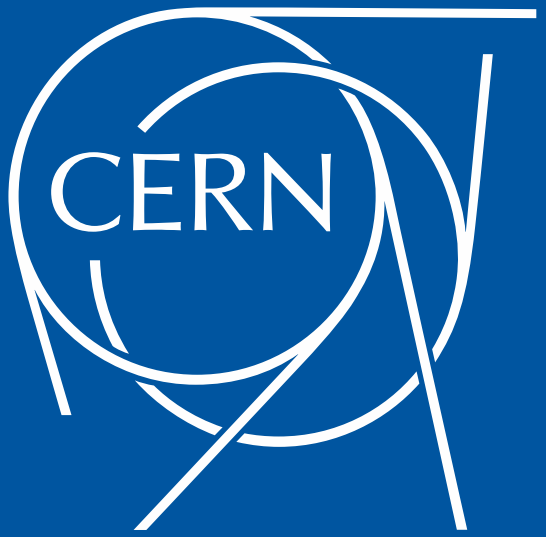
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Vacuum tests for CLIC module prototypes

Outline:

- Reminder: specification and specificity
- Tests on first Lab. Module
  - Configuration
  - Leak tests and consequences
  - Representative vacuum tests on accelerating structure mock-up
- Towards next module prototype
  - New vacuum system configurations
  - Vacuum tests on accelerating structure mock-up
  - Thermal outgassing tests on SiC
- Conclusion

Specification and specificity

The vacuum specification for the CLIC two beam modules is:

- $1.3.10^{-9}$ mbar for the main beam [EDMS 992778]
- 4.10^{-8} mbar for the drive beam [CLIC CDR, Section 4.4]

The vacuum system is unbaked.

System with low conductances (typical geometrical size ~ 10 mm) and large areas (~0.5 m^2/AS).

Vacuum system configuration on 1st Lab. module

Central manifold equipped with:

- 2 ports for NEG cartridge pumps (2* 2000 l/s H2)
- 1 port for ion pump (~60 l/s) for methane and noble gases
- 1 port for mobile pumping group

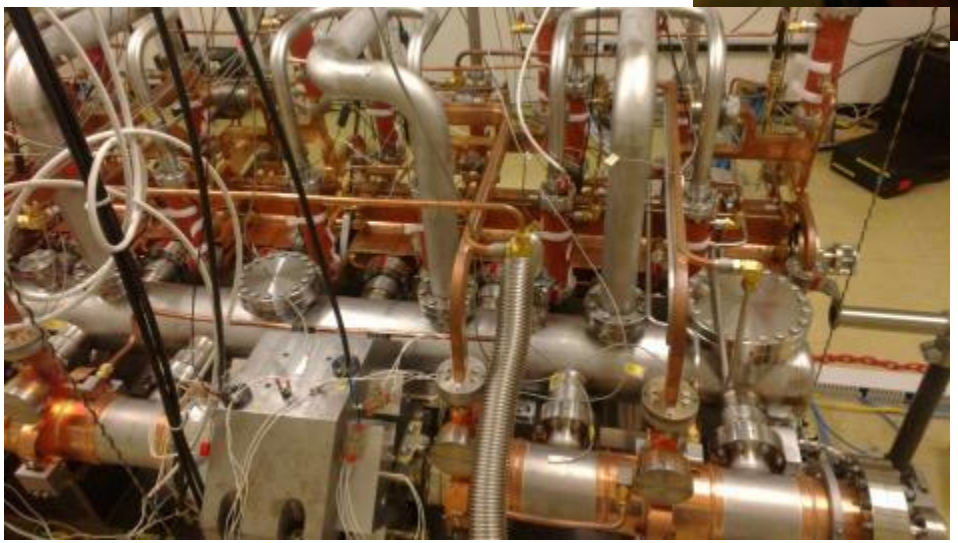
Transverse connections to accelerating structures and PETS → conductance limited system (~40 l/s)

Transverse connections to RF loads

Leak tests on 1st Lab. module

Two main leaks in the 10^{-5} mbar.l/s on accelerating structures:

few others fixed with araldite and one on the RF network.

