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Life-Detection Microscope (LDM) onboard 2020 Mars Mission MELOS

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Life-Detection Microscope (LDM) is the primary science payload onboard the MELOS rover which we propose to launch in 2020. LDM is designed to achieve a sensitivity (10^4 cells per gram soil) which is two orders of magnitude better than the Viking Lander experiments. The strategy to achieve this high sensitivity includes: 1) cells, if exist, are dyed with SYTO24, PI, and CDMA pigments; 2) the fluorescence from dyed cells (excited with blue light at 488 nm) is imaged with 1 um/pixel resolution; 3) the field of view in one image is 1 mm^2; and 4) 2 mm^3 volume of Martian soil is scanned.

LDM consists of 3 components: Sample-Handling System (SHS), Fluorescence Microscope (FluM), and Driver and Data Processor (DDP). To receive soil sample from the robotic arm of the rover, one ”empty” sample container is selected and is moved to the sample inlet position (X and Y movements in SHS). After receiving the soil sample, the dye is injected and then the container lid is closed so that the rapid evapolation of the solvent under the atmospheric pressure (6 hPa) of Mars is avoided. A set of regolith and dust images in white light are acquired before ”fluorescence” mode is started. In ”fluorescence” mode, a set of images with different focal depths (0 to 0.1 mm) are acquired at each of 20 (X, Y) positions, achieving scan of desired volume (2 mm^3) of soil sample. The images are examined for suspicious objects and small sections of images which include such objects, if any, are stored in the rover’s data recorder for later downlink to the earth.

We will report progress in development of LDM and will discuss the operation strategy of LDM in the mission period on Mars.

Keywords: Mars, Life, Microscope, Fluorescence, Soil, Rover