Experimental setup for the study of the effects of vibrations on multiphase systems in suborbital flights

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Summary
We present an experimental setup for the study of the effects of controlled harmonic vibrations applied to multiphase systems in microgravity. This setup was recently launched on-board an ESA/DLR/SNSB Mini-Texus rocket with the aim of obtaining data for the study of vibrations on two-phase flows with different liquids. We present preliminary results on the behaviour of bubbles under high acceleration variations.

The experimental setup is ready to fly using the same test cell or a new one with different contents. We propose a new experiment consisting of the study of the interaction of granular media with different fluids under harmonic vibrations in microgravity.

Introduction
The study of the effects of controlled vibrations in mutiphase systems in microgravity has generated increasing attention in recent years. The inelastic collisions of particles in a dilute "gas" excited by vibrations was studied in Falcon *et al.* 2006. Studies on the average motion of fluids near their gas liquid critical point under harmonic vibrations in microgravity were carried out in Beysens *et al.* 2007. On a different scale, vibrations in microgravity can play an important role in surface evolution processes in low gravity bodies (see presentations in the 2010 Next-Generation Suborbital Research Conference).

Suborbital flights are the most appropriate microgravity platforms for the study of many vibrational phenomena. On the one hand, the duration of the low gravity phase makes it more possible to observe both the transient and the steady states. On the other hand, the good level of microgravity in suborbital flights fits perfectly with experiments with induced vibrations since they require avoidance of external noise (g-jitter).

Experimental setup
Shown in Fig.1 is a picture of the experimental setup which flew on-board a Mini-Texus rocket. The design was conceived to have the lowest possible cost, weight, volume and power consumption. Different amplitude, frequency and duration of the vibrations can be programmed. A test cell, high-speed camera, an array of LEDs and a mirror are placed on the upper floor. A shaker connected to the test cell and the electronics are located on the lower floor.

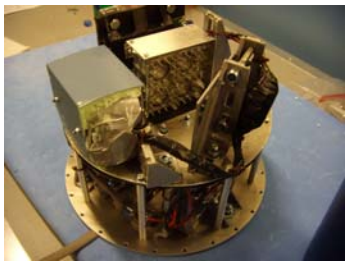
Figure 1: Experimental setup

Two-phase fluids
The experimental setup was designed to study the dynamics of bubbles in different liquids in three cases: bubbles with and without harmonic vibrations during the microgravity phase, and bubbles under high acceleration oscillations during the reentry phase of the rocket. Shown in Fig 2 is an image of the bubbles in microgravity when no vibrations were applied.


Figure 2: Bubbles without applied vibrations in microgravity.

Proposed experiment
We propose to use the present experimental setup for the study of granular media under controlled vibrations. Our aim is to analyze the interaction of a granular medium with different fluids at different vibration frequencies, which would provide new insight for space applications.

References
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