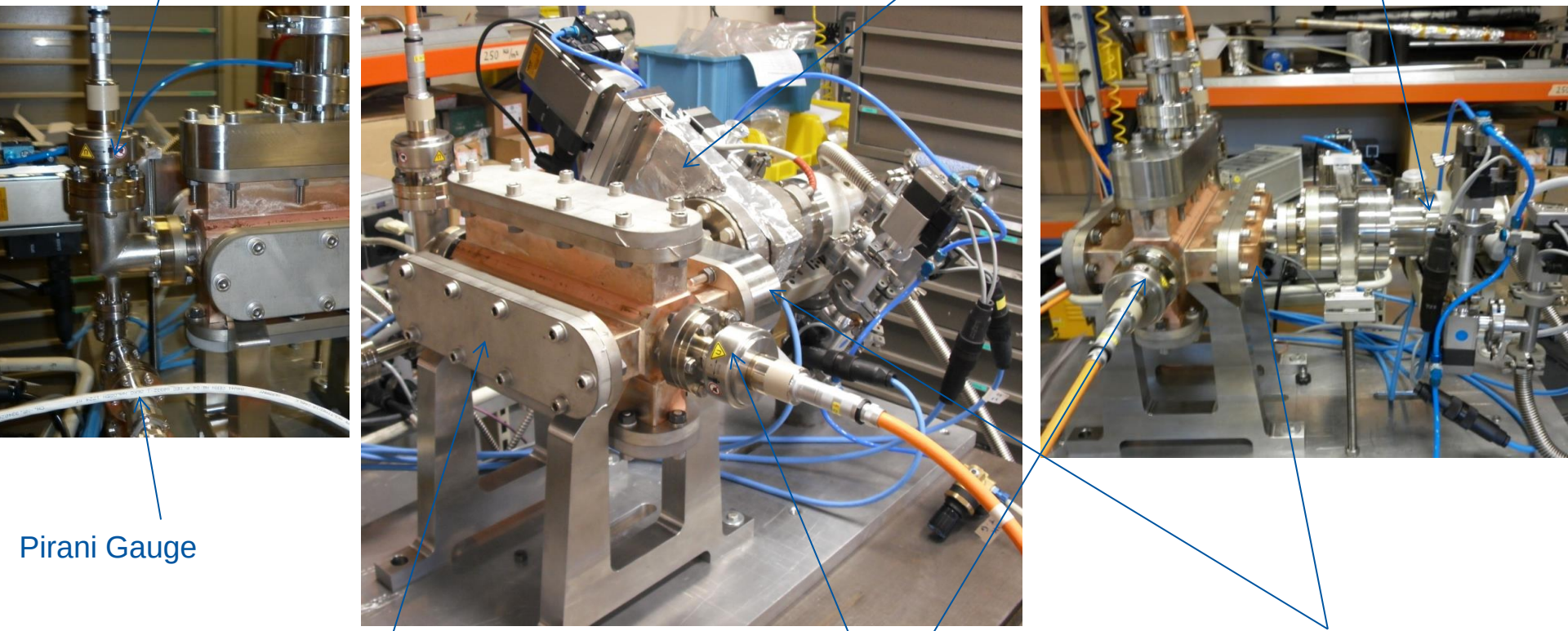


Consequences:

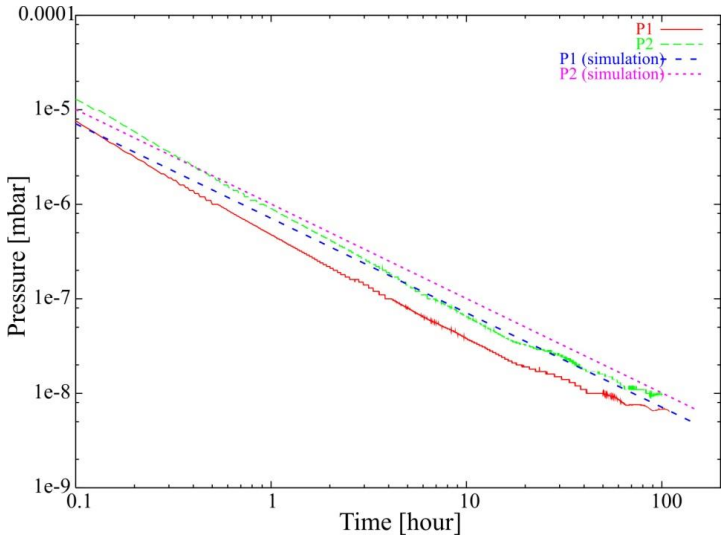
→ Main beam isolated from the vacuum system with blank gasket

