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The Poincaré and BMS flux-balance laws with application to binary systems

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Abstract

Asymptotically flat spacetimes admit both supertranslations and Lorentz transformations as asymptotic symmetries. Furthermore, they admit super-Lorentz transformations, namely superrotations and superboosts, as outer symmetries associated with super-angular momentum and super-center-of-mass charges. In this paper, we present comprehensively the flux-balance laws for all such BMS charges. We distinguish the Poincaré flux-balance laws from the proper BMS flux-balance laws associated with the three relevant memory effects defined from the shear, namely, the displacement, spin and center-of-mass memory effects. We scrutinize the prescriptions used to define the angular momentum and center-of-mass. In addition, we provide the exact form of all Poincaré and proper BMS flux-balance laws in terms of radiative symmetric tracefree multipoles. Finally, we derive the exact form of all BMS charges for both an initial Kerr binary and a final Kerr black hole in an arbitrary Lorentz and supertranslation frame, which allows to derive exact constraints on gravitational waveforms produced by binary black hole mergers from each BMS flux-balance law.

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