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**Are we there yet? Time to detection of nanohertz gravitational waves based on pulsar-timing array limits** STEPHEN TAYLOR, MICHELE VALLISNERI, JUSTIN ELLIS, Jet Propulsion Laboratory, CHIARA MINGARELLI, California Institute of Technology, JOSEPH LAZIO, RUTGER VAN HAASTEREN, Jet Propulsion Laboratory — Pulsar timing arrays have placed highly constraining upper limits on the amplitude of the nanohertz gravitational-wave stochastic signal from the mergers of supermassive black-hole binaries ($\sim 10^{-15}$ strain at $f = 1/\mathrm{yr}$). These limits suggest that binary merger rates may have been overestimated, or that environmental influences from nuclear gas or stars accelerate orbital decay, reducing the gravitational-wave signal at the lowest, most sensitive frequencies. This prompts the question whether nanohertz gravitational waves are likely to be detected in the near future. In this talk, we answer this question by deriving the range of true signal amplitudes that are compatible with current upper limits, and computing expected detection probabilities as a function of further observation time. We conclude that small arrays consisting of the pulsars with the least timing noise, which nevertheless yield the tightest upper limits, have discouraging prospects of making a detection in the next two decades. By contrast, we find large arrays have an $\sim 80\%$ probability of detection within the next ten years, even in the most pessimistic source modeling scenarios.

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