→ No UHV tests

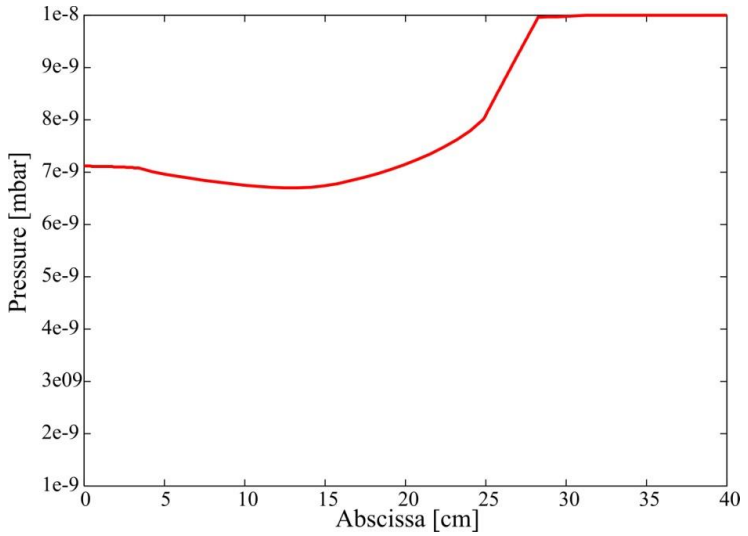
Representative vacuum tests on accelerating structure mock-up



Representative vacuum tests on accelerating structure mock-up

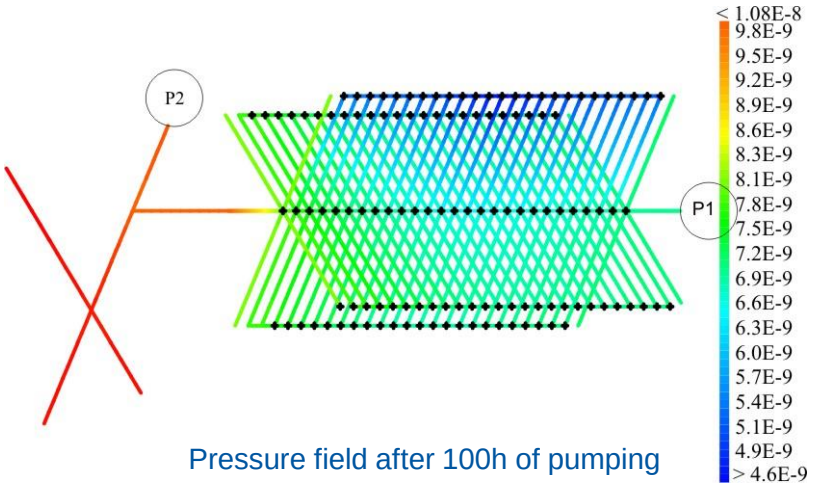


Evolution of pressure



Pressure profile along beam axis after 100h of pumping

→ Good agreement between the measurements and the simulation
→ Non significant influence of manifold size
→7.10^{-9} mbar is reached after 100 hours of pumping



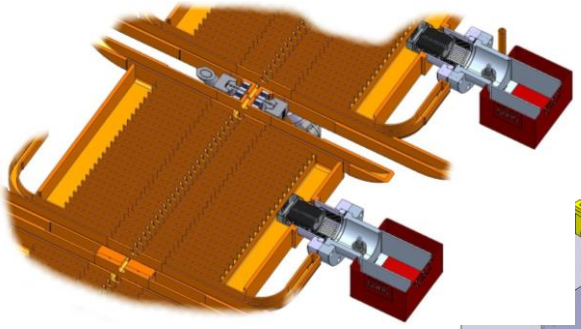
Pressure field after 100h of pumping

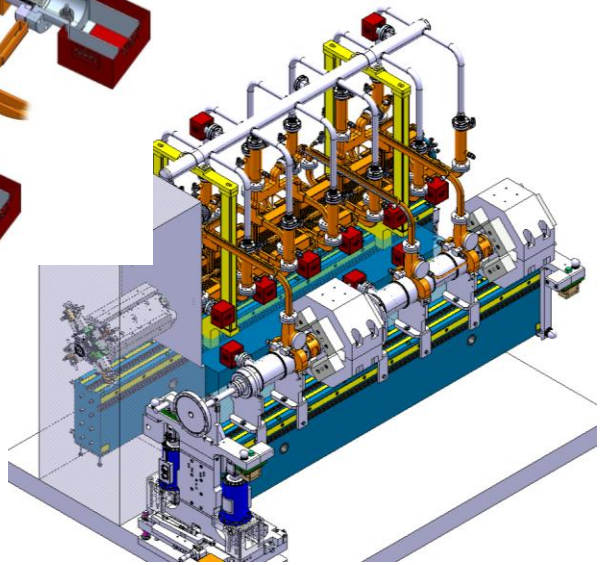
Towards next module prototype - New vacuum system configurations

NEG cartridge pumps + small ion pumps installed on (in) accelerating structures and PETS.

