SUMMARY OF OBSERVATION OF INTERPLANETARY AND INTERSTELLAR DUST BY MARS DUST COUNTER ON BOARD NOZOMI. S. Sasaki[1], E. Igenbergs[2], H. Ohashi[3], R. Münzenmayer[2$], W. Naumann[2#], R. Senger[2], F. Fischer[4], A. Fujiwara[5], E. Grün[6], K. Nogami[7], I. Mann[8], H. Svedhem[9], [1] Mizusawa Astrogeodynamic Observatory, National Astronomical Observatory of Japan, 2-12 Hoshigaoka, Mizusawa, 023-0861, Japan (sho@miz.nao.ac.jp), [2] LRT, TU-München, 85748 Garching, Germany, [3] Tokyo University of Marine Science and Technology, Tokyo 108-0075, Japan, [4] RTSG, TU-München, 80333 München, Germany, [5] ISAS/JAXA, Sagamihara, 229-8510, Japan, [6] MPI-Kernphysik, 69117 Heidelberg, Germany, [7] Dokkyo University School of Medicine, Tochigi 312-0207, Japan, [8] Institut für Planetologie, Westfälische Wilhelms-Univ., 48149 Münster, Germany, [9] ESA-ESTEC, PO Box 299, 2200 AG Noordwijk, The Netherlands, [$] Now at Astrium Space, Postfach 1420, 88039 Friedrichshafen, Germany, [#] Now at Kayser-Threde GmbH, 81379 München, Germany.

Introduction:

Mars Dust Counter (MDC) is a dust detector of impact ionization type on board Japanese Mars mission NOZOMI. Although its weight is only 730g, MDC can determine mass, velocity, and direction of a dust particle using rise time of impact-induced charge signals [1]. The main objective of MDC is to discover the predicted martian dust ring or torus [2]. Dust abundance detectable by NOZOMI-MDC was predicted under the self-sustaining mechanism, where satellite-dust collisions are the main dust source [3].

Due to a problem at the powered fly-by with the Earth on December 1998, NOZOMI orbital plan was changed. From December 1998 to December 2002, NOZOMI takes an eccentric orbit whose perihelion and aphelion are at the Earth's orbit and at the Mars' orbit, respectively. Then, after two flybys with the Earth in December 2002 and June 2003, NOZOMI approached Mars in December 2003. NOZOMI would have observed circummartian environment by highly elliptic orbits around Mars from 2004. However, NOZOMI did not recover from electronic trouble which occurred in April 2002. Insertion into circummartian orbit was finally given up in December 2003. MDC continued observation of interplanetary (and interstellar) dust by April 2002. Here we summarize dust observation of MDC.

Dust detection:

After the launch on 4th, NOZOMI took eccentric parking orbits around the Earth for five months performing two fly-bys with the moon. MDC has detected more than 20 impact during the circumterrestiral orbit. During encounter with Leonids meteor stream, MDC detected a couple of high-velocity dust particles but their direction differed from meteor stream dust. From 1999, NOZOMI entered the cruising phase. Particles with impact velocities smaller than 4km/s have not been detected in the cruising phase. On the contrary, high velocity particles (v>40km/s) are detected only during the cruising phase, especially in 1999.

Impact data in the cruising phase are shown in Figs. 1 nd 2. Impact events in 1999 are shown in Figs. 1. Most of dust particles are Keplerian dust particles moving around the sun. There are several high velocity particles which are apparently different from such Keplerian particles, although there is direction ambiguity of ±several tens degree because of the large aperture of MDC sensor. In Fig. 1 (b), direction of two dust particles (**b**, **e**) corresponds to that of typical interstellar particles, which should correspond to the direction of the solar system moving against the surrounding interstellar gas cloud with a relative velocity 26km/s [4]. Particle **a** has a large vertical component. Other high-velocity particles **c**, **d** would have different origin but the component with this direction has not been reported in the interstellar dust source [5].

In 2000-2001 season, MDC detected similar number of dust particles but fewer high velocity particles (Fig. 2(a)) compared with those in 1999. Figure 2(b) shows that there is only one candidate **f** of interstellar dust. Most of particles are typical interplanetary dust particles moving around the sun. The difference between 1999 data and 2000-2001 data does not necessarily mean the change of interstellar dust flow. It could be rather explained by the change of dust detection efficiency according to NOZOMI spin axis direction.

In summary, MDC detected more than 100 dust particles in space. Not only Keplerian dust particles but also interstellar dust particle candidates were detected by MDC.

References: [1] Igenbergs, E., Sasaki, S., et al., *Earth Planets Space* **50**, 241-245, 1998. [2] Sasaki, S., *Adv. in Space Res.* **23**, 1907-1910, 1999. [3] Sasaki, S., *In Physics, Chemistry, and Dynamics of Interplanetary Dust*, ASP Conf. Ser. **104**, 187-190, 1996. [4] Grün, E.,et al., *Astron. Astrophys.* **286**, 915-924, 1994. [5] Taylor, A. et al., *Nature* **380**, 323-325, 1996.

