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Micrometeoroid Detection in the Inner Planetary Region by the IKAROS-ALADDIN

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Abstract. The ALADDIN (Arrayed Large-Area Dust Detectors in INterplanetary space) made of 0.54 m^2 PVDF sensors was deployed on the anti-Sun face of the thin polyimide sail membrane of the deep space solar sail spacecraft gIKAROS (Interplanetary Kitecraft Accelerated by the Radiation Of the Sun)h. It has measured micrometeoroid flux between the Earthfs orbit and Venusf orbit (i.e., 1.0 $\sim$ 0.7 AU of heliocentric distance) for 1.5 revolutions from June 2010 until October 2011. The ALADDIN dust detector is arrayed by 8 channels of 9-20 micron-thick PVDF sensors, which are capable of detecting hypervelocity impacts of micrometeoroids at $>\sim 10^{-12}$g, according to ground calibration impact experiments. The sensors filter electronic, thermal and vibration noises and can record time, peak hold value above its threshold, and relaxation duration of each impact signal. In total, its cruising measurements counted more than 3000 dust impacts after screening noise signals. The ALADDIN flux in the 2010-2011 epoch was compared with fluxes at similar mass range of micrometeoroids and in similar heliocentric distances measured by Helios in 1970fs and Galileo in 1990fs, both of which were composed of much less number of impact data. Then, it suggested enhancement of dust flux in the trailing edge of circumsolar orbits of the Earth and Venus, which are consistent with previous reports of larger dust grain enhancements observed by infrared telescopes. This also implies that the temporal flux enhancement of large micrometeoroids in the blob may have caused a cascading effect to produce smaller dust by collisions with sporadic meteoroids. Also it is apparent that the micrometeoroid flux increases by approximately one order of magnitude from 1 AU to 0.7 AU during the 2010-2011 epoch. The temporal variance of the Helios flux data in 1976-80 in the same region of 1 AU may be associated with difference of averaged solar activities during both epochs. Since the solar activity in the years 2010-2011 was around the minimum of the solar cycle, smaller micrometeoroids, which are more affected by solar radiation pressure than larger ones, may have survived longer than those in the Helios epoch, which covered from the minimum to the maximum of the solar cycle in late 1970fs.