

Update on PSD and pumping properties measurements at SOLEIL

5th IFAST Task 10.5 Meeting on 24th September 2024

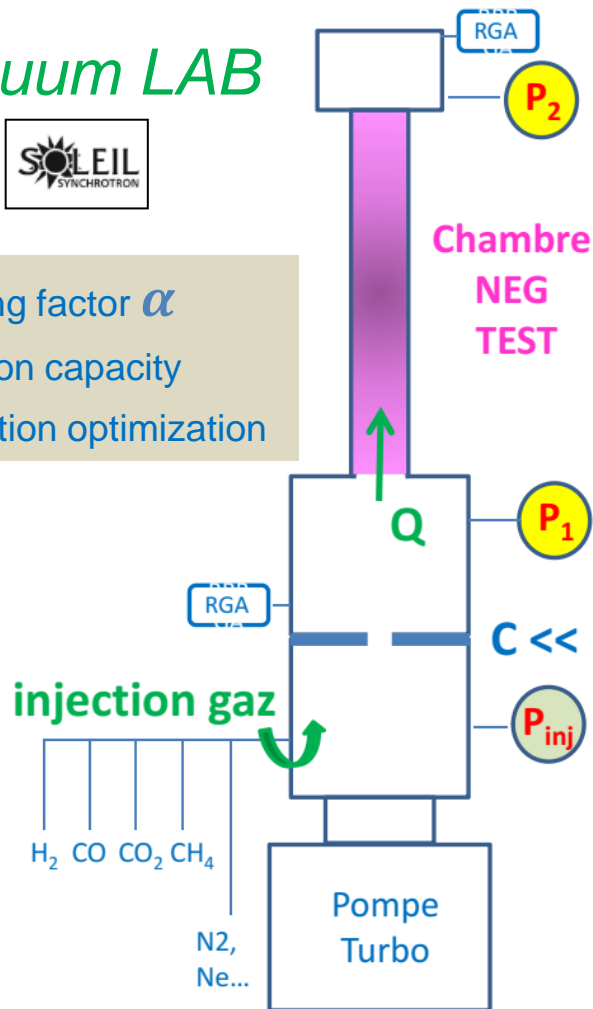
Nicolas Béchu, Christian Herbeaux, Thomas Souské,
Angélique Rouquié, Nicolas Baron, Cyril Arrachart

On behalf of Vacuum Group, D08-1 PSD and Transmission Bench 3 Task Forces

@ Vacuum LAB



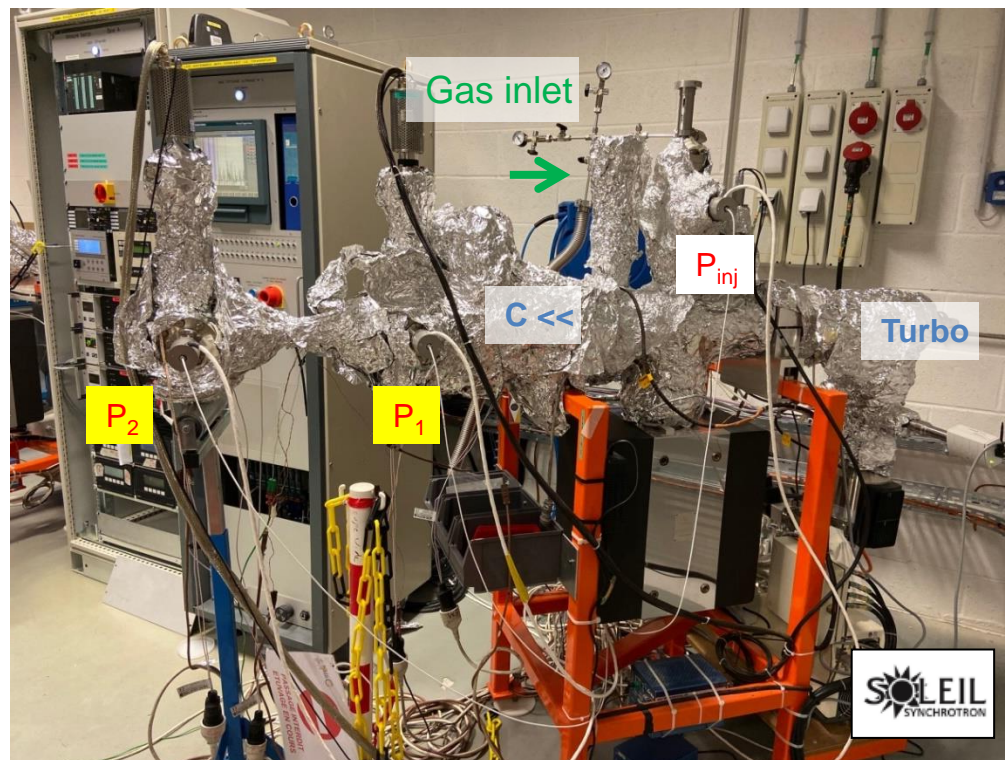
- Sticking factor α
- Sorption capacity
- Activation optimization



