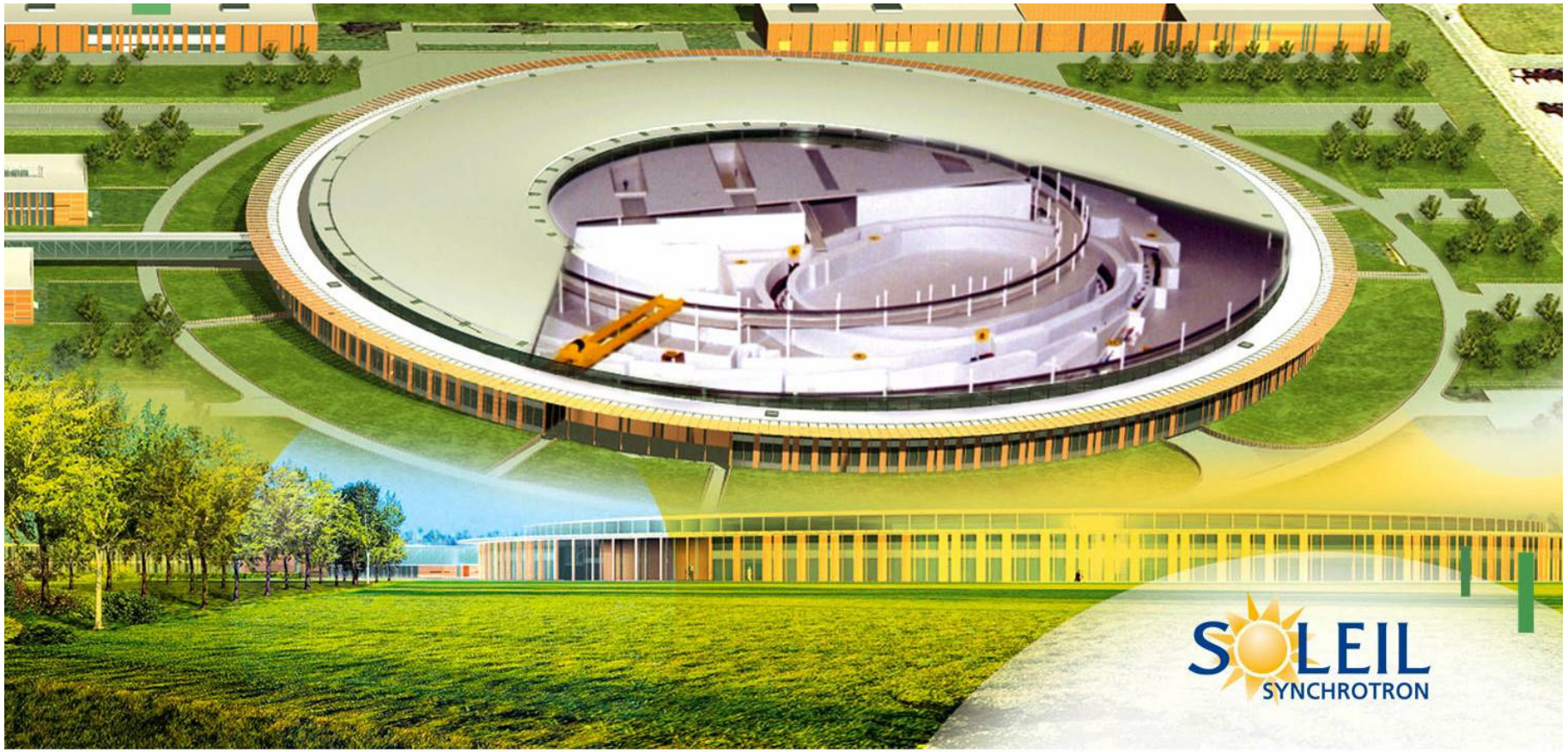
SOLEIL SYNCHROTRON



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Experience with NEG coated vessels at SOLEIL

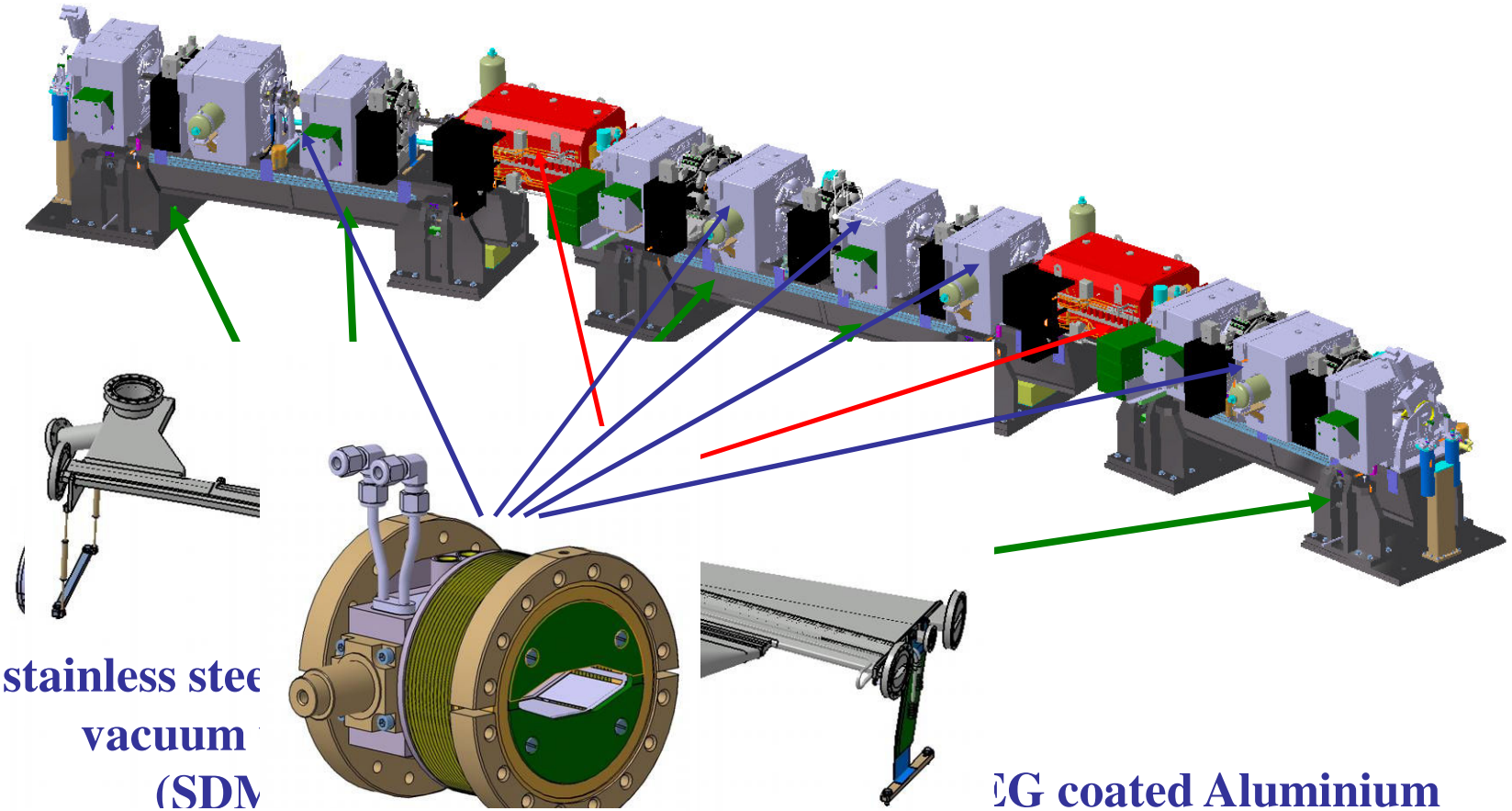
Contents

- Short overview of the vacuum system
- NEG coated vacuum vessels at SOLEIL
- Some figures of vacuum during commissioning
- First results on vacuum conditioning

