



REXUS Campaign 2013– 2014

CAESAR Team - hepia - HES//SO



L'avenir est à créer

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et d'architecture de Genève



Propellant management in microgravity

- Context
- Possible solutions
 - Diaphragms
 - Passive PMDs
- Passive devices (PMDs)
 - Traps, Vanes or Gutters, Troughs, Sponges, Phase filters, Galleries
- Test facilities
- HES // SO @ REXUS



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Context

- In every industrial process where liquids **stockage** is necessary, there is the need to **locate its position** in order to assure its correct **aspiration**



- Gravitationa environments: The liquid moves towards the « Bottom ».



- Weightless environments: Difficulties in defining a « Bottom ».



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Context

- **The incapability to locate a liquid in a tank brings to problems in its extraction.**



- The incapability in expelling the propellant brings to the failure of the system ...



- ... with consequences that can sometimes be regrettable.



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Context

The management of liquids in **weightlessness** is therefore an important and complex task which main industrial application is the flow control within the liquid propellant systems in the **Spacecraft** tanks



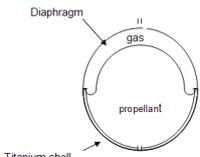

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Possible solutions



Diaphragm

gas

propellant

Titanium shell

- Two main solutions are usually foreseen:
- Diaphragms,
- Passive PMDs (Propellant Management Devices) using the capillarity as driving force.



- Diaphragms: the simplest choice.
- PMDs: Necessary in case :
 - Long time compliance with aggressive liquids (NTO)
 - High reliability (no moving parts or devices)



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Passive devices (PMDs)



- Several kinds of PMDs exist
 - Communication devices (*establish a communication between the bulk propellant and the aspiration port*)
 - Vanes or gutters
 - Galleries
 - ...
 - Control devices (*Hold the propellant in proximity of the desired location*)
 - Sponges
 - Traps
 - ...
 - Phase filters



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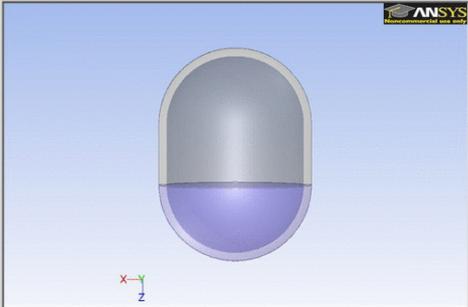
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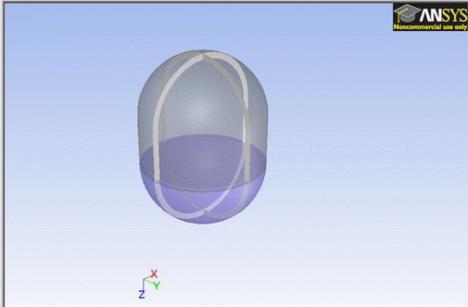

Passive devices (PMDs)

Vanes, or Gutters

- Open communication devices
- Moving the liquid towards the aspiration port
- Working under limited accelerations



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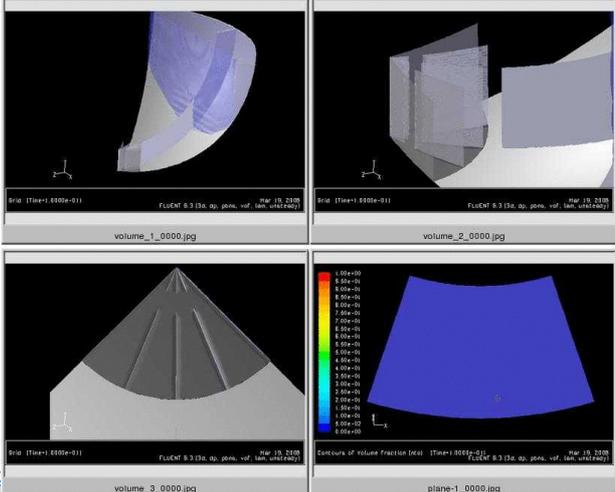
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Passive devices (PMDs)

Sponge Refilling



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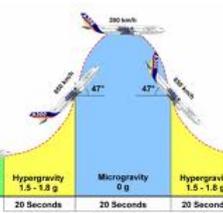
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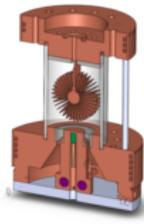
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Test facilities

	time	mg level
Drop Towers:	3 to 10 sec	10^{-4} to 10^{-8} g
Parabolic flights	15 to 60 sec	10^{-2} to 10^{-3} g
Sounding rockets (REXUS)	5 to 15 min	10^{-2} to 10^{-4} g
Buoyancy tests	-	-
Only steady-state investigations, analyses strongly depending on temperature and cleanliness		
Magnetic levitation	-	-
Very limited volume (30 [mm] test chamber) and usable materials		

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Caesar Team (Rexus 2013– 2014)

- A team of Master students from the Swiss University of Applied Sciences was selected to fly on REXUS 13.14

Along their Master Thesis they will:

- Design systems and subsystems of an experiment flying on REXUS
- Collect information on the **sponges** behavior
- Fly the experiment from ESRANGE (ESA launch platform) on march 2013
- Compare it with other available data:
 - Theretical
 - Numerical
 - Experimental (buoyancy)



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- Further information can be found on:
 - **The website** <http://www.caesar-rexus.ch>
 - **FaceBook** <http://www.facebook.com/CAESAR.REXUS.13.14>
 - At e-mail address info@caesar-rexus.ch



Want to join in?



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