

Status of infusion studies at IJCLab/IRFU

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On behalf of all people involved :

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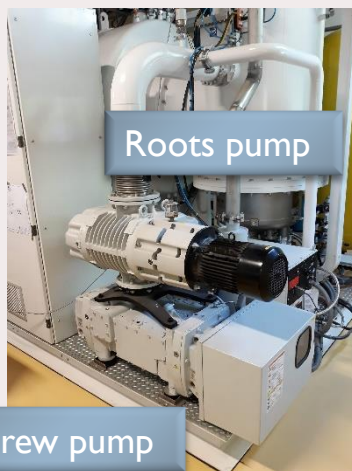
T. Proslie, C. Antoine, E. Cenni, IRFU, CEA Saclay



- ▶ **Facilities (the furnace)**
- ▶ **Furnace qualification**
 - ▶ Conventional H-degassing
 - ▶ Infusion-like degassing
- ▶ **Infusion test**
 - ▶ First on sample
 - ▶ Second on cavity
- ▶ **Conclusion and upgrades**

Furnace presentation

- ▶ Built by TAV Vacuum Furnaces Spa and commissioned in 2016
- ▶ Routinely used for hydrogen degassing (650°C, 10h) of SPOKE resonators with Ti jacket
- ▶ Dimensions : Max diameter : 700 mm. Max Length : 1600 mm
- ▶ Temperature up to 1300°C (1°C – 10 °C per minutes). Homogeneity : +/- 5°C
- ▶ Vacuum systems
 - ▶ Primary : Dry screw pump + roots
 - ▶ Secondary : cryogenic pump
 - ▶ Vacuum : 5^{E-7} – 1^{E-6} mbar



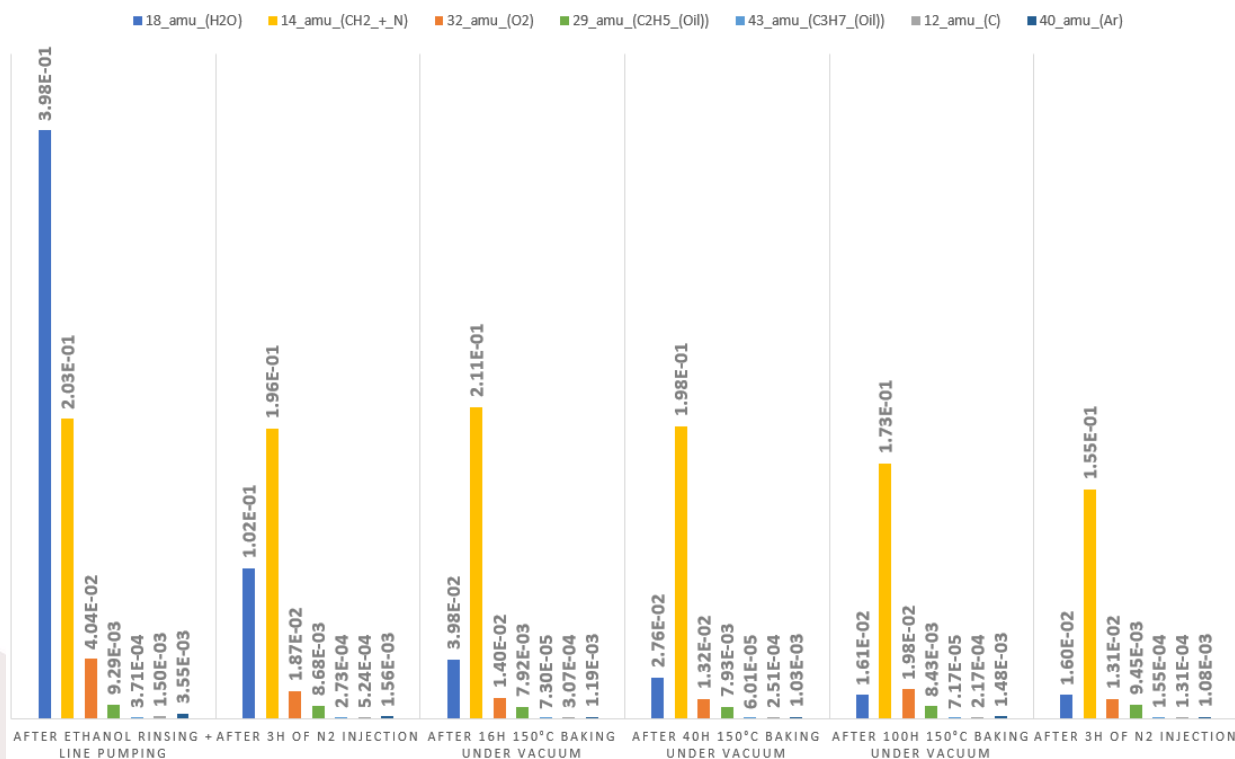
- ▶ Air liquide ALPHAGAZ 2 (>99.9999%)
- ▶ Stainless steel line
(Ethanol rinsed + 150°C baking for > 100h)
- ▶ Contamination measurement with RGA while injecting at 10⁻⁴ mbar in furnace