Small manifold above the main beam, connected to the RF loads, equipped with pumping ports (fixed pumps and mobile pumping group)

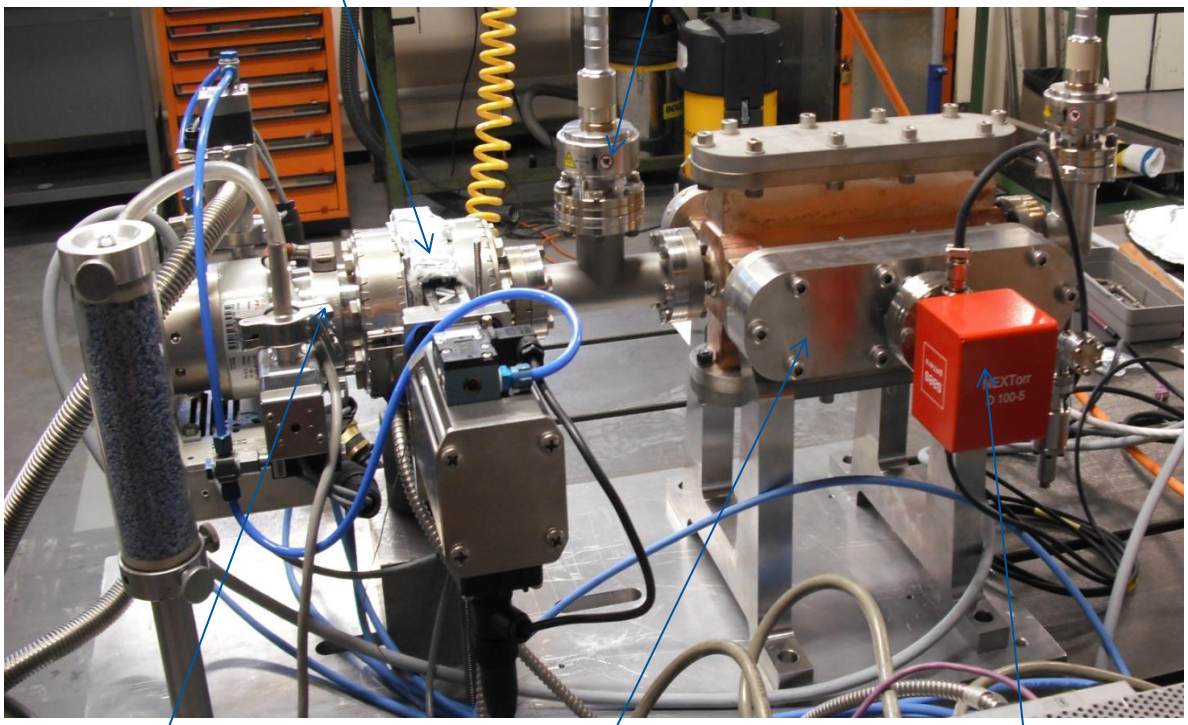
Nextorr pump from SAES



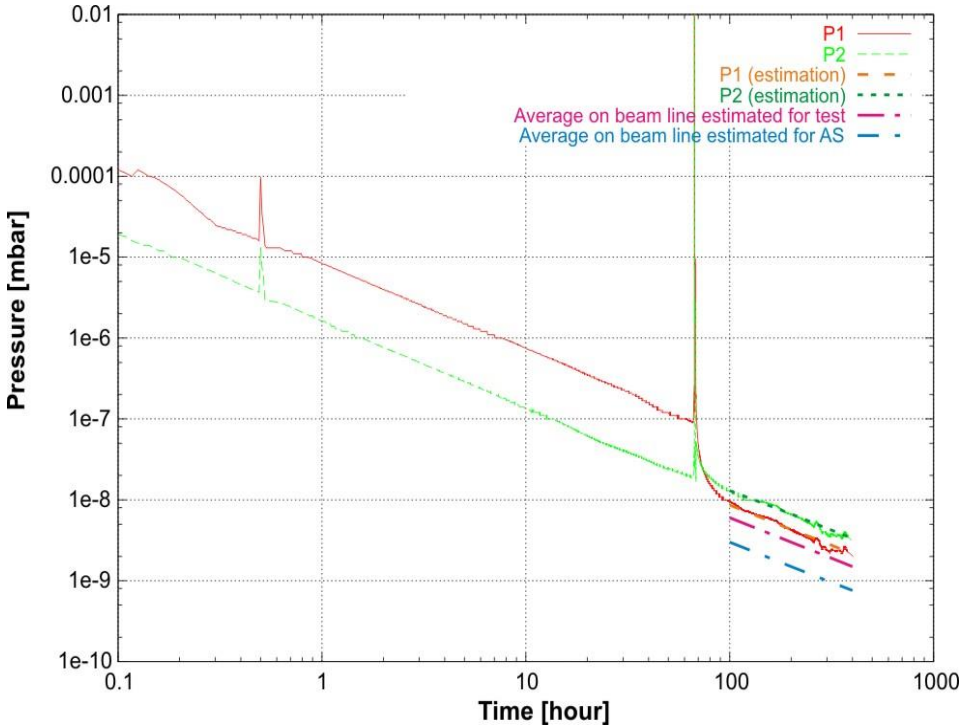


Advantages:
- Pumping speed not (PETS) or much less (AS) limited by the pumping port conductance
- No transverse vacuum force on the accelerating structures and PETS
- More compact

