Vacuum Studies in ILD

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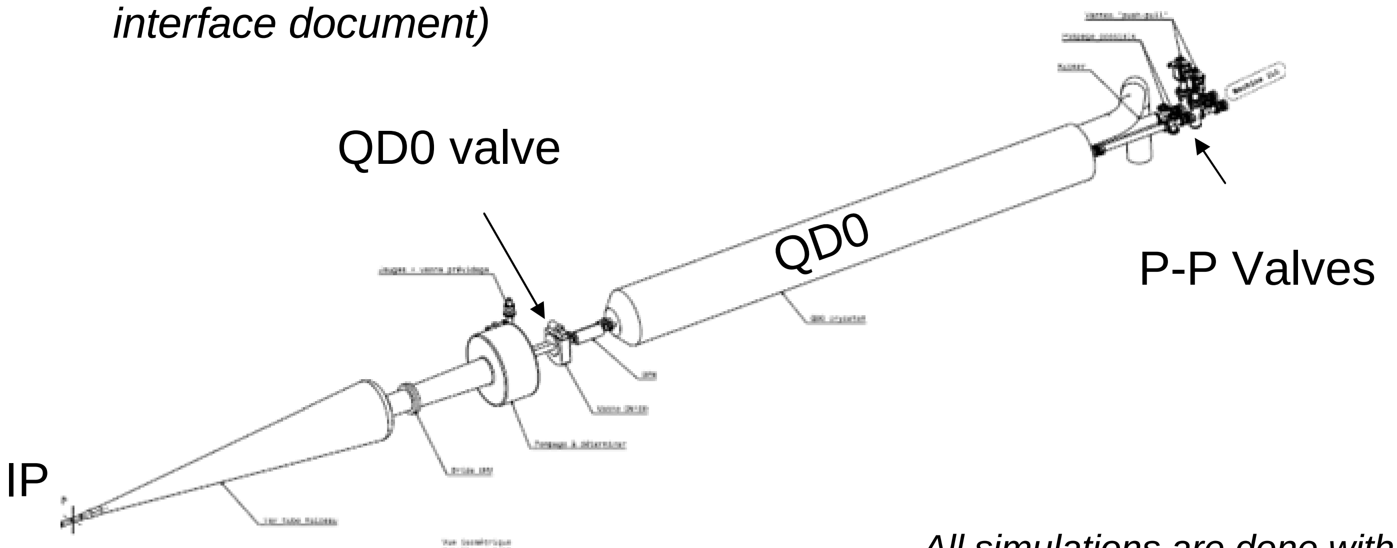
- Several studies already exists
- The aim of these one is to simulate with details the present ILD design and this in different conditions :
  - Beam pipe alone : evaluate pumping speed needed after LHCal
  - QD0 alone : evaluate pumping speed needed to reach cooling down pressure
  - Complete beam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

