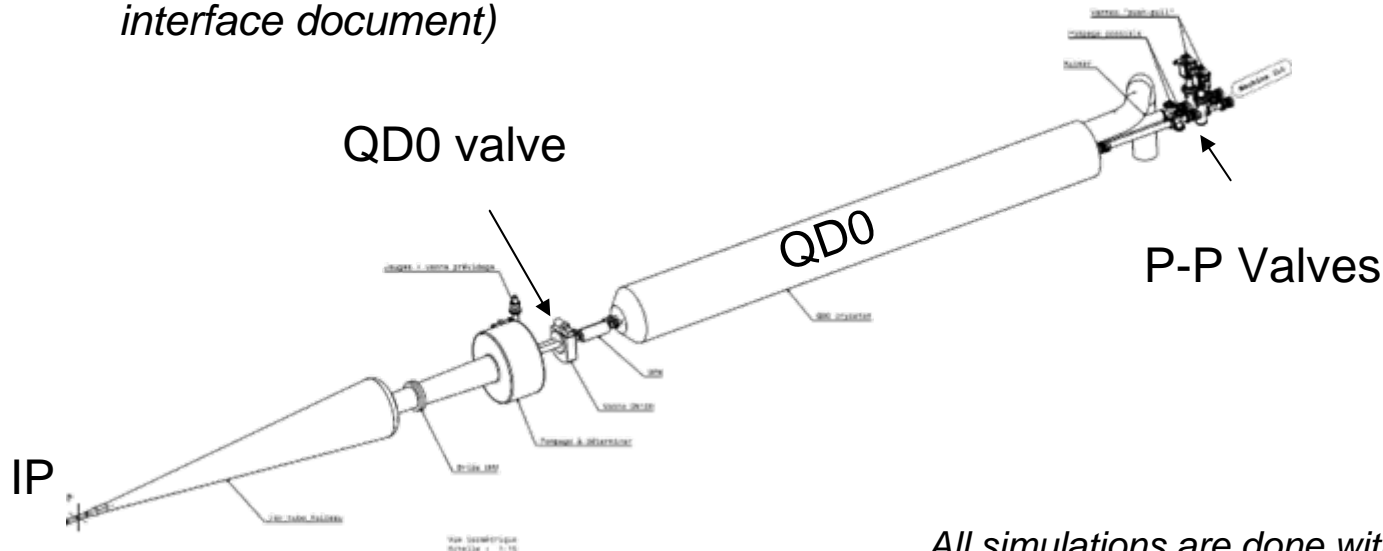


Status of Vacuum Studies

Bruno Mercier (LAL) mercier@lal.in2p3.fr

- Several studies already exists
- The aim of these one is to simulate with details the present design and this in different conditions :
 - Beam pipe alone : evaluate pumping speed needed after LHCa1
 - QD0 alone : evaluate pumping speed needed to reach cooling down pressure
 - Complete beam line : check if we reach the required pressure (*1nTorr in interface document*)

