TASCA separator – *T*rans *A*ctinide *S*eparator and *C*hemistry *A*pparatus

Task A: TASCA working group

Differential pumping and gas control

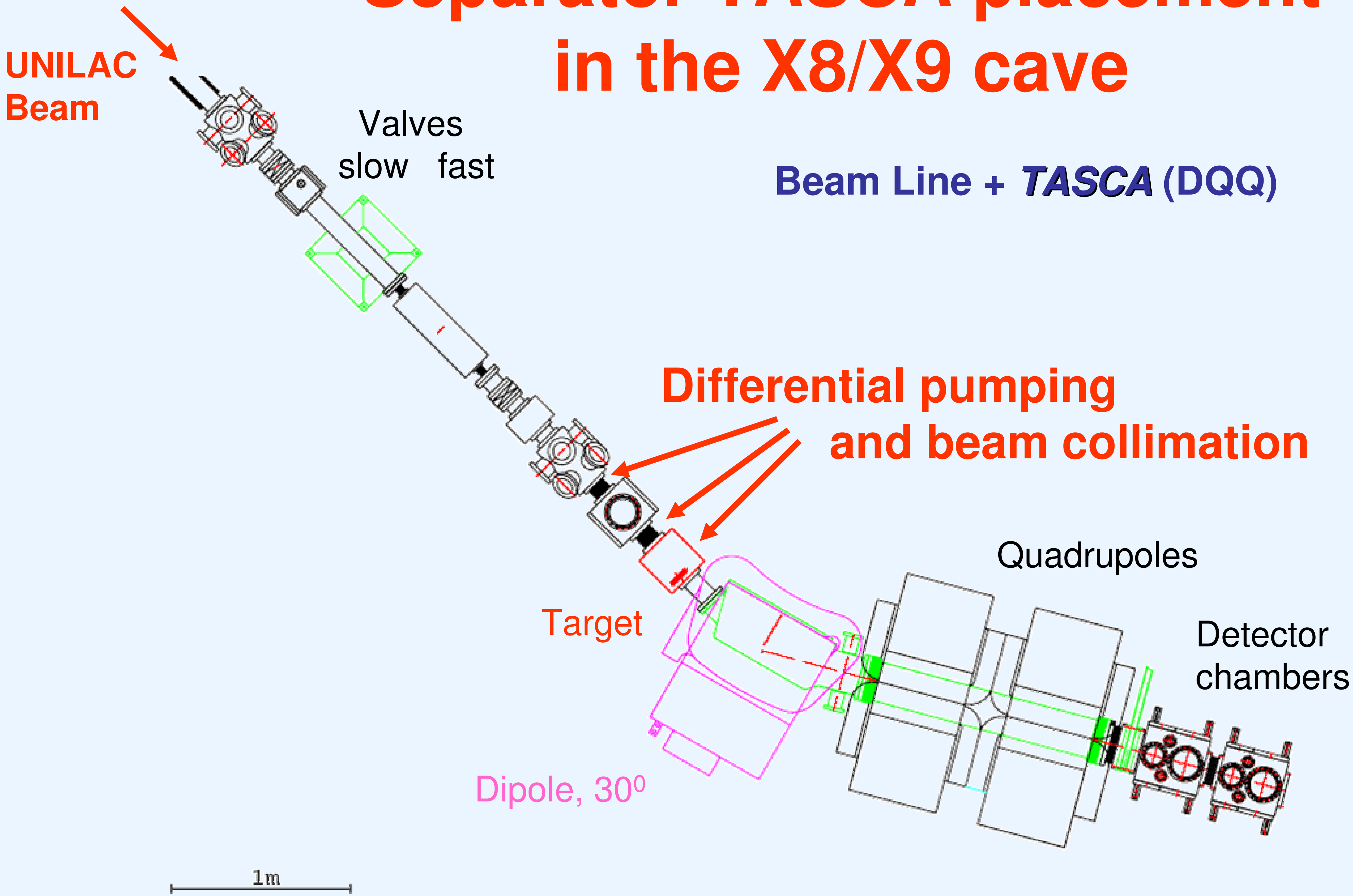
Main idea of work

- Windowless operation of separator

Main questions:

