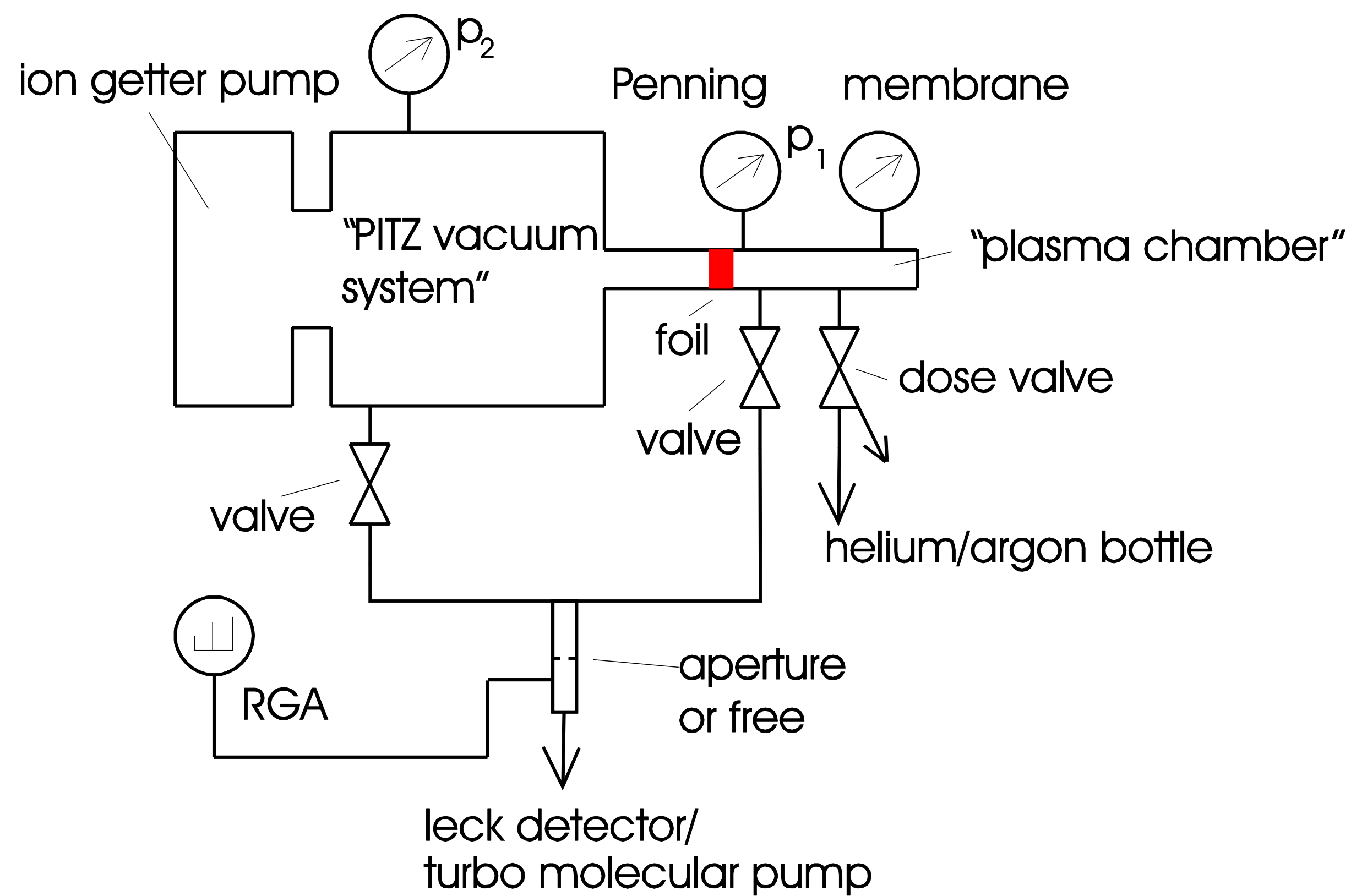


Investigation of foils for the termination of the plasma call

Permeation gas current measurements and influences of gas loads on PITZ operation.



Experimental setup



The plasma chamber is terminated by two thin foils.

During operation the electron beam penetrates the foils. Therefore they must be as thin as possible to reduce their influence on the electron beam. However, a noble gas current from the plasma chamber will permeate the foils too and the gas will come into the PITZ vacuum system. If its residual gas pressure is too high in the PITZ vacuum system, an instable operation of the ion getter pumps and of the rf system is expected.