Parameters of the storage ring

Energy	2.75 GeV
Circumference	354 m
Quantity and length of the straight sections	4 x 12 m 12 x 7 m 8 x 3.5 m
Emittance H Emittance V	3.7 nm.rad 37 pm.rad
Current multi-bunch Beam lifetime	500 mA 18 h
Current (8 bunches) Beam lifetime	90 mA 16 h

Storage Ring Vacuum system
Vacuum system for one typical cell

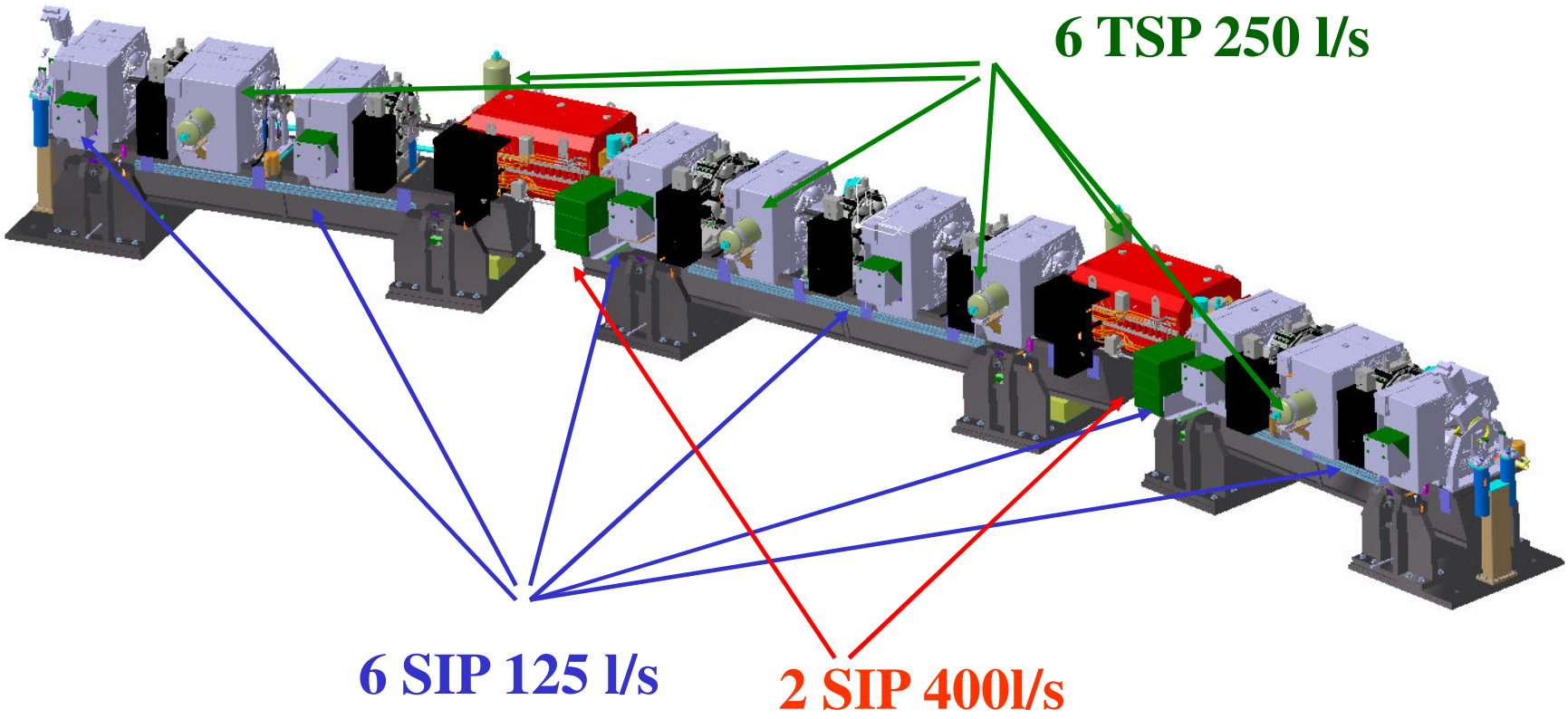


2 stainless stee
vacuum
(SDM

5 stainless steel BPM-Bellows modules with RF shield (COMVAT/RIAL)

:G coated Aluminium quadrupole type vacuum vessels with SS/Al flanges (SDMS/SAES)

The pumping system

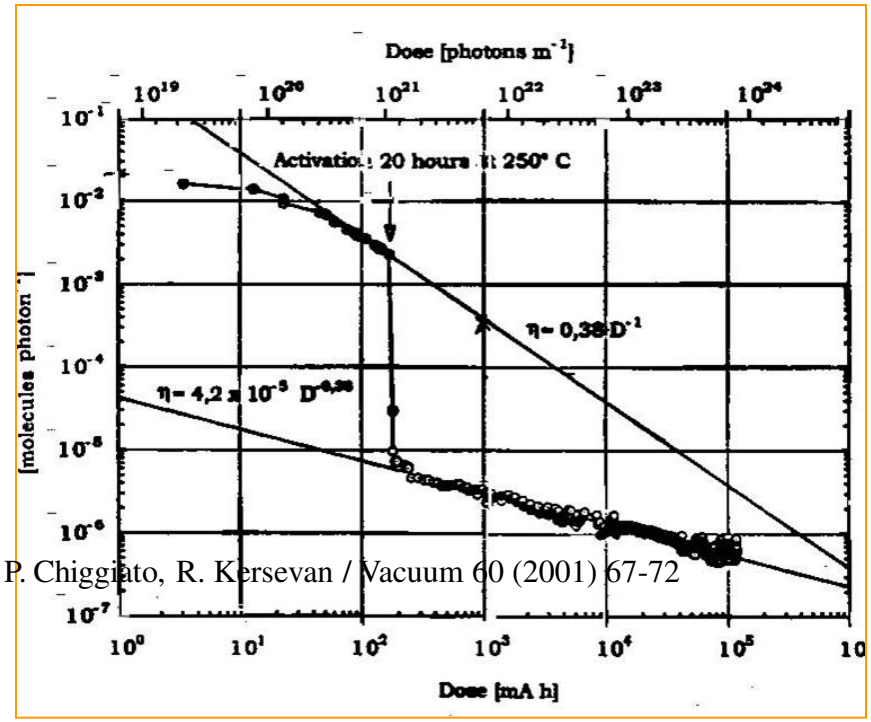


Total pumping speed on the ring : S ≈ 20 000 l/s

NEG coating

What was expected?