*** pressure – 0.3 – 2 mbar**
*** purity**
*** exhaust**
*** recycling**
*** construction**
*** control**

Separator TASCA placement in the X8/X9 cave

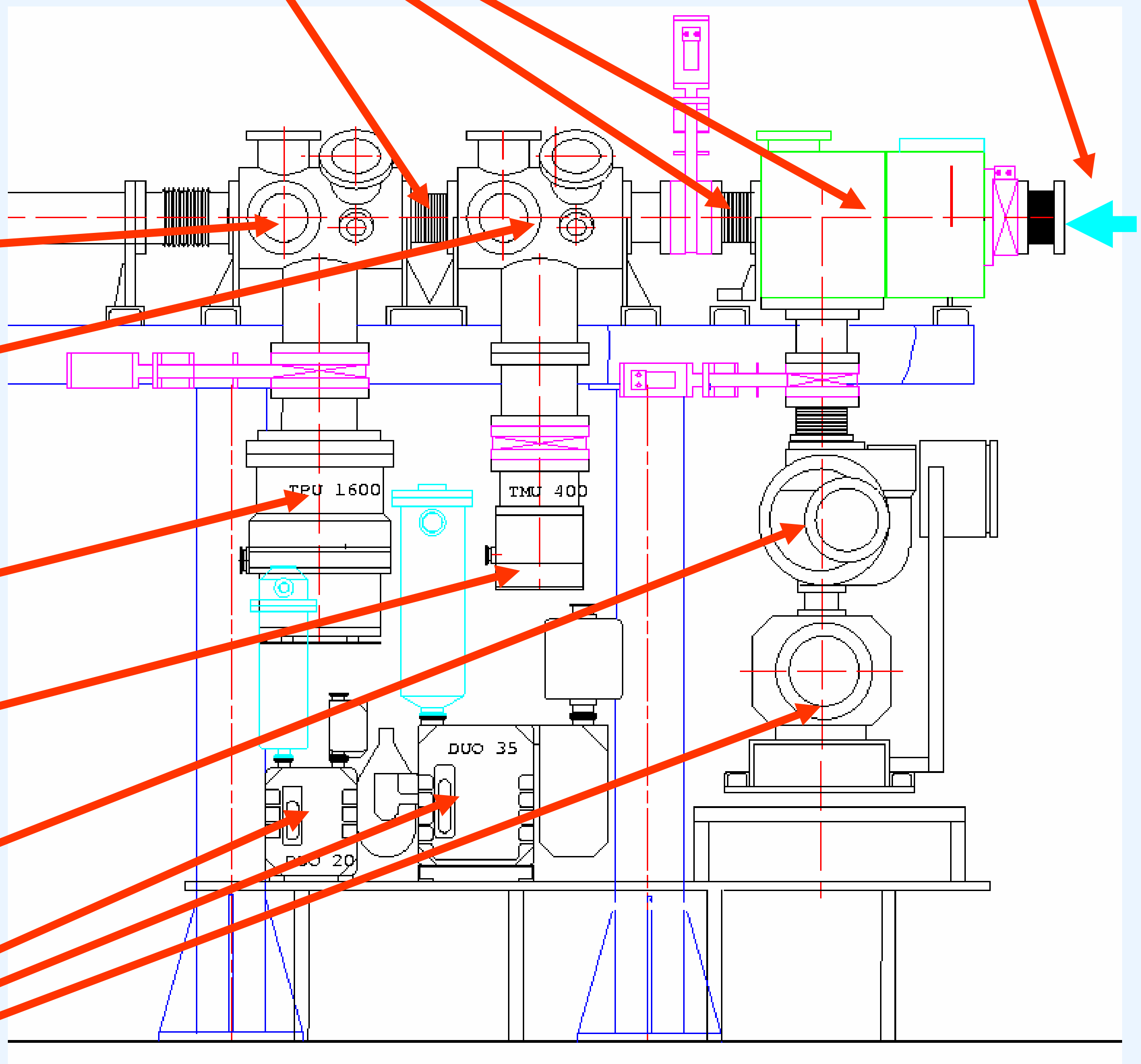


Drawings of Differetial Pumping Part of TASCA gas-vacuum system

Collimators

Target chamber

Gas flow from separator



Diagnostic box 1

Diagnostic box 2

Pumping units:

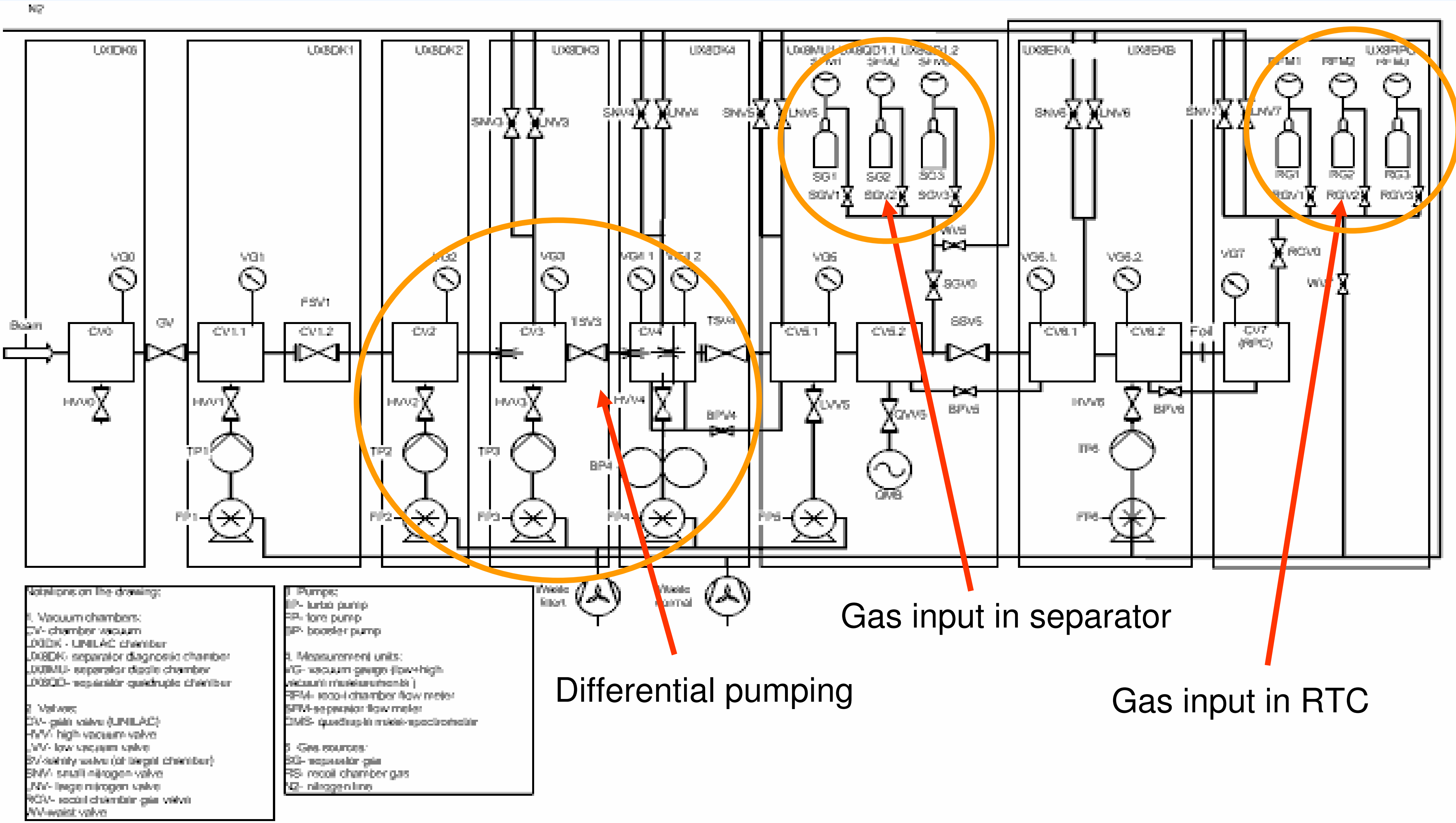
Turbo-pump 1

Turbo-pump 2

