Science, Technology and Mission Design for the Laser Astrometric Test of Relativity

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The Laser Astrometric Test of Relativity (LATOR) is a Michelson-Morley-type experiment designed to improve current tests of the Einstein's theory of general relativity by more than four orders of magnitude. The LATOR mission uses laser interferometry between two laser sources placed on separate small spacecraft, whose lines of sight pass close by the Sun, to measure accurately the deflection of light in the solar gravity field. The key element of the experimental design is a redundant geometry optical truss provided by a long-baseline ($\sim$100m) Michelson stellar optical interferometer. The interferometer is used to measure the angles between the two spacecraft (with accuracy of 0.1 picoradian) and for orbit determination purposes (via laser-ranging-enabled orbit determination). The three arms of the spacecraft-interferometer-spacecraft triangle are monitored with laser ranging (accurate to less than 1 cm). From these three length measurements one can calculate the value for any of the angles in this triangle. The direct interferometric angular measurement and resulting geometric redundancy enables LATOR to probe for the first time the second-order effects in the gravitational field strength. By using independent time-series of highly accurate measurements of the Shapiro time-delay and gravitational deflection of light, LATOR will test Einstein's general theory of relativity in the most intense gravitational environment available in the solar system – the close proximity to the Sun – measuring gravitational deflection of light in the solar gravity with accuracy of 1 part per billion, a factor $\sim$30,000 better than currently available (i.e. Cassini 2003 experiment). LATOR will perform series of highly-accurate tests of gravitation and cosmology in its search for cosmological remnants of scalar field in the solar system. In this talk we will discus the science, technology and mission design for the LATOR mission.