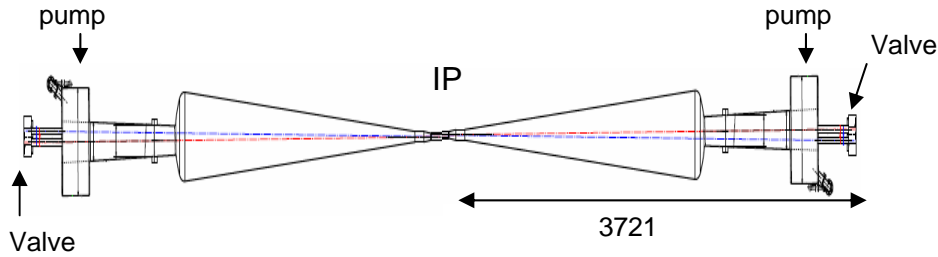


All simulations are done with the Vasco program

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

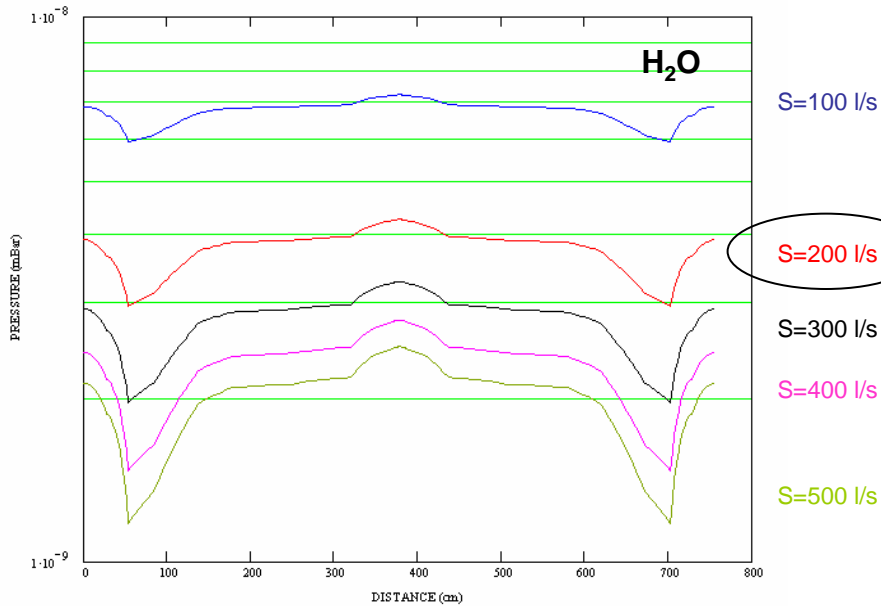
WITHOUT BAKING



For Al, SS or Cu after a classical cleaning and ~ 100 h pumping

$$\tau (\text{H}_2\text{O}) \approx 2.10^{-11} \text{ mbar.l.s}^{-1}.\text{cm}^{-2}$$

Pressure distribution vs effectif pumping speed



What pumping?

Annular triode ion pump from LHC

15 cells 18 l/s(N₂) nominal, Ø_{int} =62 Ø_{ext} =200 L=25,4



Optimized annular triode pump for experimental areas in the LHC M. Busso and all, LHC Project Report 670

