MICROGRAVITY SCIENCES AND PROCESSES (A2)
Microgravity Experiments from Sub-orbital to Orbital Platforms (3)

Author: Mr. Tim Jankowski
University of Duisburg-Essen, Germany

Mrs. Caroline de Beule
University of Duisburg-Essen, Germany
Mr. Thorben Kelling
University of Duisburg-Essen, Germany
Prof. Gerhard Wurm
Other, Germany
Dr. Jens Teiser
Other, Germany
Mr. Matthias Lischper
University of Münster and University of Twente, Germany
Mr. Markus Tegeder
Universität Münster, Germany

MICRO-GRAVITY EXPERIMENTS OF TEMPERATURE GRADIENT INDUCED DUST EJECTIONS FROM PLANETARY SURFACES ONBOARD A PARABOLIC FLIGHT

Abstract

In a low-pressure gaseous environment (mbar) the illumination of dust beds leads to particle ejections from the surface into the surroundings. The incident light results in temperature gradients within the dust bed with a maximum temperature slightly below the surface, which then induce thermal creep forces (photophoresis, Knudsen compressor effects) which act on the upper dust layers. If the induced forces overcome gravity and the tensile surface strength, particles are eruptively released. The ejections support the transportation of dust particles into the Martian atmosphere by triggering dust storms or dust devils. Particle ejections are also part of the very complex process of planet formation by disassembling bodies and reintroducing small dust in the formation cycle. Dusty bodies can lose up to several kg/s (100 m parent body) by these temperature gradient induced ejections. While gravity is very dominant on Earth, Mars has a reduced and km sized bodies in protoplanetary disks have even vanishing gravity. In addition to detailed laboratory experiments (1g) the gravitational dependency of the particle ejections were determined in a parabolic flight campaign (ESA "Fly your thesis!" 2009 campaign) with the JSC Mars 1A soil simulant (0g, 1g and 2g). Earlier microgravity experiments showed, that the threshold for particle ejections depends linear on gravity. Our microgravity experiments showed that the rate of the released particles depends exponential on gravity. Further parabolic flight experiments with different dust samples and dust grain sizes proofed the strong exponential gravity dependence. In addition experiments under Martian (0.4g) and Moon like (0.16g) gravity in July this year will complement the measurements. The results demonstrate that the effect of light-induced dust ejections is much more significant than previously thought. We present first comprehensive results of our experiments.