

# ***Pressure Retaining Deep-sea Sampler***

*... from idea to realization ...*

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*presenting member of the HPS-project team*



**Royal Netherlands Institute for Sea Research**



## *From WHOI to NIOZ...*





## *Royal NIOZ at a glance:*

- At the island Texel
- Working area: North/Mid Atlantic, North sea, Mediterranean
- Staff: 240 persons
- Founded in 1876



**Research vessel: Pelagia**





## ***High Pressure Sampler***

- **Scientific Question: what is the real contribution of deep-sea bacteria in the Carbon Cycle?**
- **Practical Problem: when using decompressed deep-sea water samples bacterial respiration and production are affected by this decompression**
- **Technical Question: how can we recover pressure retaining samples from the deep-sea?**
- **Involved scientist: Prof Dr Gerhard Herndl**



## ***1<sup>st</sup> Specification***

- **Small biological inert bottles**
- **Several volumes: 50, 200 and 500 ml**
- **Max. pressure loss = 5%**
- **Onboard radioactive tracer addition**
- **Appr. 12 bottles/depth, 4/6 depths/cast, 4 sets**  
**==> 288 bottles**
- **Water depth down to 6.000 m**



# Analysis of the known systems:

<p><b>Double floating piston system</b> Seewald, Woods Hole, 2001</p> <p>* = activator</p>	<p><b>Floating piston system</b> Bianchi, Marseille, 1999</p> <p>* = activator</p>	<p><b>Free flowing standard-like cylinders</b> Tabor, Maryland, 1981</p> <p>* = activator</p>	<p><b>Vacuum sampling cylinder</b> De Lange, Utrecht, 1998</p> <p><b>Sketch</b></p> <p>* = activator</p>
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-/- complicated

-/- complicated

-/- > 25% pressure loss

-/- extreme flow rates



# Pressure Retaining Deep Sea Sampler

... from idea to realization ...

- small inert bottles
- several volumes (50, 200, 500 ml)
- appr. 10 bottles/depth, 4/6 depths per cast
- onboard tracer addition
- water depth down to 6.000 m

Aug 2003

MRF-BIO SAMPLING workgroup sketches the rough outlines

Composition Project Team:  
3 technicians, 3 scientists  
+ Kick Off Meeting

Literature/reference study

Overview and analysis  
of known systems

1<sup>st</sup> sketches of possible principles,  
calculations of pressure losses

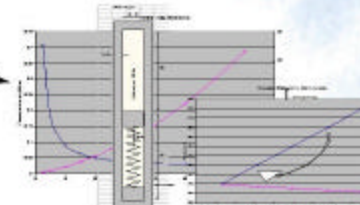


Visit to CNRS Marseille/  
Université de Marseille

Jan 2004



Model 0: calculation  
validation model

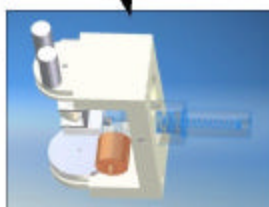


Engineering 1<sup>st</sup> prototype

Construction 1<sup>st</sup> prototype

Testing, modification 1<sup>st</sup> prototype

Constr. and testing 2<sup>nd</sup> prototype



Model 1: Russian Syringe



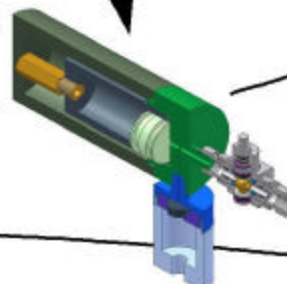
Pressure Tank testing

Aug 2004

Construction and testing of  
5 extra prototypes (mod. 2)