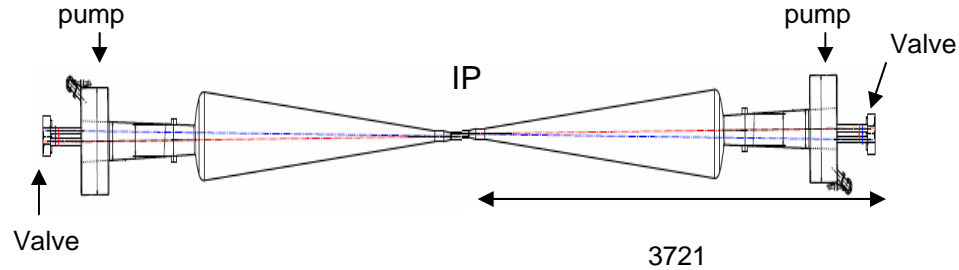
With ≈200 cells



VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

WITH BAKING

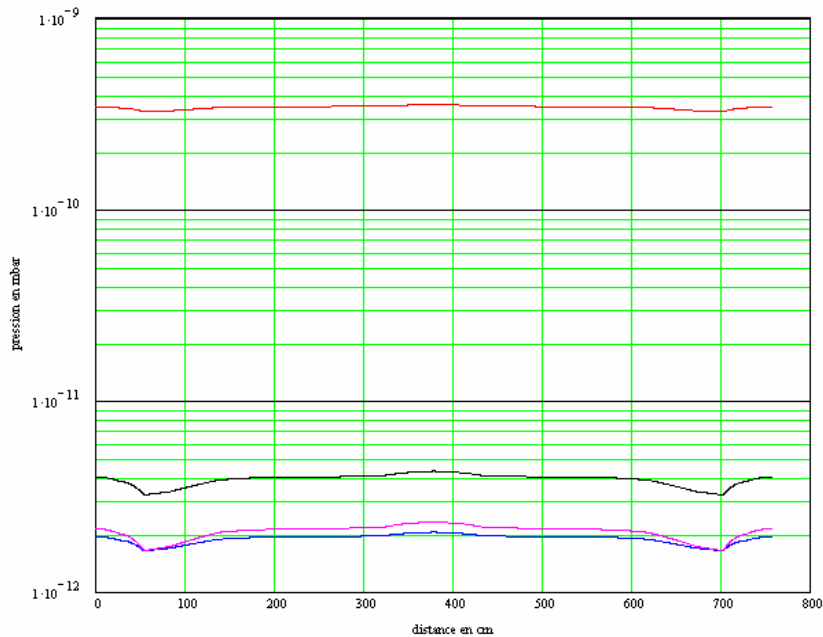


For Cu, 150°C x 24 h and after ~ qq h pumping,
S=120 l/s (-40%) for all gases

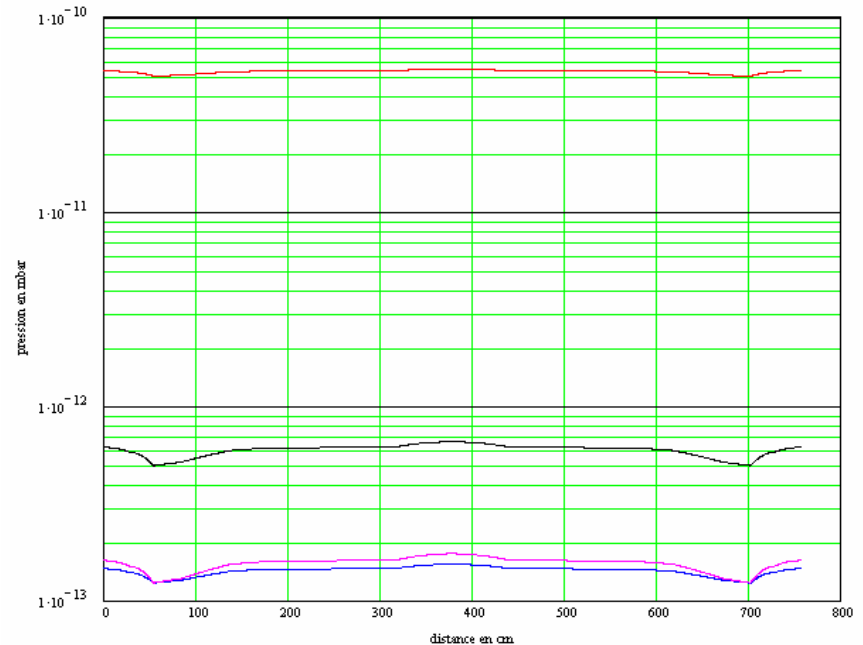
For Al, 150°C x 24 h and after ~ 100 h pumping,
S=120 l/s (-40%) for all gases

$$\begin{aligned} \tau(\text{H}_2) &\approx 1.3 \cdot 10^{-12} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} & \tau(\text{CO}_2) &\approx 6.7 \cdot 10^{-15} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} \\ \tau(\text{CO}) &\approx 1.3 \cdot 10^{-14} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} & \tau(\text{CH}_4) &\approx 6.7 \cdot 10^{-15} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} \end{aligned}$$

$$\begin{aligned} \tau(\text{H}_2) &\approx 2.10 \cdot 10^{-13} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} & \tau(\text{CO}) &\approx 2.10 \cdot 10^{-15} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} \\ \tau(\text{CO}_2) &\approx 5.10 \cdot 10^{-16} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} & \tau(\text{CH}_4) &\approx 5.10 \cdot 10^{-16} \text{ mbar.l.s}^{-1}.\text{cm}^{-2} \end{aligned}$$

