HYPERVELOCITY MICROMETEOROID IMPACTS ON THE ARRAYED LARGE DUST DETECTORS IN INTERPLANETARY SPACE (ALADDIN) ONBOARD THE IKAROS SOLAR SAIL SPACECRAFT.

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Introduction: In May of 2010, the world's first interplanetary solar sail demonstrator called the "Interplanetary Kite-craft Accelerated by the Radiation of the Sun (IKAROS)" was launched by an H-IIA rocket. On the anti-Sun face of its 7.5-micron thick polyimide sail membrane, a large-area but still light-weight dust detector made of 8 channels of 9-20 micron-thick PVDF were attached [1, 2, 3].

ALADDIN Description: This detector is called the Arrayed Large-Area Dust Detectors in INterplanetray Space (ALADDIN) and has effective detection area of 0.54 m^2. These PDVF sensors are capable of detecting hypervelocity impacts of micrometeoroids at >~10^-12 g, according to ground calibration impact experiments. These sensors filter electronic, thermal and vibration noises and can record time, peak hold value above its threshold, and relaxation duration of each impact signal. The first objective of ALADDIN is to test this large PVDF array system on thin sail membrane in the interplanetary operation and the second objective is to measure heliocentric flux variance inside the orbit of the Earth (~1.0 AU) down to the vicinity of Venus (~0.7 AU) continuously, and opportunistic detections of possible fine dust structures (flux anisotropy) [4, 5].

In-situ Measurements in Deep Space: During the 16-month cruising between the Earth's orbit and Venus' orbit (i.e., 1.0~0.7 AU of heliocentric distance) in 1.5 revolutions from June 2010 until October 2011, ALADDIN has successfully measured about 2800 dust impacts, after screening noise signals. The impact flux was separated by a 24-hour bin, thus enabling to discuss heliocentric dependency of the flux variation around >10^-12 g mass range in the finest detail among any previous spacecraft such as Helios-1/2 in 1970's and Galileo in 1990's in similar heliocentric distances.

The ALADDIN dust flux in 2010-2011 shows continuous raising of the flux about an order of magnitude between the Earth and Venus orbits, for both inward cruising to its perihelion and outward cruising to its aphelion; it is also generally consistent with flux trends of Helios in 1970's and Galileo in 1990's although temporal and spatial resolutions of the IKAROS results are much finer than these previous spacecraft. It is evident that some fine structures in different locations and epochal variations at the similar heliocentric distance but different orbital position, which may imply the infrared dust enhancement in the trailing edge of the Earth, unknown cometary dust trails, and a possible flux enhancement near Venus.

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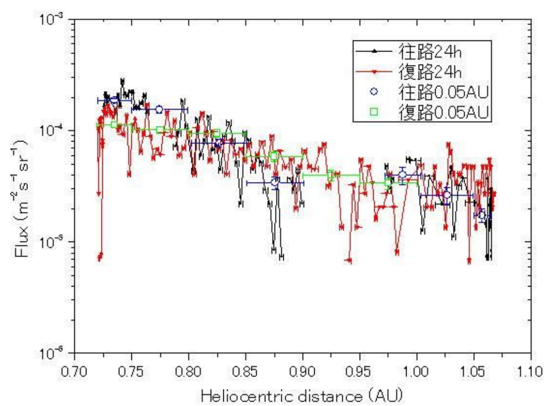

Fig.1 24-hour bin of impact flux on ALADDIN for inbound and outbound cruising periods.

Table 1: Meteoroid Fluence to 20-micron PVDF Sensors of ALADDIN

	inbound	outbound
Period	2010.06.30~12.03	2010.12.15~2011.05.31
Heliocentric Distance	1.07~0.72 AU (0.97~0.90 missing)	0.72~1.08 AU
Impact Signals	969	1260