Sep 2004

Ocean trials during  
BADE cruise  
on RV Pelagia

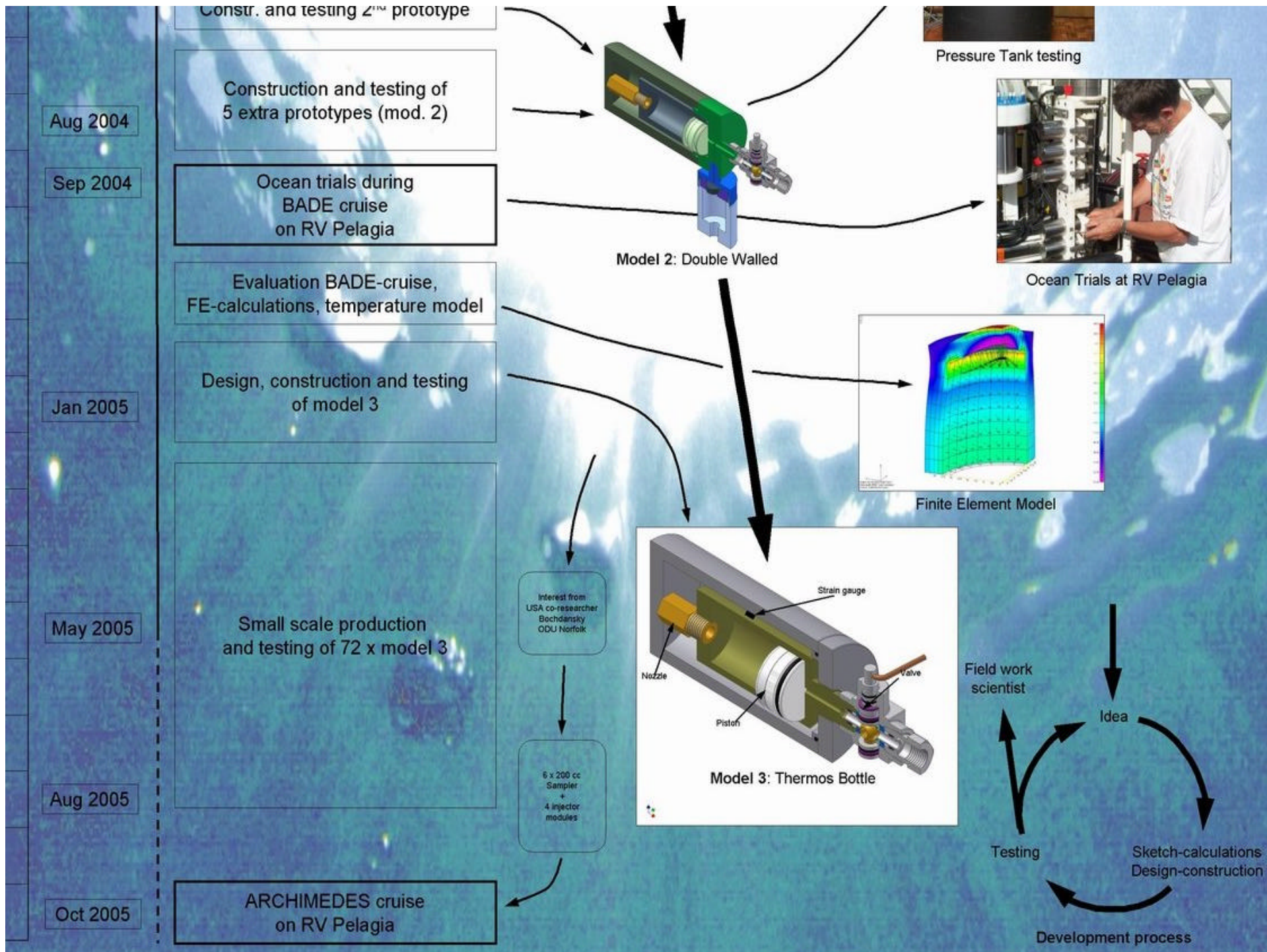


Model 2: Double Walled



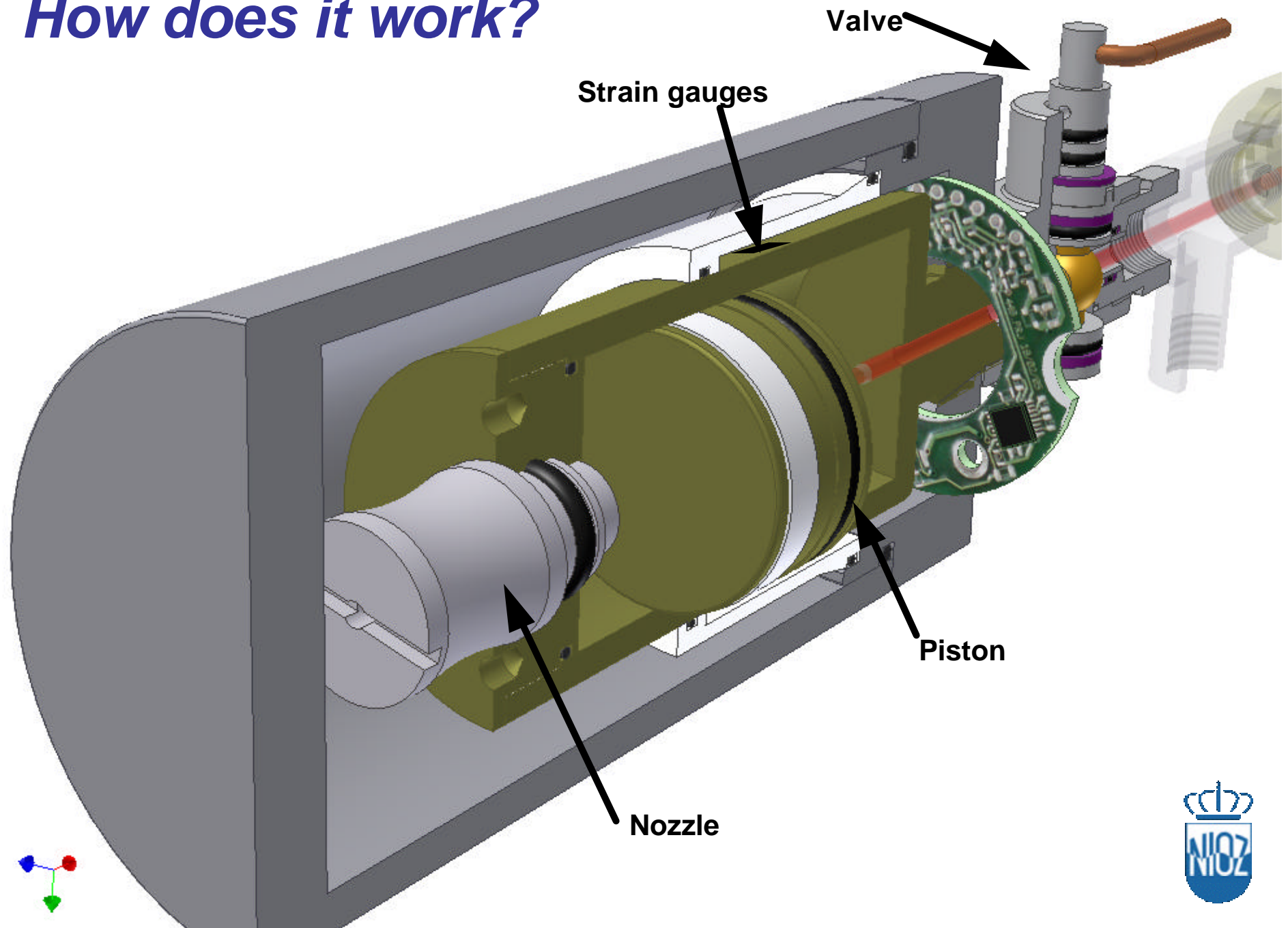
Ocean Trials at RV Pelagia



