EPFL NEWS

EPFL Researchers in microgravity with their bubbles

A team of researchers from EPFL, Oxford University and Max-Planck Institute participated last week to the 53rd European Space Agency (ESA) Parabolic Flight Campaign. They chased the effects of gravitational forces on the very last stages of the collapse of a short-lived vapor bubble in a liquid, a phenomenon still poorly understood and responsible for severe erosion in a variety of industrial. The experiment was developed at EPFL Laboratory for Hydraulic Machines with the support of the EPFL Space Center and the Swiss National Science Foundation.

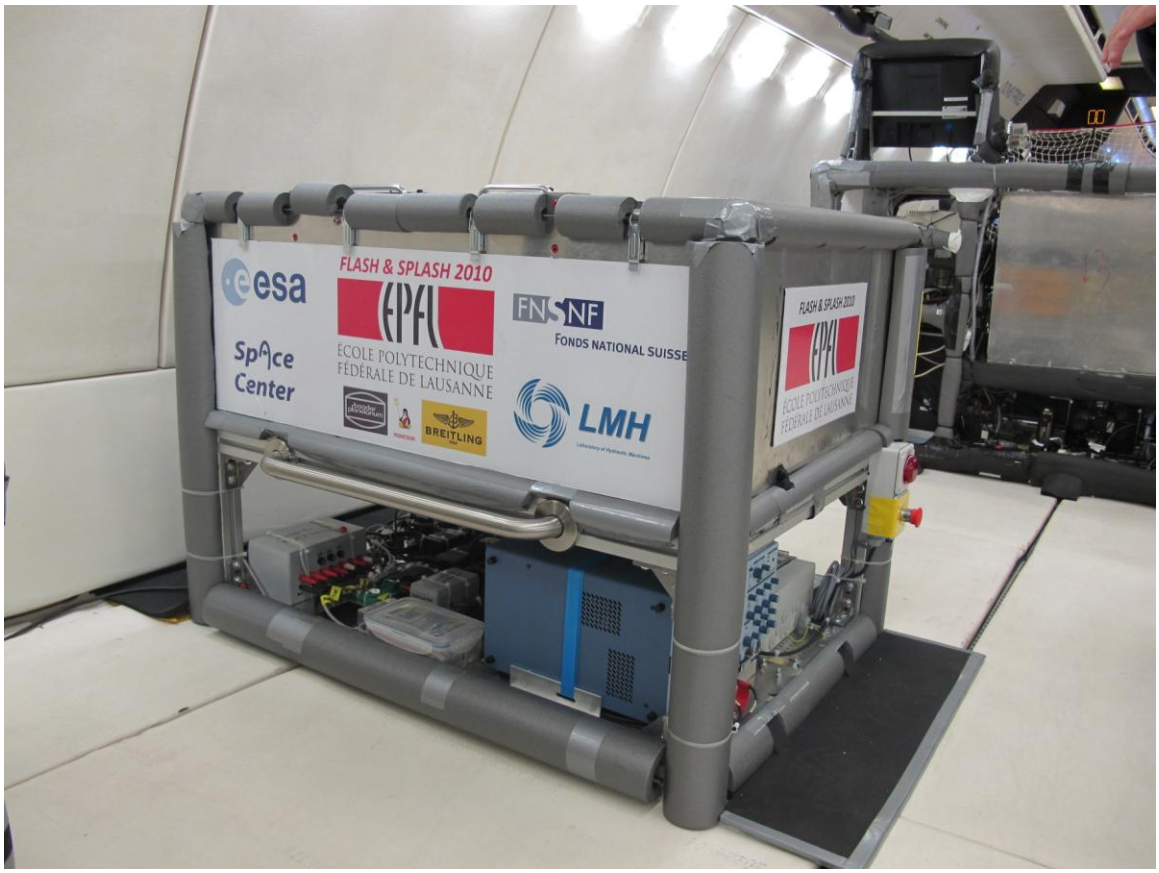
Twice per year the European Space Agency organizes microgravity research campaign onboard the 'Airbus A300 ZERO-G', a specially-equipped aircraft that reproduces weightlessness conditions by flying a sequence of free-fall parabolic maneuvers. Around ten different experiments may be run at the same time.

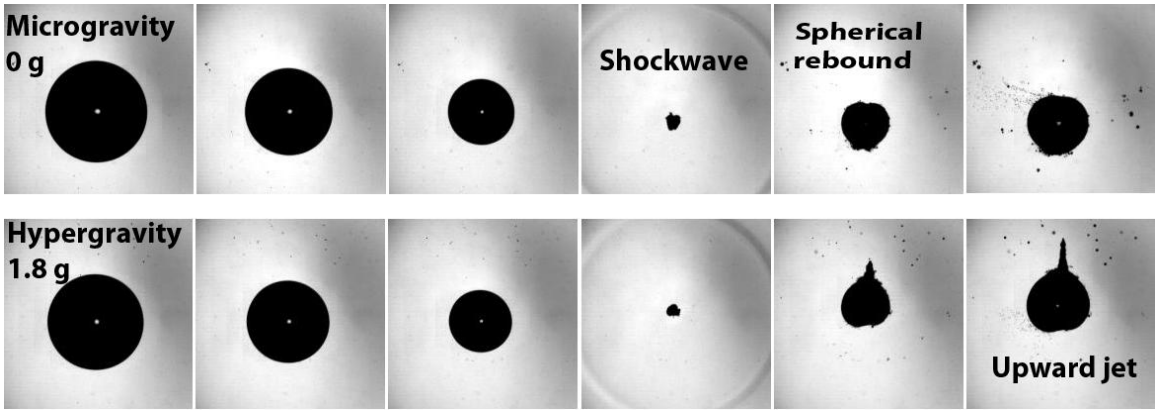
Following their successful participation at two ESA parabolic flight campaigns in 2005 and 2006, the team flew once more with a novel experiment, to investigate the effects of gravity on the growth and collapse of cavitation bubbles. The occurrence of such cavities is a common phenomenon in hydraulic machinery. The cavitation erosion is known to be due to liquid jets and shockwaves emitted at the last stage of a bubble collapse. The magnitude of these processes depends on the sphericity of the collapsing bubble, which is dictated by the geometry of surrounding boundaries. The gravity vector itself also contributes to such a symmetry breaking; however, its role in the collapse of cavitation bubbles has been ignored so far.