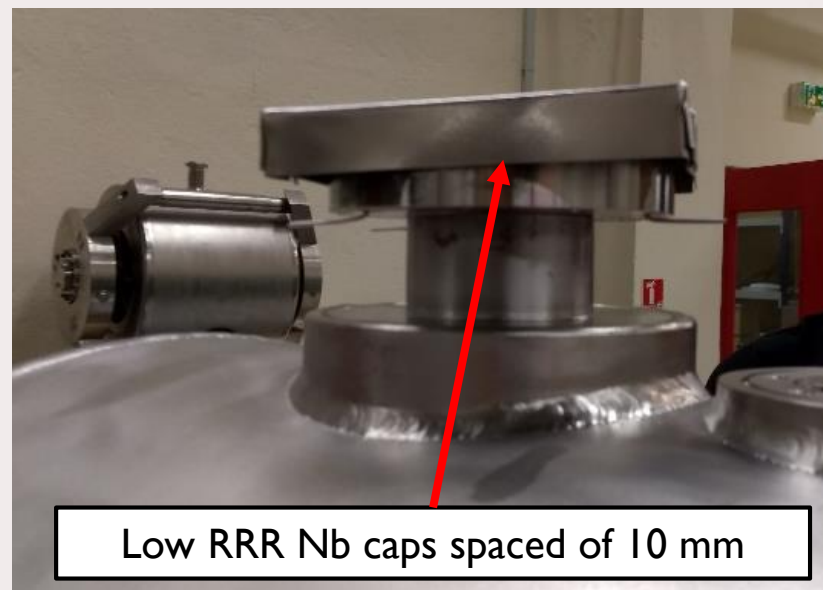
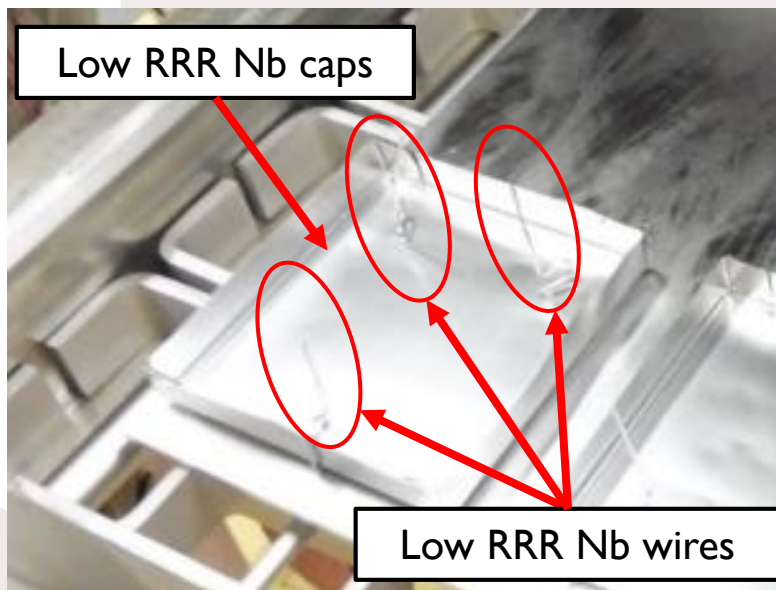
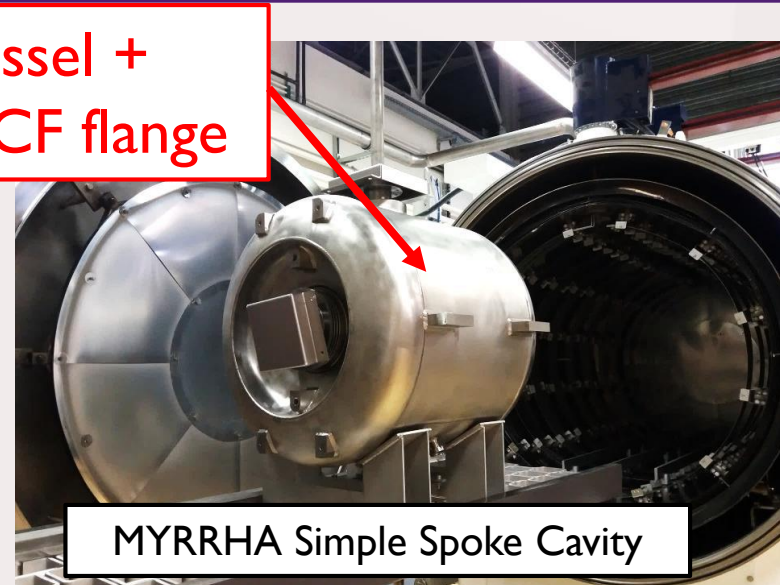
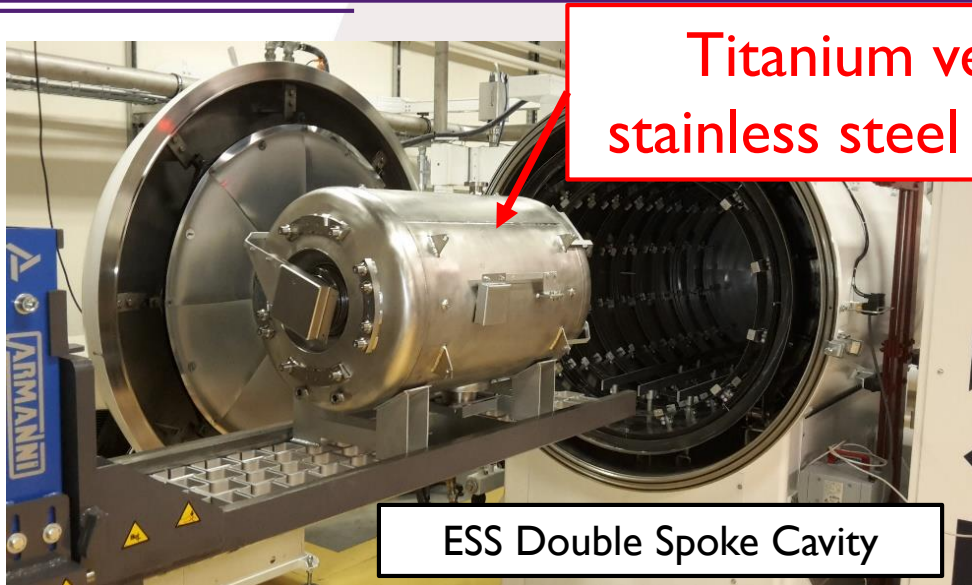
ALPHAGAZ 2 AZOTE

