GRAVITY

Einstein still right

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Starting from Mercury's perihelion passage and the deflection of light during the solar eclipse of 1919, Einstein's general theory of relativity (GR) has been put to the test several times and has so far passed with flying colours. Anne Archibald and collaborators performed the most stringent test of GR so far using a triple stellar system, achieving an almost 1,000-fold improvement in precision over previous tests.

PSR J0337+1715 comprises a pulsar/white dwarf binary in a 1.6-day orbit and another white dwarf orbiting the binary in a 327-day orbit. By measuring the way the pulsar and the inner white dwarf accelerate under the influence of the strong gravitational pull of the outer white dwarf, the strong equivalence principle (SEP) can be tested. If GR is correct, the two bodies should experience the same acceleration. This equivalence is quantified by what is known as the strong-field Nordtvedt parameter and that is what Archibald et al. constrained with their analysis.

The authors exploited the very high precision of the arrival times of pulses from the system to calculate the orbit of the pulsar and the three-body system as a whole. While calculation of the individual gravitational acceleration for each member of the inner binary was not possible, the presented analysis put limits on the SEP violation parameter Δ. Because the self-gravity of the white dwarf is negligible compared to that of the pulsar, Δ can be defined solely in terms of the difference between the inertial and gravitational mass of the pulsar. With a value of <0.0000026, Δ is found to be very close to the GR prediction of zero.

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