Measurement of permeation constant

For measuring the permeation gas current passing different kind of foils the plasma chamber was filled either with helium or argon (pressure p_1). With the help of the pressure gauge (p_2) or the residual gas analyser the noble gas pressure p_{ng} in the PITZ chamber was measured. Due to the used aperture the effective pumping speed S_{ng} for the used noble gases was known. With its help and the pressure p_{ng} the gas current through the foil was calculated by $\dot{Q} = S_{ng} \times p_{ng}$. The permeation constant depending on the thickness d and the area A could be calculated by

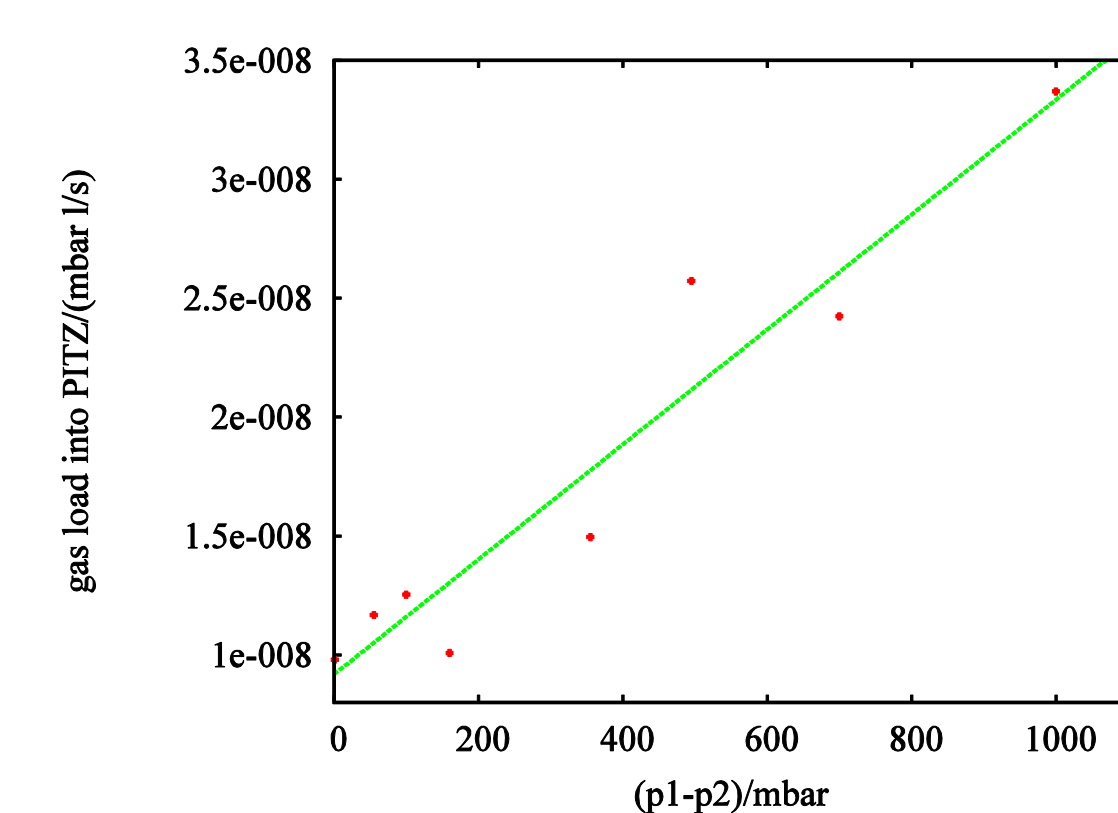
$$K = \frac{d \dot{Q}}{dp} \times \frac{d}{A}$$

Finally, depending on the properties of the foils we get the gas load into the PITZ vacuum system in different orders of magnitude:

$$\dot{Q}_p = K \times \frac{A}{d} (p_1 - p_2)$$

The pressure p_1 in the plasma chamber is assumed to be 0.27 mbar .