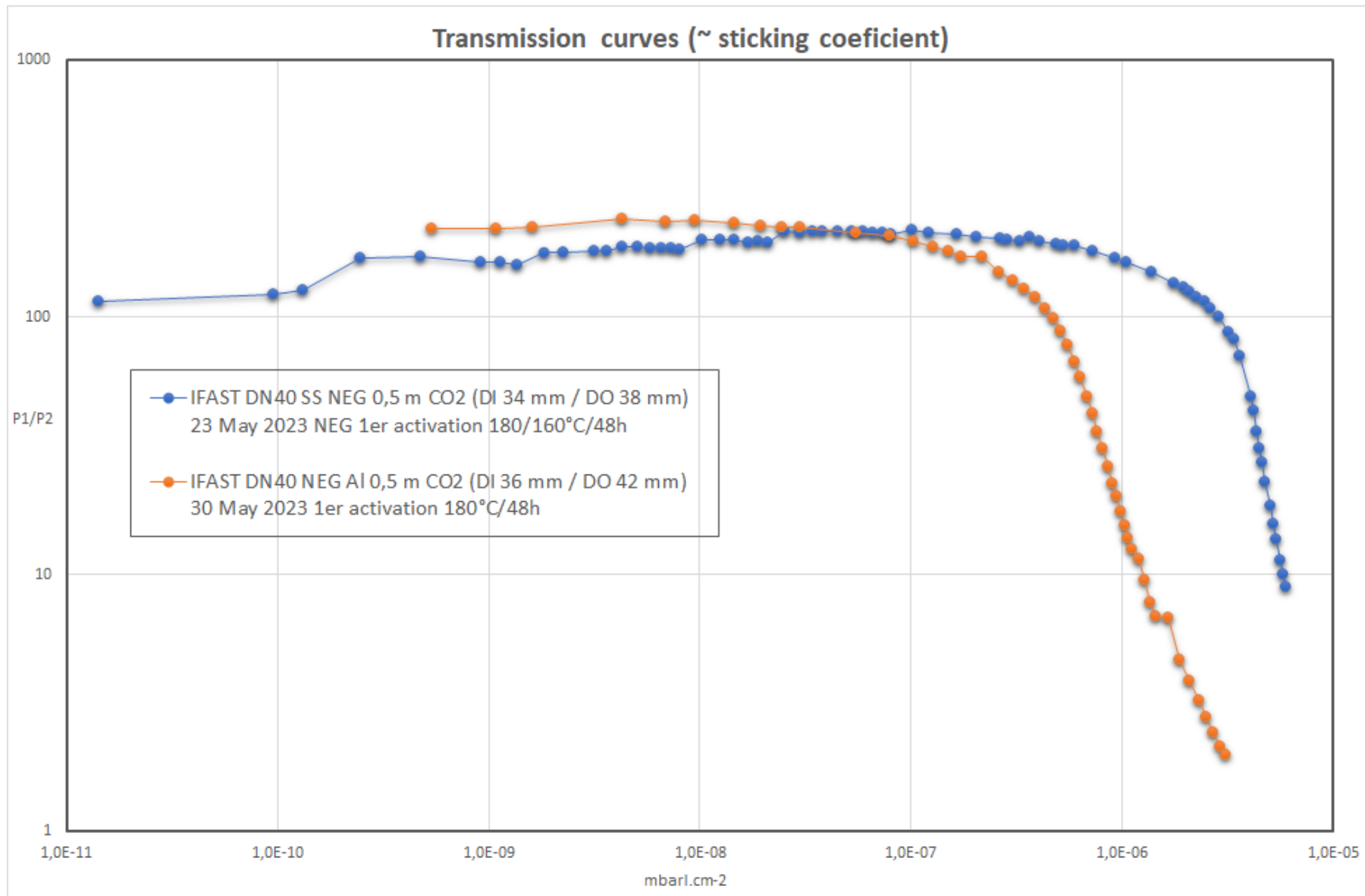
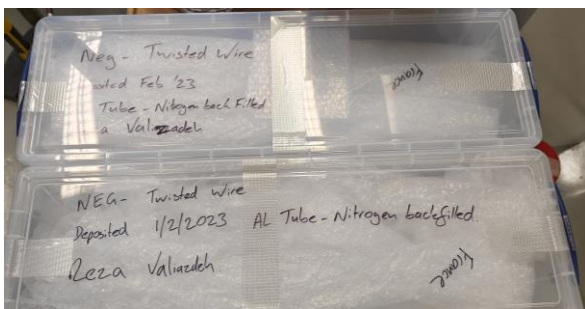
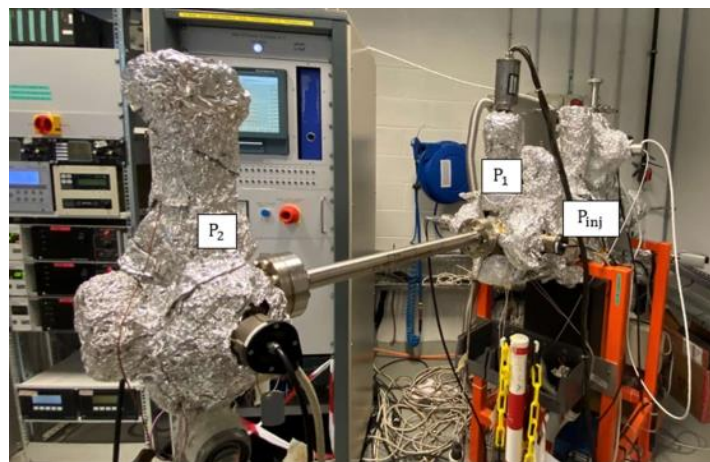
Transmission Method

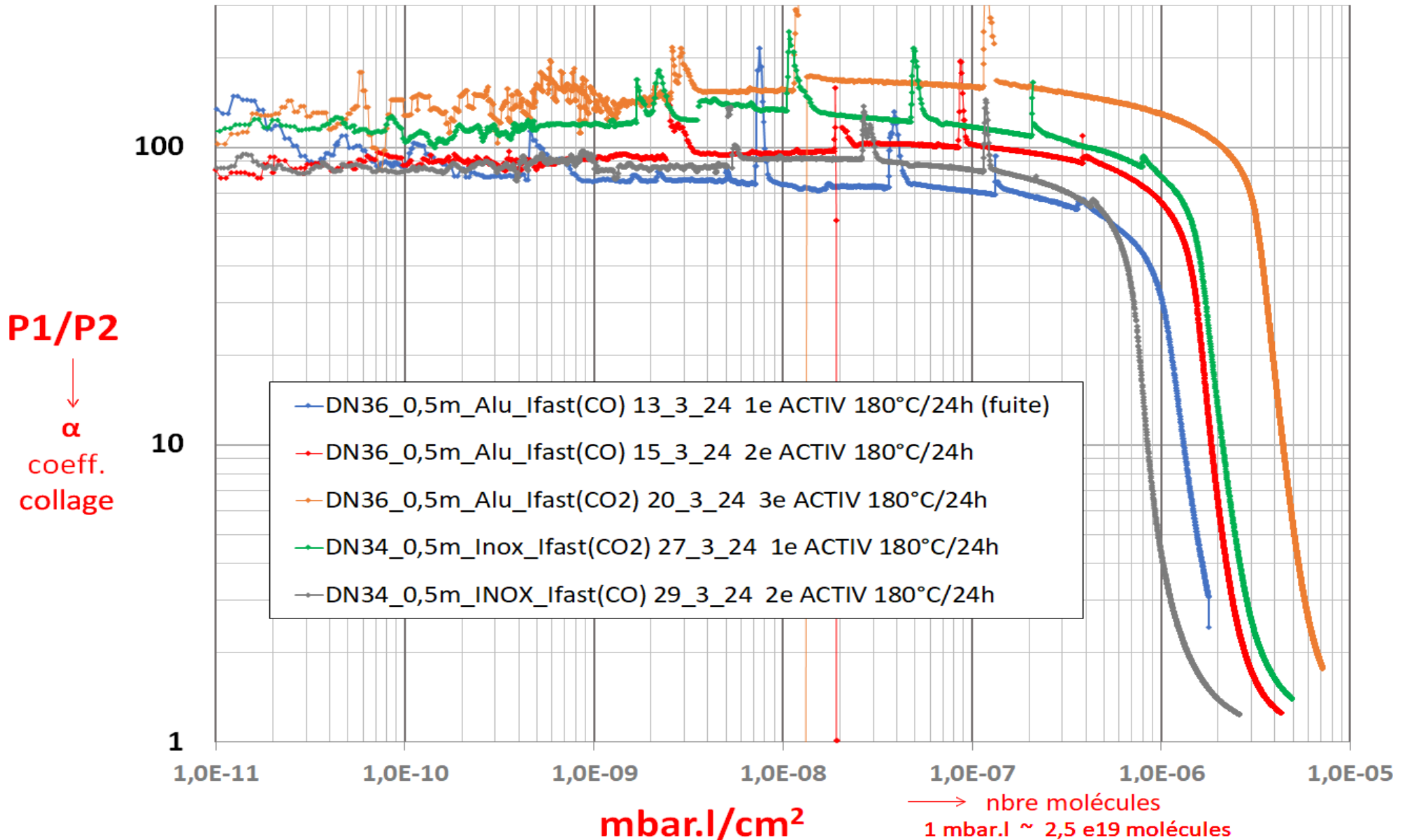
P. Costa Pinto, P. Chiggiano, A. Sapountzis, T. Sinkovits, M. Taborelli,
CERN
 80th IUVESTA Workshop, NSRRC, Hsinchu, Taiwan (2016)