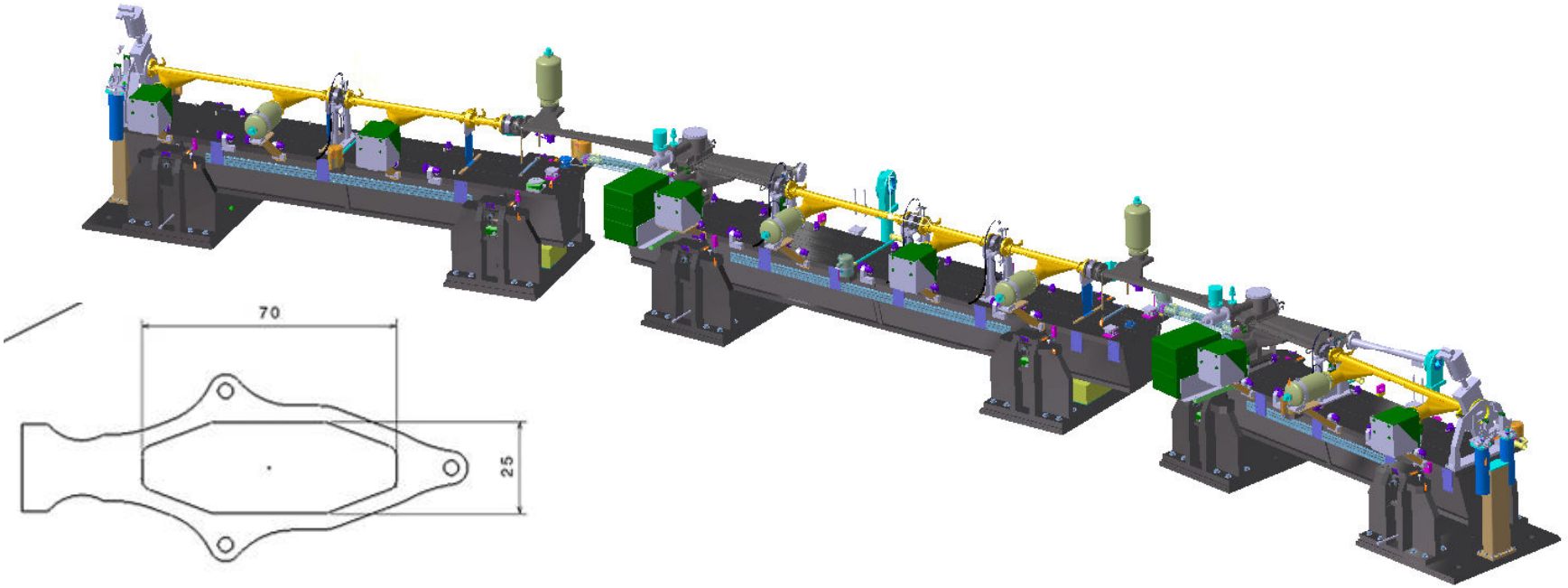
Fast decreasing of the photon stimulated desorption rate in comparison with the raw material



P. Chiggiato, R. Kersevan / Vacuum 60 (2001) 67-72

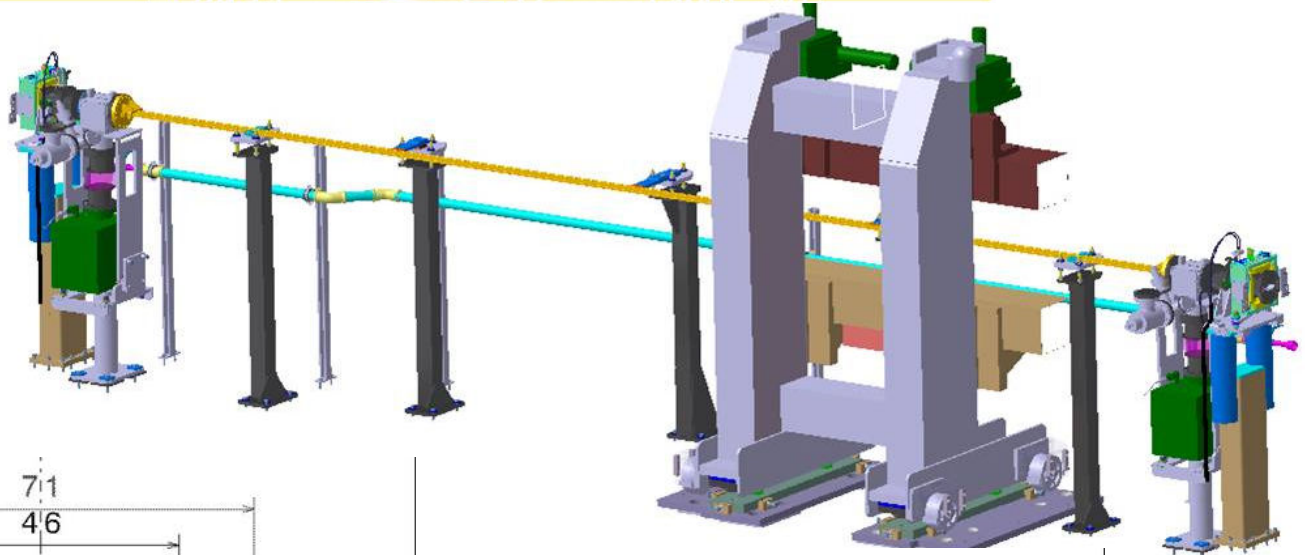
- Fast decrease of the PSD rate
- Shorter conditioning time
- Fast decreasing of the Bremstrhalung radiation rate

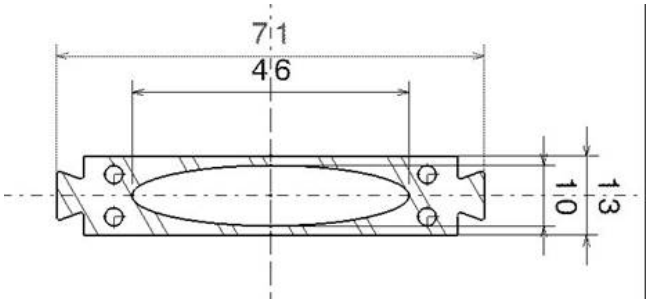
The NEG coated vacuum vessels of a cell

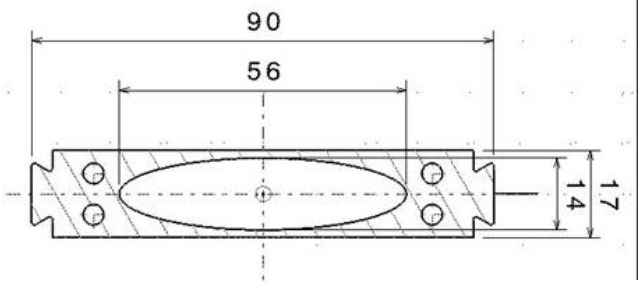


Together with the Straight Sections chambers,
~200 m of NEG coated Al chamber (56% of the ring)

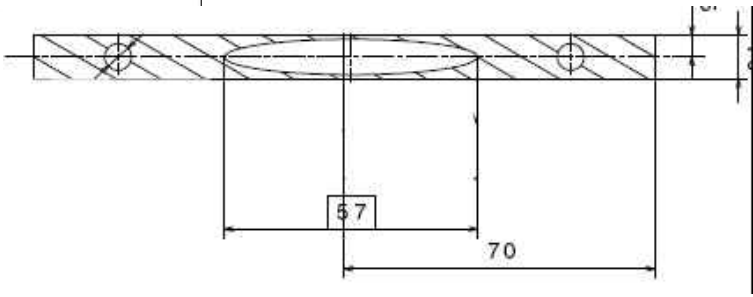
NEG coated vacuum vessels for insertion devices







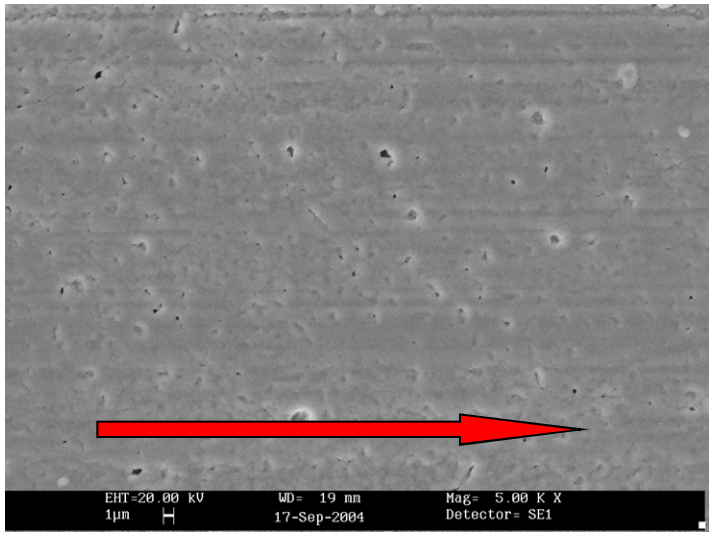
Vacuum vessels for insertion devices
Quantity 20 distributed over 5 different types
Length : from 3 to 10,5 meters
Specific treatment : NEG on the main tube