Pureté globale (% mol)	Impuretés (ppm-mol)	
N ₂		
≥ 99,9999	H ₂ O	≤ 0,5
	O ₂	≤ 0,1
	C ₂ H ₆	≤ 0,1
	CO	≤ 0,1
	CO ₂	≤ 0,1
	H ₂	≤ 0,1

N2 INJECTION LINE DECONTAMINATION, NORMALIZED N2 (RAW SIGNAL)

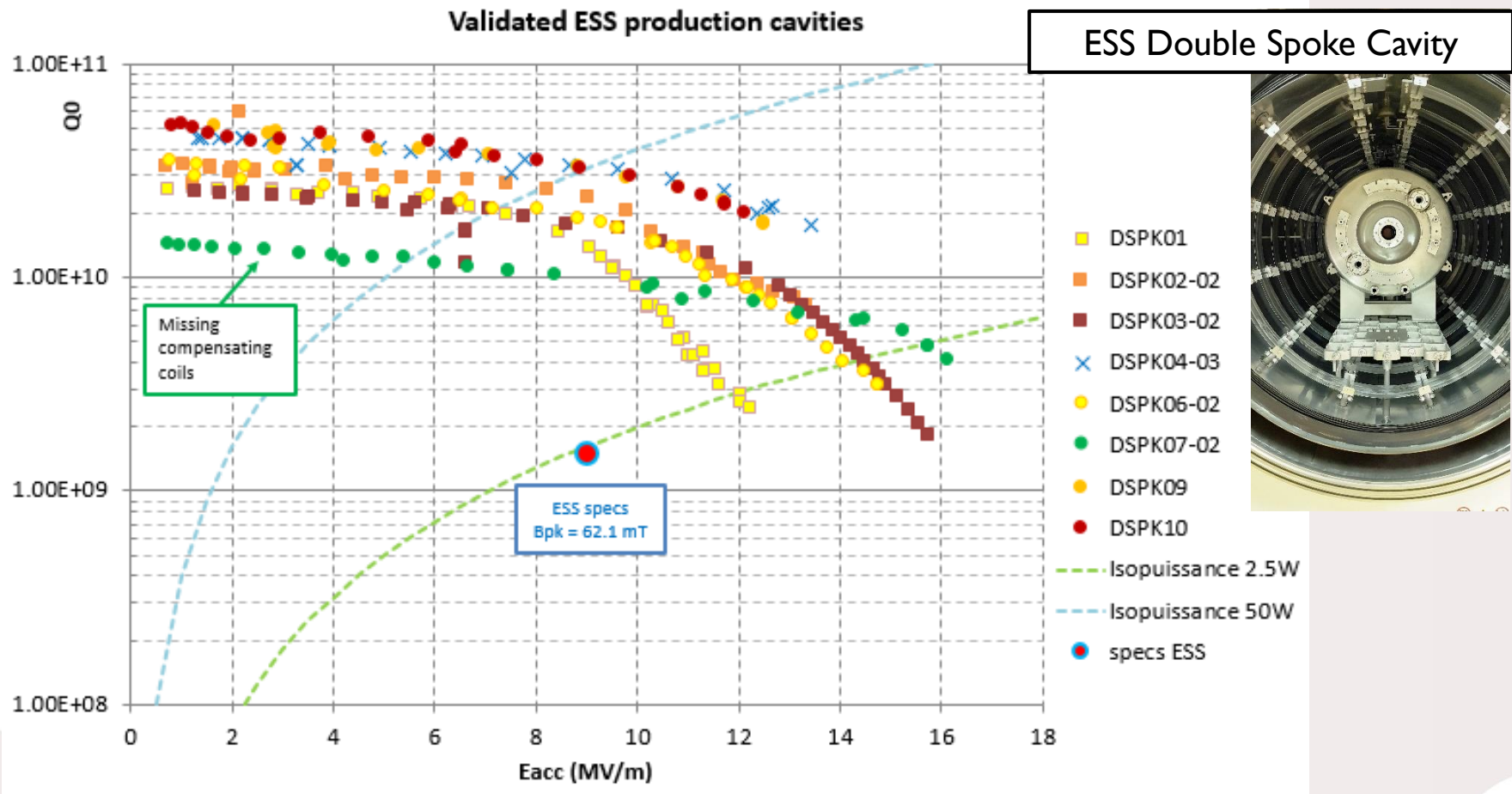


Cavities and caps



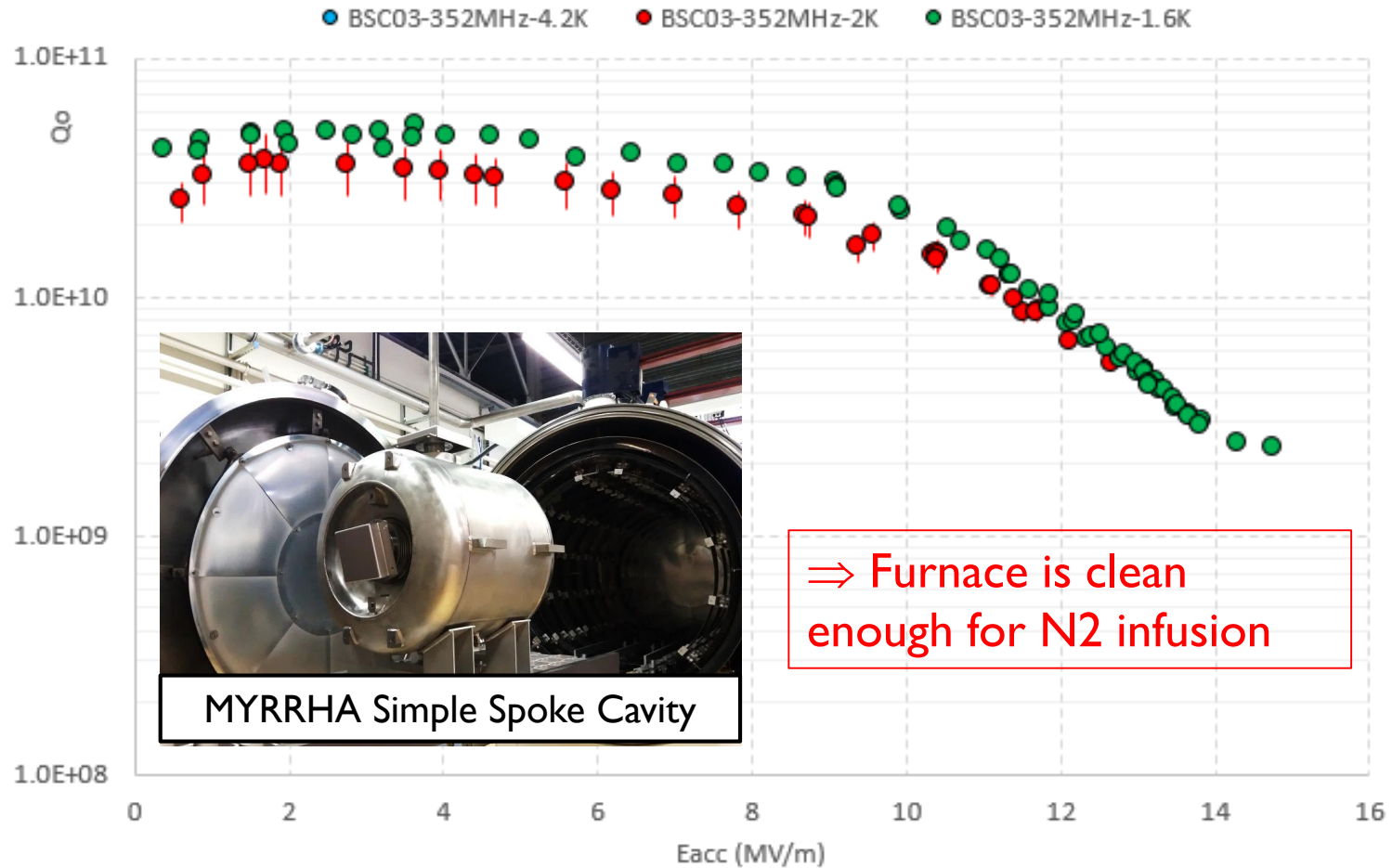
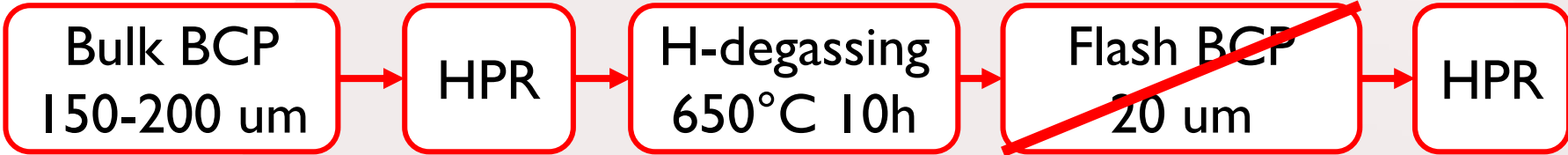
Conventional H-degassing