To assess the influence of gravity, a specific experiment was designed and assembled at LMH to generate the most spherical cavitation bubble ever created, so that gravity is by far the major perturbation on its collapse. A special focus was put in minimizing all sources of asymmetry by using a parabolic mirror to focus the energy of a high-power pulsed laser into a small plasma point within a large water volume. They clearly observed gravity-induced geometrical perturbations on the very end of the bubble lifetime, and directly visualized the emission of shock waves and luminescence following the collapse. Unprecedented data were collected during a total of 96 parabolas. These data are now analyzed and will be published soon.

It should be noticed that the present project was initiated in 2005 at LMH laboratory by the "Flash and Splash" team, made of 4 talented EPFL students (D. Obreschkow, Ph. Kobel, N. Dorzas and A. Debosset), led by Dr. Farhat, who investigated the dynamic of a cavitation bubble within a water drop in the frame of ESA Student Parabolic Flight Campaign. The project gained such a momentum that five years after, the team reinforced by a new PhD student (M. Tinguely), is willing to pursue this exciting adventure with more investigations on bubble dynamics under microgravity. It is also expected to involve more students and laboratories in the project.

Check out the team's website for more information: www.flashandsplash.ch


FLASH & SPLASH 2010
esa
Space Center
EPFL
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
FNSNF
FONDS NATIONAL SUISSE
BREITLING
LMH


Microgravity
0 g
Shockwave
Spherical rebound
Hypergravity
1.8 g
Upward jet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NOVESPACE
A300 ZERO-G
LabVIEW
LMH


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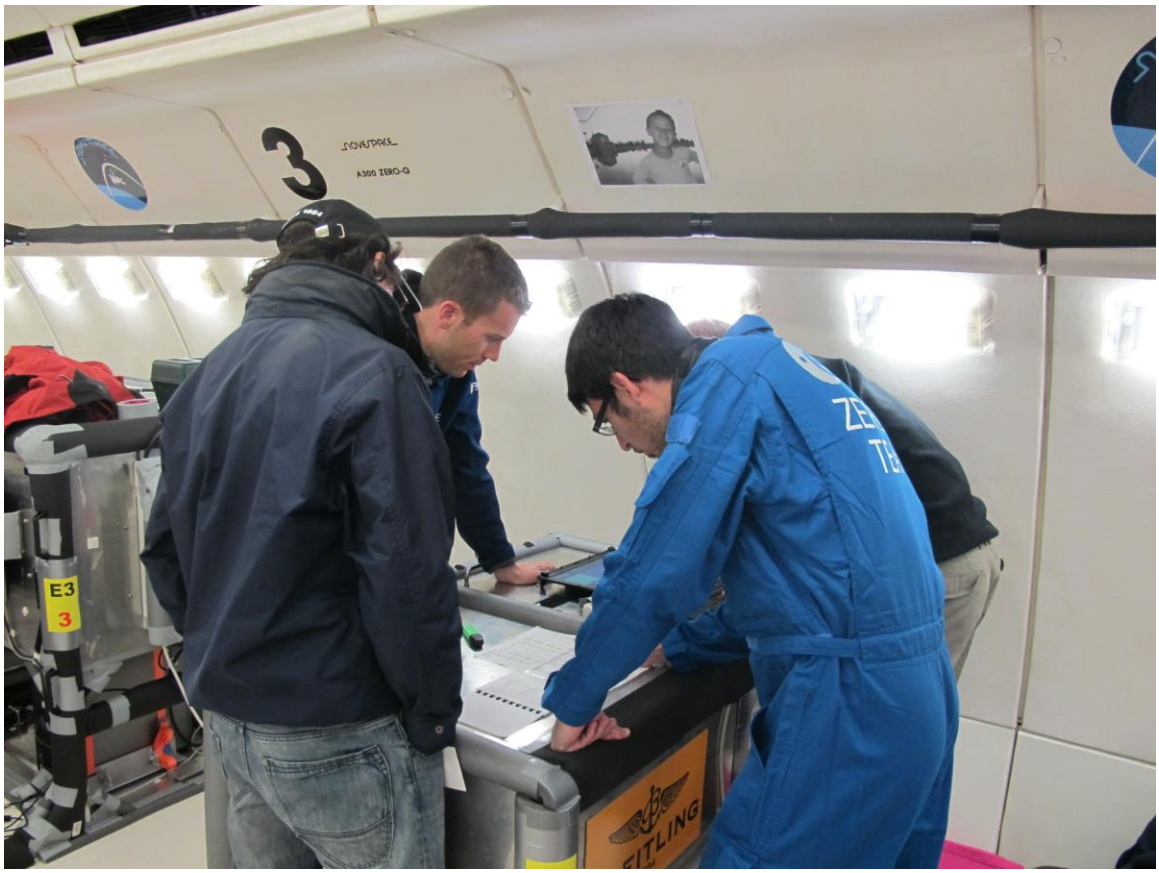
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