ESRF profile

Coating roughness

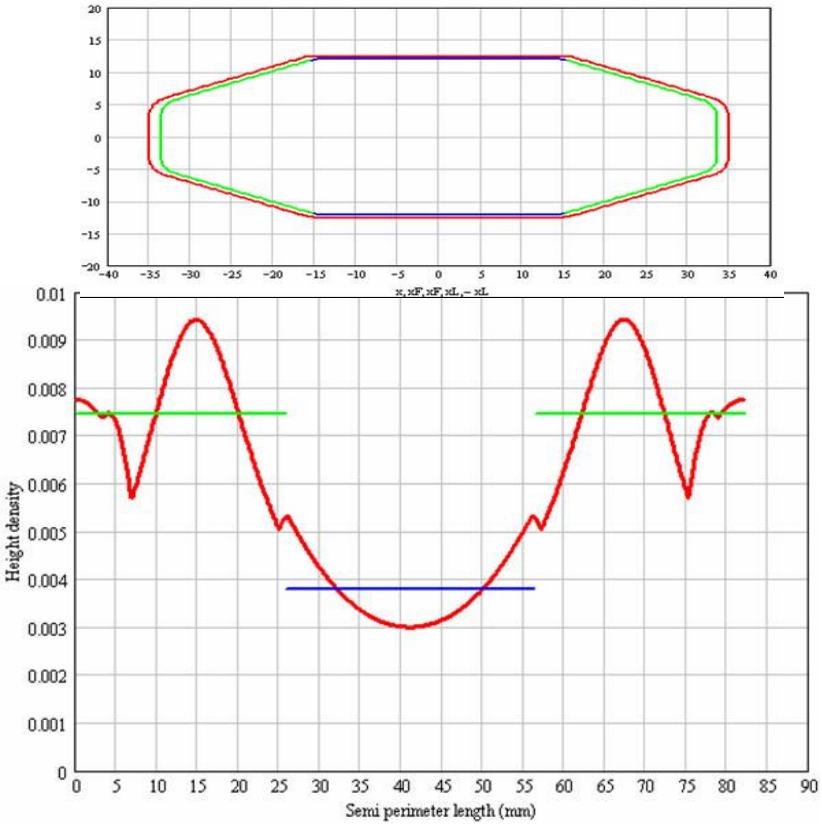
- Final roughness depends on :
  - the roughness of the buffer : Ra = 0.3 µm RMS
  - Growth conditions of the layer



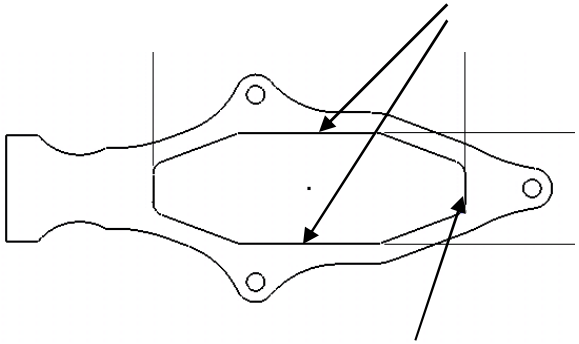
NEG coating on the test vacuum vessel (SAES Getter)

Extrusion direction = e^- beam direction

Thickness distribution of the coating



Maximum image current densities



Primary photon impact area

Coating with 2 cathodes
0.5 µm < e < 1.5 µm

Manufacturing of the quadrupole vessels

107 vacuum vessels have to be coated after manufacturing

- **1 manufacturer for the chambers**
- **1 manufacturer for the NEG coating**

Cleaning can be an critical issue for the quality of the coating particulary for aluminium

The cleaning procedure have been validated by the manufactuer of the NEG coating after expertise of CERN

The vacuum chambers have been delivered for NEG coating after acceptance by SOLEIL following the vacuum tests made by the manufacturer

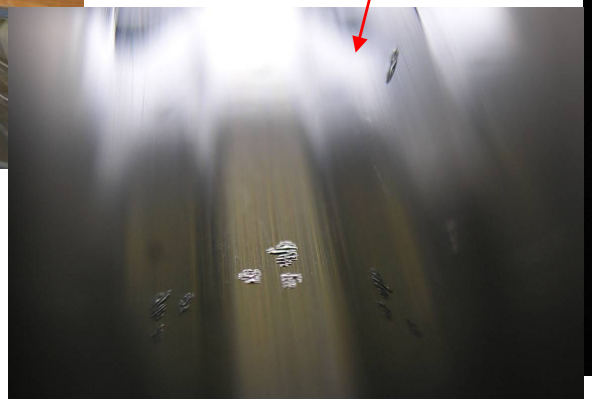
Despite all the steps of acceptance, different defects have been observed anyway leading SOLEIL to reject the NEG coating

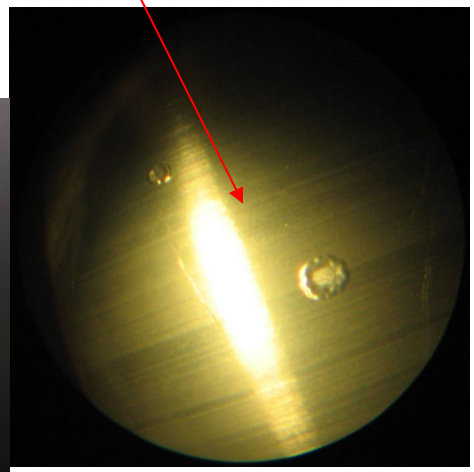
Contrôle des dépôts NEG

100% of NEG coated vessels have been checked befor
- 120 quadrupole type vessels
- 30 vessels for straight sections

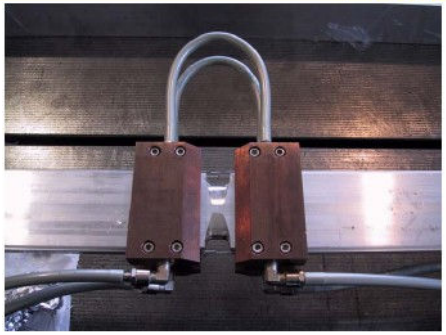
The quality of the coating is observed with an endoscop
Effeciency of the NEG is also mesured during an activa

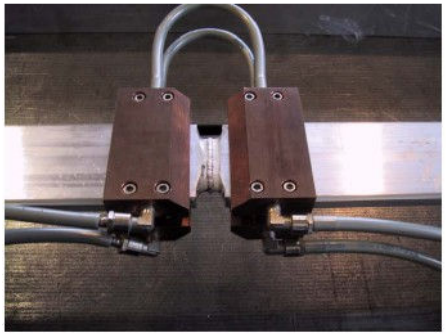
Different types of defects have been observed





