

213). This tub or pit-wheel introduced a new feature, which confined the stream and made more efficient use of the force exerted by the moving water on the vanes of the wheel. Thus the hydraulic action was more precisely controlled,



FIGURE 214—Agricola's simple suction-pump. On the left a man is hollowing out tree-trunks, for pipes, with augers (P, Q). 1556.

not enough to make the wheel a true turbine, but enough to improve its performance [3]. This wheel, and other types that developed around Toulouse, undoubtedly set the stage for the invention of the water-turbine. The sixteenth century, however, worked with such loosely articulated machinery that a true turbine would have been inconceivable to the millwrights of the period.

The predominance of wood in the construction of mills is to be inferred from





# THE VACUUM LAB SUPPORTS



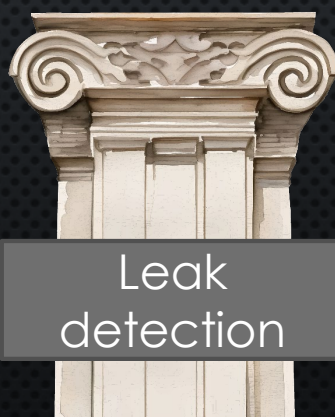
Sorry did not find it



External design



Internal design



Leak detection



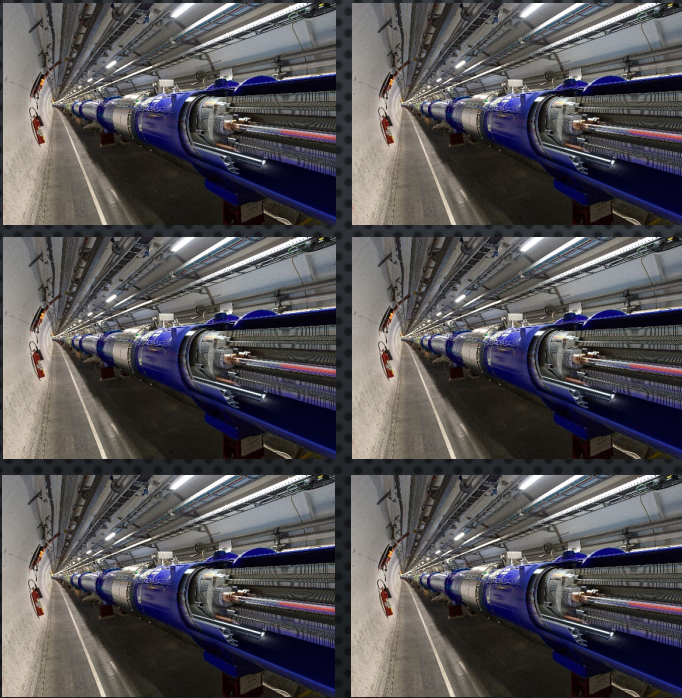
Maintenance & management



Research and qualification

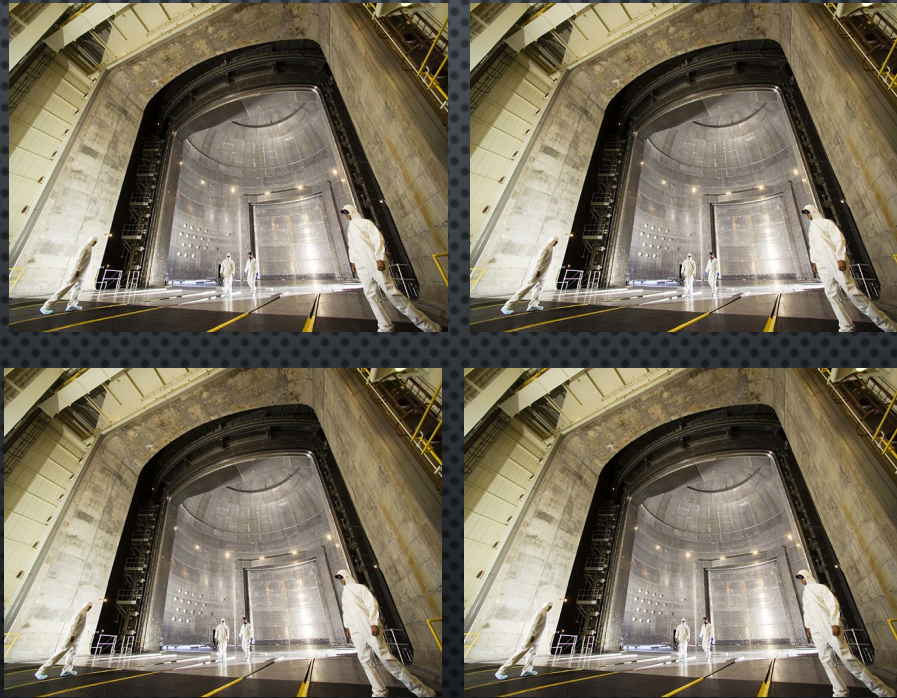


# THE EXTREME SCALE OF EINSTEIN TELESCOPE



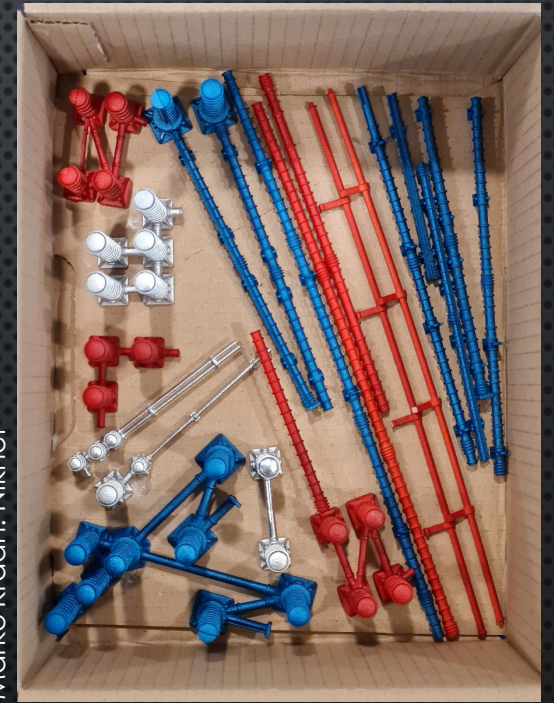
Dominguez, Daniel: CERN

LHC insulating vacuum  
volume: 15 000 m<sup>3</sup>  
Pressure range: 10<sup>-6</sup> mbar



<https://www1.grc.nasa.gov/facilities/sec/#gallery>

SEC vacuum chamber  
volume: 22 653 m<sup>3</sup>  
Pressure range: 10<sup>-6</sup> mbar

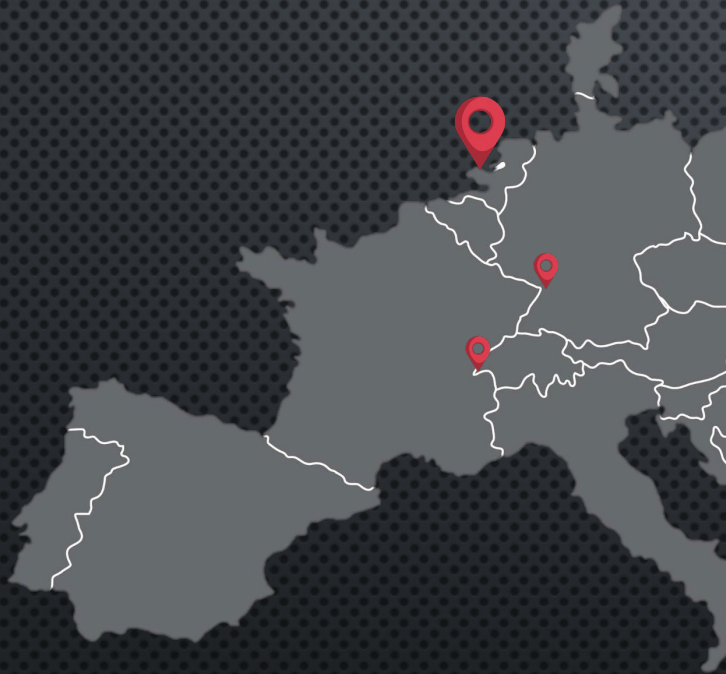


Marko Kraan: Nikhef

ET beam pipe vacuum  
volume: 6 x 15 700 m<sup>3</sup>  
Pressure range: 10<sup>-11</sup> mbar



