

Abstract Submitted
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Reconciling different expressions for the pulsar timing residuals induced by single-source gravitational waves¹ HYO SUN PARK², Bryn Mawr College, ANDREA LOMMEN, Haverford College — Pulsars are fast-spinning neutron stars that send electromagnetic pulses to Earth at regular intervals. The times of arrival (TOAs) of their pulses vary when gravitational waves (GWs) pass through, as GWs stretch and shrink the spacetime between the pulsars and the Earth. Pulsar Timing Arrays (PTAs) can directly detect individual GW sources by measuring the timing “residual,” the difference between the observed TOAs and the expected TOAs. Due to their high sensitivity in the nano-Hz band, PTAs are the primary GW detector for supermassive black hole binaries (SMBHBs). Many authors have derived the expression for the timing residuals induced by a GW emitted from a SMBHB in a circular orbit. However, we find that there are discrepancies in the published equations, and the notations and coordinate systems being used vary considerably among the authors. We trace their references back to the 1975 and 1989 documents and derive the timing residuals directly using the equations in these original references. We describe how to do conversions between the published expressions and attempt to correct the inconsistencies between them. We also point out the misunderstanding of the “Earth term” in timing residuals having the same phase across all the pulsars.

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