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The State of Gravitational Wave Detection with Pulsar Timing Arrays[1]

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The use of ensembles of well-timed millisecond pulsars (meaning pulse arrival times are measured with precisions better than 1 microsec) to directly detect nanohertz frequency gravitational waves (GWs) has reached a very important milestone. Our current sensitivities are constraining models of the mergers of super-massive black hole binaries (SMBHBs) throughout the universe. Each of the three main pulsar timing arrays (PTAs; NANOGrav in North America, EPTA in Europe, and the PPTA using the Parkes telescope in Australia) has comparable sensitivity, and over the coming few years, their joint efforts as part of the International Pulsar Timing Array (IPTA), should definitively detect GWs from SMBHBs, or very strongly constrain theories of galaxy and black hole mergers throughout cosmic time. Additionally, by measuring these systems to such high-precision, many "secondary" science products result for "free", such as new neutron star masses which can constrain the high-density matter equation of state, and new tests of general relativity which cannot be achieved here in the solar system. The next few years of millisecond pulsar astronomy should be very exciting.

[1]NSF NANOGrav PFC