Meteoroid impact detections by the Gaia spacecraft at L2

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Abstract

Gaia is the European Space Agency's cornerstone mission to measure the positions of a billion stars in our galaxy with unprecedented precision. In operational orbit at the second Sun-Earth Lagrange point (L2) 1.5 million km from the Earth since early 2014 Gaia has been exposed to a flux of high velocity impacts from micrometeoroids. These almost daily events are a known hazard of the space environment and Gaia is able to operate in these conditions without degradation to its primary function. When a meteoroid particle strikes Gaia it transfers enough energy to disturb the spacecraft attitude and at the same time cause local heating and deformation of the spacecraft structure. Because of the demanding requirements of the primary mission the spacecraft is equipped with extremely accurate on-board sensors for attitude and rate determination that are recording the frequent disturbances due to meteoroid impact events. This paper presents the analysis of several micrometeoroid impacts on the spacecraft sun-shield where it has been possible to determine the energy and direction of the impactor. Because of the extremely stable thermal environment at L2 it has also been possible to observe the small localised changes to the spacecraft thermal balance caused by deformation due to these events. For a subset of these impacting particles the probable parent body has been identified by correlating the direction of the impactor with the radiants of known meteoroid streams. In comparison to low Earth orbit which is contaminated with man made debris the environment at L2 is a pristine environment for meteoroid research and Gaia is providing a valuable insight into this environment.