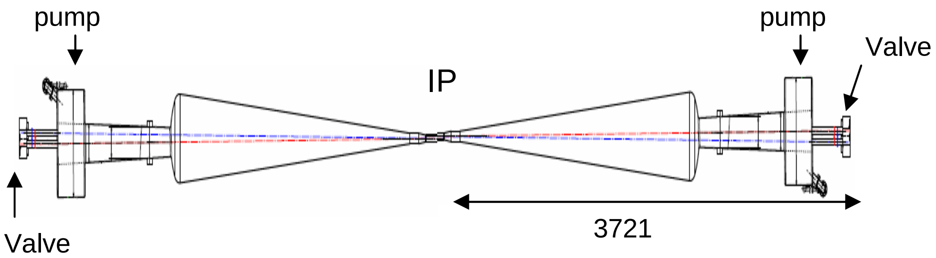


All simulations are done with the Vasco program

VACUUM DISTRIBUTION ON ILD

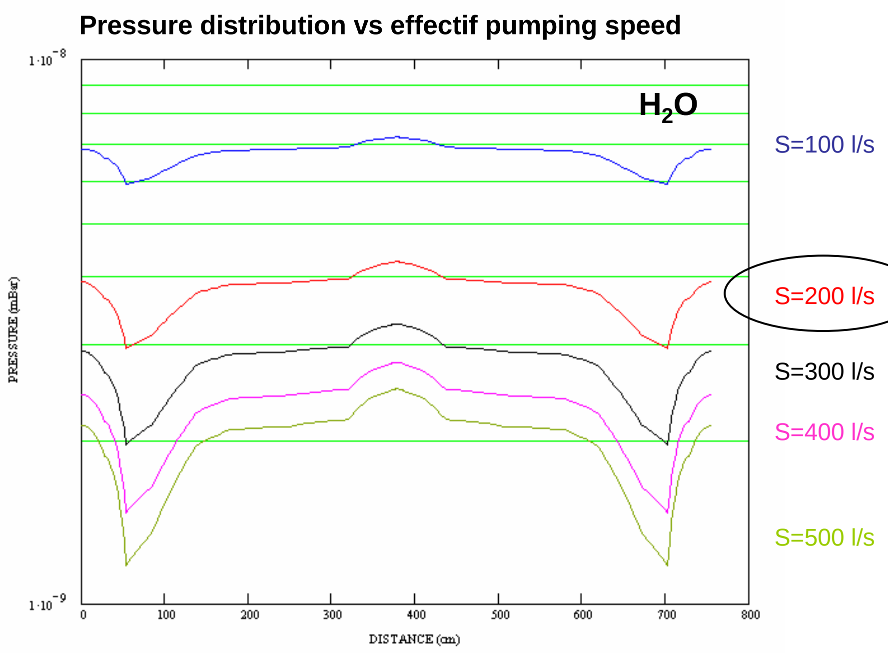
UNDER STATIC CONDITION

WITHOUT BAKING



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

$\tau\ (H_2O) \approx 2.10^{-11}$ mbar.l.s^{-1}.cm^{-2}



What pumping?

Annular triode ion pump from LHC

15 cells 18 l/s(N_2) nominal, ∅int =62 ∅ext =200 L=25,4

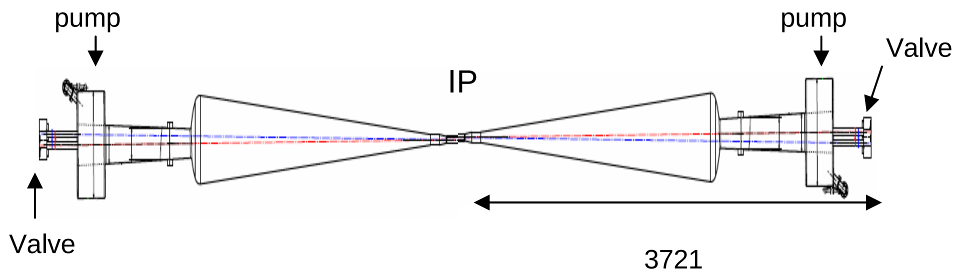
Optimized annular triode pump for experimental areas in the LHC M. Busso and all, LHC Project Report 670