2 Transmission Method Test Benches for NEG coating characterization

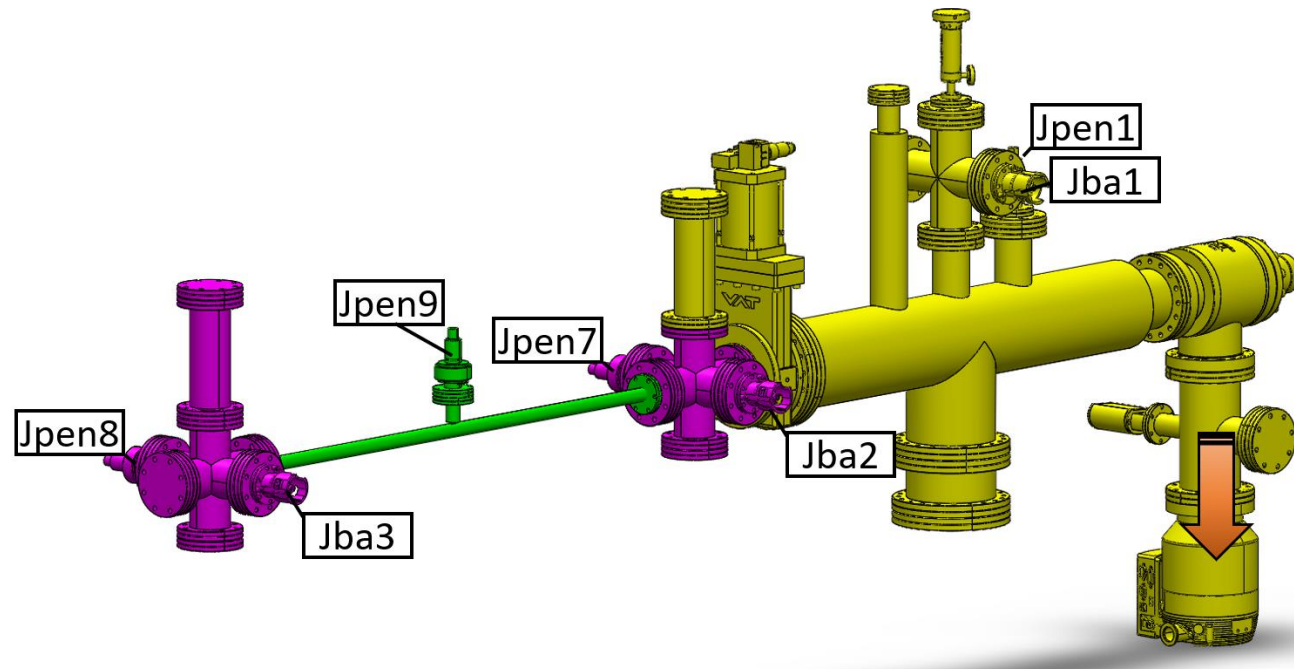
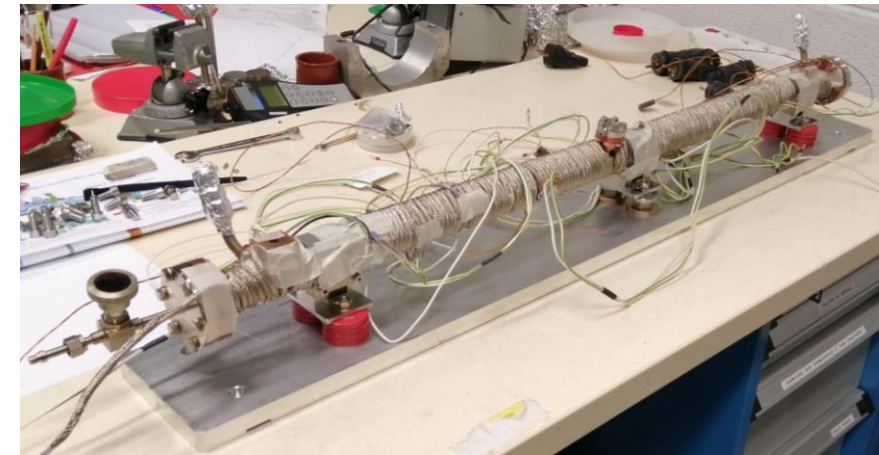
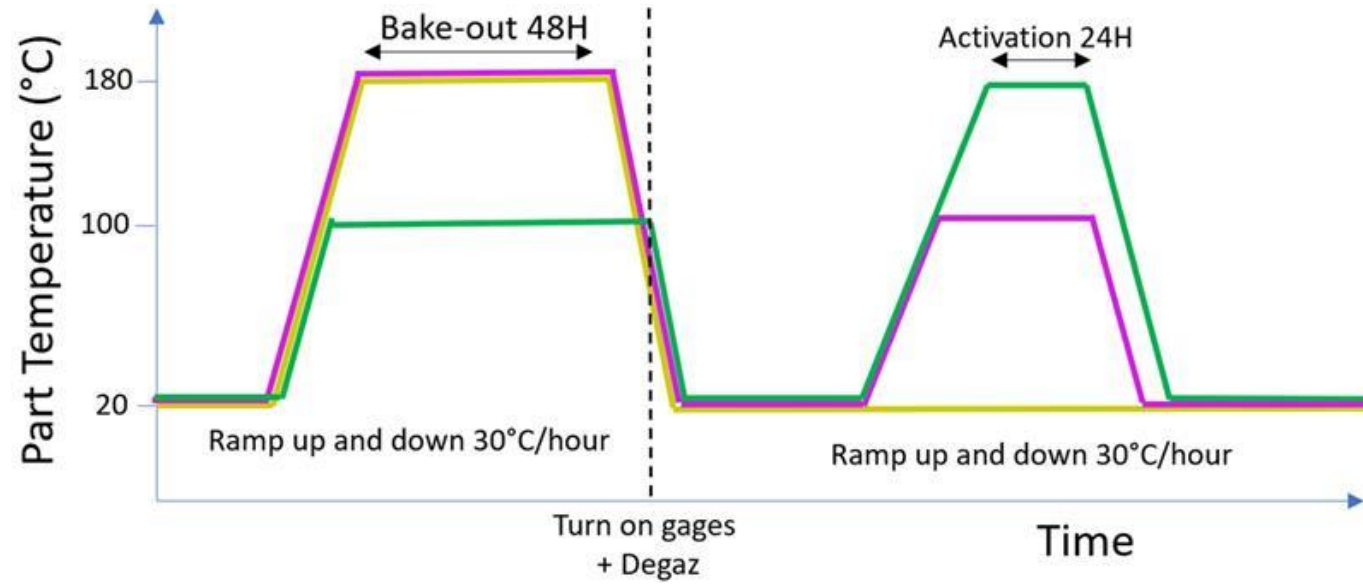


P_1/P_2 is calibrated with **MOLFLOW+** to find α



Pressure ratios measured by transmission method for both CO and CO₂ up to NEG saturation

Standardized NEG activation procedure for transmission tests



Referred as IFATS#1

IFAST Tube – 21207.1.01 #03

Deposition (05/12/23)

Bakeout – 150 °C

Pressure before deposition: 6.1×10^{-10}

Parameter	Unit	Value
Target		3 x 1 mm TiZrV twisted wire
Power (Pulsed)	W	76 - 85
Current	A	0.47 – 0.51
Voltage	V	161 – 167
Solenoid Current	A	16 - 18
Solenoid Voltage	V	60
Pressure	mbar	2.5×10^{-2}
Duration	HH:mm:ss	05:16:03

Dense TiVZr coating

Gas injection (08/01/24)

Facility baked and tube activated following standard Daresbury procedure.