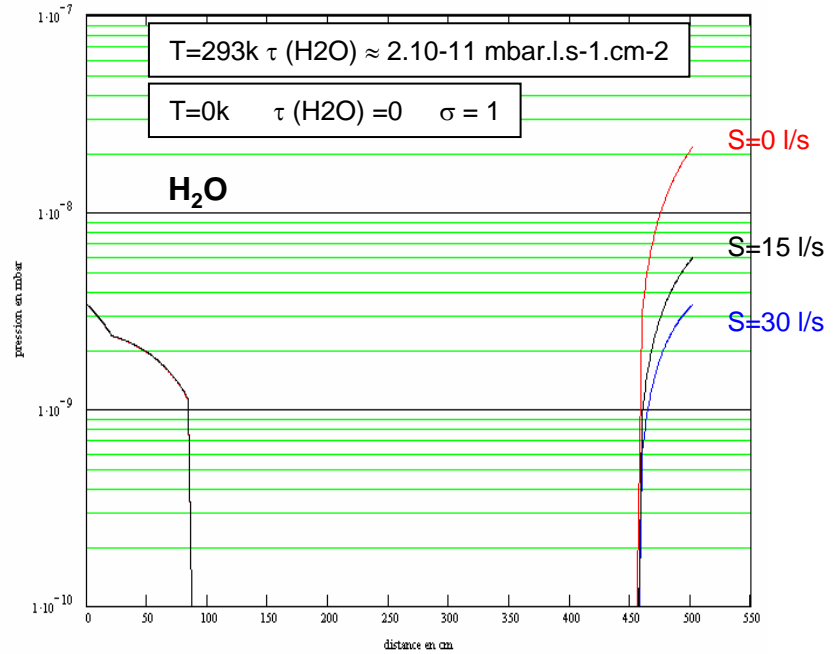
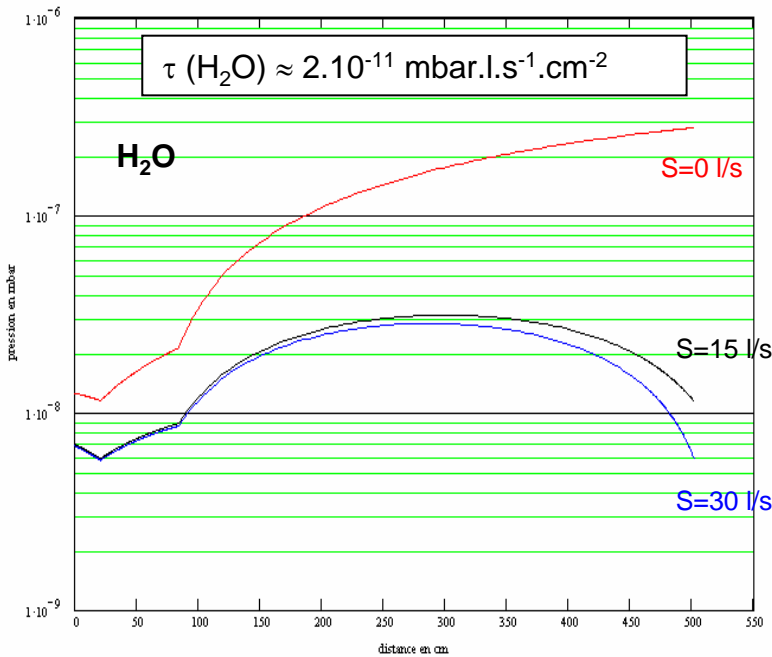
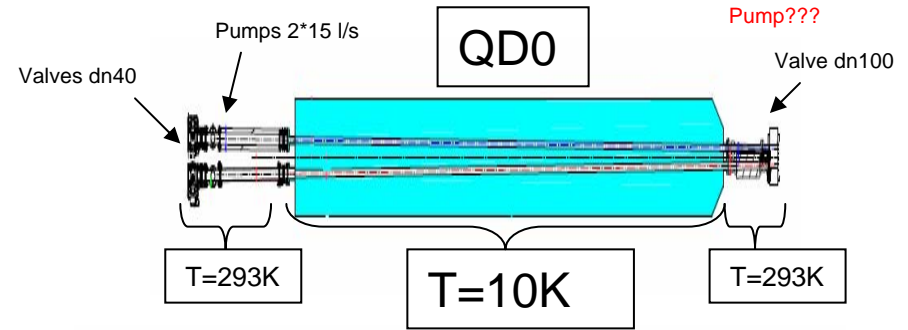
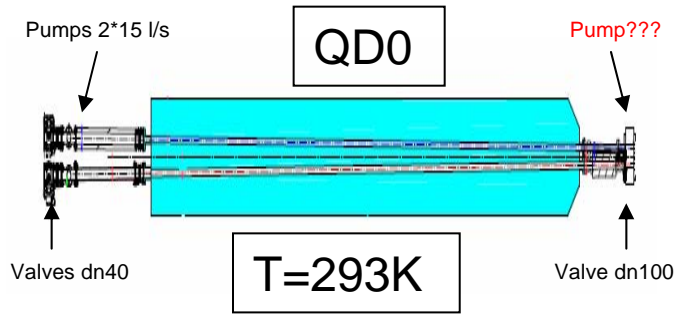