With ≈200 cells

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

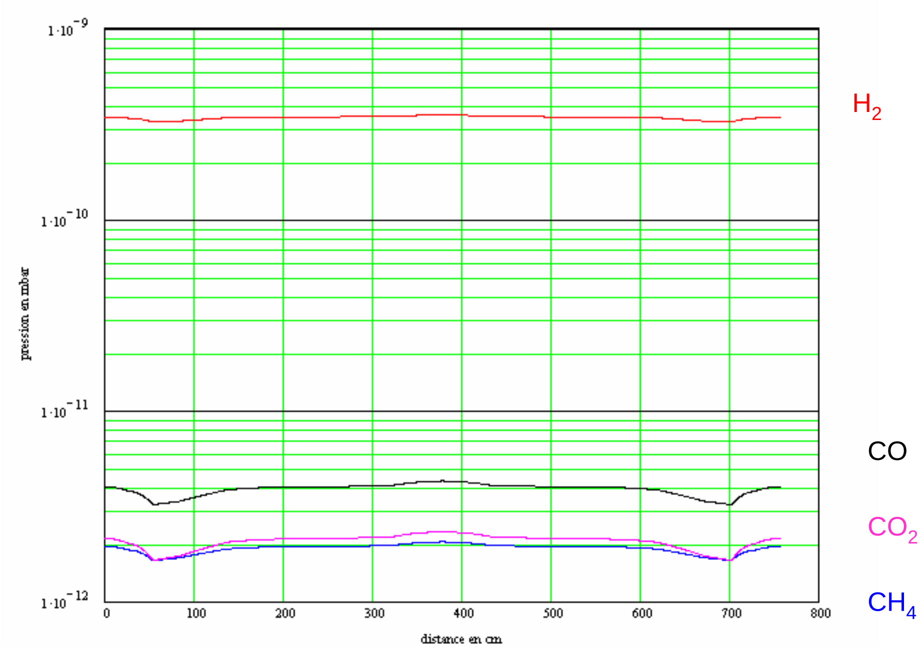
WITH BAKING



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

τ (H_2) ≈ 1.3.10^{-12} mbar.l.s^{-1}.cm^{-2} τ (CO_2) ≈ 6.7.10^{-15} mbar.l.s^{-1}.cm^{-2}

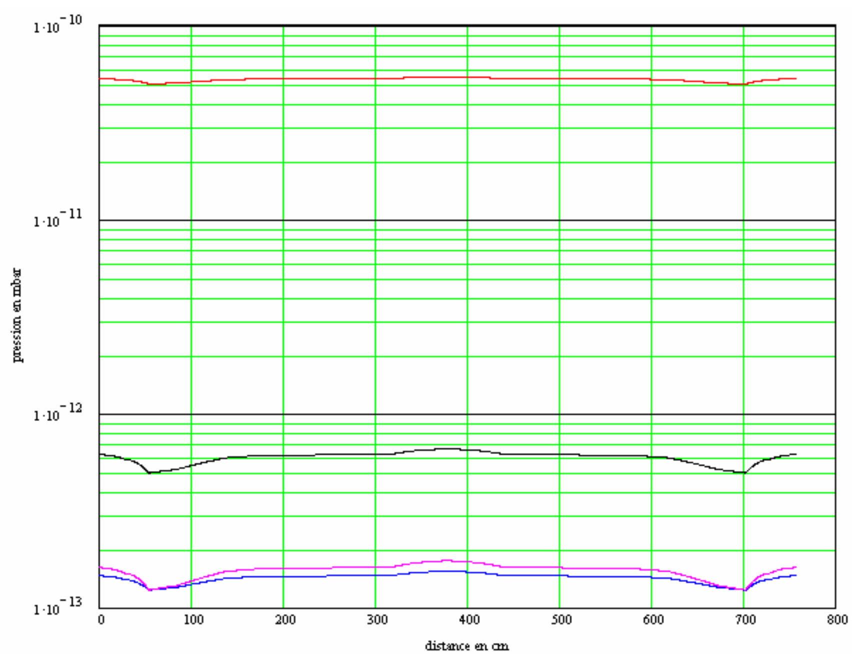
τ (CO) ≈ 1.3.10^{-14} mbar.l.s^{-1}.cm^{-2} τ (CH_4) ≈ 6.7.10^{-15} mbar.l.s^{-1}.cm^{-2}



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

τ (H_2) ≈ 2.10^{-13} mbar.l.s^{-1}.cm^{-2} τ (CO) ≈ 2.10^{-15} mbar.l.s^{-1}.cm^{-2}

