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Orbital Motion in the Reference Frame of a Blackhole

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I compare two versions of the analysis of the gravitational wave signal GW150914 presented previously by the LIGO/Virgo collaboration (LVC). The first version was presented in 2016 by this collaboration along with their announcement of the first experimental detection of gravitational waves [1]. It was based on rigorous general-relativistic treatment of the coalescing two-body problem. The second analysis of this signal by the same authors [2] was based on the quadrupole post-Newtonian (PN) approximation of General Relativity (GR). I revisit this post-Newtonian analysis and estimate the mass of the coalescing binary blackhole system using frequency values read directly from the time-frequency diagram of GW150914. My estimation, similarly to the PN-result from LVC [2], coincides with the rigorously calculated mass for this system from the LVC first publication. Additionally, I estimate the masses of other coalescing binary systems by using the same quadrupole PN-approximation formula applied to the data from the published gravitational wave transient catalogues. Practically all of myPN-approximation estimates coincide with the published masses based on the rigorous methods. In my view, this coincidence means that the rigorous theory for gravitational waveforms of coalescing blackhole binaries does not fully account for the difference between the source and detector reference frames because the PN-approximation, which is used for the comparison, does not make any distinction between these two reference frames: by design and by the
principles and conditions for building the PN-approximation. I discuss possible implications of this conflict and find that the accuracy of the previously estimated characteristic (chirp) masses of coalescing binary blackhole systems is likely to be affected by a systematic error.
REFERENCES
[1] LIGO Scientific and Virgo Collaborations, Abbott B.P. et al. Observation of Gravitational Waves from a Binary Black Hole Merger Phys. Rev. Lett., 2016,vol.116, 241102. DOI:10.1103/PhysRevLett.116.061102
[2] Abbott B.P. et al. The basic physics of the binary black hole merger GW150914, Ann. Phys. (Berlin)vol. 529, 1600209. DOI:10.1002/andp.201600209

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