H₂
CO
CO₂
CH₄



VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

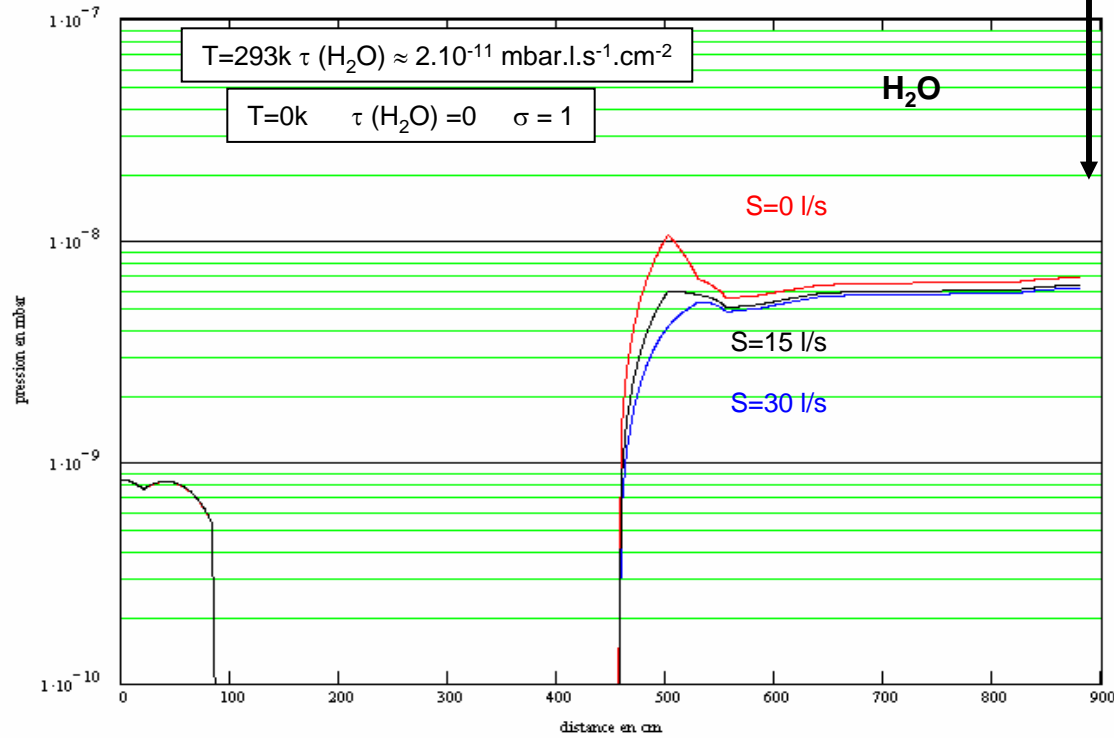
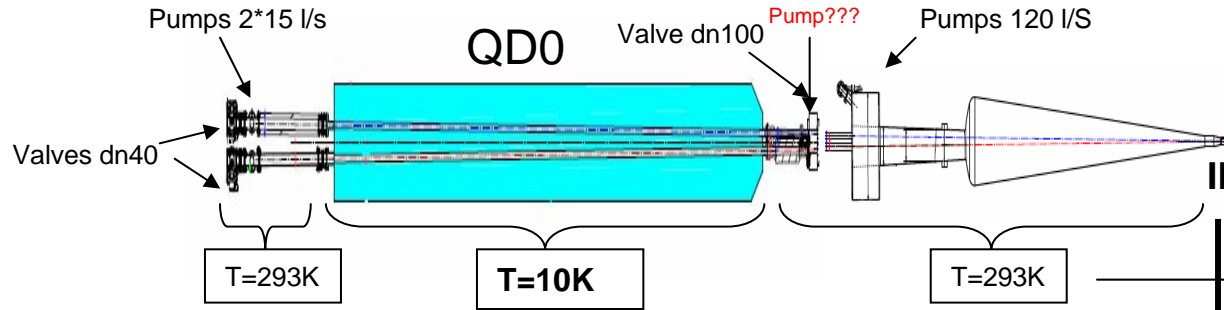