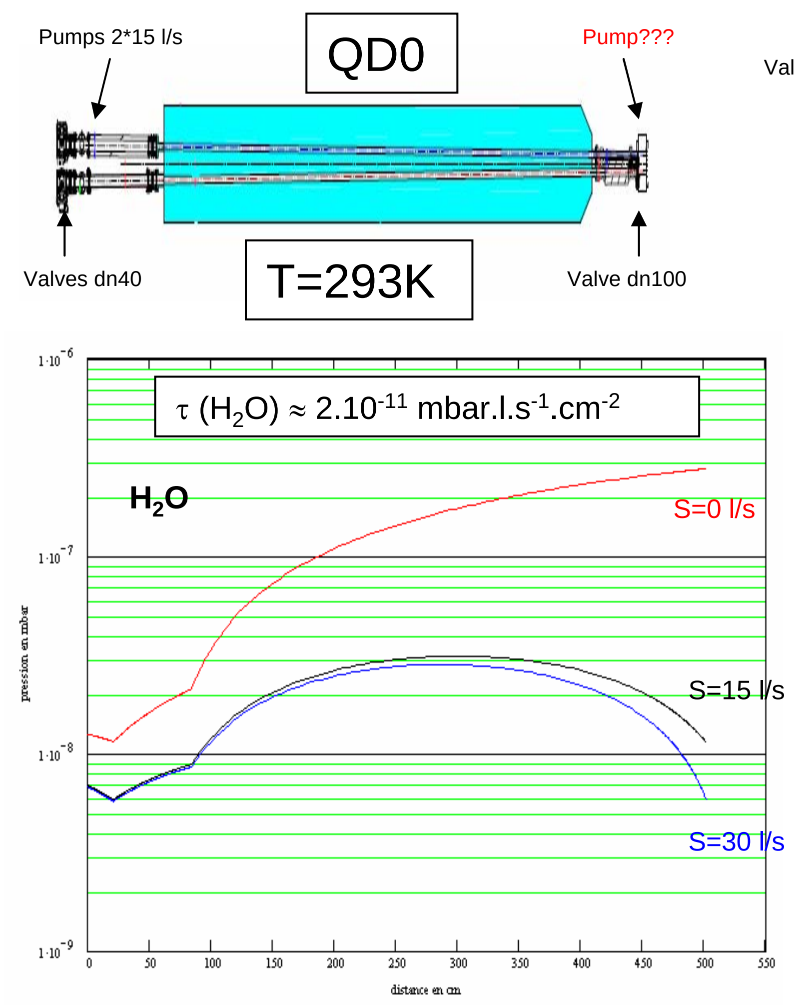
τ (CO_2) ≈ 5.10^{-16} mbar.l.s^{-1}.cm^{-2} τ (CH_4) ≈ 5.10^{-16} mbar.l.s^{-1}.cm^{-2}