Tube activated to 180 °C

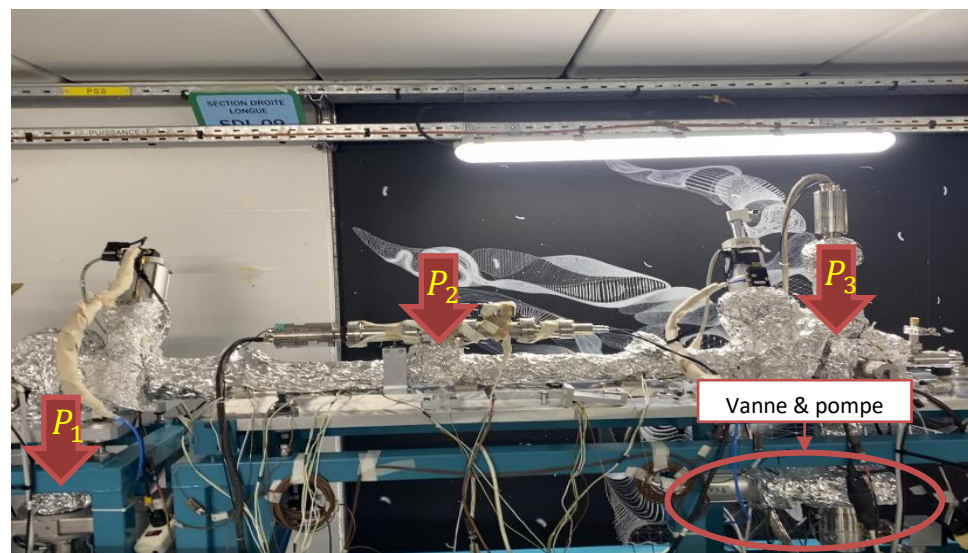
Sticking probability for CO \approx 0.008

Sticking probability for H₂ \approx 0.001

Ratio=10 Capacity for CO $\approx 2 \times 10^{18}$ CO/m²

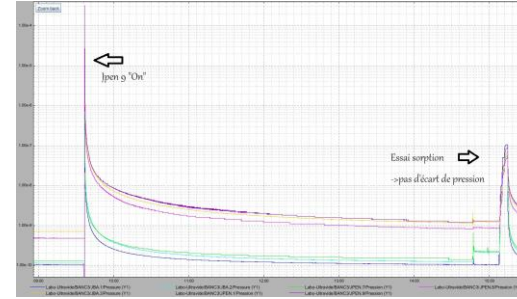
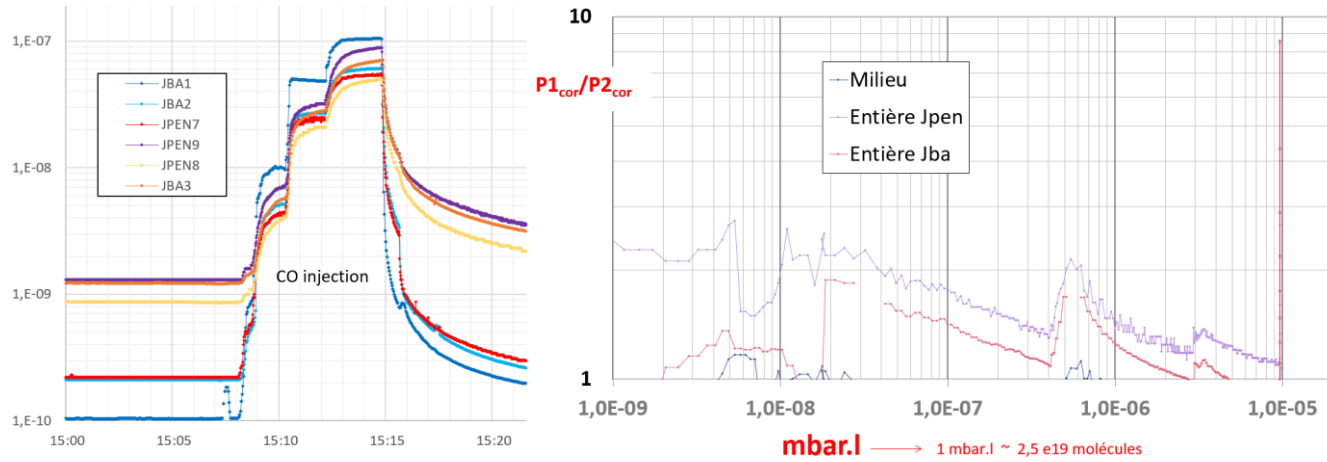
15/01/23 – Tube vented and filled with Nitrogen

Installed on PSD D08-1 Front-End in SOLEIL's tunnel (April 2024) for 3-gages measurement after transmission measurements



Summarizing results from 15/05/2024 email

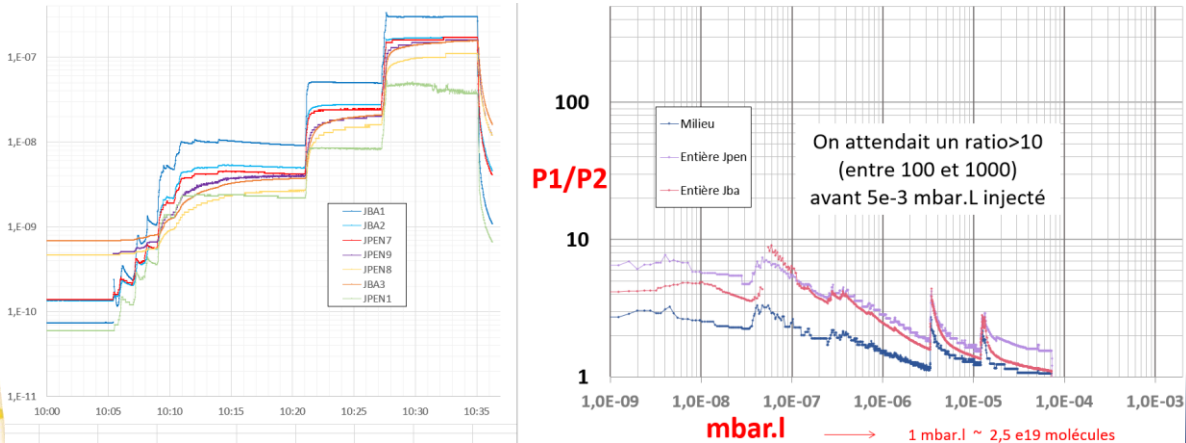
Fist activation 180°C / 24h – CO injection after 3rd middle gage called JPEN9 tuned on !