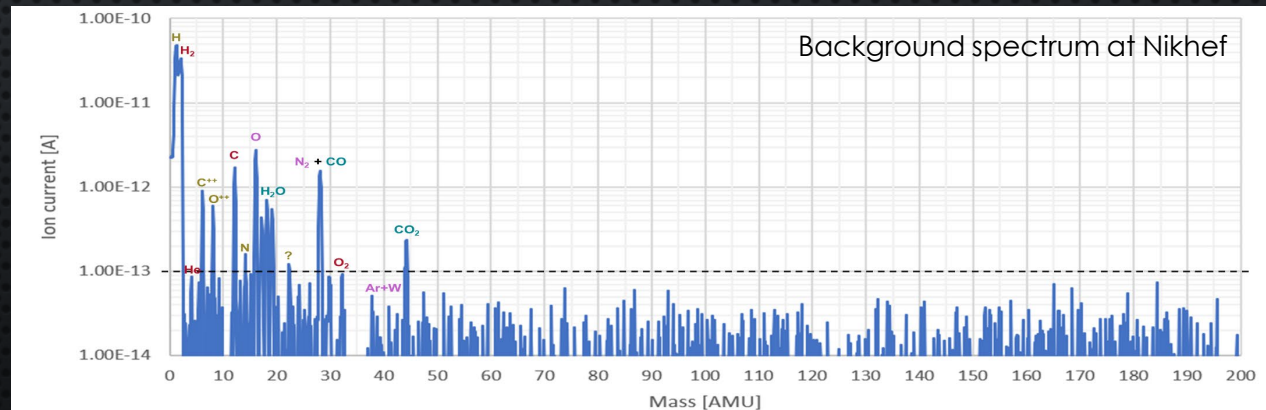
# WHO CAN MEASURE EXTREME NOTHINGNESS



CERN: vacuum, surfaces and coatings group  
 KIT: OMA setup (potentially)

	Mbar
Atmospheric pressure	1013
Low vacuum	1E3 till 1
Medium vacuum	1 till 1E-3
High vacuum	1E-3 till 1E-7
Ultra high vacuum (UHV)	1E-7 till 1E-11
Extremely high vacuum (XHV)	< 1E-11
Outer space	< 1E-14

Gas species	Pressure max mbar
$H_2$	$5.3 \times 10^{-11}$
$H_2O$	$9.6 \times 10^{-12}$
$N_2$	$5.6 \times 10^{-12}$
$CO$	$2.2 \times 10^{-12}$
$CO_2$	$2.0 \times 10^{-12}$
$Hydrocarbon_{100}$	$9.1 \times 10^{-14}$