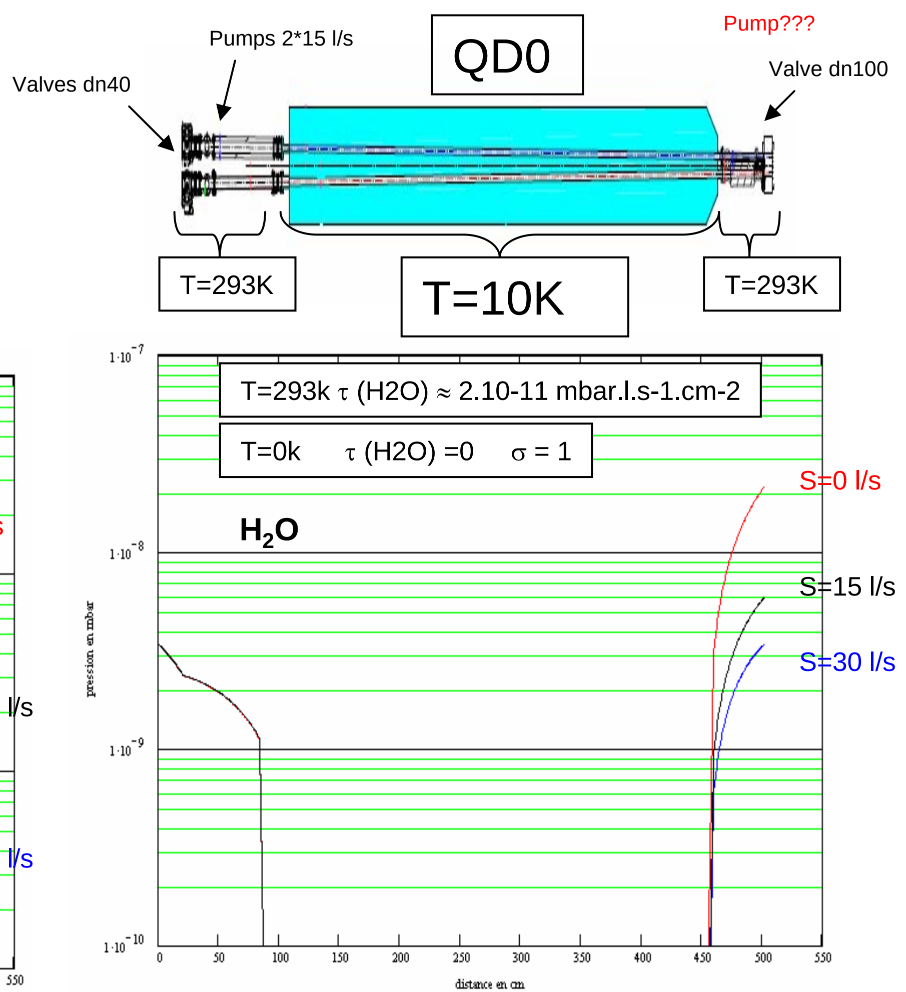


(A. G Mathewson et al, LHC project note 21 CERN)

