Results of Mars Dust Counter (MDC) on Board NOZOMI in the Earth-Mars Region

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The Mars Dust Counter (MDC) is an impact ionization dust-detector which is designed to detect micrometeoroides with mass between 10-7 and 10-15 g. Although its weight is as small as 730g, MDC can determine mass, velocity, and direction of a dust particle using change of impact-induced charge. MDC was launched in July 1998 on the Japanese satellite NOZOMI. The main aim of MDC is to detect dust particles around Mars and clarify the distribution of the predicted Martian ring or torus of dust particles from Phobos and Deimos. Due to propulsion problems during the earth fly-by, ISAS revised the NOZOMI orbital plan that leads to a prolonged transfer phase until Mars insertion in December 2003.

NOZOMI is a spin-stabilized satellite with high gain antenna on its top. Its spin axis is pointing to the Earth to keep high telemetry rate basically during the interplanetary cruising phase. The sensor aperture axis is 135 degrees from the spin axis of NOZOMI. The field of view of MDC aperture is close to 180 degree on the plane parallel to the side panel of NOZOMI, and 135 degree on the plane vertical to the side panel of NOZOMI. Since the solar direction angle (Sun - NOZOMI - Earth) is always less than 45 degree, the MDC sensor box can thus avoid direct sunlight which would increase noise signals due to photoelectrons.

Between 1998 and 2001, MDC has detected about 90 impacts of dust particles. MDC has detected more than 20 impact signals during this circumterrestrial phase. In November 1998, NOZOMI encountered the Leonids meteoroid stream. MDC detected two dust impacts, but directional analysis showed that those particles probably did not belong to the Leonids stream particles.

In the interplanetary observation from the beginning of 1999, NOZOMI takes an elliptic orbit whose perihelion and aphelion are at the Earth's orbit (1.0AU) and at the Mars' orbit (1.5AU), respectively. From March 10, 1999, the spin axis of NOZOMI has been pointing to the Earth on the ecliptic plane. MDC has detected about 70 interplanetary particles moving around the sun. Judging from high velocity and direction, several particles are of interstellar origin. High velocity particles (higher than 40km/s) are detected only during the cruising phase. In 2000-2001 season, MDC detected similar number of dust particles but fewer high velocity particles than 1999 season. The difference between 1999 data and 2000-2001 data could be ascribed to the change of dust detection efficiency according to NOZOMI direction.

In future, after two flybys with the Earth in December 2002 and June 2003, NOZOMI will enter circummartian orbits at the beginning of 2004. During this extended cruising interplanetary phase as long as five years, MDC can continuously observe interplanetary dust. During the Mars observation phase from 2004, MDC will detect predicted dust rings around Mars originated from Phobos and Deimos. Structure and seasonal variation of dust ring/torus will be compared with theoreteical predictions. Dust abundance would be related to the surface regolith properties of the satellites. Satellite-derived dust particles, which would have fallen, would be detected on the surface of Mars. Probable collaborations with Mars Express mission are discussed.

Followings are group members and collaborators on MDC project:
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