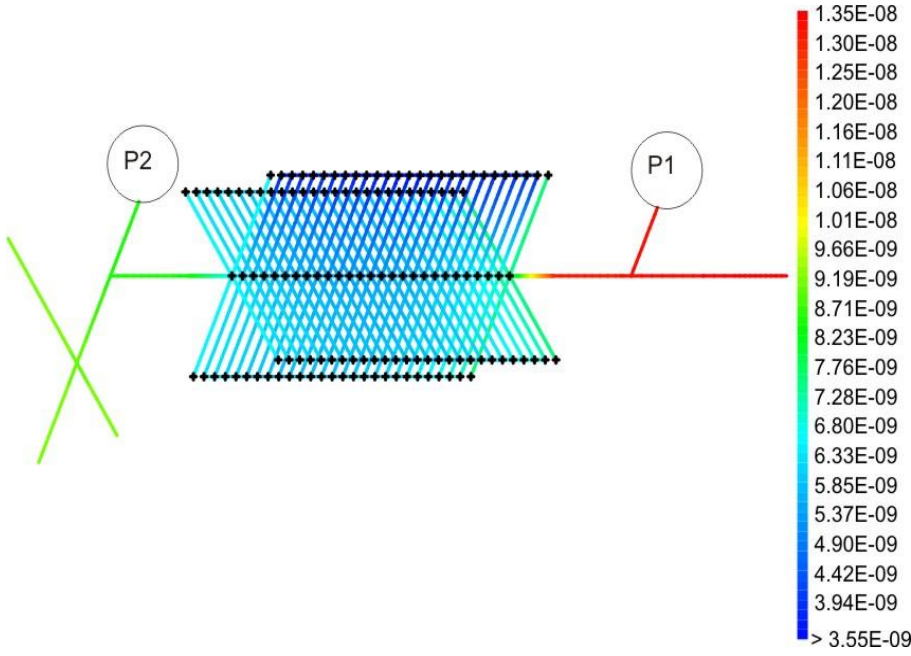
Towards next module prototype -Vacuum tests on accelerating structure mock-up