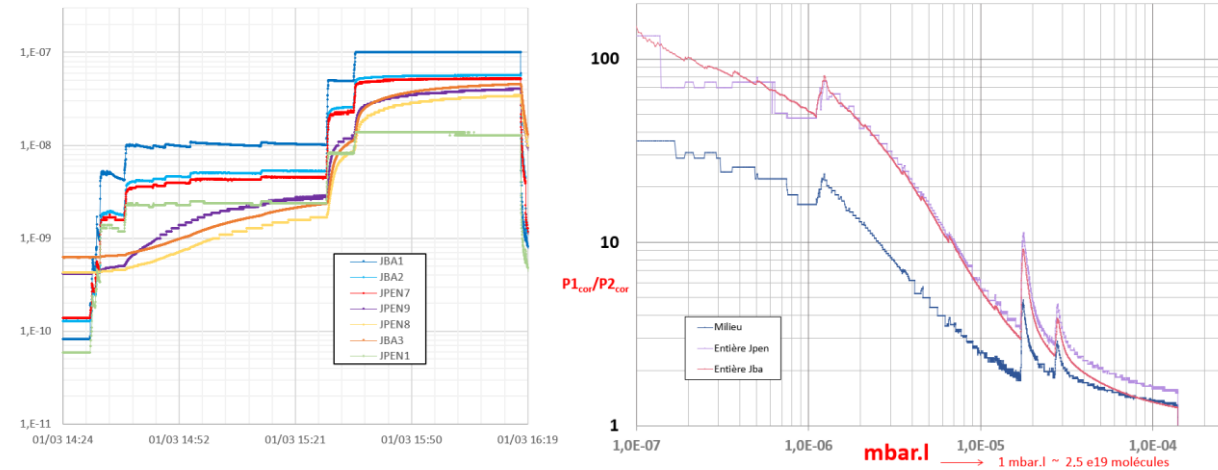
Expected results @20°C

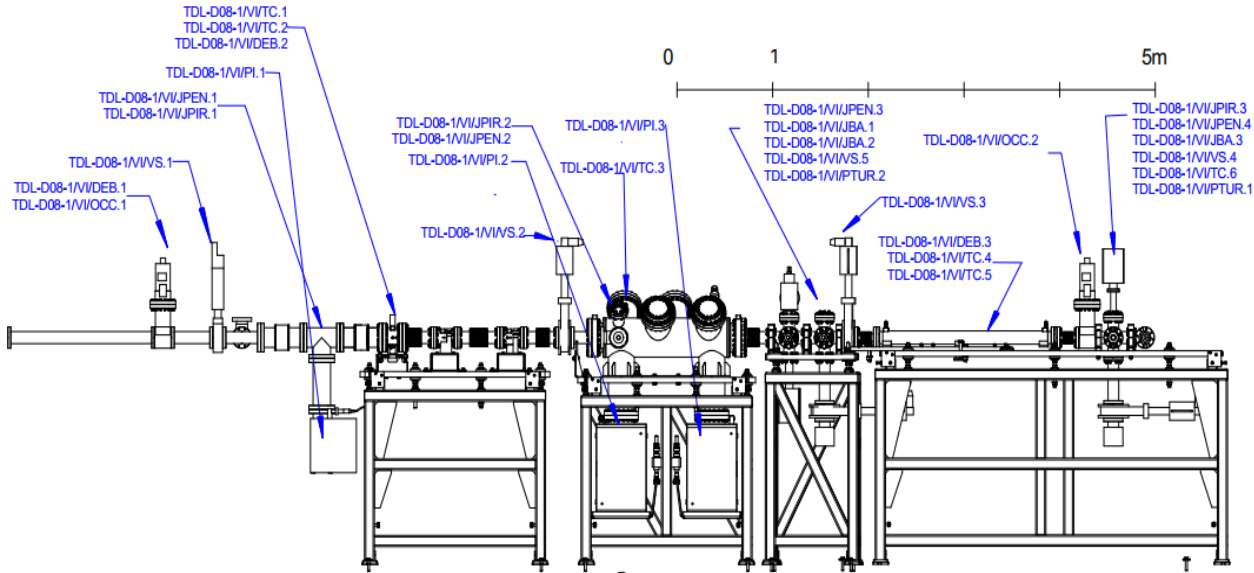
Specific capacity	2E+18	CO/m ²
	2E+14	CO/cm ²
	3,32E-10	mol/cm ²
	8,09E-06	mbar.l/cm ²
Total capacity	5,09E-03	mbar.l

Second activation 180°C / 24h – CO injection (gage already on)



Third activation in recovery mode 230°C / 24h – CO Injection





TDL-D08-1

P1 = JPEN3 + RGA

P2 = JPEN1 + RGA

P2 = JPEN4 + RGA

LIBRES

DEB.3:

mks

1 calibrated
1 not calibrated

CAV2

PI.2: 1.3E-10 mbar

PI.3: 1.8E-11 mbar

JPEN.2: NaN mbar

JPIR.2: NaN mbar

TC.3: 21.6 °C

CHAMBRE AMONT

JPEN.3: 4.7E-10 mbar

JBA.1: NaN mbar

JBA.2: NaN mbar

VS.5:

PTUR.2:

CHAMBRE NEG

JPEN.1: 2.9E-9 mbar

TC.4: 21.5 °C

TC.5: 21.4 °C

OCC.2:

VS.3:

HIDEN ANALYTICAL

CHAMBRE AVANT

PI.1: 8.9E-10 mbar

JPIR.1: NaN mbar

MTx.1: 1.00 mm

MTx.2: -2.50 m

VS.2:

OCCULTEUR

DEB.1:

occ.1:

RGA.1

VS.1:

CHAMBRE AVANT

JBA.3: NaN mbar

JPEN.4: 1.3E-8 mbar

JPIR.3: 5.6E-2 mbar

TC.6: 21.6 °C

TC.7: 21.7 °C

VS.4:

PTUR.1:

ETUVAGE

TC_SURV.1: 23.3 °C

TC_SURV.2: 22.4 °C

ETUV.1: 22.5 °C

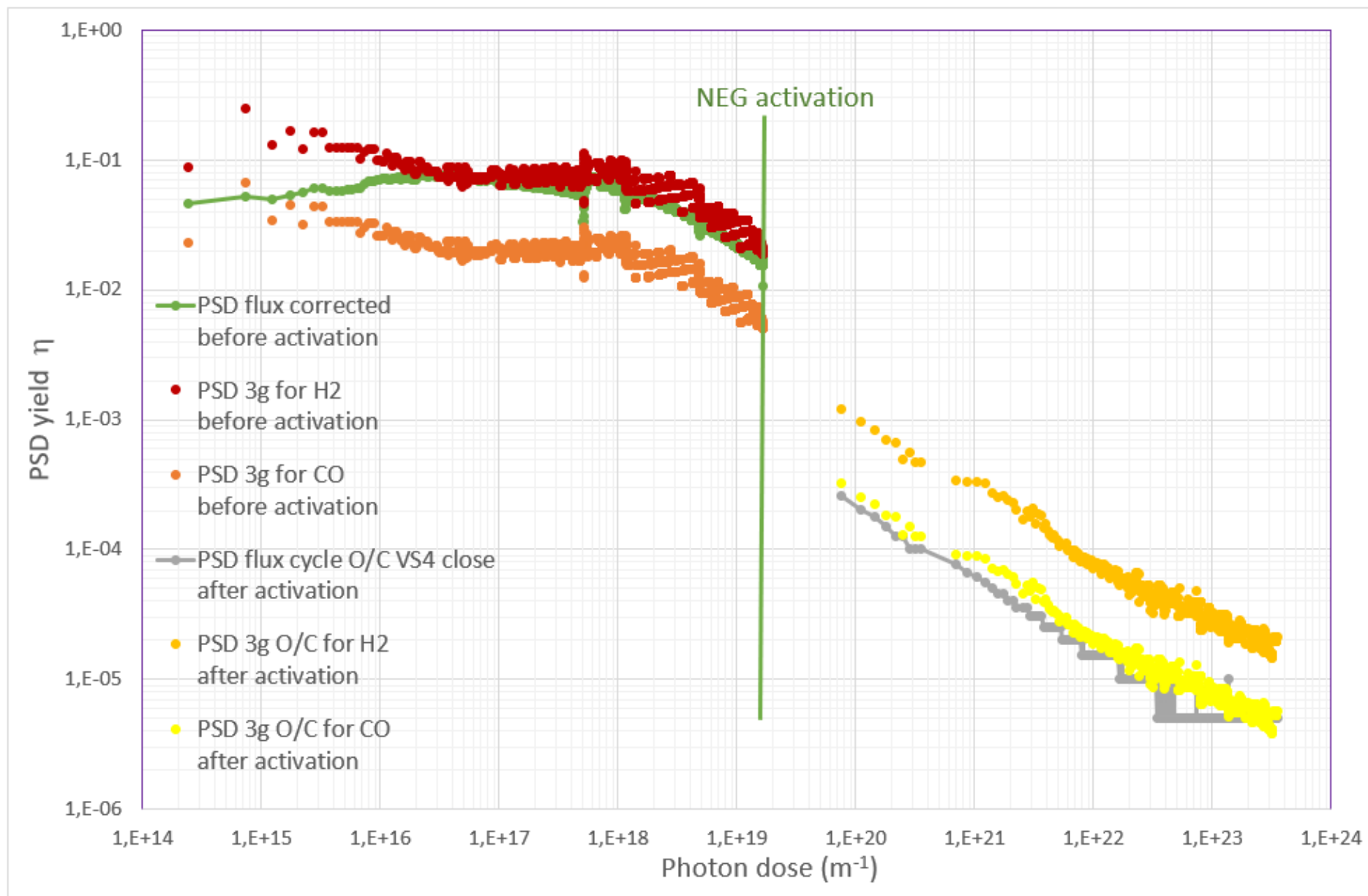
ETUV.2: 21.6 °C

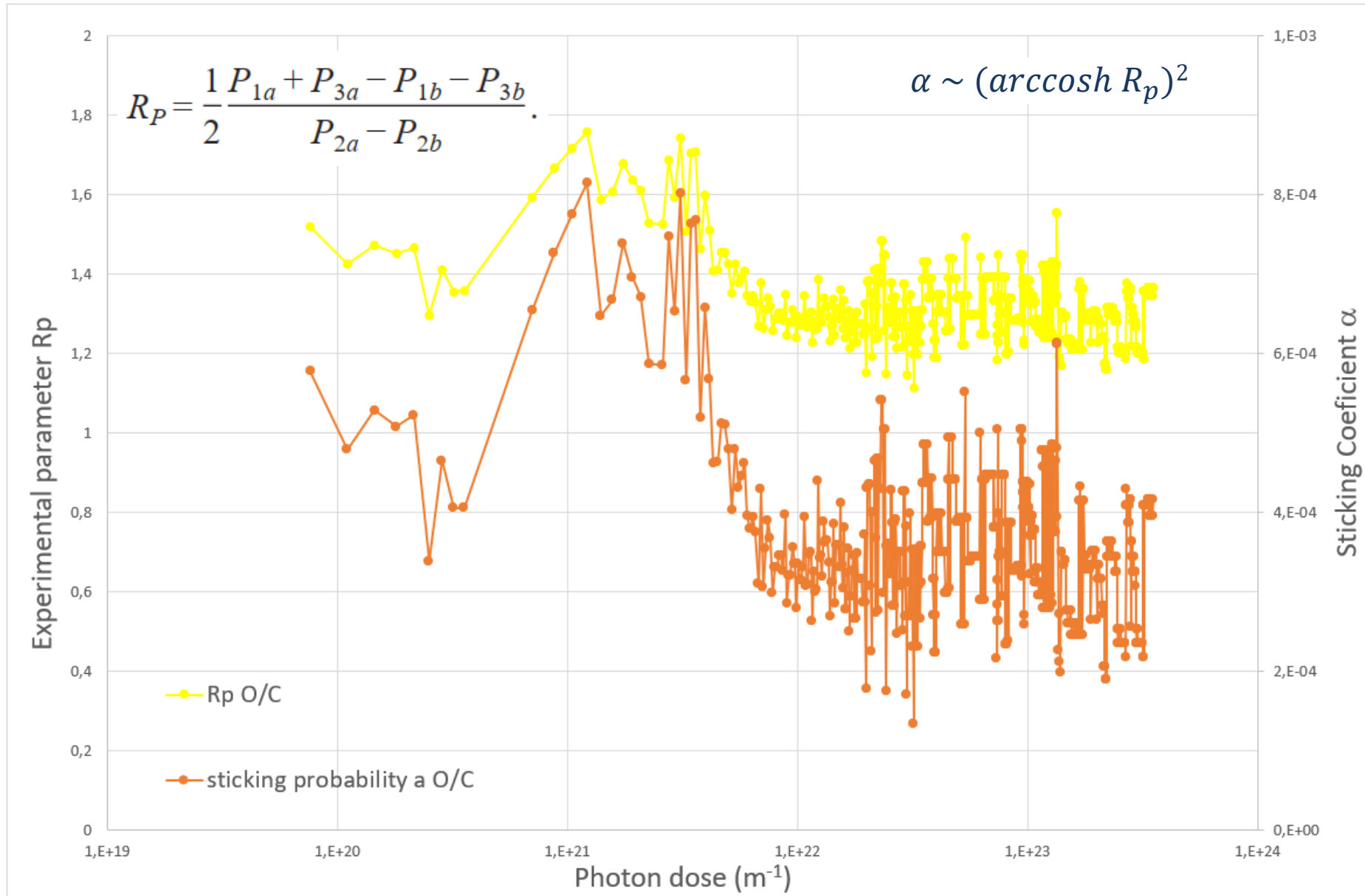
