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Grains on Mars in motion: wind, charge, and light

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Abstract

In laboratory experiments on ground and in parabolic flights, we studied different aspects of particles interacting with a low-pressure atmosphere. Wind tunnel experiments under Martian gravity reveal a rather low threshold for saltation. Gas flow by light induced thermal creep allows higher mass rates for dust entrainment in dust devils and discharge between individual grains strongly limits the capabilities of charging grains.

1. Moving grains on Mars

The work presented in this contribution will describe recent work on 3 different phenomena which are connected by the fact that the ambient pressure on the Martian surface is only a few mbar. All 3 are important to initiate particle motion, to support particle lift, or to inject charged grains into the atmosphere.

1.1. Wind

Wind is still a major driver of dust and grains on Mars in spite of the low pressure. Just how much wind is really necessary to lift grains has been and is a matter of debate. We started to study erosion under Martian gravity and at Martian pressure on parabolic flights in a low-pressure centrifuge wind tunnel. Thresholds for shear stress and erosion rates have been determined [1]. The status of this research will be reported.

1.2. Thermal Creep

At low pressure gas flows through pores of a dust bed from a cold to a warm side (thermal creep) [2]. In nature this only occurs on Mars not on Earth. Within the insolated Martian soil, light sets a temperature gradient which supports particle lift by thermal creep [3]. Shadowing can increase the capability of this mechanism to lift dust [4]. We carried out new experiments, supporting this, which will be presented.

1.3. Tribocharging

During saltation, many collisions between particles occur. Tribocharging of these grains is almost inevitable. However, the low Martian pressure makes discharges easier. This is not only true for large scale discharges. We recently showed that this already limits the maximum charge grains can acquire in collisions [5]. We will also show these studies, which might be important for grain lifting and atmospheric charge balance.

Acknowledgements

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