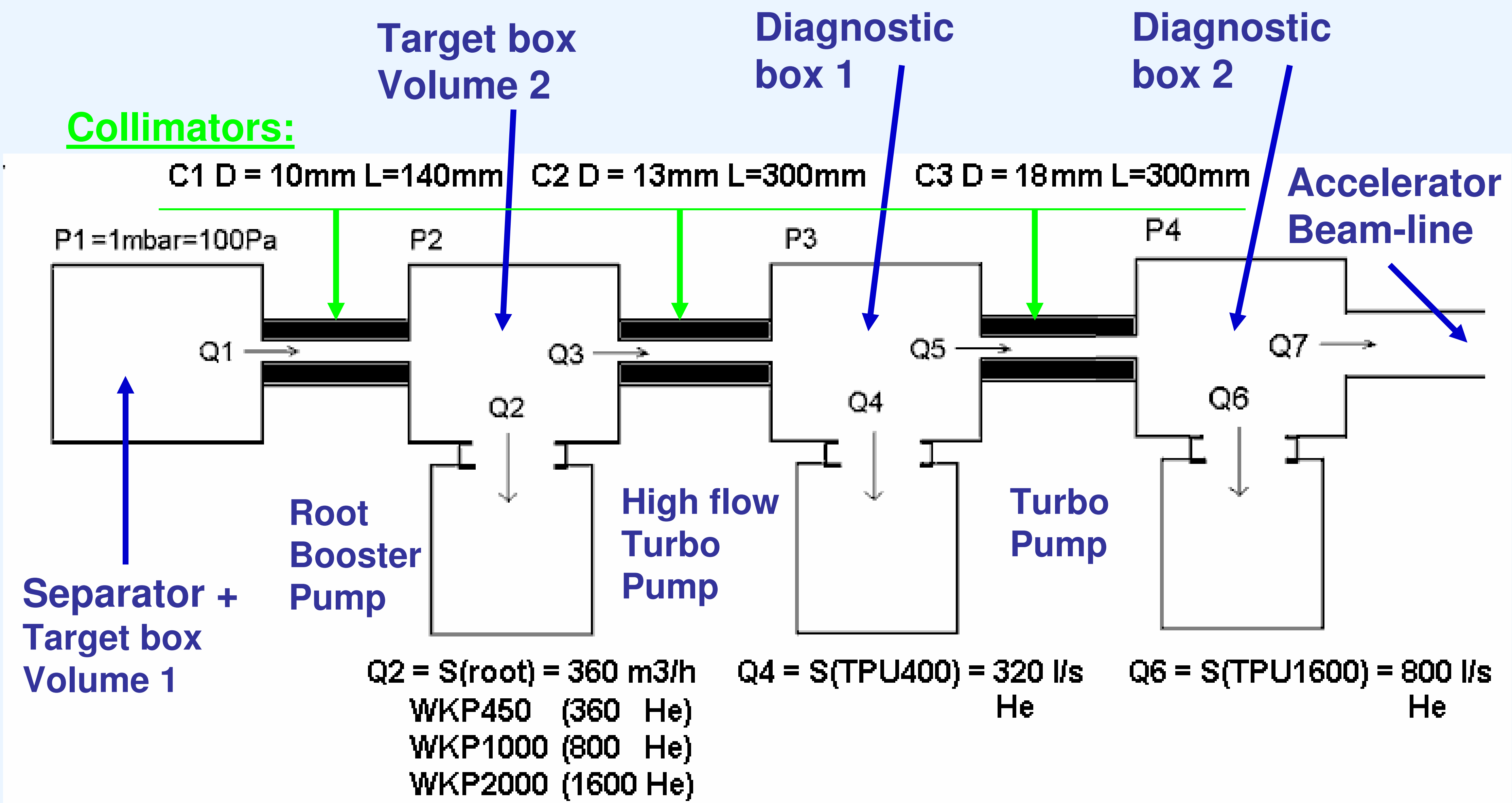
Root Booster Pump

Backing fore-pumps