Towards next module prototype - Vacuum tests on accelerating structure mock-up



Evolution of pressure

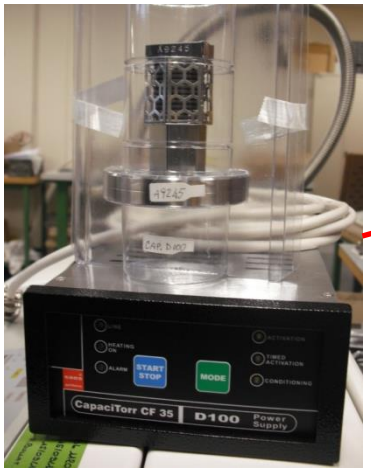


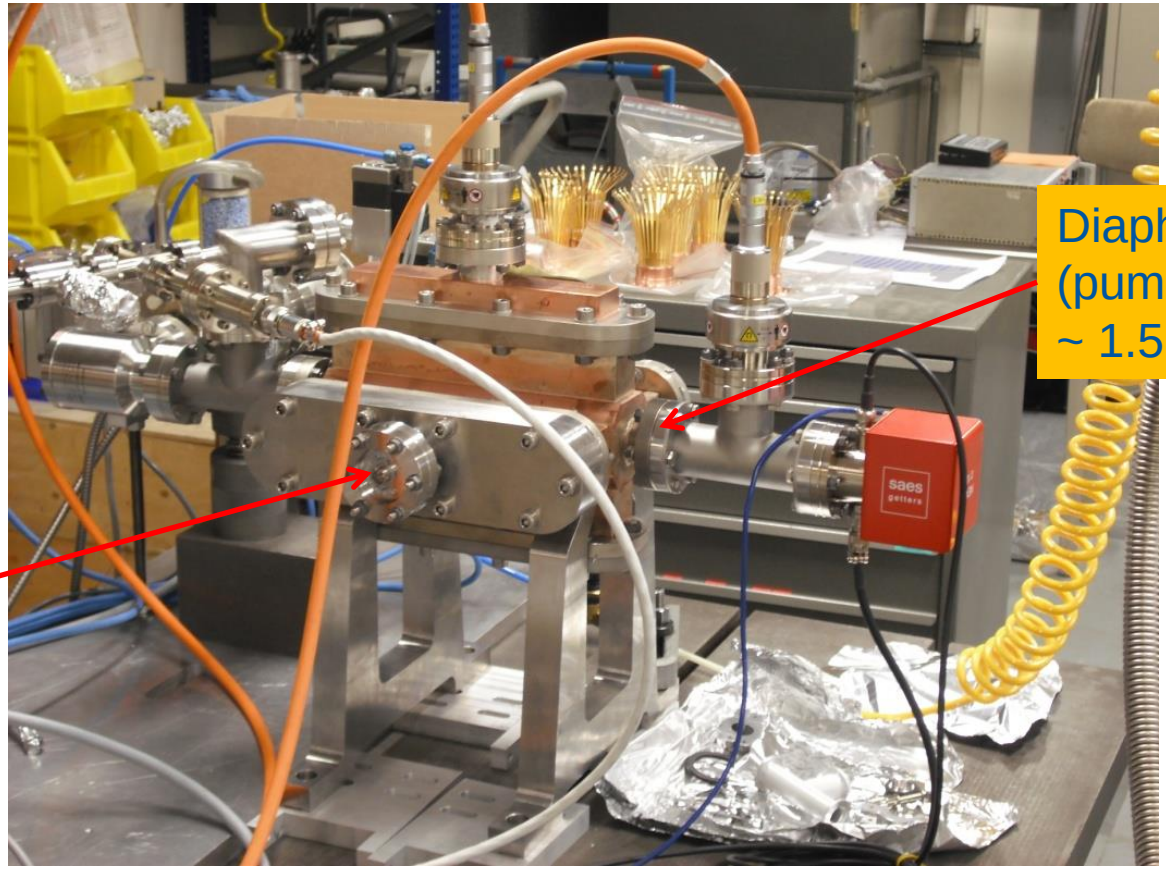
Pressure field after 100h of pumping

→Good agreement between the measurements and the simulation

→3.10^{-9} mbar is reached after 100 hours of pumping

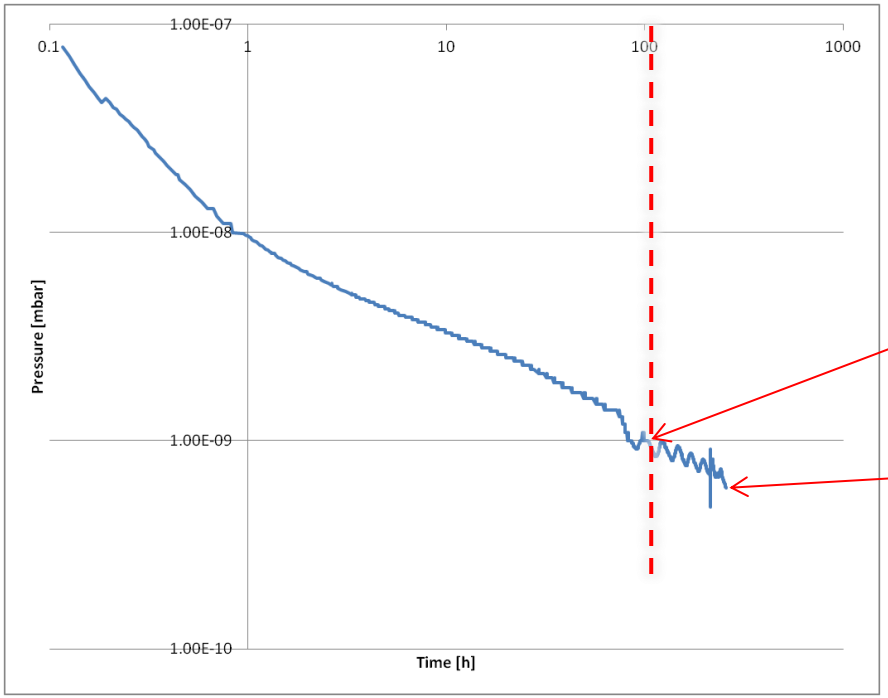
Towards next module prototype - Vacuum tests on accelerating structure mock-up





Diaphragm (pumping speed ~ 1.5l/s)

Towards next module prototype - Vacuum tests on accelerating structure mock-up



~10^{-9} mbar after 100h.

