Observation plan for Martian meteors by Mars-orbiting MMX spacecraft

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Introduction

In 2015, the "Martian Moons Explorer (MMX)" mission plan is selected as the next Japanese middle scale space mission by JAXA. Targets of the spacecraft are focused on Martian moons (Phobos and Deimos). The main mission is sample-return of surface materials on one of the Martian moons like Hayabusa and Hayabusa-2, however, when staying on the Mars-orbiting stage on the exploration, the spacecraft would have enough time to take many images from the orbit not only to the targeting Martian moons but also Martian surface. If we have a high-sensitivity camera aboard the MMX spacecraft, the first statistical study on the Martian meteors might be realized.

MMX mission

The MMX mission has been discussed by special team and working groups in Japan deeply collaborating with the society of planetary science in Japan as well as in JAXA HQ. At a timing of the Announcement of Opportunity (AO) calling for the next middle scale space mission in 2015, the MMX mission plan was selected and announced to the public in June 2015. After the selection, many kinds of discussions for science targets as well as onboard instruments with specifications were rapidly and deeply discussed by many teams including foreign scientists. The AO for MMX onboard instruments and suites was held in February 2016, and currently in the selection process as of March 1. The exploration orbit plan for the MMX spacecraft surely includes Mars-orbiting phase for a while for ensuring the multiple encounters for Phobos and Deimos. The period of parking on the Mars-orbiting is currently discussed by the mission design team in JAXA, however, it will be fixed for a year or more, thus the period could be a significant opportunity for making special observation not only for the Martian moons but also for Mars itself. For the meteor/meteoroids study, if we could focus on the dark side of Mars, the first statistical study on the Martian meteors might be realized during the Martian stay of the MMX spacecraft. The significant aspect is if the sample-return from the Marsorbiting mission were realized, high-quality datasets including GB or TB scale movies could be obtained with the memory cards within the capsule instead of the extremely limited narrow-band space data link from the MMX to the Earth.

Meteors at Mars orbit

Meteors at Mars orbit has been studied theoretically by

using an empirical function between the dust particle density and the distance from the Sun. However, such dataset is extremely limited for the outer space in spite of the Earth orbit. In 1997, for discussing an opportunity for European Martian explorer, a Martian meteor camera was designed [1]. Since the basic parameters are not significantly changed for Martian meteor environment, the case study could be imported into the MMX scientific consideration. The observation plan defined if we can put a high-sensitivity camera with capturing +4.5 magnitude or darker meteors, 1 meteor per 30 minutes can averagely be realized if the FOV of 40 degrees is appropriately selected for the dark side of Mars seen from about the Phobos orbit. As for the meteor shower prediction, several works have been carried out for encountering simulation between known periodic comets and Mars. For example, during 2021 for MMX arrival, the following Martian meteor shower is predicted by numerical calculations [2]. - May 5: 49P Arend-Rigaux - Feb. 9:13P Olbers - Jul. 30: 81P_Wild2 - Aug. 9: 144P Kushida - Aug. 14: C_1854L1_Klinkerfues -Oct. 29: 2007H2

- Nov. 10: Pi-Puppids - Dec. 23: 9P Tempel1

If we can operate high-sensitivity camera in the meteor shower periods as well as not in the shower periods for comparison, existence of the Martian meteor showers can be statistically proven. Light curve and spectrum study might be interested but it depends on the instruments equipped with the MMX.

Summary

The next Japanese Mars explorer MMX is introduced with discussing about the possibility of observing Martian meteors for monitoring the dark side of Mars from the Mars-orbiting spacecraft at the altitude of several thousands of km from the Martian surface. If we can install a high-sensitivity camera on the MMX spacecraft and operating it for a long time during the Mars-orbiting phase, the statistical study on the Martian meteor and meteor showers could be realized. Though it is still in the discussing phase for the engineering model of the instrumentations for the MMX, the discussion on this Meteoroids 2016 conference will be significant for the feedback from the international meteor/meteoroids society to the MMX mission.

References

[1] Koschny, D., et al., MIOS-Meteor and Impact Observations from Space on Mars, A proposal for the ESA Mars Express mission orbiter payload, 1998.

[2] Vauvaillon, J., private comm.