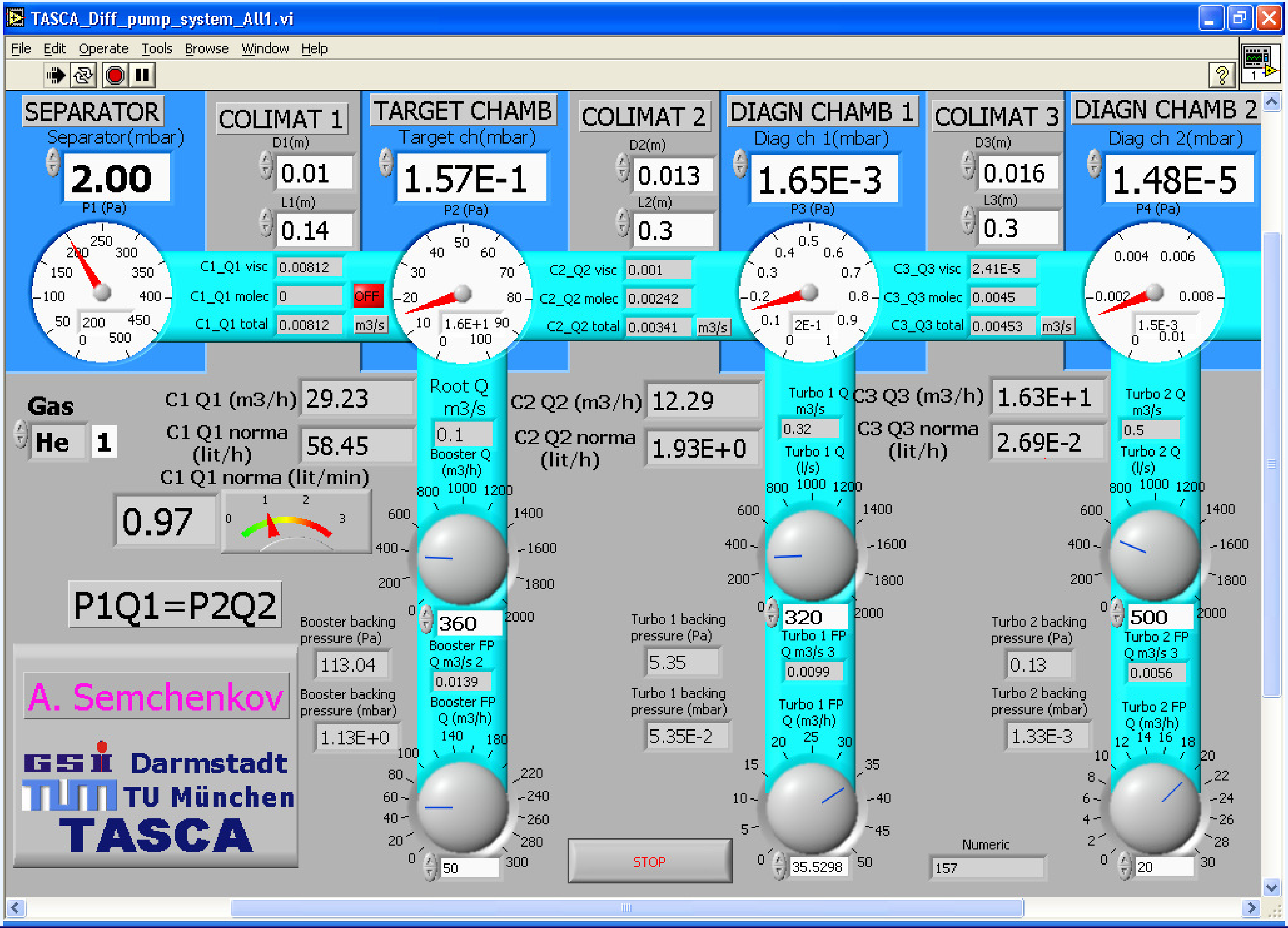
Structure scheme of TASCA gas-vacuum system