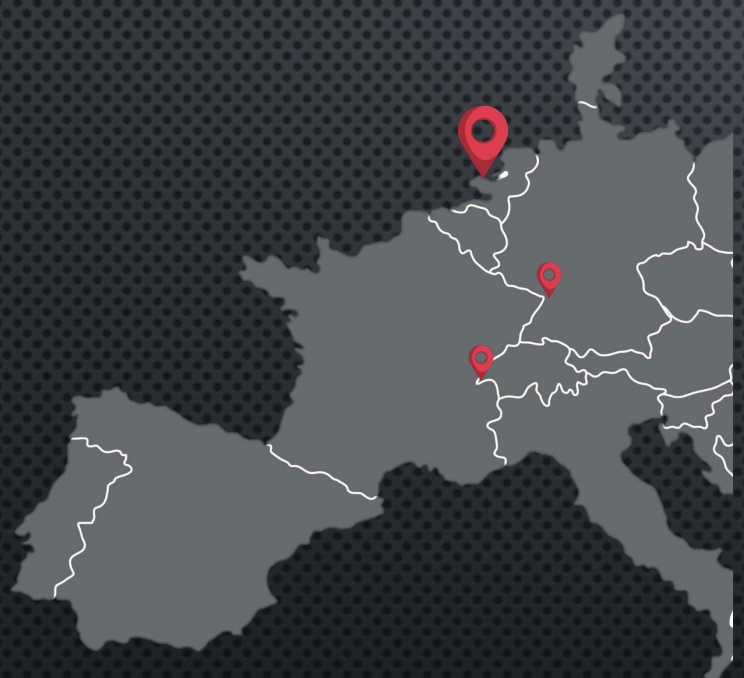


<https://www.overleaf.com/project/63bfe8cfea42cf35c7402c0e>



UHV compatible ≠ UHV clean

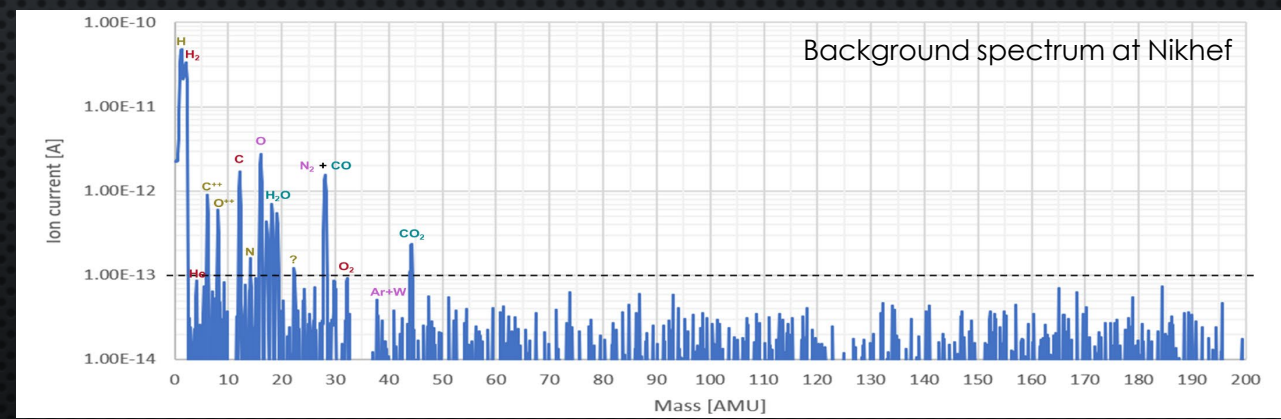
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<https://www.overleaf.com/project/63bfe8cfea42cf35c7402c0e>



# ITEM QUALIFICATION - UPCOMING



Stan Heijnen vindt dit interessant

**Marco Kraan** • 1e  
Mechanical Engineer at NIKHEF  
6 d • Bewerkt •

Update van de nieuwe [CERN #LHCb VELO C-side RF Box](#) op [Nikhef \(Nationaal instituut voor subatomaire fysica\)](#). [Stan Heijnen](#)