Furnace qualification



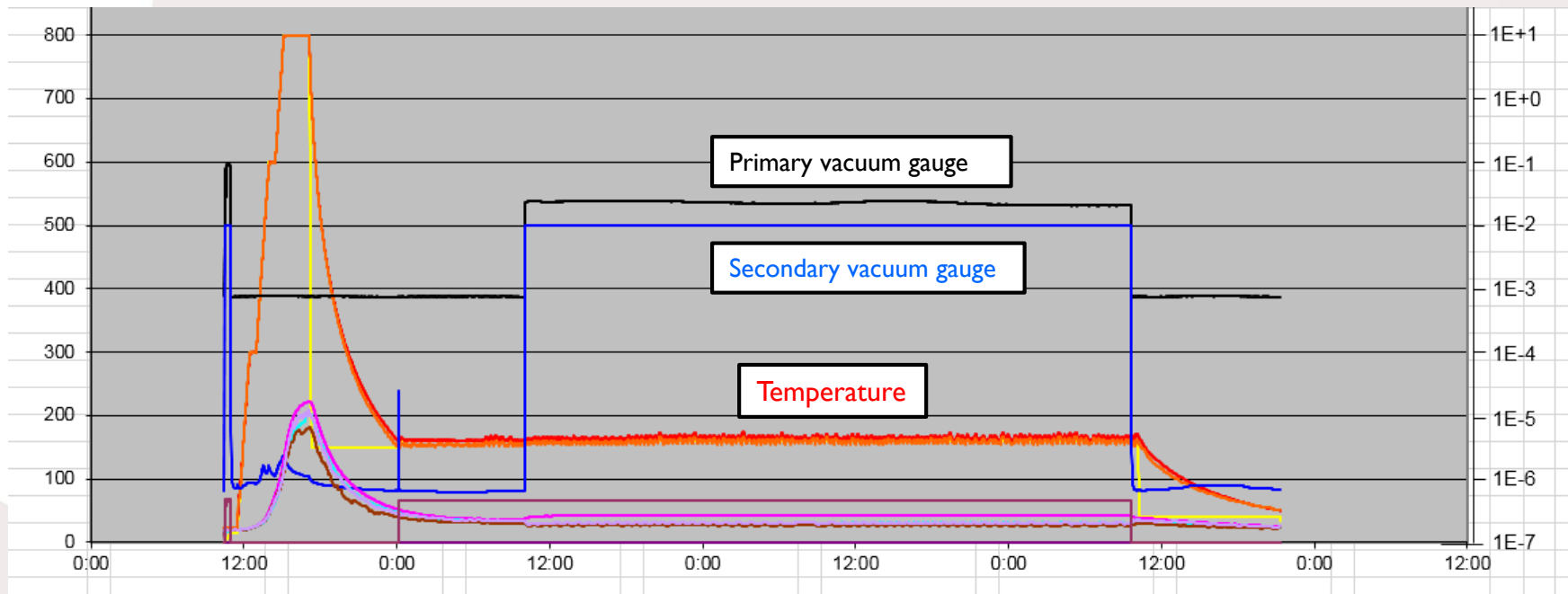
Infusion-like H-degassing

Furnace qualification

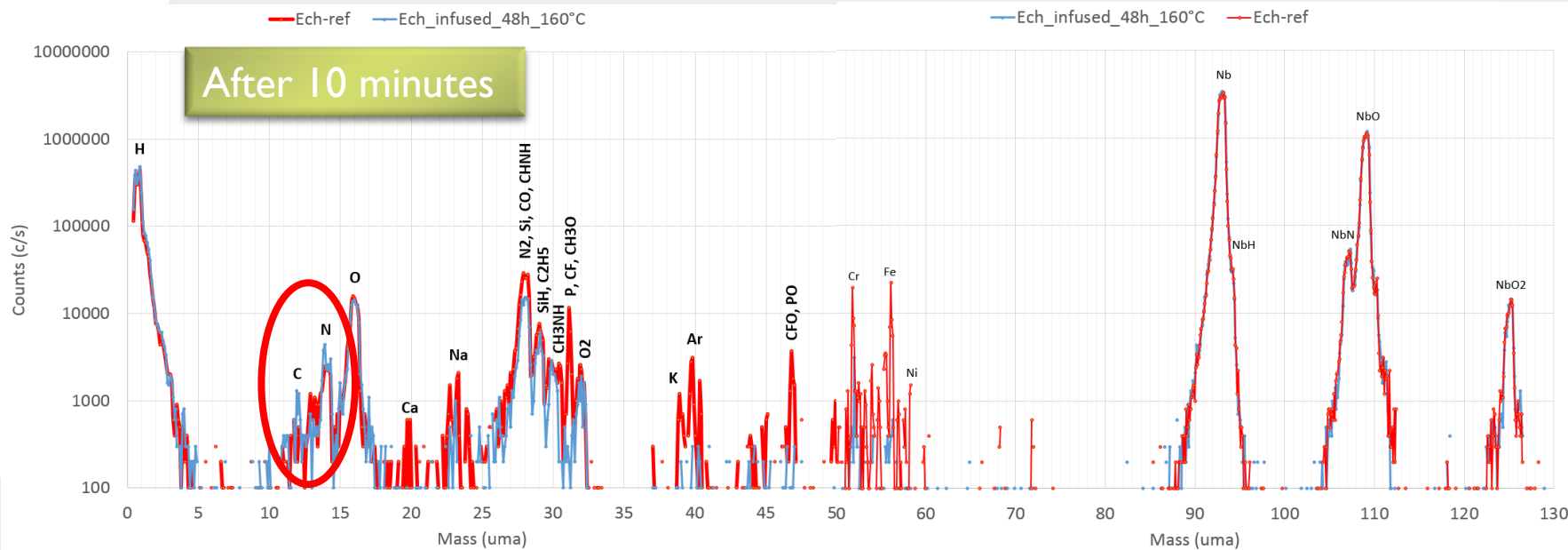


⇒ Furnace is clean enough for N₂ infusion

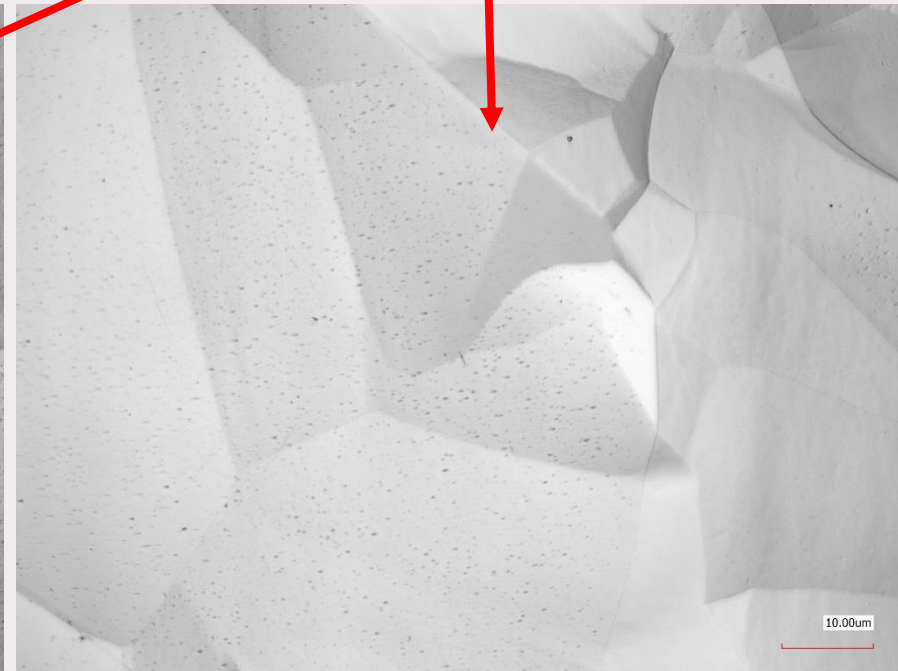
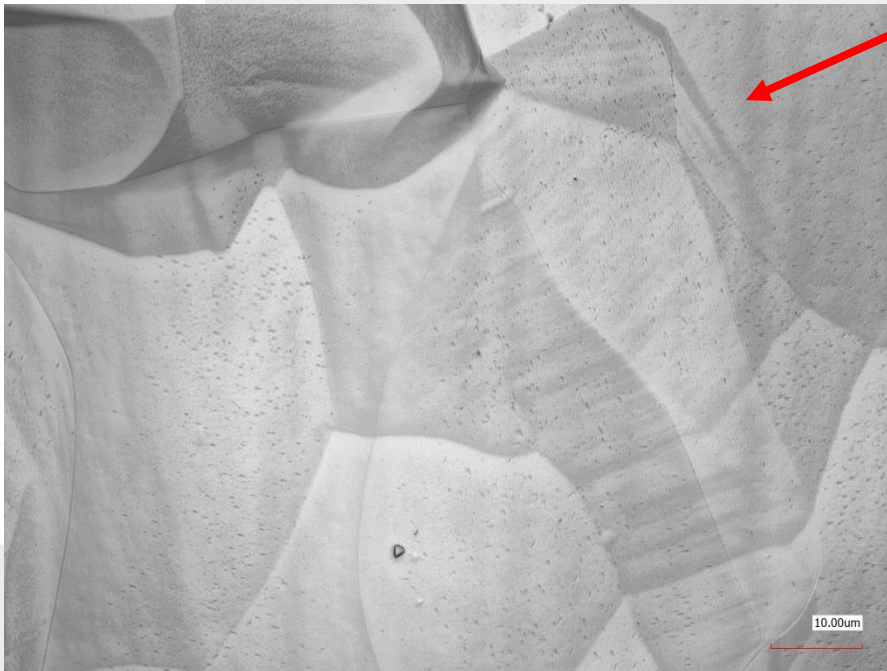
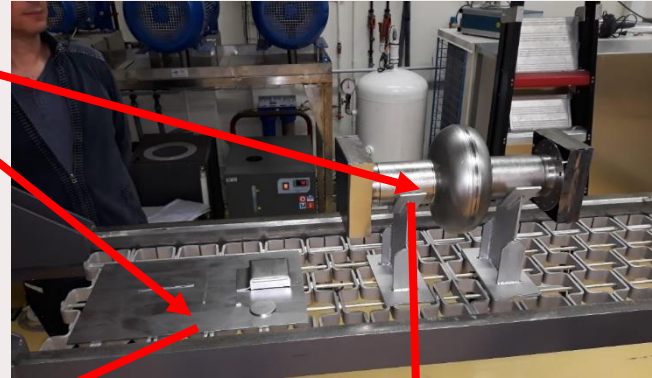
- ▶ First infusion test done on Niobium samples (50 um BCP) exposed directly in furnace (not in Niobium box)
- ▶ Cycle :
 - ▶ 800°C during 2h under vacuum
 - ▶ Cooling down at 160°C under vacuum
 - ▶ 160°C during 48h with 2.5×10^{-2} mbar N₂
 - ▶ Cooling down to 40°C under vacuum