Structure of TASCA gas-vacuum system



Programm for differencial pumping system calculations



Equations used in calculations:

1. Viscosic flow:

$$Q_v = \pi D4dP/256\eta L \quad [m^3/s],$$

$\eta = 1.86*10^{-5}$ [kg/(m*s)] – viscosity of Helium at $t=20^oC$

D – diameter of collimator in m

L- length of collimator in m

P – pressure in Pa.

2. Molecular flow:

$$Q_m = (1/6)*(2\pi KT/m)1/2*D3/L \quad [m^3/s],$$

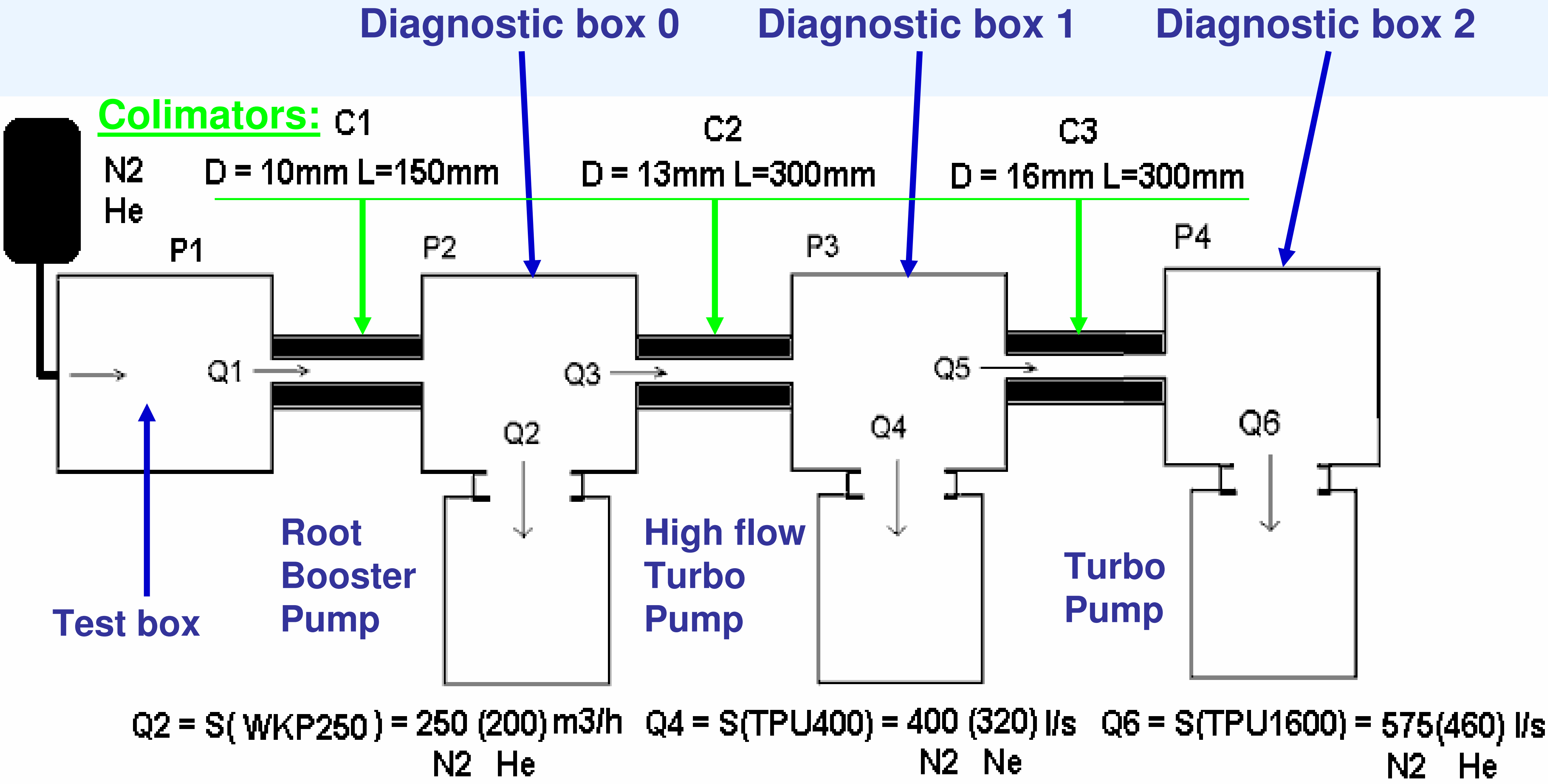
$K = 1.38*10^{-23}$ J/K - Bolzman constant