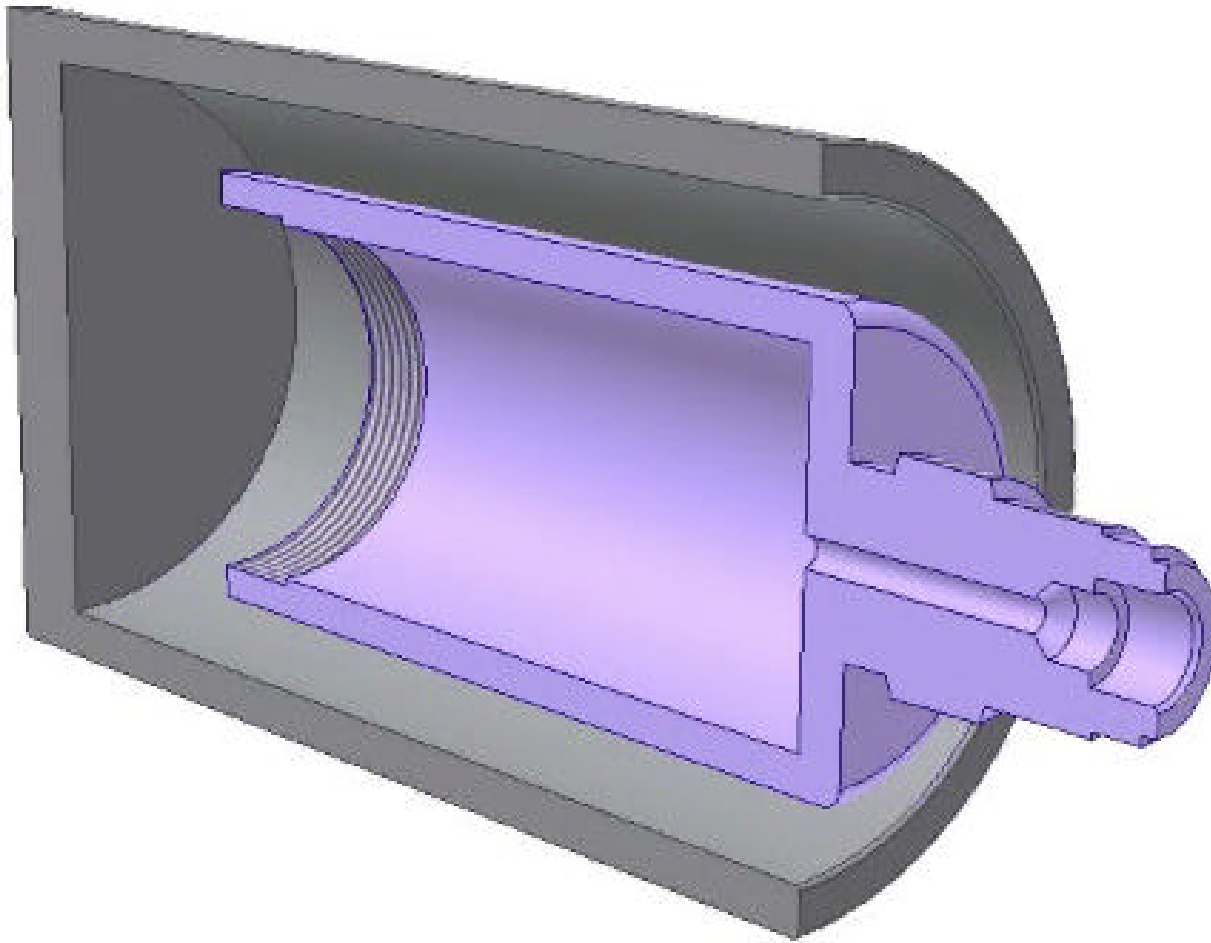




## *How does it work?*



## *How does it work-2?*







# *Pressure tests of 36 samplers at 400 bar and 4 degr C*

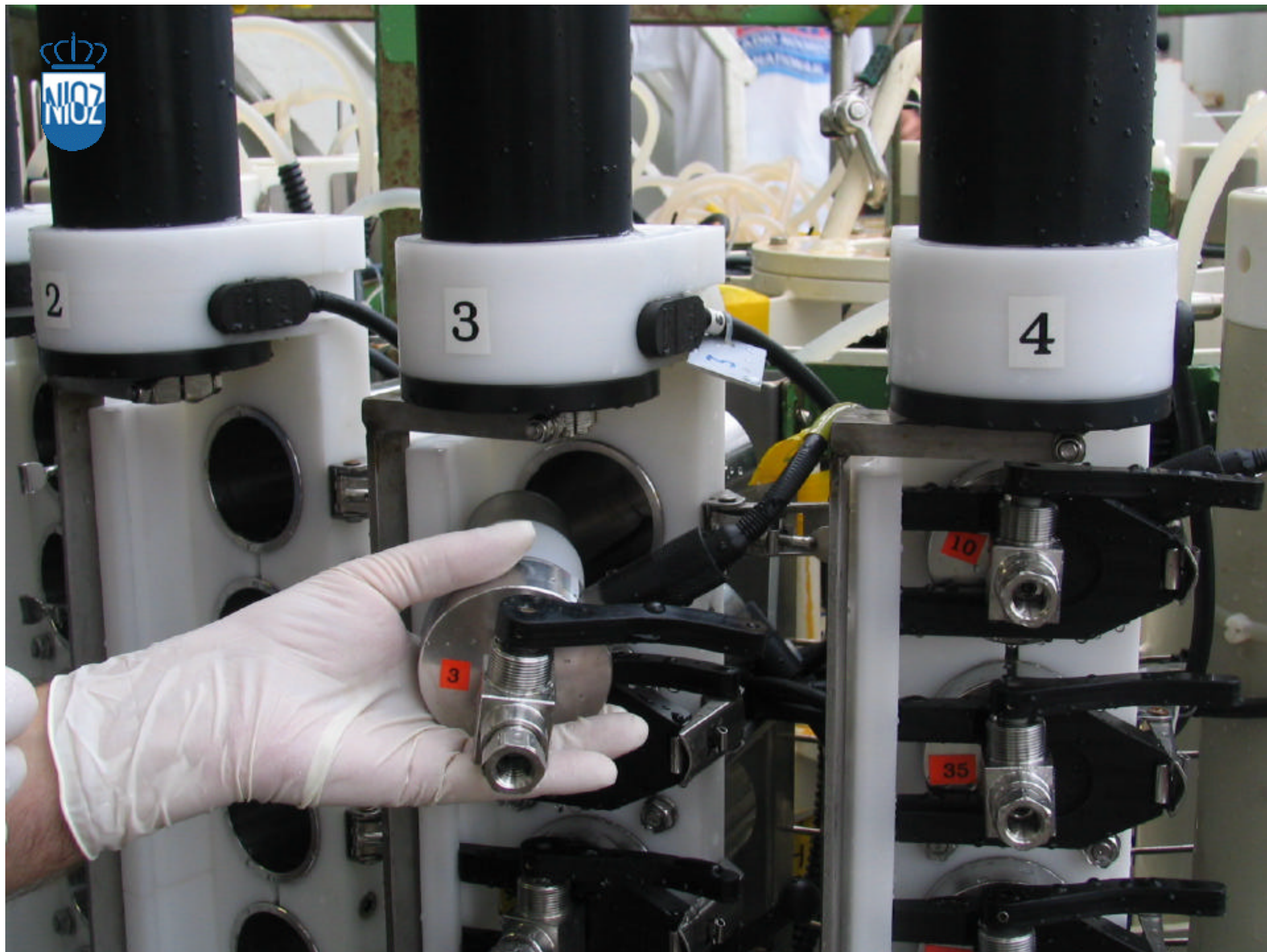






*Mounting in  