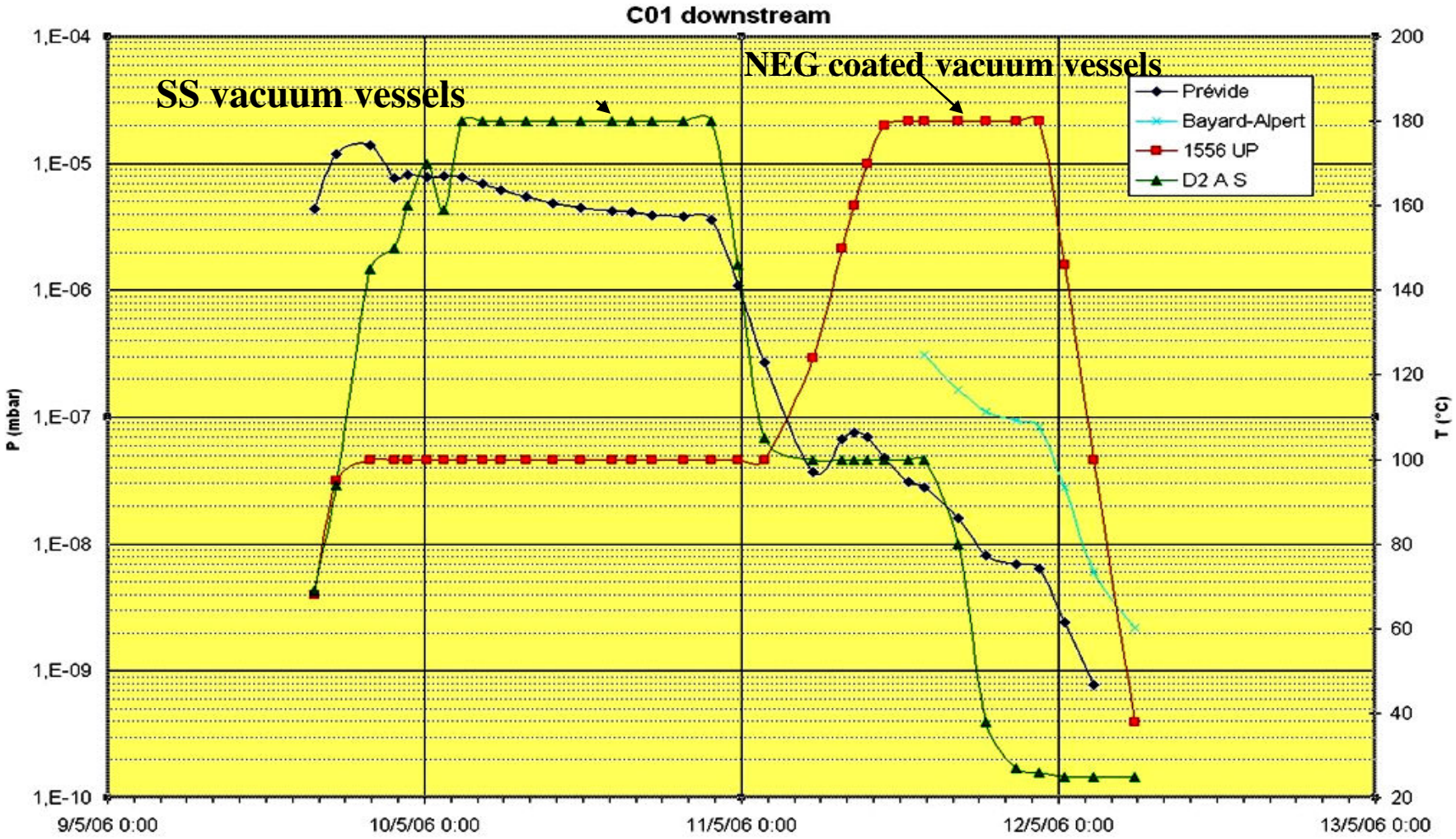
Vacuum chamber for HU640





- NEG coated in 2 parts 5m long (SAES)
- Welded together (CINEL)