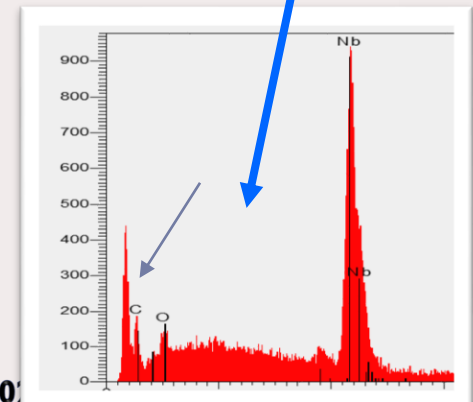
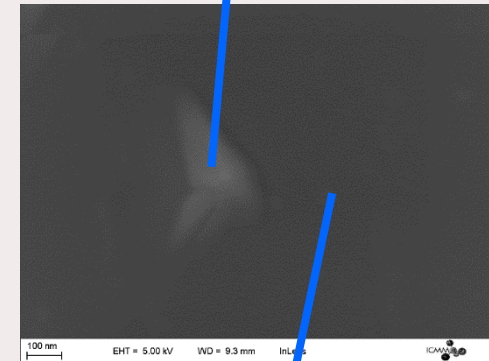
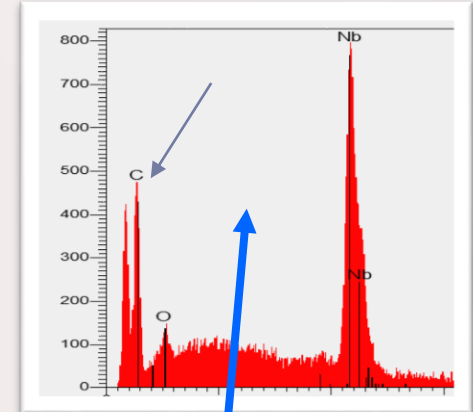
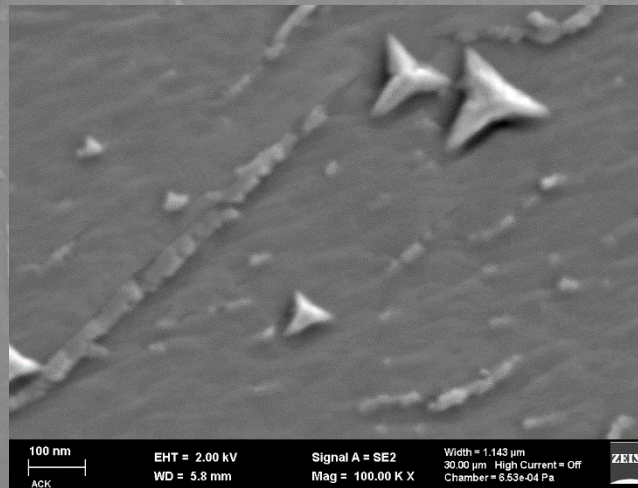
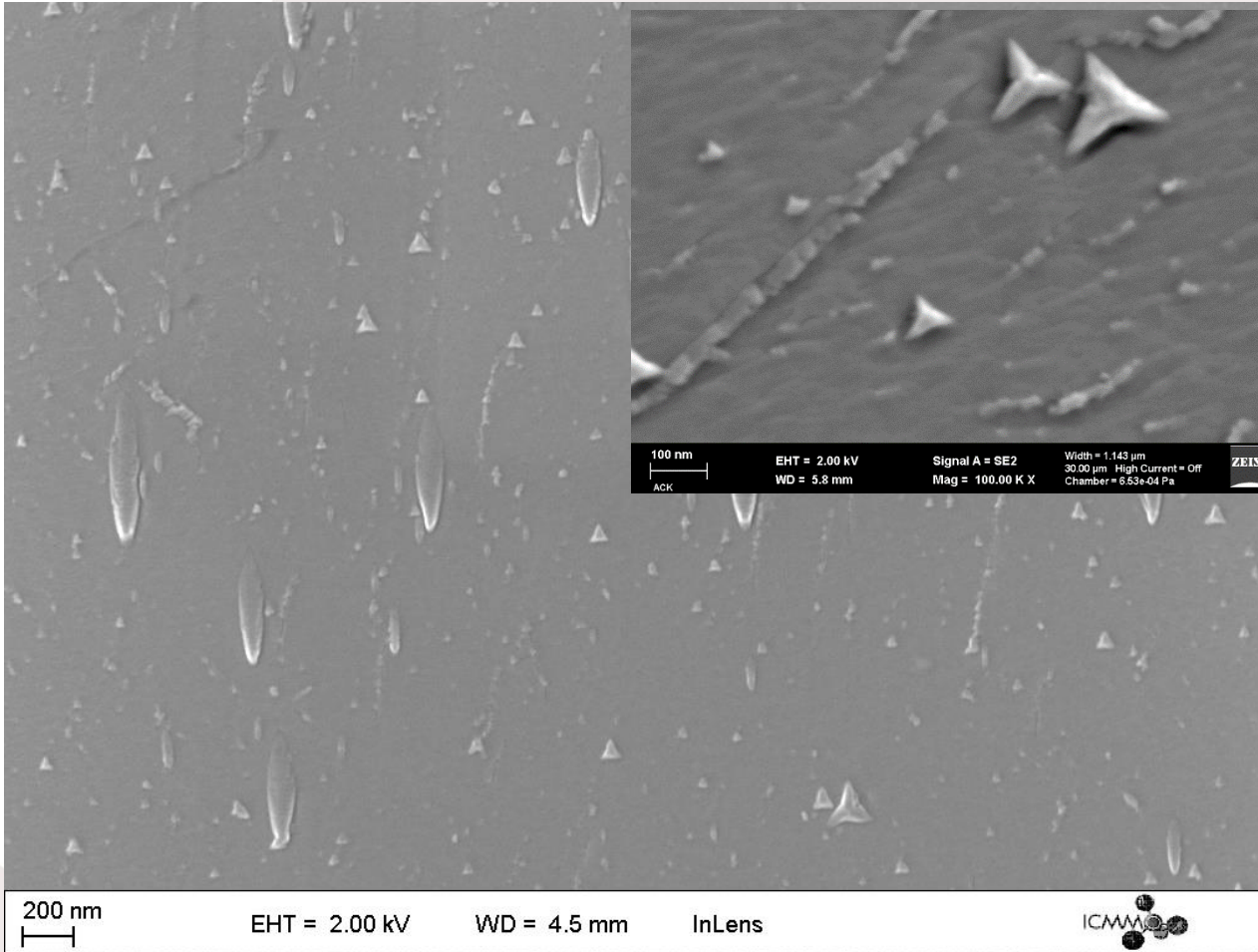
- ▶ Compact SIMS from Hidden Analytical available at IJCLab
 - ▶ Argon 5 keV at 300 nA
 - ▶ Oxygen 5 keV at 300 nA
- ▶ Sample analysis with Oxygen :
 - ▶ Red : reference sample (just BCP)
 - ▶ Blue : sample infused with N₂