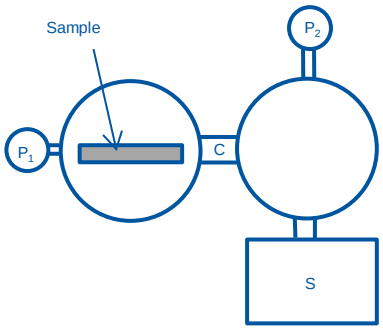
5.9.10^{-10} mbar

Pump down curve (bakeout of Te and ion pump not represented).

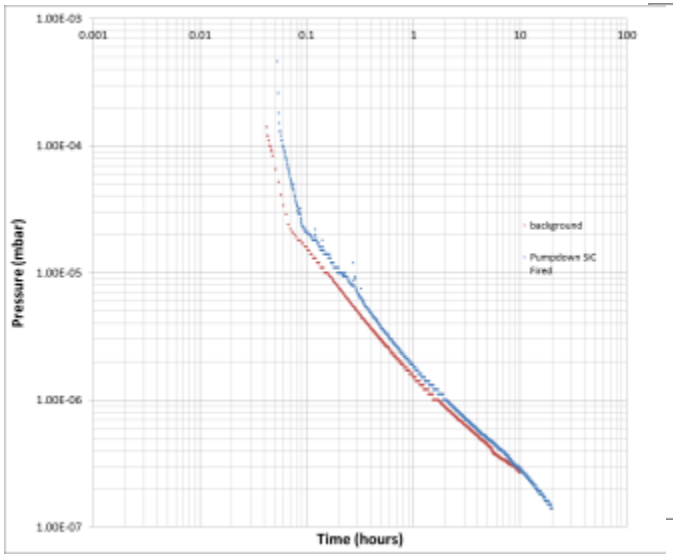
Towards next module prototype – Thermal outgassing tests

Thermal outgassing measurements of SiC.

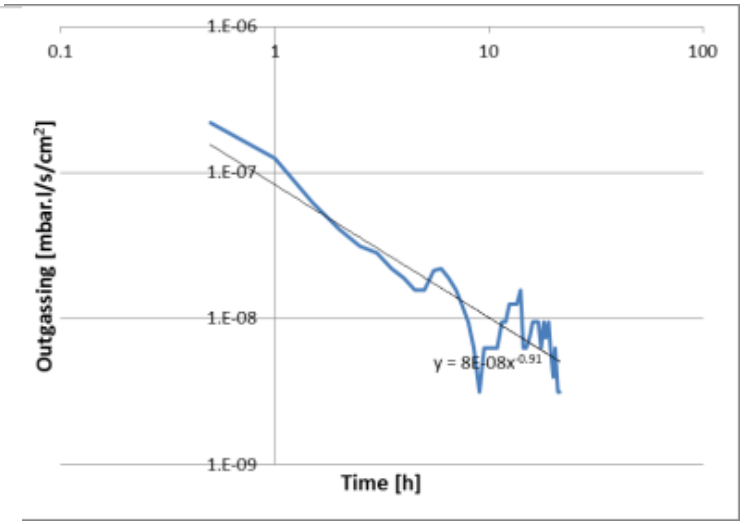
Sample have been tested after heat treatment corresponding to soldering cycle.



Schematic diagram of the throughput method



Pump down curve



Thermal outgassing for unbaked sample

→ Factor ~ 40 higher than copper of stainless steel (at least after few hours of pumping).

→ Measurement on baked samples in preparation

Conclusions

Vacuum system for the first module in Lab is based on a central manifold equipped with vacuum pumps. This is not anymore the preferred technical solutions.

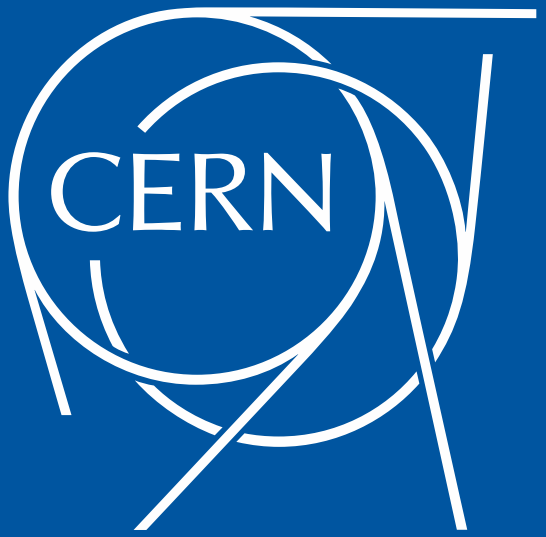
No UHV tests have been carried out due to external leaks.

Vacuum tests have been performed on a dedicated accelerating structure mock-up showing:

- Good agreement between simulations and measurements
- Interest of small mini-pump connected directly on the accelerating structures.

SiC outgassing rate is significant (at least at the beginning of pumping).