With outgassing valves

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

QD0 + IP region

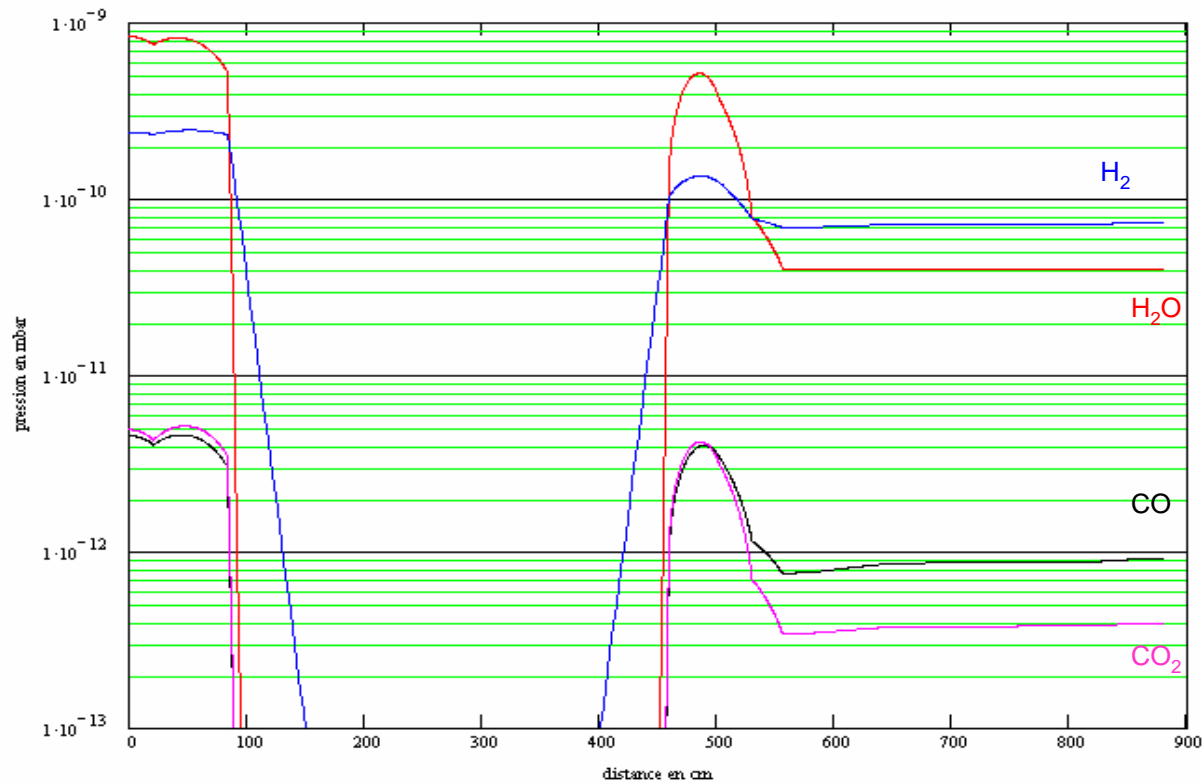
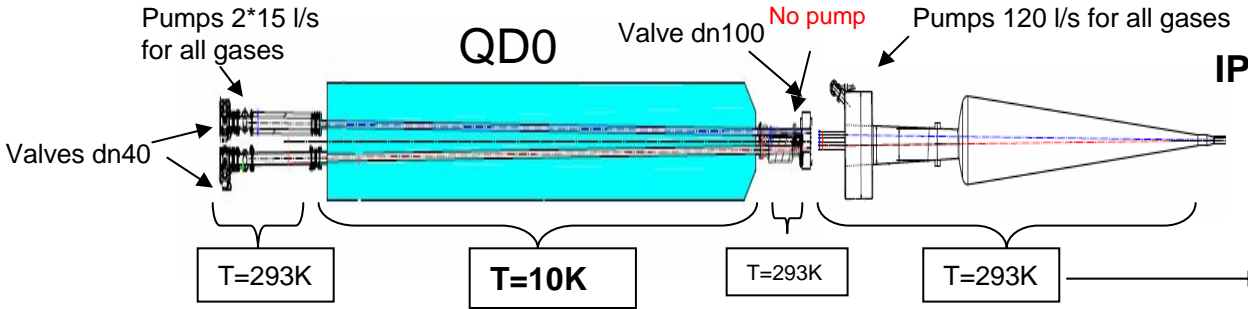


