Testing General Relativity Using a Pulsar in a Triple System

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Some of the highest profile, and highest impact, results from pulsar timing involve probing the high-density physics at the cores of the neutron stars or testing general relativity in new and better ways. These efforts almost always involve the rarest and most exotic of recycled binary systems, including those which formed in unusual ways, or those whose orbits or companions were altered later, as often happens in globular clusters. We report recent results, using timing and search observations from the GBT and Arecibo, on several of these exotic systems. We have new and potentially exciting neutron star mass measurements and new tests of general relativity. And we suggest that it is well worth the efforts involved to uncover and examine these "1%" pulsar systems.

228.03 — Testing General Relativity Using a Pulsar in a Triple System

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The millisecond pulsar PSR J0337+1715 is in a 1.6-day orbit with an inner white dwarf companion, and the pair is in a 327-day orbit with an outer white dwarf companion. This hierarchical triple provides an excellent laboratory to test a key idea of Einstein's theory of gravity, the strong equivalence principle (SEP): do all objects, even those with strong gravity like neutron stars, fall the same way in the same gravitational field? Almost all alternative theories of gravity predict violations of the SEP at some level. We have carried out an intensive program of timing this pulsar, and we are able to perform a very sensitive test of the SEP. I will discuss our methods, our result, and its theoretical implications.

228.04 — The NANOGrav 11-year Data Set: New Insights into Galaxy Growth and Evolution

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The NANOGrav collaboration monitors an array of over 70 precisely timed millisecond pulsars with the Green Bank Telescope and Arecibo Observatory in order to detect perturbations due to gravitational waves at nanohertz frequencies. These gravitational waves will most likely result from an ensemble of supermassive black hole binaries. I will present the most recent upper limits on various types of gravitational wave sources and will demonstrate that these limits are already constraining models for galaxy formation and evolution. I will then describe the dramatic gains in sensitivity that are expected from discoveries of millisecond pulsars, more sensitive instrumentation, improved detection algorithms, and international collaboration and show that detection is possible before the end of the decade.

228.05 — Current results and future prospects from PSR J1757-1854, a highly-relativistic double neutron star binary.

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