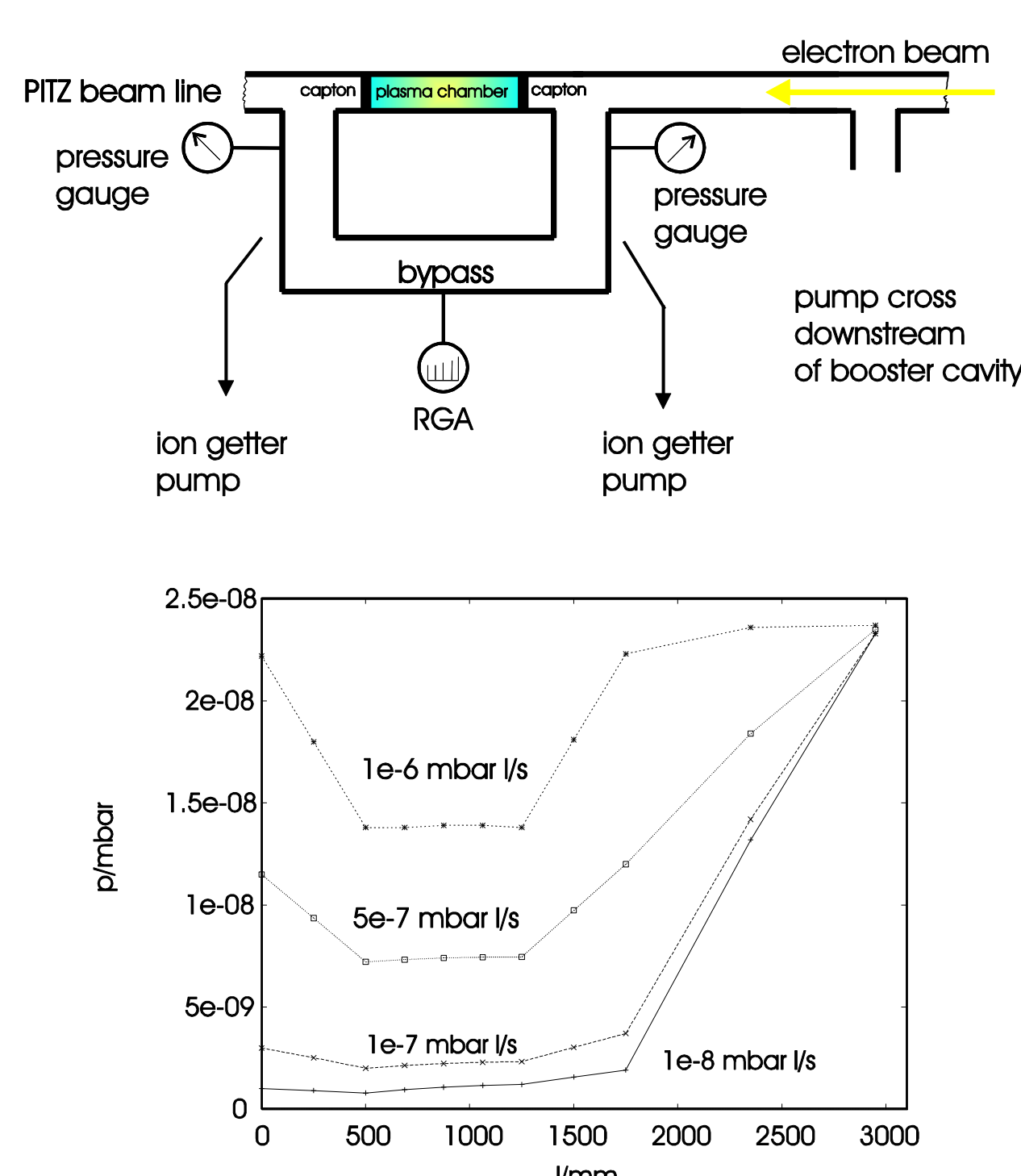
Gas load using a kapton foil ($d = 8 \mu\text{m}$, $A = 19.6 \text{ mm}^2$)



Results of some foils (M...Mylar, K...Kapton, P...PET, $A = 19.6 \text{ mm}^2$)

foil	$K/(m^2 s^{-1})$	gas	\dot{Q} into PITZ/(mbar l/s)
M, $2 \mu\text{m}$	$9.88 \cdot 10^{-9}$	He	$3 \cdot 10^{-5}$
M, $6 \mu\text{m}$, gold coated	$5.77 \cdot 10^{-9}$	He	$5 \cdot 10^{-6}$
K, $25 \mu\text{m}$	$1.97 \cdot 10^{-13}$	He	$4 \cdot 10^{-11}$
K, $8 \mu\text{m}$	$9.85 \cdot 10^{-15}$	Ar	$4 \cdot 10^{-12}$
P, $0.9 \mu\text{m}$, aluminum coated $2 \times 27.5 \text{ nm}$	$2.58 \cdot 10^{-14}$	Ar	$1 \cdot 10^{-10}$

Influence of the gas load on the PITZ vacuum system



Pressure distribution along the bypass up to the booster cavity. Parameter: Gas load from the plasma chamber

The foils should be as thin as possible. Measured gas loads vary over several orders of magnitude.

Furthermore different methods to mount the foils were tested. They caused a more or less additional gas current into PITZ.

Therefore the corresponding pressure distributions were investigated.

Result: Gas loads up to $1 \cdot 10^{-6} \text{ mbar l s}^{-1}$ coming from the foils do not compromise the operation of the booster cavity.

Almost all tested foils can be used.

Experiments are ongoing.