# In-situ Dust Flux Measurement inside 1 AU Heliocentric Distance by the IKAROS Solar Sail Spacecraft

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The world's first deep space solar sail spacecraft "IKAROS (Interplanetary Kite-craft Accelerated by the Radiation Of the Sun)" was successfully launched in May 2010 and has been continuously conducting micrometeoroid flux measurement between 1 AU and 0.7 AU of heliocentric distance since June 2010. For this purpose, the world's largest active dust detector ALADDIN (Arrayed Large-Area Dust Detectors in INterplanetary space) made of 0.54 $m^2$ PVDF sensors are deployed on the anti-Sun face of IKAROS' 200 $m^2$-sized, thin polyimide sail membrane.

The dust detector is arrayed by 8 channels of 9-20 micron-thick PVDF, which is capable of detecting hypervelocity impacts of micrometeoroids at $>\sim 10^{-12}$ g, according to ground calibration tests. The sensors filter electronic, thermal and vibration noises and can record time, peak hold value, and relaxation duration of each impact signal.

During its 6-month cruising from the Earth to the vicinity of Venus, ALADDIN measured abundant dust flux each of which separated by 0.01 AU bin and compared with fluxes measured by Helios in 1970's and Galileo in 1990's, both of which were composed of much less number of impact data at similar mass range of micrometeoroids. Then, statistically valid enhancement of dust flux in the trailing blob of the Earth's circumsolar dust ring was confirmed and this discovery is consistent with previously reported results of infrared telescopes. This suggests 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 epoch measured by IKAROS. In the same region, the Helios data in 1976-80 show significant lower flux, even admitting its large error bars. This temporal variance inside 1 AU may be associated with difference of averaged solar activities in both epochs. Since the solar activity in the latter half of the year 2010 was around its minimum, even small 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 activity in late 1970's.

Keywords: Micrometeoroids, Dust flux, In-situ measurement, Solar sail, Circumsolar dust ring, Heliocentric distance