Procédure d'activation

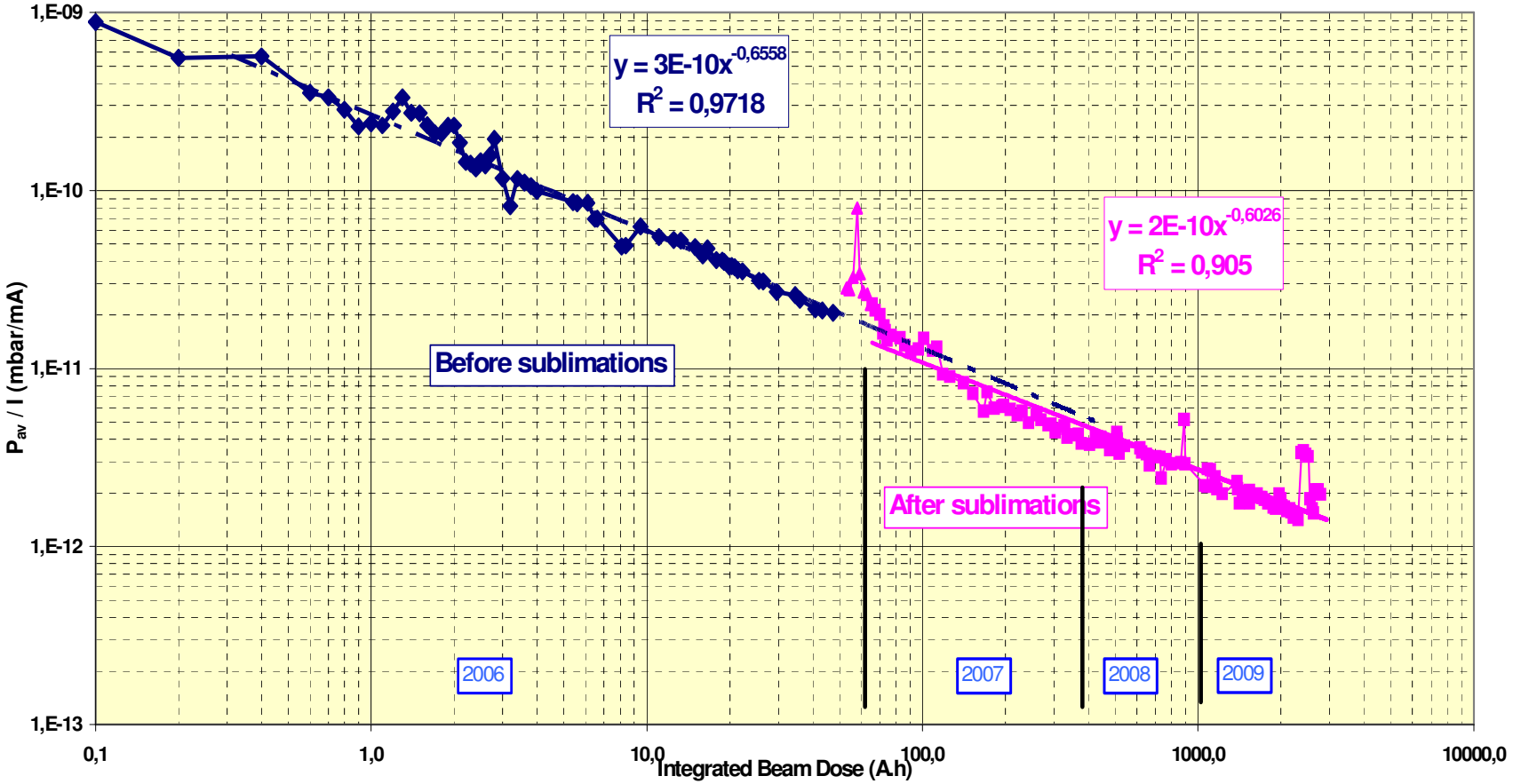


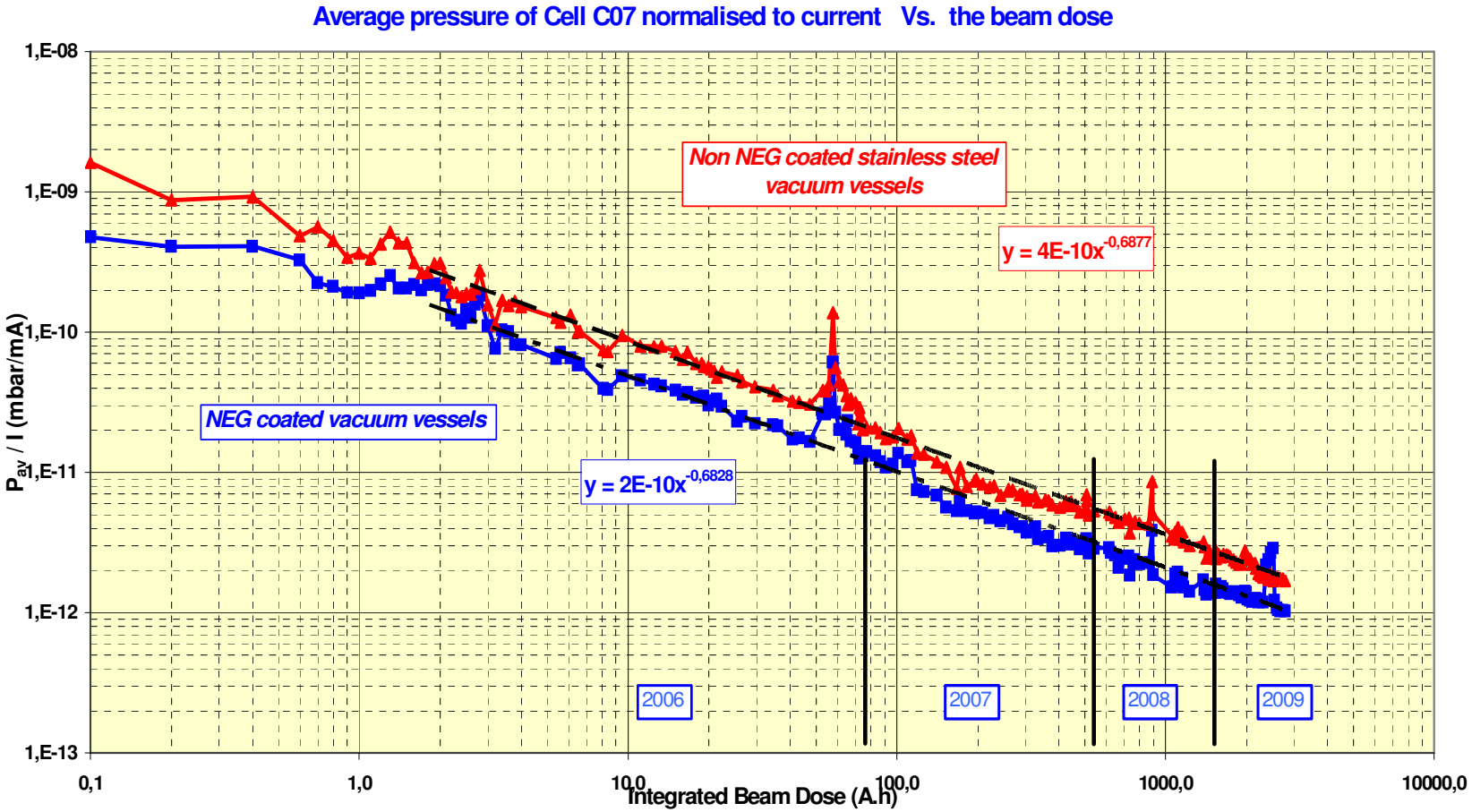
Conditioning : some figures

- Average pressure without beam : P= 4 10^{-10} mbar
  after bake-out except for the injection straight section
- Pressure increase with the first stored beam@ I=0.8 mA : P_{max} = 2 10^{-8} mbar

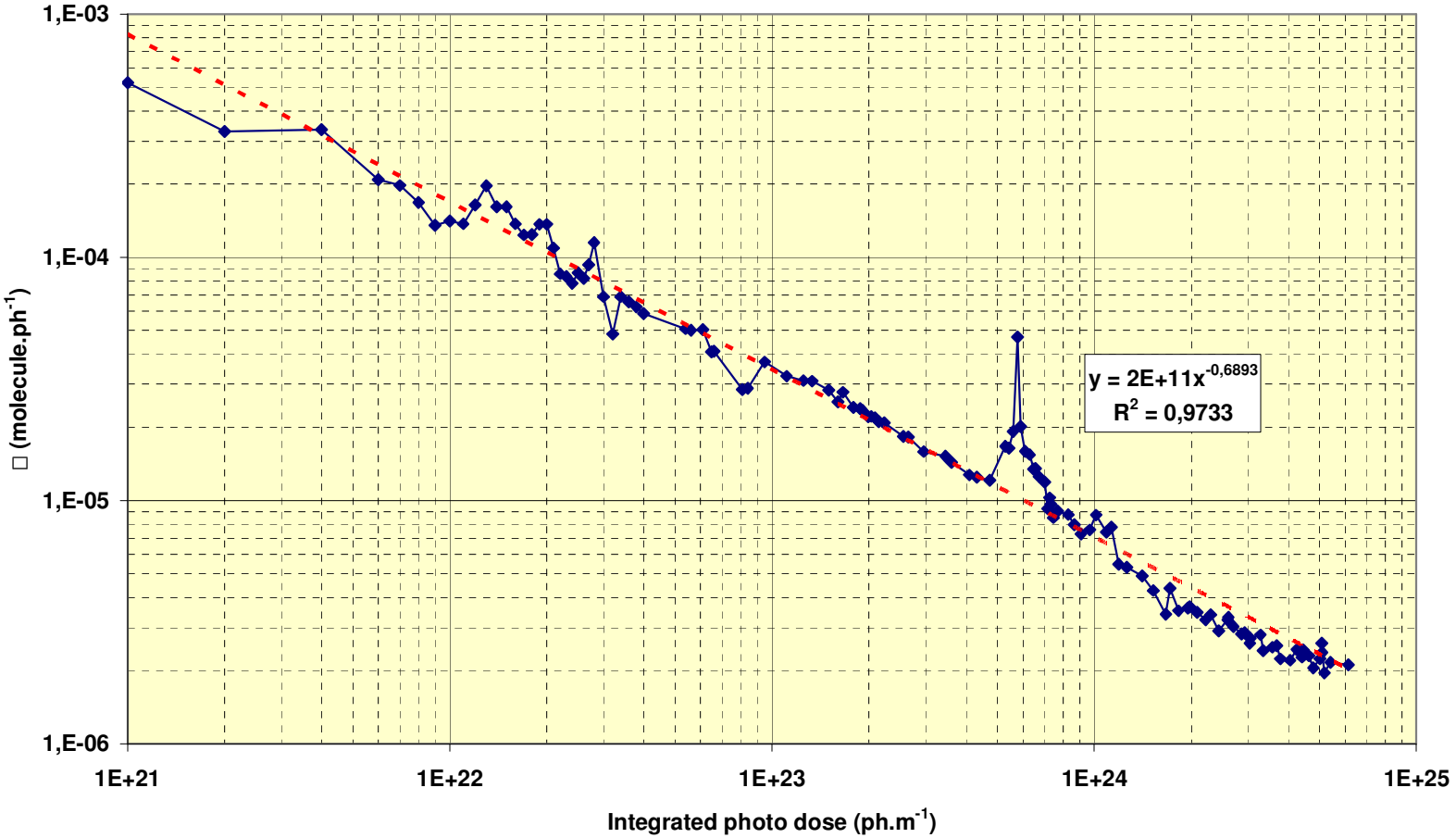
- Integrated beam dose : D=2200 A.h
  - Static pressure : P = 2.5 10^{-10} mbar
  - @ 300 mA beam for users :
    - Beam lifetime : Tau 20 h Pav = 8.2 10^{-10} mbar
  - @ 400 mA Maximum current:
    - Beam lifetime : Tau 16 h Pav = 1.2 10^{-9} mbar

