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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 Einstein's general theory of relativity by more than four orders of magnitude. The space experiment uses laser interferometry between two laser sources placed on two small spacecraft separated by 1 degree (as seen from the Earth), whose lines of sight several times pass close by the Sun, to measure accurately the deflection of light by the solar gravitational 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 that is used to measure the angle between the two spacecraft (with accuracy of 0.1 picoradian). The three arms of the light triangle formed by three space nodes are monitored with laser metrology (accurate to $\sim$1 cm). By using a combination of independent time-series of highly accurate measurements of gravitational deflection of light in the immediate proximity to the Sun, along with measurements of the Shapiro time delay on the interplanetary scales, LATOR will significantly improve our knowledge of relativistic gravity in the solar system. The experiment will measure the key post-Newtonian Eddington parameter γ with accuracy of 1 part in 10^9 and will also conduct a number of other unique measurements of the gravity effects on light propagation. This primary measurement pushes to unprecedented accuracy the search for cosmologically relevant scalar-tensor theories of gravity by looking for a remnant scalar field in today's solar system. LATOR will lead to very robust advances in the tests of fundamental physics: this mission could discover a violation or extension of general relativity and/or reveal the presence of an additional long range interaction in the physical law. In this talk we will discus the science, technology and mission design for the LATOR experiment.