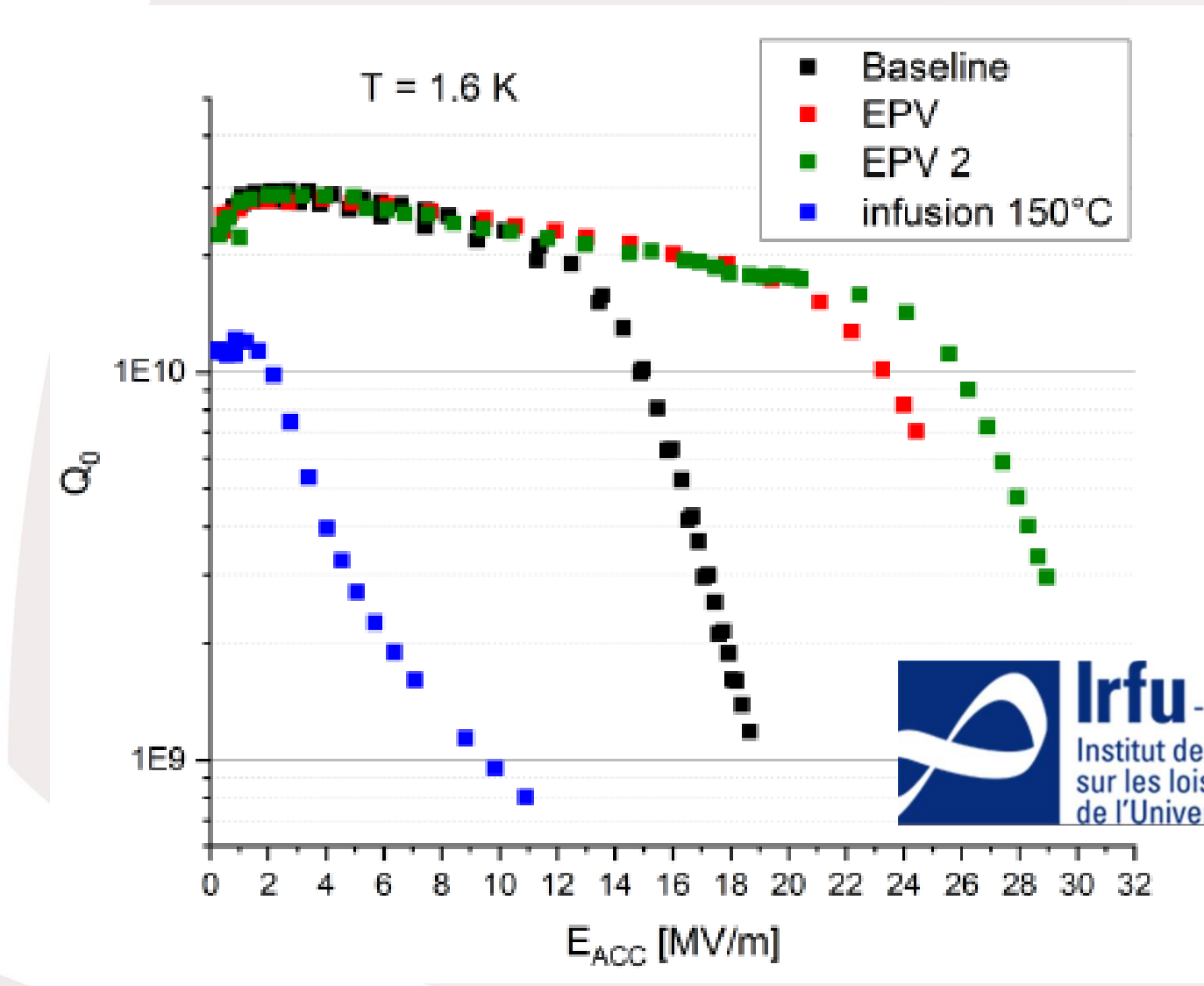


- ▶ Second infusion test done on 1.3 GHz elliptical cavity (EP) with Nb caps (BCP) + Nb samples (BCP)
- ▶ Cycle :
 - ▶ 800°C during 2h under vacuum
 - ▶ Cooling down at 150°C under vacuum
 - ▶ 150°C during 48h with 2.5×10^{-2} mbar N₂
 - ▶ Cooling down to 40°C under vacuum



- ▶ SEM analysis done at ICMMO (F. Brisset)
 - ▶ ZEISS Sigma HD





- ▶ Furnace cleanliness has been qualified several times
 - ▶ Infusion-like H-degassing gives very good cavity performances
- ▶ Niobium carbides grow on the surface when nitrogen is injected
 - ▶ Nitrogen purity is not good enough
 - ▶ Injection line has been cleaned but not thoroughly
 - ▶ Chemical filter has been received to filter nitrogen just before injection



<i>SUBTRONIC® line</i>	CATALYTIC REACTORS				
Type	125	500	1 500	2 500	5 000
Purified gas	Rare gases, Argon, Nitrogen				
Capacity - Nm ³	125	500	1 500	2 500	5 000
Removed impurity	H2O, CO, CO2, O2, H2, CH4				
Impurity outlet level - ppb	<1				