Without outgassing valves dn40

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

QD0 + IP region



IP region with baking

Alu or Cu or SS after 100h pumping

$$\begin{aligned} \tau (H_2) &\approx 2 \cdot 10^{-13} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \tau (H_2O) &\approx 0 \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \tau (CO) &\approx 2 \cdot 10^{-15} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \tau (CO_2) &\approx 5 \cdot 10^{-16} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \end{aligned}$$

Between valves dn40 and dn100 Without baking

T=293K

$$\begin{aligned} \tau (H_2) &\approx 5 \cdot 10^{-12} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \tau (H_2O) &\approx 2 \cdot 10^{-11} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \tau (CO) &\approx 1 \cdot 10^{-13} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \tau (CO_2) &\approx 1 \cdot 10^{-13} \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \end{aligned}$$

T=10K

$$\begin{aligned} \tau (\text{all gases}) &\approx 0 \text{ mbar.l.s}^{-1} \cdot \text{cm}^{-2} \\ \sigma (\text{all gases}) &= 1 \text{ few monolayers} \end{aligned}$$

For H_2 beam screen 2% surface

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

Do we need to have a good static vacuum $P \sim 0.1$ nTorr ???

IP region baking in situ (150°C) is necessary

an annular triode ion pump with ~ 200 cells? (feasibility TBC)

an ion pump before the Dn100 valve is not necessary

H_2O Pressure remains important ? \rightarrow

Traitement of H_2O outgassing on valves and connecting tubes at QDO

\swarrow Ex-situ baking, quick assembly on dry air

Under dynamic condition

Photon , ion and electron desorption
E-cloud
Lost electron positron

$\text{SEY}_{\text{max}}(\text{Be}) = 2.9$ even after a baking

Neg, TiN, Carbone,.. coating ??

Geometry QDO chamber ? Beam screen, stiking coefficient, cooling down scenario....

Optmisation pumping speed vs working pressure

Optimisation outgassing rate, conductance,

SEY of Beryllium
LHC/VAC B. HENRIST 04/2000