ETUV.3: 22.7 °C

ETUV.4: 22.5 °C

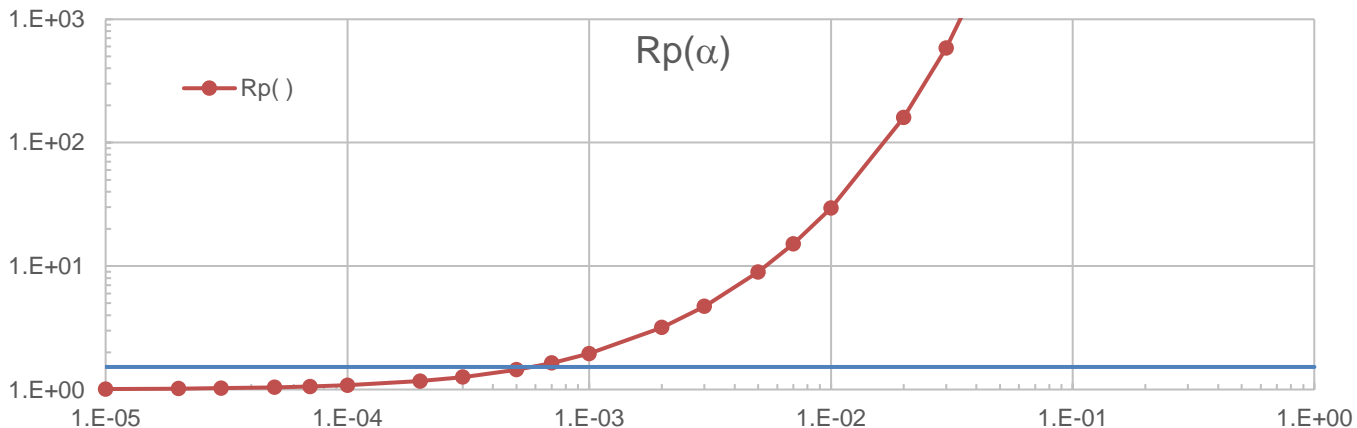
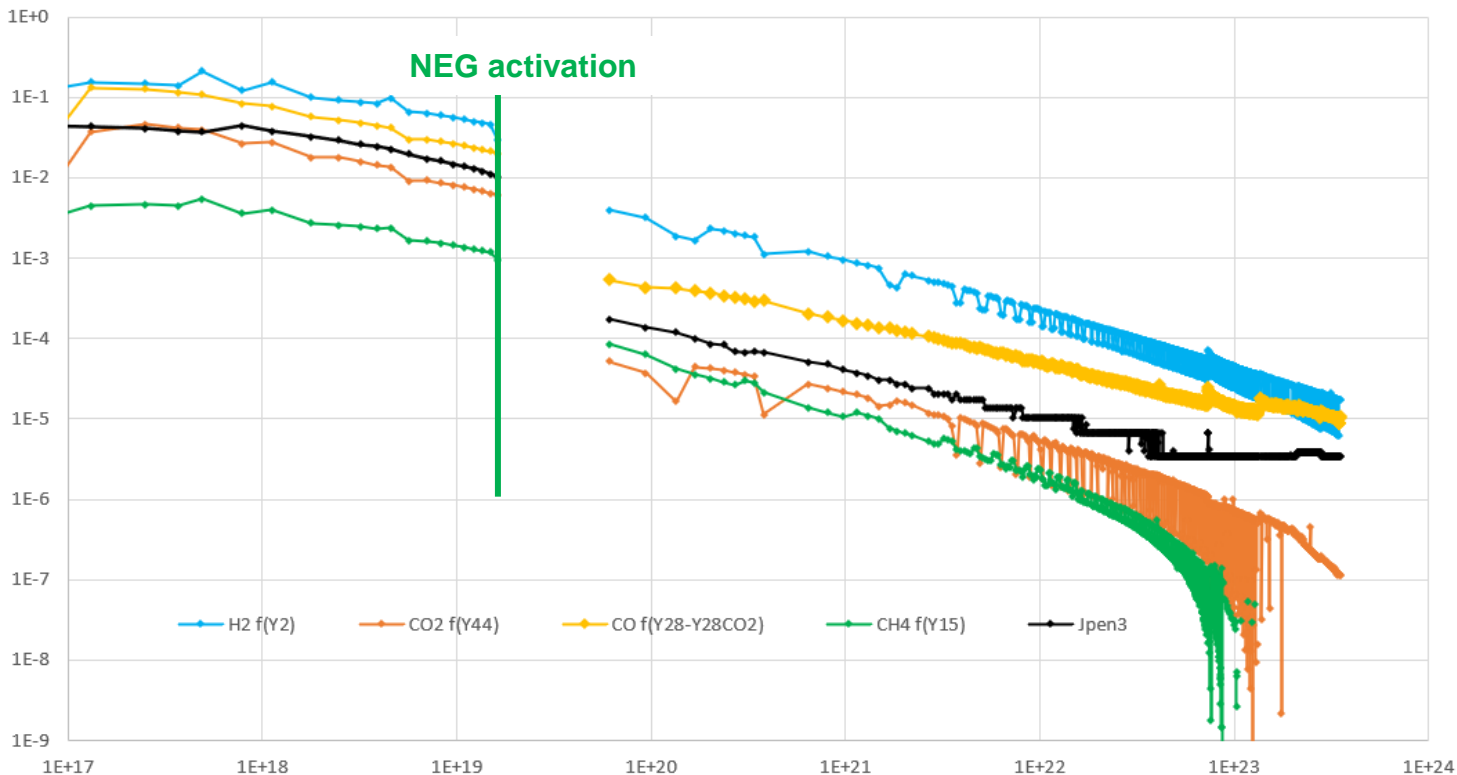
SOLEIL SYNCHROTRON **GRUPE ULTRAVIDE**