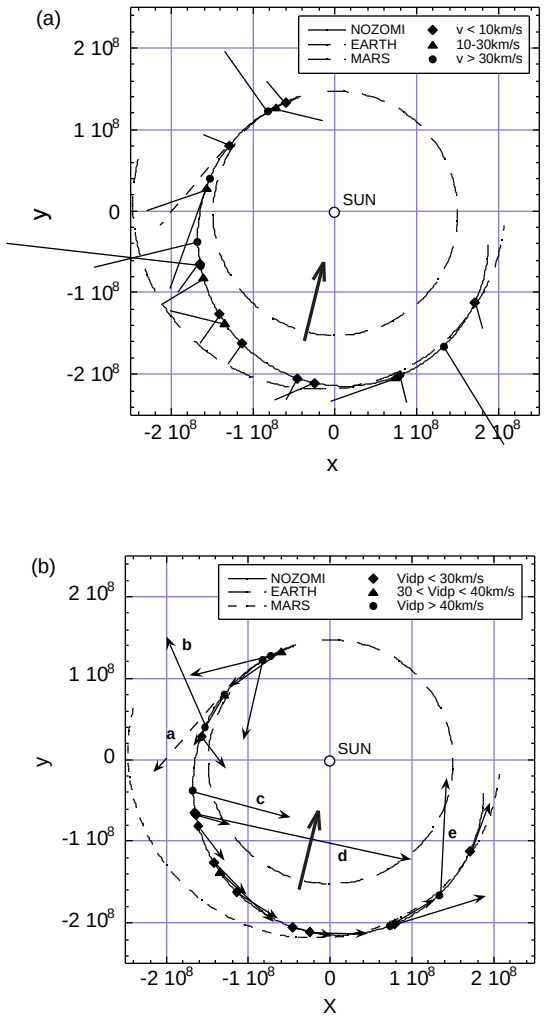

Fig. 1 Dust particle impacts detected by MDC in 1999. Orbits of NOZOMI, the Earth, and Mars are shown in the ecliptic plane. The +x direction is the direction of the Sun at vernal equinox. An arrow toward the sun denotes the direction of interstellar gas flow into the solar system. (a) Direction of MDC sensor aperture and impact velocity (i.e. relative velocity between NOZOMI and a dust particle). For each impact, direction is expressed by a line from the impact mark. The length of each line corresponds to velocity of the impacted particle. One event with a broken line denotes a fast impact with a large vertical velocity component. (b) Velocity of dust in the interplanetary space calculated from impact velocity and orbital velocity. Dust particles with high velocity (>40km/s) are denoted by attached characters (**a**, **b**, **c**, **d**, **e**).

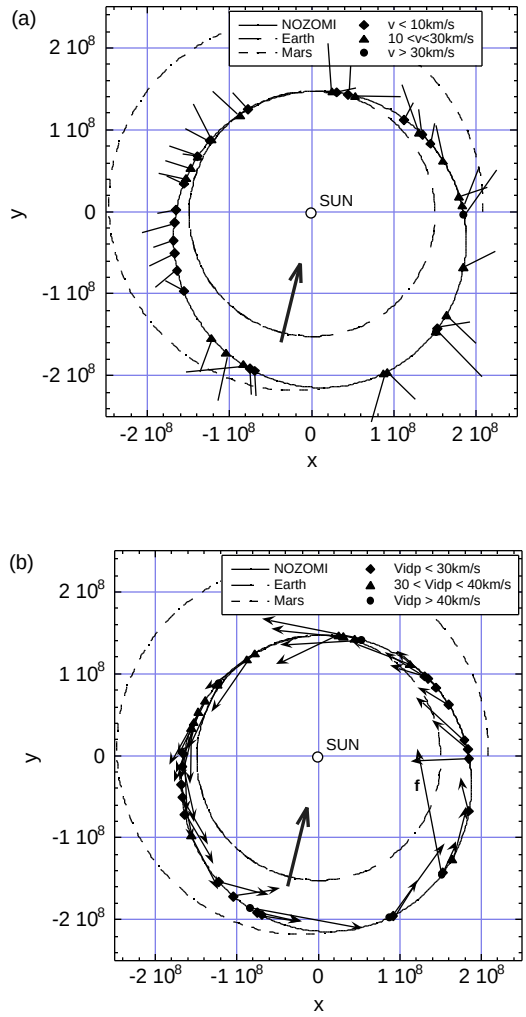

Fig. 2 Dust particle impacts detected by MDC in 2000 and 2001. Legends and figure formats are the same as Fig.2. (a) Direction of MDC sensor aperture and impact velocity. (b) Velocity of dust in the interplanetary space calculated from impact velocity and orbital velocity. A dust particle with high velocity is denoted by attached characters (**f**).