Max van 't Hek en 11 anderen

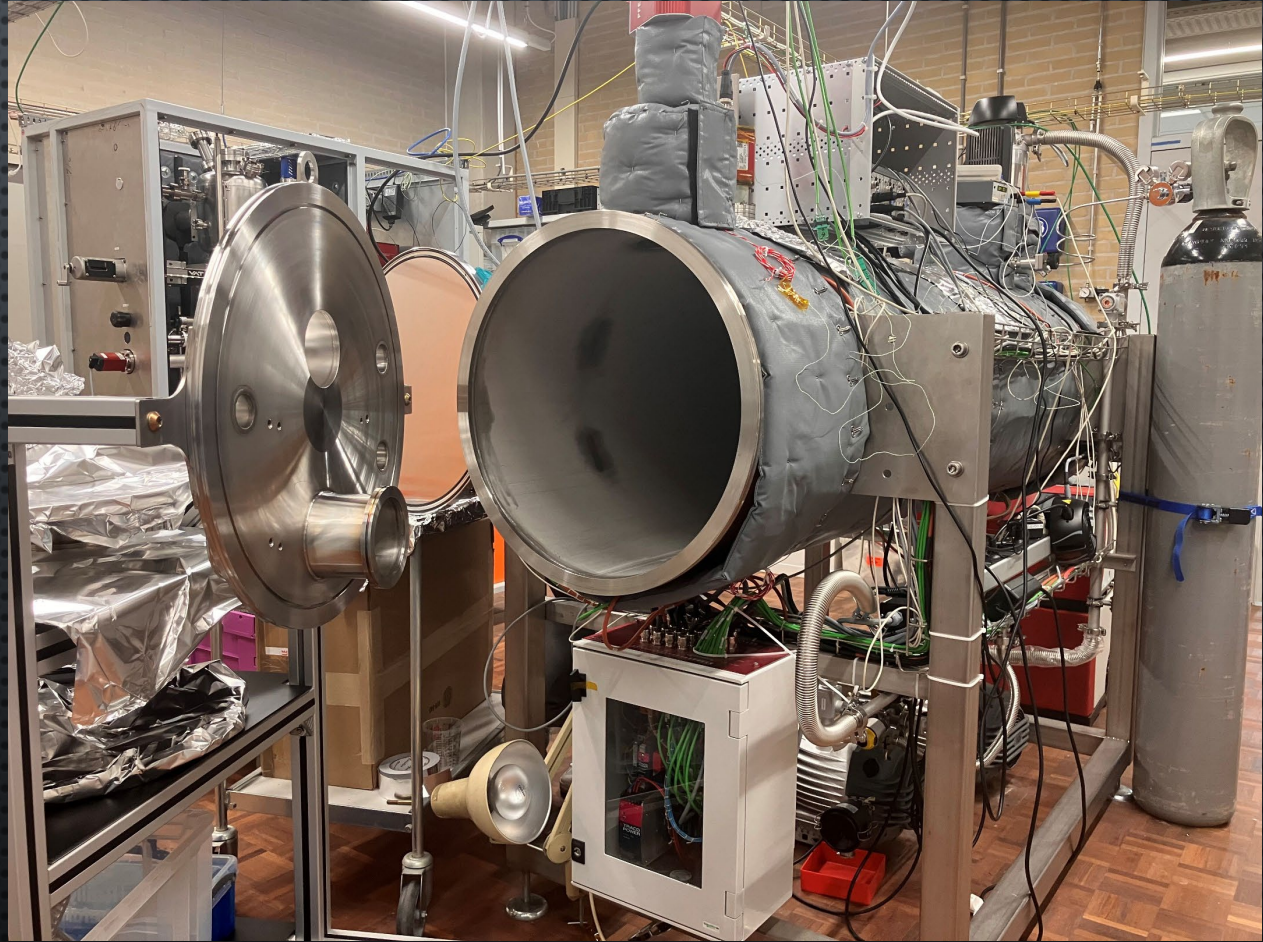
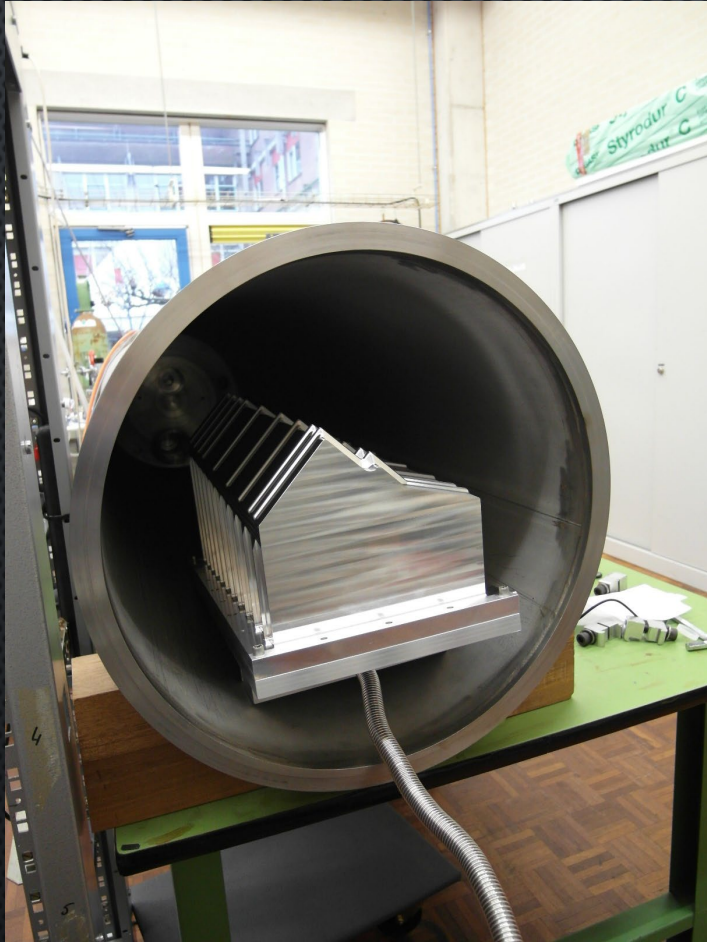
- Listen
- Interessant
- Commentaar
- Reposten
- Versturen