T – absolute temperature in K

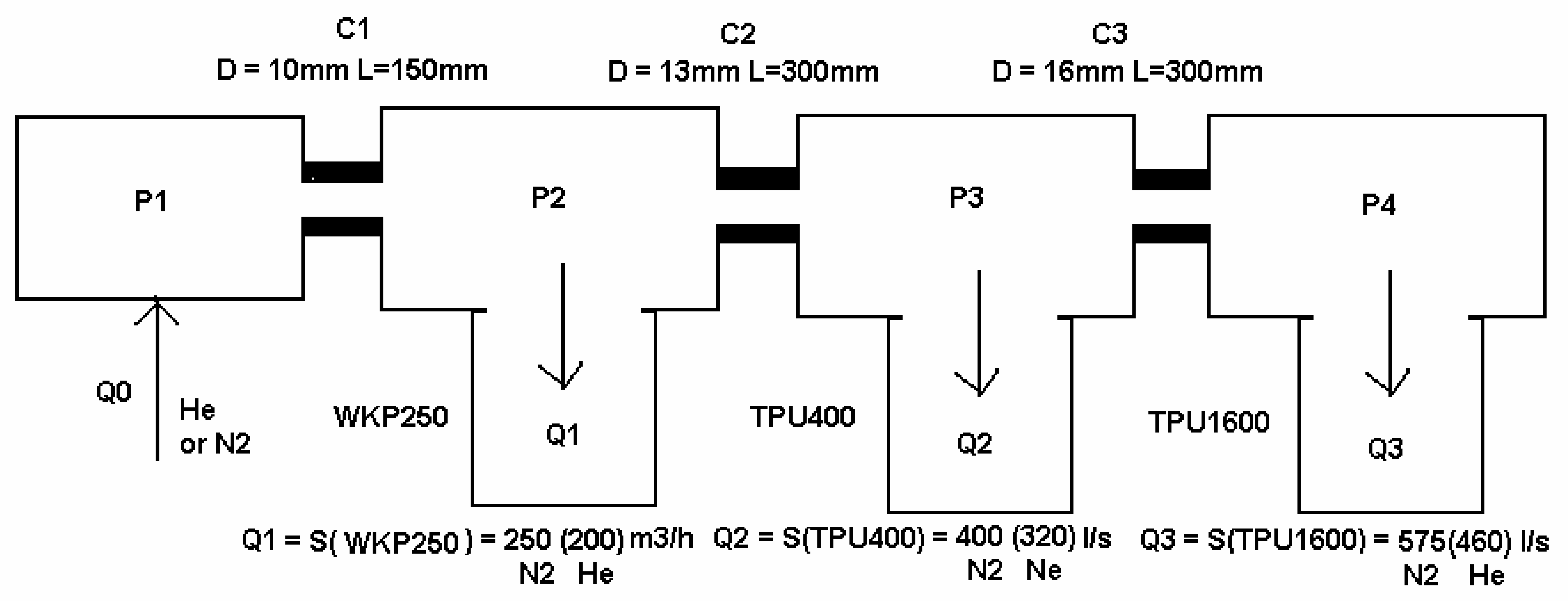
D – diameter of collimator in m

L- length of collimator in m

Structure of test stand of TASCA gas-vacuum system

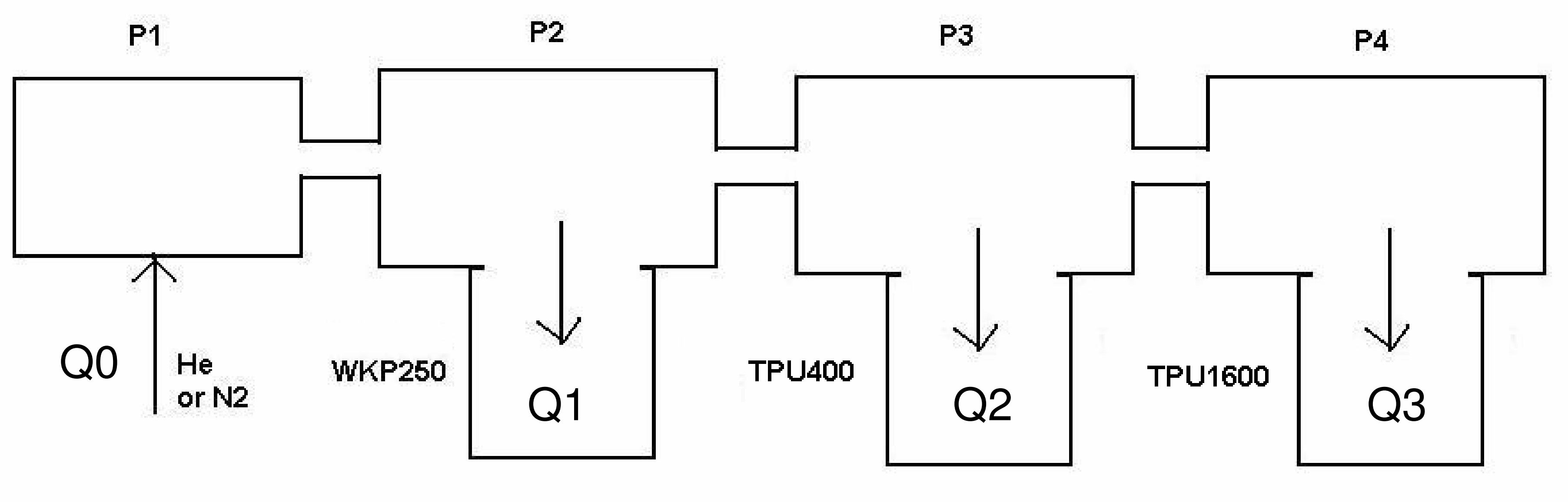


Test of differencial pumping system with N_2



Q0 l/min		P1 mbar	P2 mbar		P3 mbar		P4 mbar		Q1 m^3/h	Q2 l/s	Q3 l/s
exp	calc		exper	calcul	exper	calcul	exper	calcul			
0.21	0.26	1	$7.7*10^{-2}$	$6.0*10^{-2}$	$4.8*10^{-4}$	$2.2*10^{-4}$	$5.7*10^{-6}$	$5.8*10^{-7}$	250	400	575
0.66	1.0	2	$2.1*10^{-1}$	$2.3*10^{-1}$	$3.2*10^{-3}$	$1.3*10^{-3}$	$1.3*10^{-5}$	$4.5*10^{-6}$	250	400	575
1.24	2.1	3	$3.4*10^{-1}$	$5.0*10^{-1}$	$7.5*10^{-3}$	$4.6*10^{-3}$	$1.5*10^{-5}$	$1.4*10^{-5}$	250	400	575