Next module, based on “mini pumps”, should also integrate, at least one accelerating structure, with all loads.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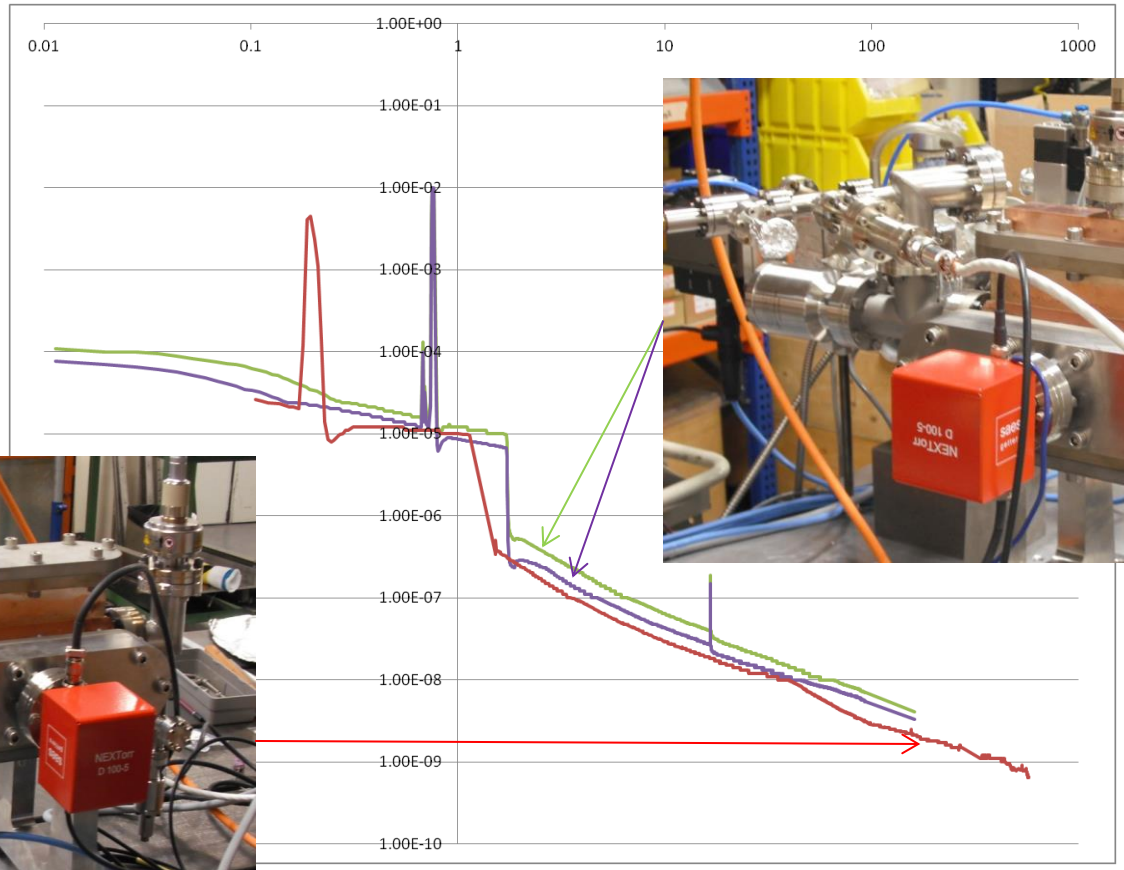
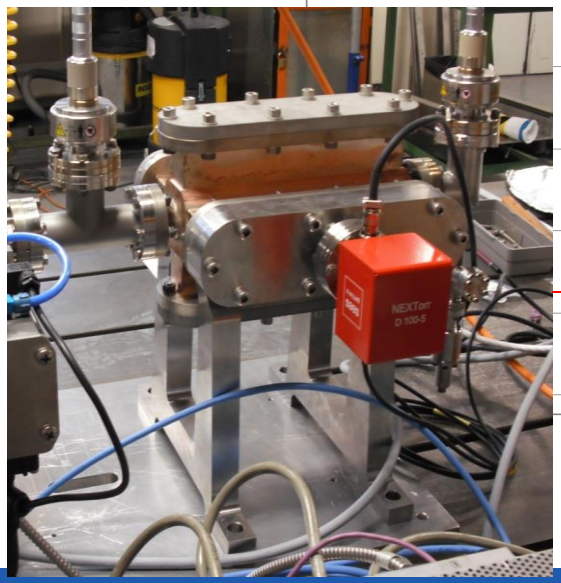
Towards next module prototype - Vacuum tests on accelerating structure mock-up





Measurement on the additional manifold is representative of average pressure along the beam axis but the test set-up introduces an additional gas load