Two-Step Laser Ranging for Precise Tracking of a Spacecraft

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A document proposes a two-step laser ranging technique for precise tracking of a coasting interplanetary spacecraft to determine the degree to which leakage of fuel, solar wind, and/or solar-radiation pressure causes it to deviate from a purely gravitational trajectory. Such a determination could contribute to the precision of a test of a theory of gravitation. In the technique, a proof mass would be released from the spacecraft. By use of laser ranging equipment on the spacecraft and retroreflectors attached to the proof mass, the relative position of the spacecraft and proof mass would be determined. Meanwhile, the position of the spacecraft relative to the Earth would be determined by ranging by use of a laser transponder. The vector sum of the two sets of ranging measurements would be the position of the proof mass relative to the Earth. Unlike the acceleration of the spacecraft, the acceleration of the proof mass should not include a residual component attributable to leakage of fuel. In addition, the effects of solar radiation and solar wind on the proof mass could be minimized by releasing the proof mass into the shadow of the spacecraft.

This work was done by Talso Chui and Konstantin Penanen of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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