Average pressure of Cell C07 normalised to current Vs. the beam dose

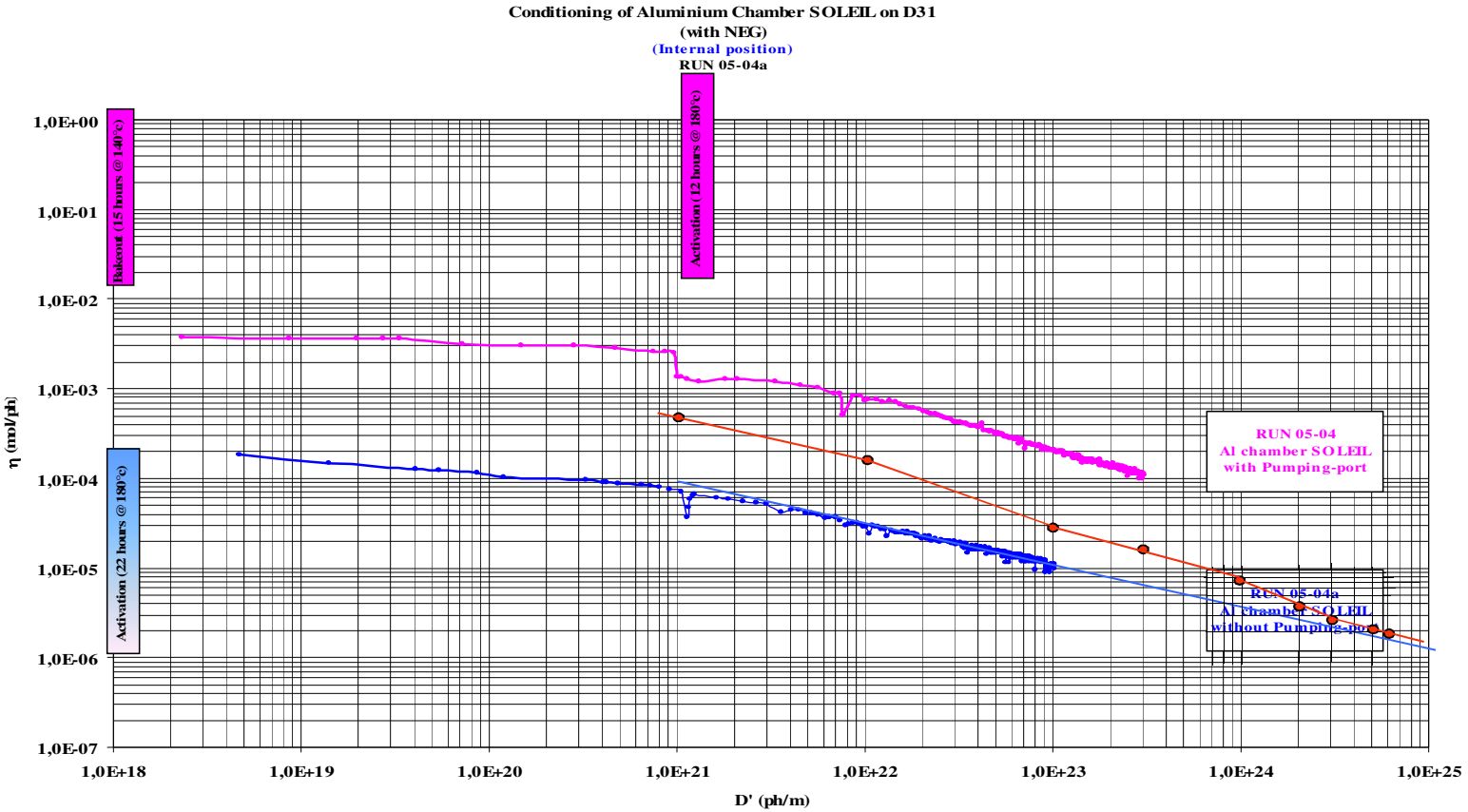



Average pressure of Cell C07 normalised to current Vs. the beam dose
1,E-08
1,E-09
1,E-10
1,E-11
1,E-12
1,E-13
Pav / I (mbar/mA)
Non NEG coated stainless steel vacuum vessels
y = 4E-10x-0,6877
NEG coated vacuum vessels
y = 2E-10x-0,6828
2006
2007
2008
2009
0,1
1,0
10,0
100,0
1000,0
10000,0
Integrated Beam Dose (A.h)

PSD molecular yield of cell C07 Vs. beam dose



Photon stimulated desorption
Comparison with the expexcted value



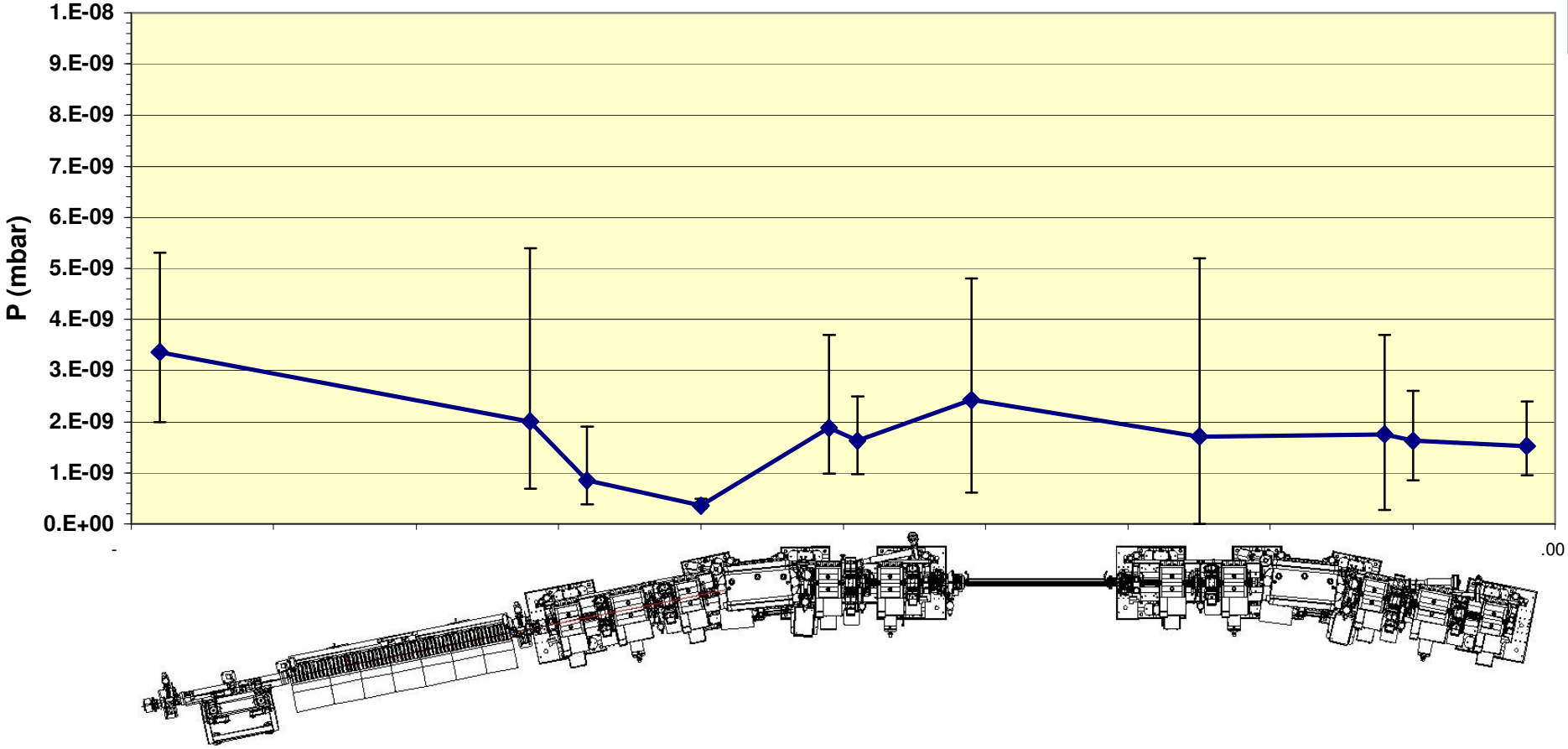
The two vacuum vessels have different behaviours :

The vacuum vessels with the pumping ports has a desorption yield with a factor of about 20 higher