CTD-frame*





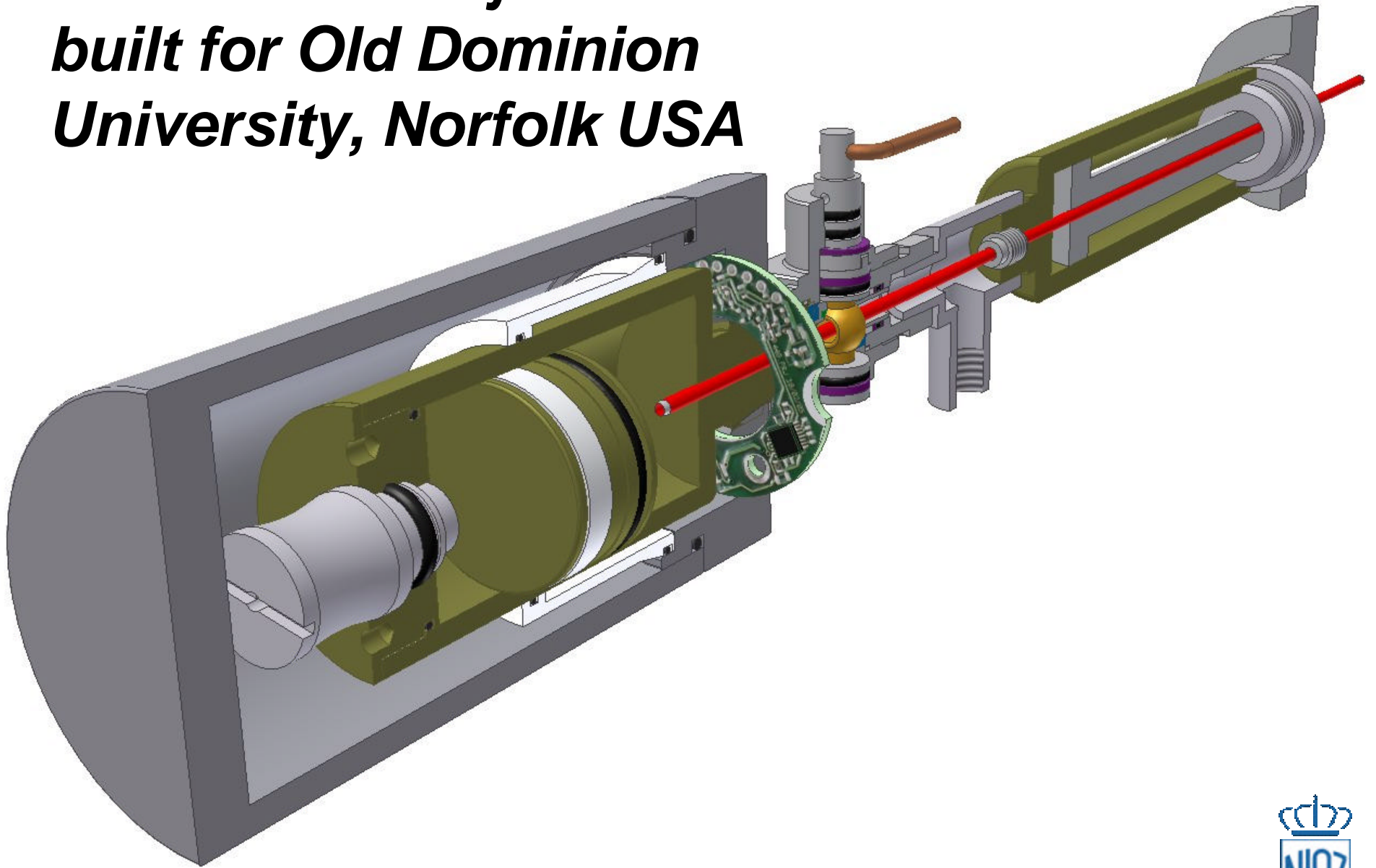


## *Micro-meter pressure measurement*





***3 D model of injector module  
built for Old Dominion  
University, Norfolk USA***





***“Feeding the animals at 600 bar”***

***Injector module final version***

***50 ml sampler***





## *High Pressure Sampler: results*

- **Pressure performance:**  
3% pressure loss at 600 bar
- **Reduced temperature influence**  
because of double walled bottle
- **Accuracy of strain-gauges: 1.7 bar**
- **Accuracy of micrometer measurements: 9.3 bar**
- **Archimedes-cruise December 2005:**  
technically and scientifically successful.





