Solar, Cosmic Ray and Environmental physics (SCoRE) for/with ASTROD and ASTROD I

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ASTROD (Astrodynamical Space Test of Relativity using Optical Devices) is a proposed three spacecraft, drag-free, deep-space, laser ranging mission. Two spacecraft would be placed in distinct solar orbits, between 0.77 AU and 1.32 AU from the Sun, and the third spacecraft would be placed at either L1 or L2. From the precise determination of the spacecraft orbits, the solar quadrupole moment parameter could be determined to 0.3-1 $\times$ 10^{-10}; from the difference in clockwise and counterclockwise interferometry measurements, the solar Lense-Thirring effect and hence, solar angular momentum could be measured to 1×10^{-5}. These measurements would also place strict constraints on models of solar rotation and the interior structure of the Sun. Further, the high precision of ASTROD interferometry, combined with the eccentric spacecraft orbits would result in higher sensitivity to solar g-modes than any other mission, current or proposed.

ASTROD I is a first step towards the development of ASTROD. In ASTROD I, laser light would be shone between a single drag-free spacecraft, placed in a solar orbit, between 0.5-1.04 AU from the Sun, and Earth laser stations. ASTROD I will allow an improvement in the accuracy of the determination of the solar quadrupole moment parameter to 3×10^{-9}.

In this paper we discuss the possibilities for solar, cosmic ray and space weather studies using ASTROD and ASTROD I, using both the science instruments and monitors included in the payload. Although these studies are similar to those that could be performed using LISA, the diverse orbits of these missions could provide a unique opportunity for such observations. In addition, as for LISA, the drag-free error signals from both ASTROD and ASTROD I can potentially provide information on the momentum flux on the spacecraft due to environmental disturbances. For example, the spectral density of the momentum flux of solar electromagnetic radiation (sunlight) and the solar-wind could be measured. The potential for measuring the momentum flux from other sources, such as SEP's and micro-meteorites, is also discussed.