Conquering systematics in the timing of the Pulsar Triple System: Towards a unique and robust test of the strong equivalence principle

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PSR J0337+1715 is a millisecond radio pulsar in a hierarchical stellar triple system containing two white dwarfs. The pulsar orbits the inner white dwarf every 1.6 days. In turn, this inner binary system orbits the outer white dwarf every 327 days. The gravitational influence of the outer white dwarf strongly accelerates the inner binary, making this system an excellent laboratory in which to test the strong equivalence principle (SEP) of general relativity - especially because the neutron star has significant gravitational self-binding energy. This system has been intensely monitored using three radio telescopes: Arecibo, Green Bank and Westerbork. Using the more than 30000 pulse times of arrival (TOAs), we have modeled the system using direct 3-body numerical integration and performed an initial SEP violation test. I will present our efforts to quantify the effects of systematics in the TOAs and timing residuals, which can limit the precision to which we can test the SEP in this system. For example, we are applying Fourier-based techniques to the residuals in order to isolate the effects of systematics that could masquerade as an SEP violation. We are also evaluating how different aspects of the TOA production process affect the inferred systematics. Our ultimate goal is to provide an SEP test that is robust to the complications in modeling the astrophysics of the system, and which maximizes the precision we can achieve.

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