# ***Questions/discussion***





*Rinsing module*

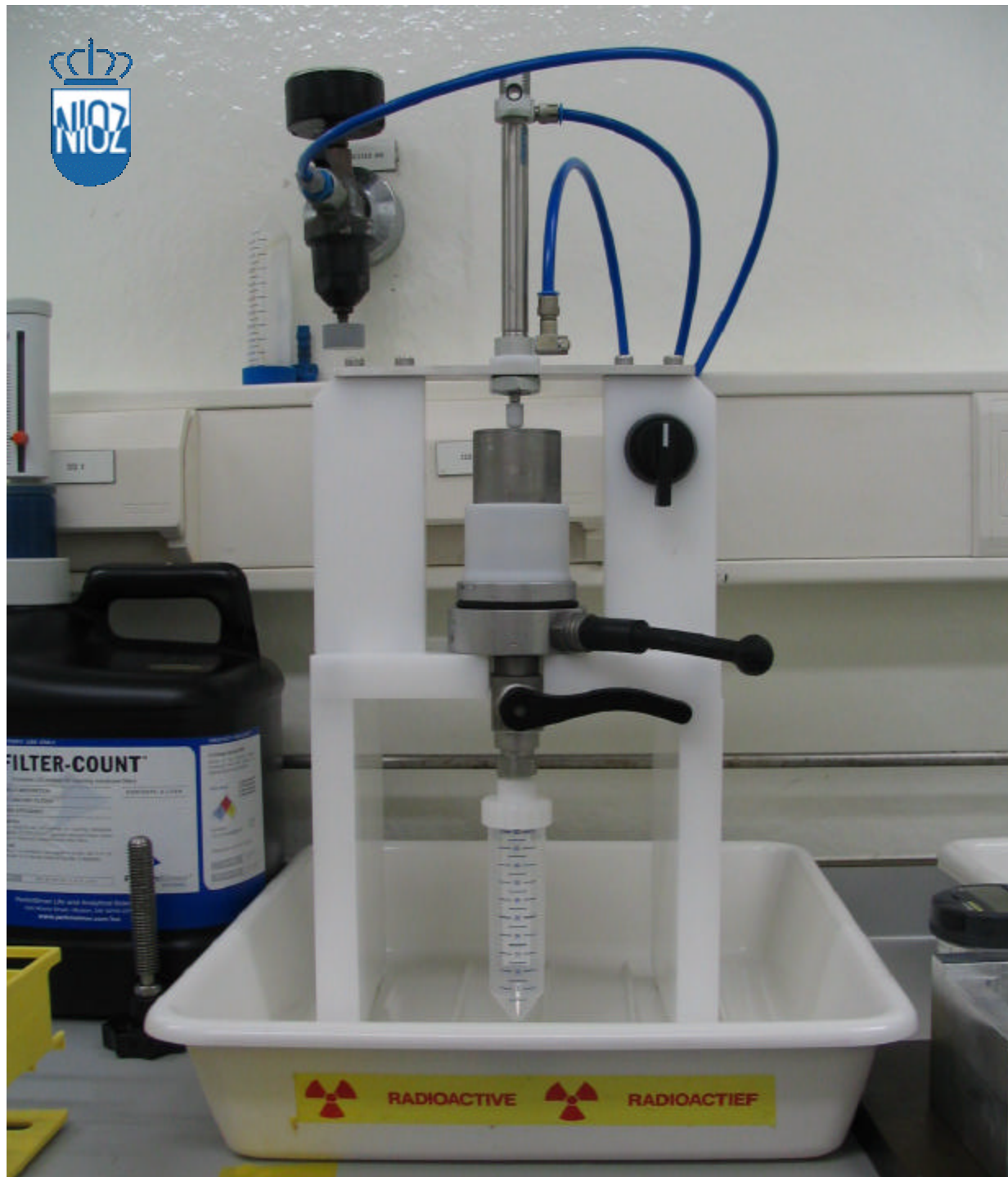


## ***Rinsing procedure:***

- Taken apart
- Aceton, de-greasing
- HCl-solution 10%
- Sonication
- 3 x Rinsing MilliQ-water
- Milli-Q fill
- Drying at 60° C