ITEM G

OMING



# ITEM QUALIFICATION - UPCOMING

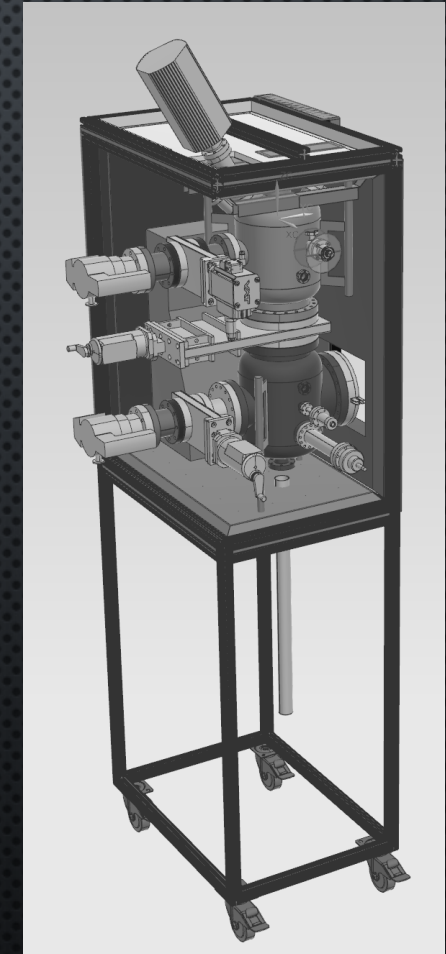
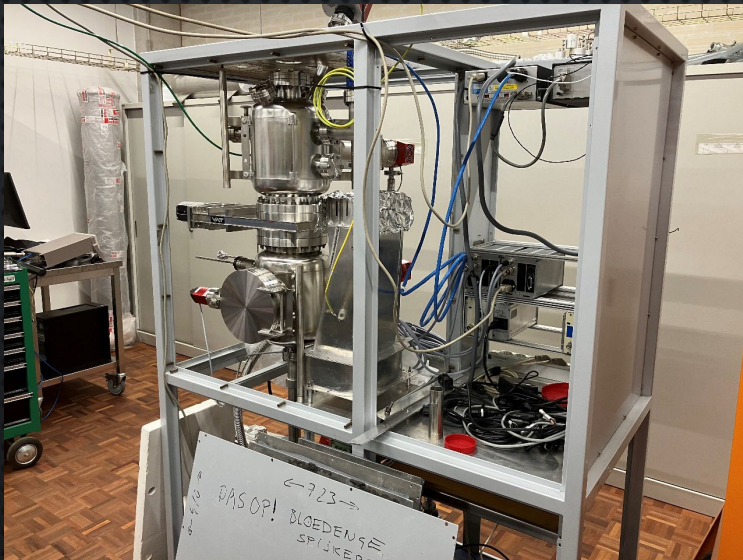




# DEVELOPMENTS: IMPROVED ACCURACY

## SMALL RGA SETUP

- BETTER INSULATION (IN PROGRESS)
- VACUUM FIRED CHAMBER (DONE)
- ELECTRONICS PANEL INTERFACE (DONE)





WHY 2 SETUPS?  
VISIT THE LAB!

LET'S THANK THE INVISIBLE BACKBONE:  
SO TO ALL WHO CONTRIBUTE  
TO CREATE NOTHING

THANK YOU





VACUUM AT NIKHEF

24 04 2024

MARIJE YOLINDE BAREL