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION



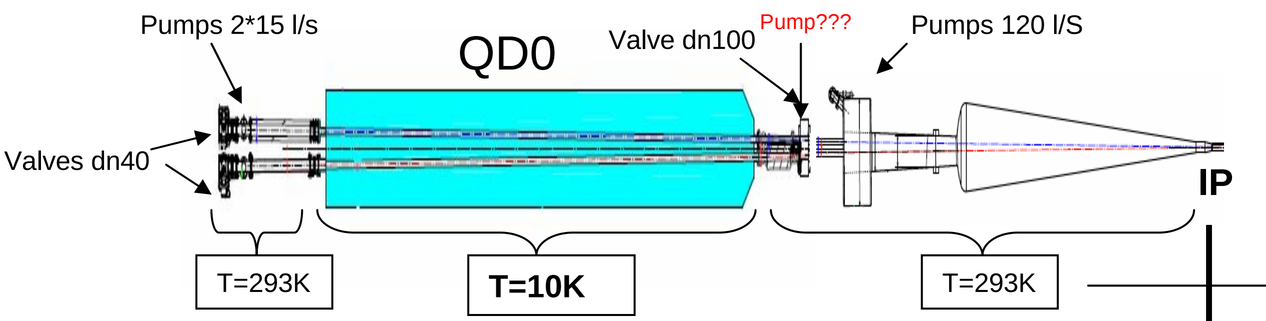


With outgassing valves

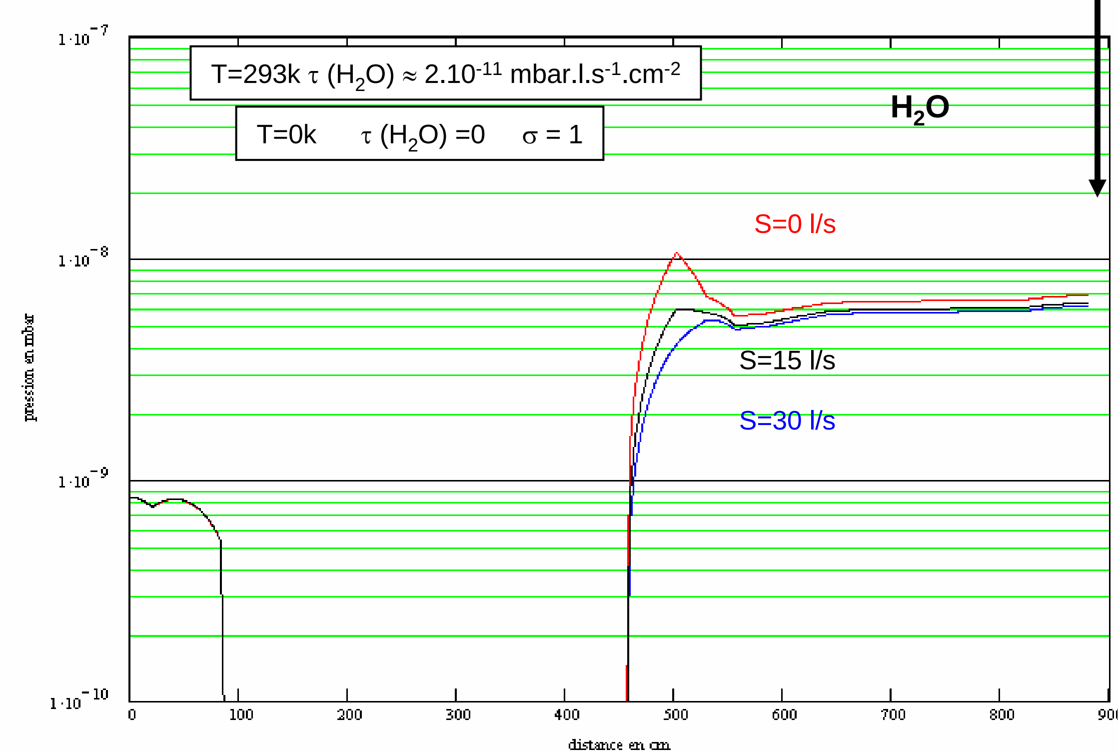
VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