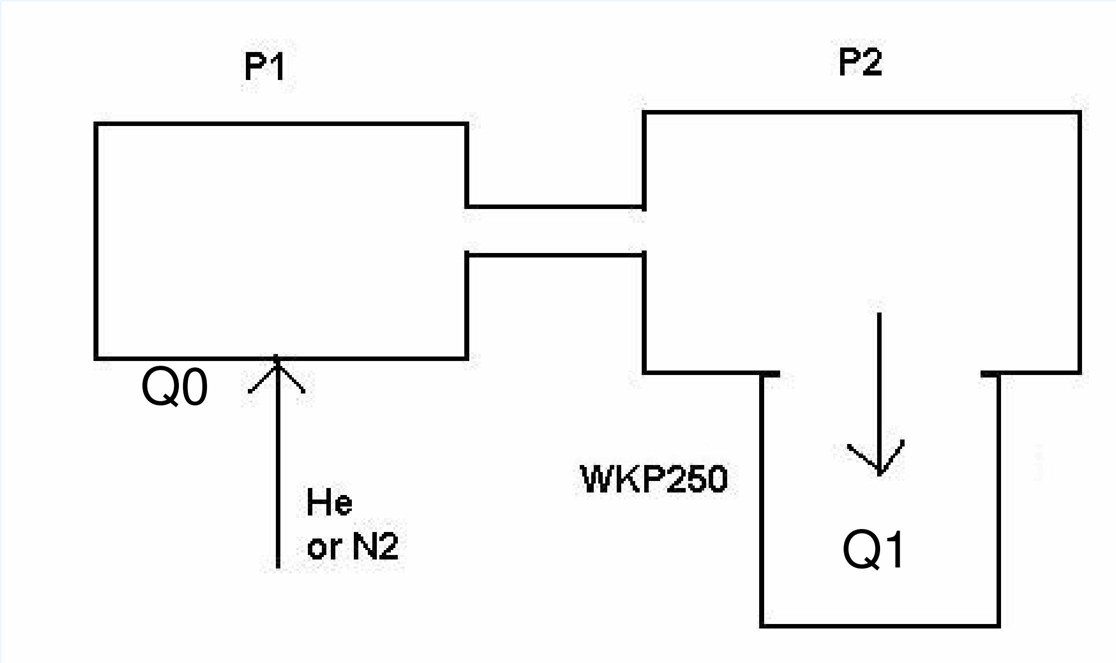
Test of differencial pumping system with He



Q0 l/min		**P1 mbar**	P2 mbar		P3 mbar		P4 mbar		Q1 m^3/h	Q2 l/s	Q3 l/s
exper	calc		exper	calcul	exper	calcul	exper	calcul			
0.15	0.1	**0.62**	$1.0*10^{-1}$	**$3.0*10^{-2}$**	**$1.5*10^{-4}$**	**$2.4*10^{-3}$**	**$9.0*10^{-6}$**	**$2.4*10^{-6}$**	200	320	460
0.41	0.32	**1.1**	$1.9*10^{-1}$	**$1.0*10^{-1}$**	**$4.0*10^{-4}$**	**$8.4*10^{-4}$**	**$1.3*10^{-5}$**	**$8.2*10^{-6}$**	200	320	460
0.87	1.00	**2**	$5.0*10^{-1}$	**$2.8*10^{-1}$**	**$8.7*10^{-3}$**	**$3.6*10^{-3}$**	**$1.5*10^{-5}$**	**$3.5*10^{-5}$**	200	320	460
0.15	0.09	**0.62**	$1.0*10^{-1}$	$1.0*10^{-1}$	$1.5*10^{-4}$	$1.0*10^{-4}$	$9.0*10^{-6}$	$1.0*10^{-5}$	**45**		
0.41	0.3	**1.1**	$1.9*10^{-1}$	$1.9*10^{-1}$	$4.0*10^{-3}$	$1.4*10^{-3}$	$1.3*10^{-5}$	$2.0*10^{-5}$	**80**		
0.87	0.85	**2**	$5.0*10^{-1}$	$5.0*10^{-1}$	$8.7*10^{-3}$	$9.0*10^{-3}$	$1.5*10^{-4}$	$1.0*10^{-4}$	**80**		

Test of differencial pumping system with He and N2

S(doc) = Q1 = 250 – N2
200 – He - 80%



Q1(He) l/min		P1	P2 mbar		Q1 m3/h		$Q0(N_2)$ l/min		P1	P2 mbar	
exper	calc	mbar	exper	calcul	calc		exper	calcul	mbar	exper	calcul
0.38	0.25	1	$2.*10^{-1}$	$7.5*10^{-2}$	70		0.23	0.26	1	$9.1*10^{-2}$	$6.2*10^{-2}$
0.93	0.9	2	$5.*10^{-1}$	$2.7*10^{-1}$	100		0.67	1.1	2.1	$2.2*10^{-1}$	$2.6*10^{-2}$
1.89	2.5	3.5	1.	$7.7*10^{-1}$	150		2.09	3.5	4	$5.8*10^{-1}$	$8.3*10^{-1}$
	plus	*oil*	*pump:*								
0.35	*0.25*	*1*	$1.3*10^{-1}$	$7.5*10^{-2}$	*100*						
0.97	*0.9*	*2*	$2.7*10^{-1}$	$2.7*10^{-1}$	*200*						

Main questions in differencial pumping system with He

1. Maximum pressure in the target chamber

   - 0.3 – 2 mbar ???

2. Capacity of pumping of ROOT Booster Pump:

   WKP 500
   WKP1000
   WKP2000

3. Dry or Oil pump, as a backing pump