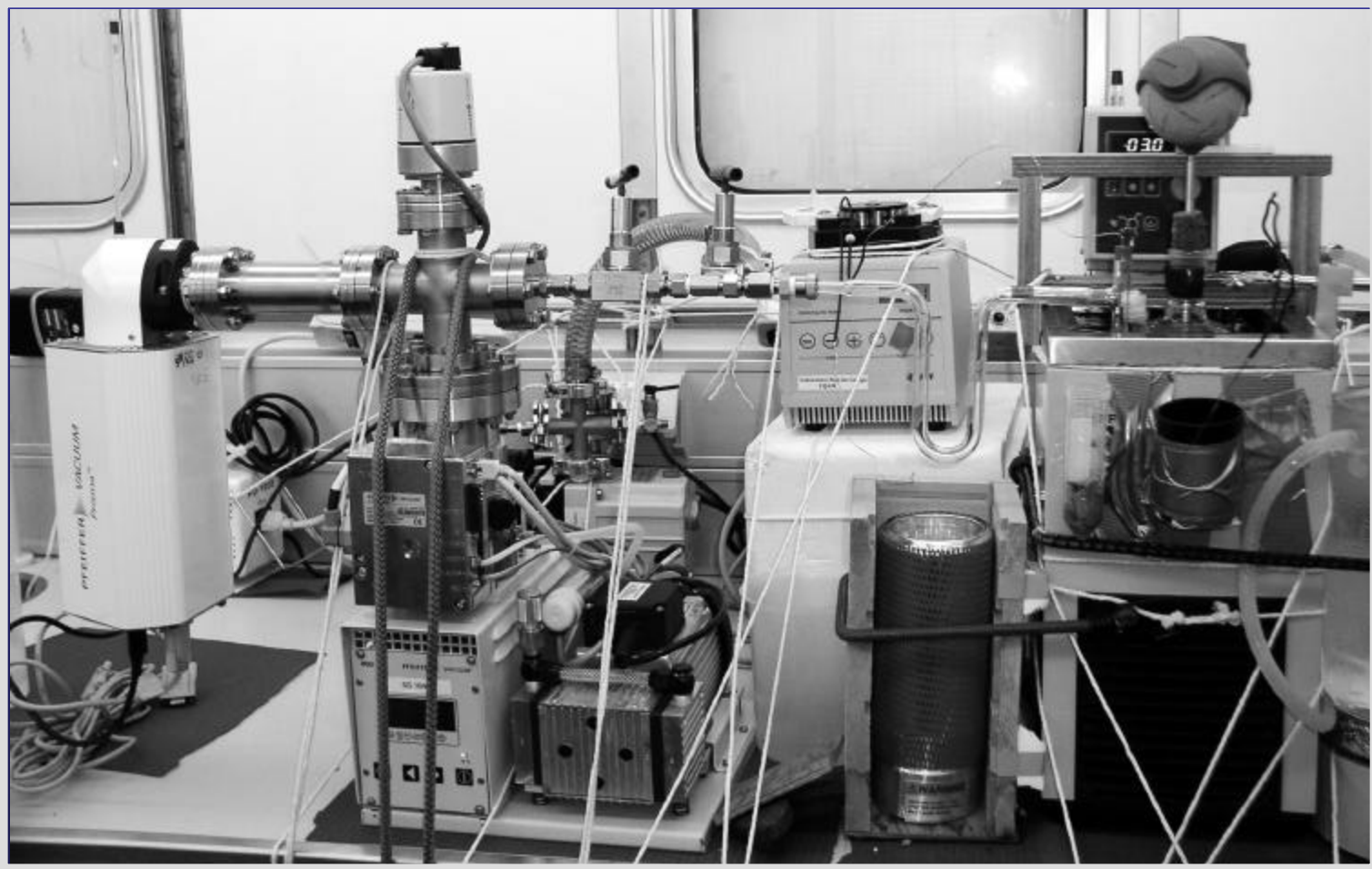




***Sub-sampling unit***



# *Membrane Inlet Mass Spectrometre*



For very fast measurement of oxygen concentration  
(Courtesy of Paul Del Giorgio, Université du Québec à Montréal)