Elements vide TREND Plan TC Quitter la page sans risque





flux method

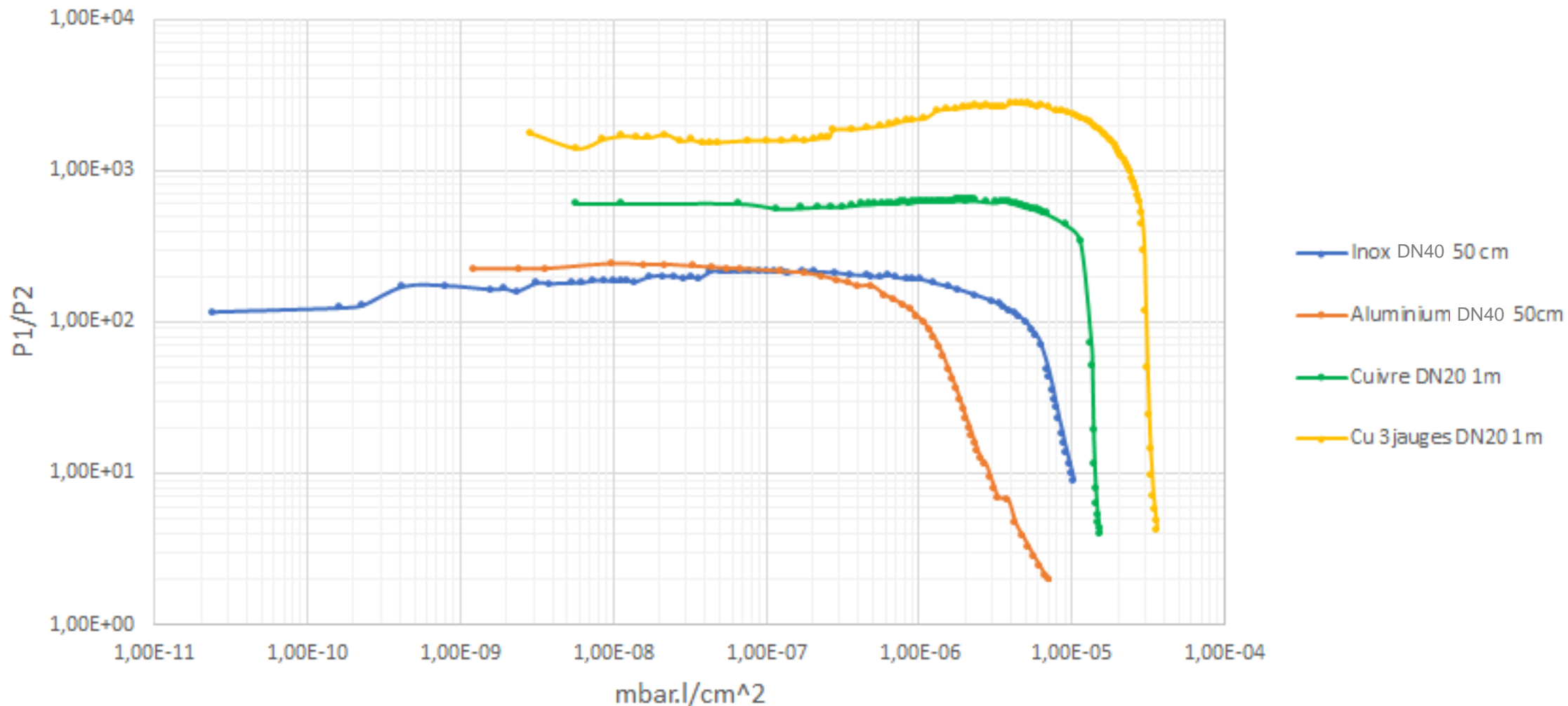


nom	var	val	unit	comments
chamber lenght	L	1	m	
chamber ray	$r = \phi/2$	1,00E-02	m	
diameter	ϕ	2,00E-02	m	20 mm
moleculer density	n		m-3	
volume/m	$V = \pi r^2$	3,14E-04	m2	
photosorbption yield	η	2,36E-04	/y	NEG ACTIVATED
photosorbption yield a	η_a	2,36E-04	/y	
photosorbption yield b	η_b	2,36E-04	/y	
photo yield H2	η_{H2}	~1,5e-5	/y	Malyshv JVSTA23(2005)570
photo yield CO	η_{CO}	<1e-5	/y	Malyshv JVSTA23(2005)570
photo yield CH4	η_{CH4}	2, E-07	/y	Malyshv JVSTA23(2005)570
photo yield CxHy	η_{CxHy}	2, E-08	/y	Malyshv JVSTA23(2005)570
photo yield CO2	η_{CO2}	<2e-6	/y	Malyshv JVSTA23(2005)570
				/y
Machine current	I	500	mA	
photos/m	Γ	1,45E+17	y/s/m	VLR : 2,9e17 x I (A/s)
sticking probability	$\alpha = (\text{arcosh Rp})2.4u/CL2$	5,78E-04	1	NEG ACTIVATED
striking H2	α_{H2}	0,007	1	Malyshv JVSTA23(2005)570
striking CO	α_{CO}	0,5	1	Malyshv JVSTA23(2005)570
striking CH4	α_{CH4}	0	1	Malyshv JVSTA23(2005)570
striking CxHy	α_{CxHy}	0	1	Malyshv JVSTA23(2005)570
striking CO2	α_{CO2}	0,5	1	Malyshv JVSTA23(2005)570
ideal wall pumping speed/m	$C = A.v/4$	2,46E+01	m2/s	
wall area/m	$A = 2\pi r$	6,28E-02	m	
mean molecular speed	$v = \sqrt{2kT/m}$	1563,87313	m/s	
specific conductance/m	$u = 1/6, \sqrt{2\pi kT/M} \cdot \phi^3/L2$	3,70E-03	m4/s	4,62E+02 3,70E-03 3,70E-03
atomic mass	M	2	g/mol	N2
atomic weigh	$m = M/N^*$	3,32E-27	kg	
avogadro number	N^*	6,02E+23		
temperature	T	294,15	K	21 °C
boltzmann constante	k	1,38E-23	m2kgs-2K-1	
upstream pressure	P1	1,9E-06	Pa	x1e-2 = mbar 1,9E-08
center pressure	P2	7,1E-06	Pa	x1e-2 = mbar 7,1E-08
downstream pressure	P3	9,5E-06	Pa	x1e-2 = mbar 9,5E-08
upstream pressure a	P1a	2,20E-06	Pa	x1e-2 = mbar 2,20E-08
center pressure a	P2a	1,00E-05	Pa	x1e-2 = mbar 1,00E-07
downstream pressure a	P3a	1,80E-05	Pa	x1e-2 = mbar 1,80E-07
upstream pressure b	P1b	1,60E-06	Pa	x1e-2 = mbar 1,60E-08
center pressure b	P2b	4,21E-06	Pa	x1e-2 = mbar 4,21E-08
downstream pressure b	P3b	1,00E-06	Pa	x1e-2 = mbar 1,00E-08
experimental parameter	Rp	1,52E+00	calc en Pa	calc en mbar 1,52E+00
JPEN3	P1	4,21E-06	Pa	x1e-2 = mbar 4,21E-08
JPEN1	P2	1,50E-05	Pa	x1e-2 = mbar 1,50E-07
JPEN4	P3	1,40E-05	Pa	x1e-2 = mbar 1,40E-07
photosorbption yield $\alpha = 0$	η	2,96E-04	/y	2,51E+06 for MAMBO [mbar] /y

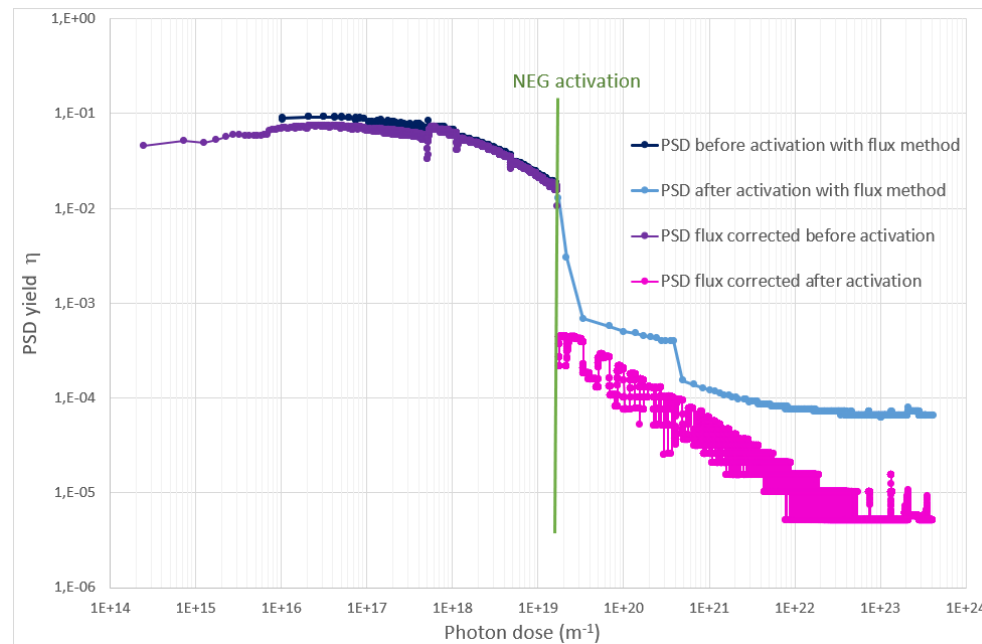
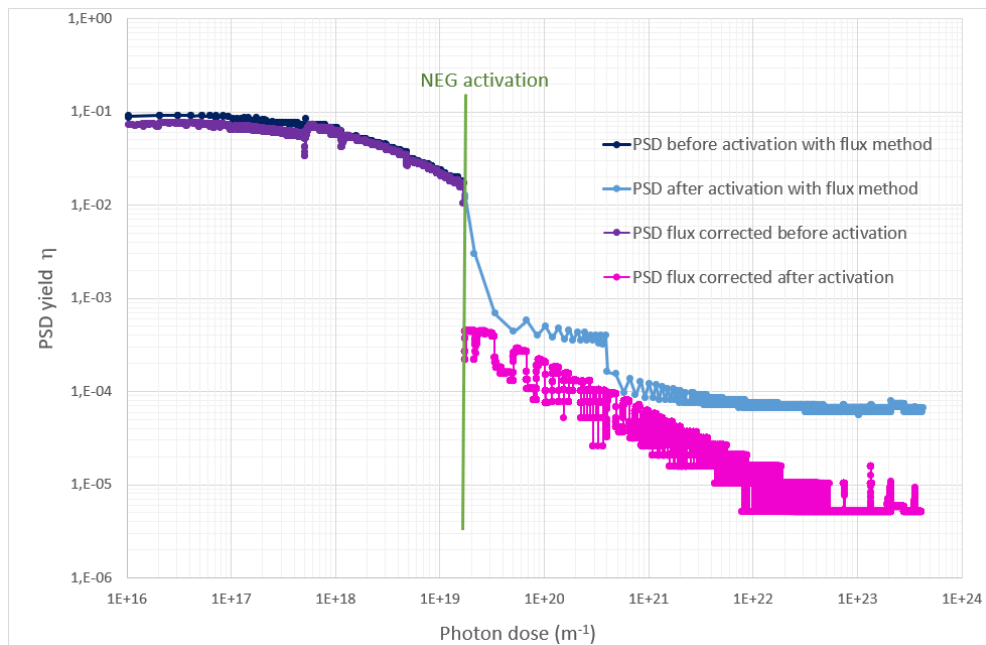
No conclusion

Preliminary 3-g calculation with total pressures (hints but wrong)
Need to address partial pressures with 3-gauge calculation

Capacité de pompage DN40 IFAST 50cm



Comparison of PSD Measurements IFAST#1(top) & IFAST#0 SAES SNEG



VS4 close (up) GOOD
VS4 open (down) BAD

