SPACE PROPULSION SYMPOSIUM (C4)
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GRAVITY LENS MAPPING MISSION

Abstract

It is generally accepted that a gravitating body will curve spacetime. The larger and denser the gravitating body, the greater is the resultant spacetime curvature. General relativity shows photons travel along worldliness that follows the spacetime curvature. The greater the curvature of spacetime, the more is the trajectory of light bent by the gravitational field. This light bending phenomenon around a spherical object can result in light from a distant object being focused at a specific point that is governed by the radius of the gravitating body and its density. This allows an effective aperture of the size of the gravitating body, theoretically enabling incredible resolution. The signal processing is difficult, because unlike conventional lenses, the focal point is a function of radial distance and the image is transformed in coordinate space. Much work has been performed by Maccone and others.

Here, the author postulates a novel mission for a gravity lens cosmological mapping spacecraft. The first requirement is to find a nearby very dense, rapidly rotating star. This star does not need to be in the immediate vicinity of our solar system, because the topology of the mission can eliminate some of the communications barriers. Since very dense stars have a highly curved spacetime, the gravity lens point is much closer than it is with sol, whose gravity lens point is at 575 au. Additionally, neutron stars rotate rapidly. The most rapidly rotating neutron star is PSR J1748-2446ad; it rotates at 716 rotations per second. Because of the intense gravitation field, the Lense-Thirring effect can be used to assist the mission. This effect will drag (precess) the inertial frame of the mapping satellite around the equatorial region of the neutron star and will change the inertial longitude of the ascending node of the satellite. This frame dragging will allow the mapping satellite to observe the entire universe from a single location. Details of this mission will be discussed along with solutions to timing, orbits and communications.

In order for the mission to be enabled, advanced nuclear propulsion is necessary. The author will discuss how nuclear propulsion and power are essential for this mission.