hole binary observations

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The pioneering discovery of gravitational waves (GW) by Advanced LIGO has ushered us into an era of observational GW astrophysics. Compact binaries remain the primary target sources for GW observation, of which neutron star - black hole (NSBH) binaries form an important subset.
GWs from NSBH sources carry signatures of the tidal distortion of the neutron star by its companion black hole during inspiral, and its potential tidal disruption near merger.
We present a Bayesian study of the measurability of neutron star tidal deformability $\Lambda_{\mathrm{NS}} \propto (R/M)^5_{\mathrm{NS}}$ using observation(s) of inspiral-merger GW signals from disruptive NSBH coalescences, taking into account the crucial effect of black hole spins.
If non-tidal templates are used to estimate source parameters for an NSBH signal, the bias introduced in the estimation of non-tidal physical parameters is found to be only be significant for loud signals with signal-to-noise ratios greater than $\simeq 30$.
We focus on how a population of realistic NSBH detections will improve our measurement of neutron star tidal deformability. For an astrophysically likely population of *disruptive* NSBH coalescences, we find that $20 - 35$ events are sufficient to constrain Λ_{NS} within $\pm 25 - 50\%$, depending on the neutron star equation of state. This number also depends on whether black hole masses lie within the astrophysical *mass-gap*.
We find that it is the loudest $5 - 10$ events that provide most of the tidal information, and not the combination of tens of low-SNR events, thereby facilitating targeted numerical-GR follow-ups of NSBHs.
These results are encouraging, and we recommend that an effort to measure Λ_{NS} be planned for upcoming NSBH observations with the LIGO-Virgo instruments.

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