

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

S. Arias, F. Suñol, R. González-Cinca  
(Universitat Politècnica de Catalunya, Castelldefels (Barcelona), Spain)

## Summary

We present an experimental setup for the study of the effects of controlled harmonic vibrations applied on multiphase systems in microgravity. This setup was recently launched onboard an ESA/DLR/SNSB Mini-Texus rocket with the aim to obtain 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 multiphase systems in microgravity has generated increasing attention in the 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. In a different scale, vibrations in microgravity can play an important role in the 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 to avoid external noise (g-jitter).

## Experimental setup

It is shown in Fig.1 a picture of the experimental setup which flew onboard 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. Test cell, high-speed camera, an array of LED and a mirror are placed at the upper floor. A shaker connected to the test cell and the electronics are located in the lower floor.

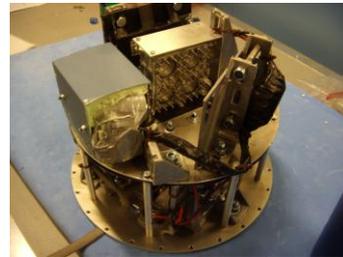


Figure 1: Experimental setup

## 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. It is shown in Fig 2 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 media with different fluids at different vibration frequencies.

## References

- Falcon, E., Aumaître, S.,Evesque, P.,Palencia, F., Lecoutre-Chabot, C., Fauve, S., Beysens, D., and Garrabos, Y. 2006. Collision statistics in a dilute granular gas fluidized by vibrations in low gravity, *Europhys. Lett.* 74 (5), 830-836.
- Beysens, D., Chatain, D.,Garrabos, Y., Lecoutre, C., Palencia, F.,Évesque, P., and Nikolayev, V. 2007. The effects of vibrations on heterogeneous fluids: Some studies in weightlessness, *Acta Astronautica* 61 1002-1009.