QD0 + IP region



Without baking

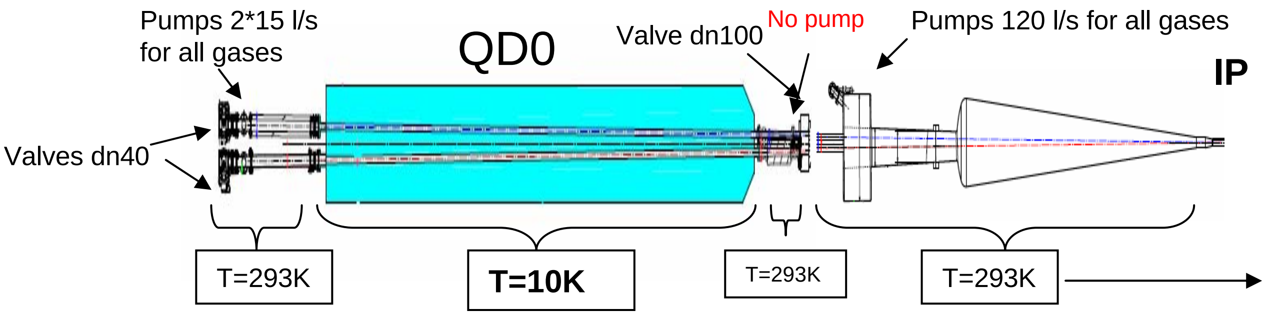


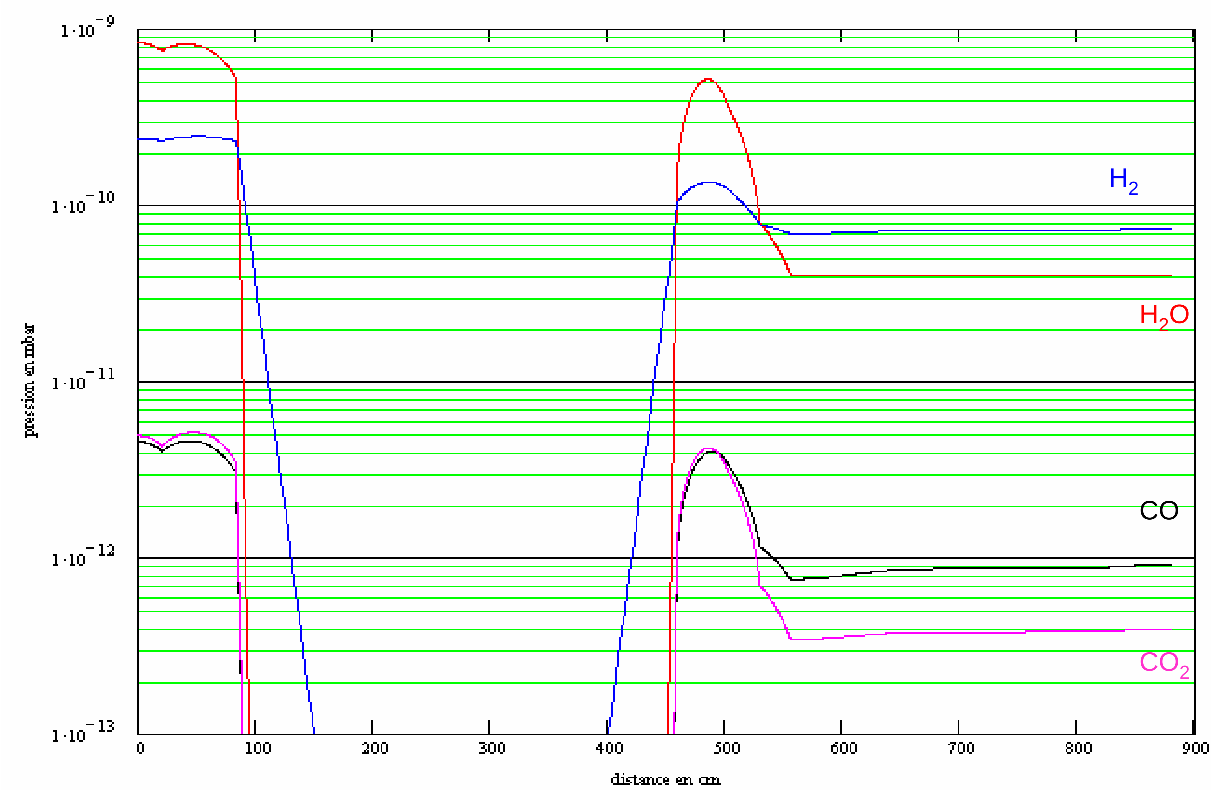
Without outgassing valves dn40

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

QD0 + IP region





IP region with baking

Alu or Cu or SS after 100h pumping

τ (H_2) ≈ 2.10^{-13} mbar.l.s^{-1}.cm^{-2}
τ (H_2O) ≈ 0 mbar.l.s^{-1}.cm^{-2}
τ (CO) ≈ 2.10^{-15} mbar.l.s^{-1}.cm^{-2}
τ (CO_2) ≈ 5.10^{-16} mbar.l.s^{-1}.cm^{-2}

Between valves dn40 and dn100
Without baking

T=293K

τ (H_2) ≈ 5.10^{-12} mbar.l.s^{-1}.cm^{-2}
τ (H_2O) ≈ 2.10^{-11} mbar.l.s^{-1}.cm^{-2}
τ (CO) ≈ 1.10^{-13} mbar.l.s^{-1}.cm^{-2}
τ (CO_2) ≈ 1.10^{-13} mbar.l.s^{-1}.cm^{-2}

T=10K

τ (all gases) ≈ 0 mbar.l.s^{-1}.cm^{-2}
σ (all gases) = 1 few monolayers

For H_2 beam screen 2% surface

VACUUM DISTRIBUTION ON ILD

UNDER STATIC CONDITION

Do we need to have a good static vacuum P ~ 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 ? → Traitement of H_2O outgassing on valves and connecting tubes at QD0 → Ex-situ baking, quick assembly on dry air