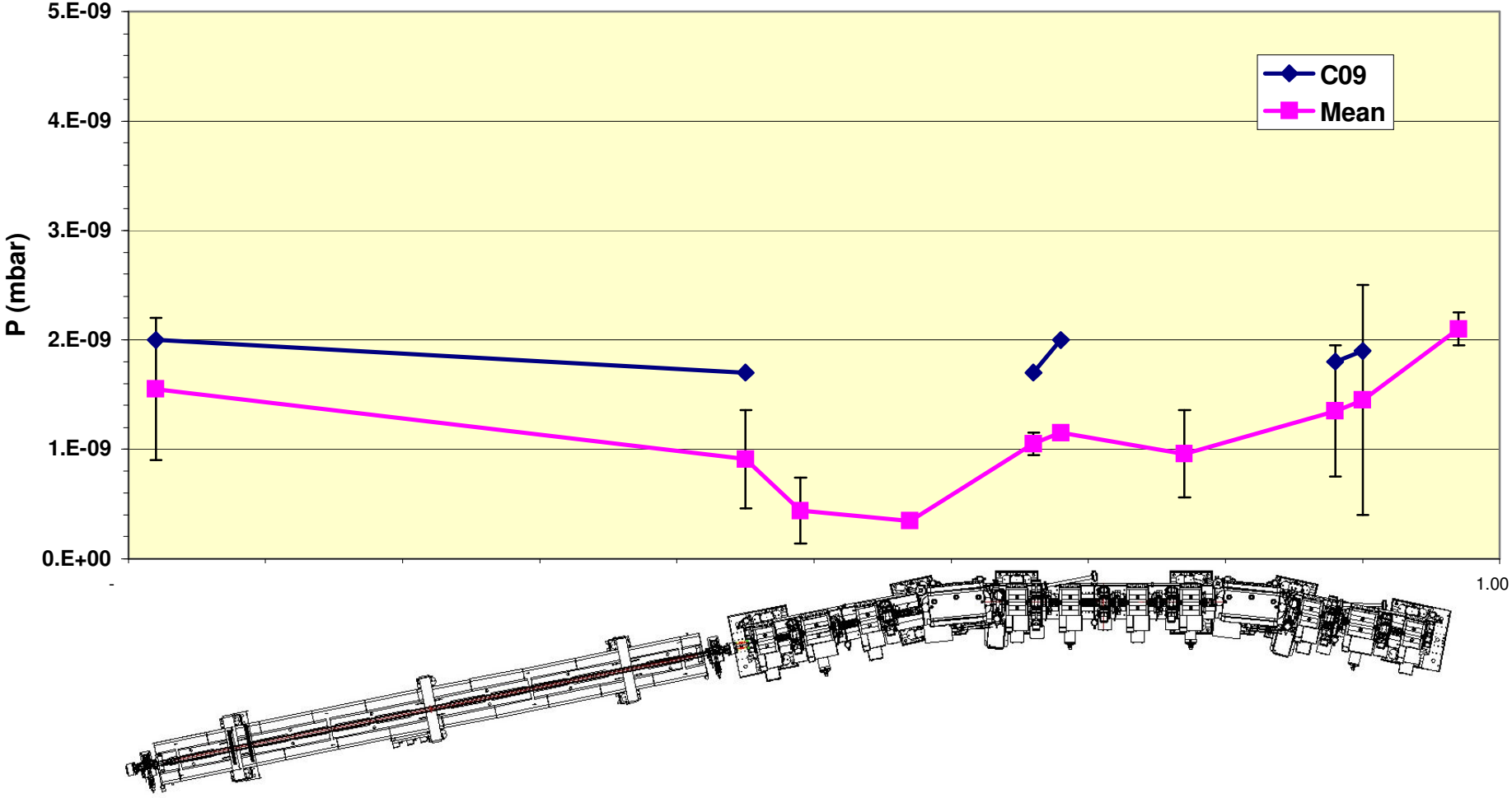
Contribution of the pumping ports (without coating and non equipped with pumps) may be the reason of that difference

Acknowledgments to ESRF : G. Debut, M. Hahn and R. Kersevan

Pressure profile for C02 type cells
(D = 426 A.h, I = 300 mA)

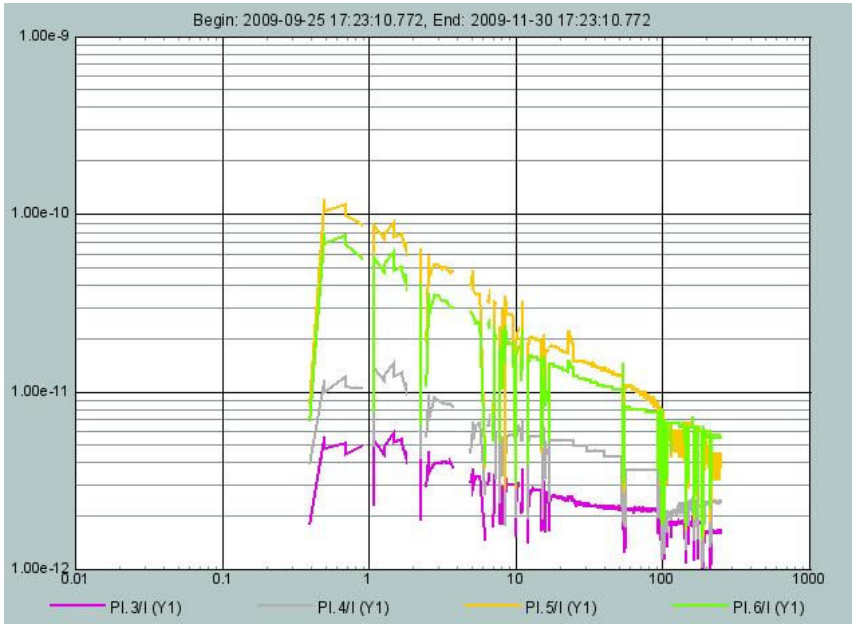


Pressure profile for C05 type cells
(D =426 A.h, I = 300 mA)



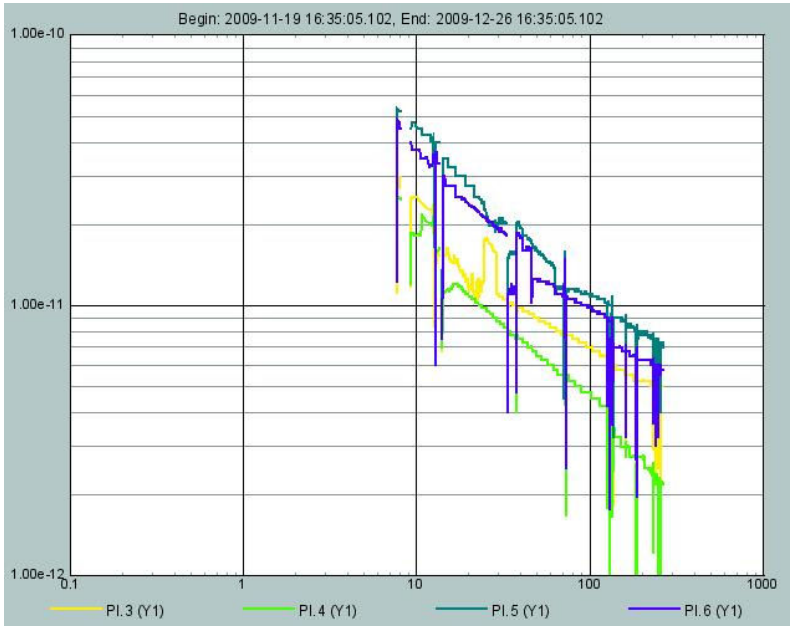
Behavior of NEG coating with no activation

Cell C10 upstream after replacement of the crotch absorber



Cell has been baked-out

Cell C11 upstream after replacement of the crotch absorber



Cell has been not baked-out because of a leak problem during the day of re-condition. We decided to start again with no bake out and so no activation of the NEG coating after reparation of the leak

Conclusions

- **Conditioning :**
  - **Fast beam current rise at the begining with no vacuum limitation**
  - **The low Bremstrahlung radiation rates measured in front of the straight section demonstrate the efficiency of the NEG coating even with small vertical aperture and very long vessel**
  - **Fast recovery of the beam lifetime after venting a cell and reactivation of the NEG**

- **Standard pumping :**
  - **Compensate the non NEG coated pumping ports (effect of the TSP)**
  - **Probably non necessary in NEG coated parts (a minimum are required for noble gases)**

- **A suitable bake-out system is required for the activation of the NEG coating**