Under dynamic condition

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

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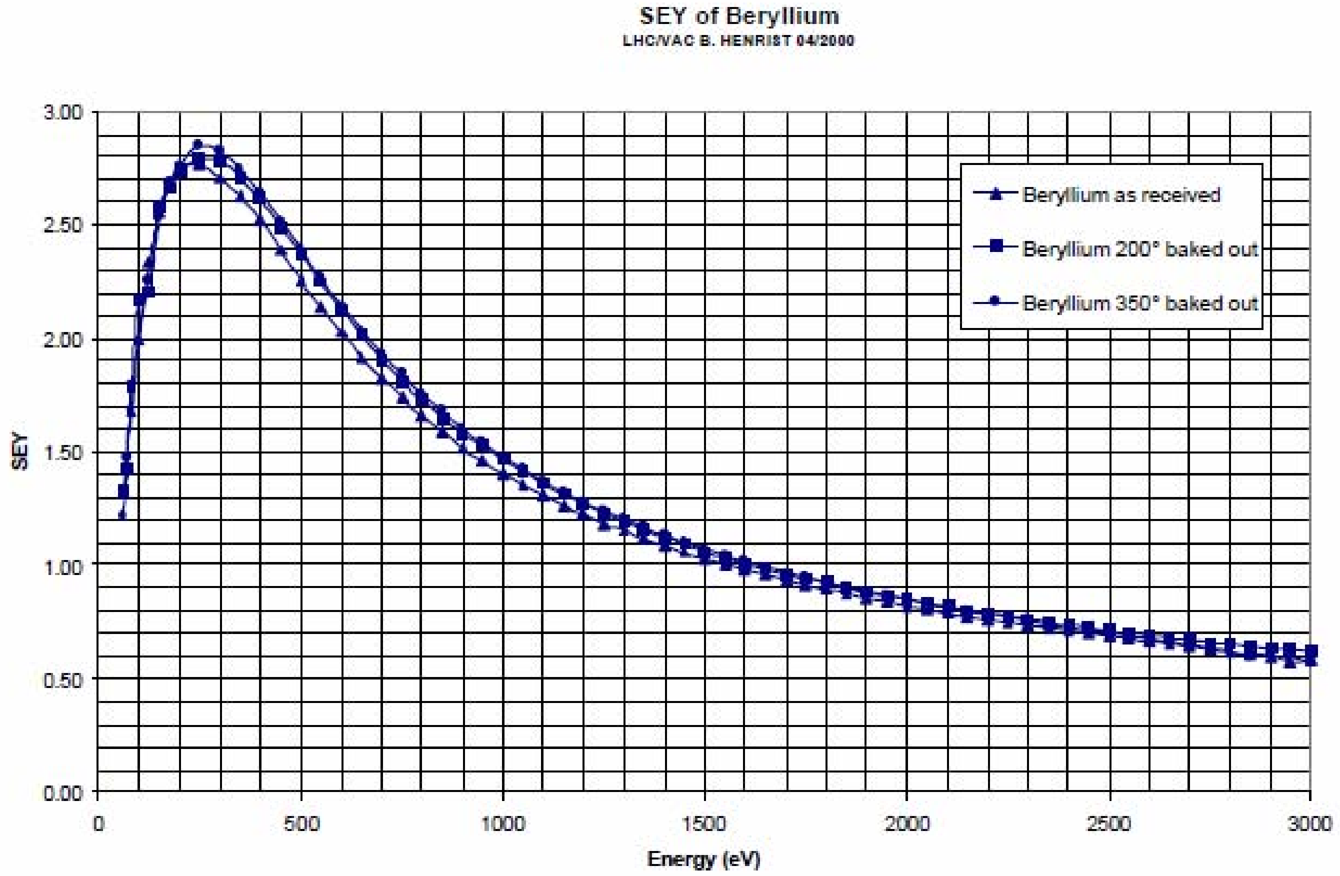
SEY$_{max}$ (Be) = 2.9 even after a baking

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
Beryllium as received
Beryllium 200° baked out
Beryllium 350° baked out
SEY
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
500
1000
1500
2000
2500
3000
Energy (eV)