DAΦNE TECHNICAL NOTE

INFN - LNF, Accelerator Division

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Note: **V-8**

VACUUM DESIGN OF DAΦNE TRANSFER LINES

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Introduction

This design will comprise all transfer lines interconnecting the Linac, the accumulator and the main ring working at the following pressures:

Linac	$\sim 10^{-8}$ Torr
Accumulator	1×10^{-8} Torr
Main Ring	1×10^{-10} Torr without beam 1×10^{-9} Torr with beam

Due to the low operating energy of 500 MeV we assume that no windows are permitted in order not to degrade beam emittance. The only mass that particle will see is residual gas which is negligible even at 1×10^{-6} Torr. The important task is to match the above three vacuum systems without degrading their operating pressures.

At present we will consider the section shown in Fig.1 for which lattice design exists. In addition to the vacuum components we include approximate location of flags F which are essential for day one operation and which require some pumping. In a forthcoming report covering the transfer line to the main ring, enough differential pumping will be provided not to contaminate the main ring.

Vacuum System

a) Vacuum chamber

304L stainless steel has been selected for the beam chamber. All components will be glow discharged before they are assembled into the final system, yielding an outgassing rate $q_D < 1 \times 10^{-11}$ Torr l/s cm^2. No bake out will be installed except for the ~10 m at the entrance to the main ring to be discussed in a later note.

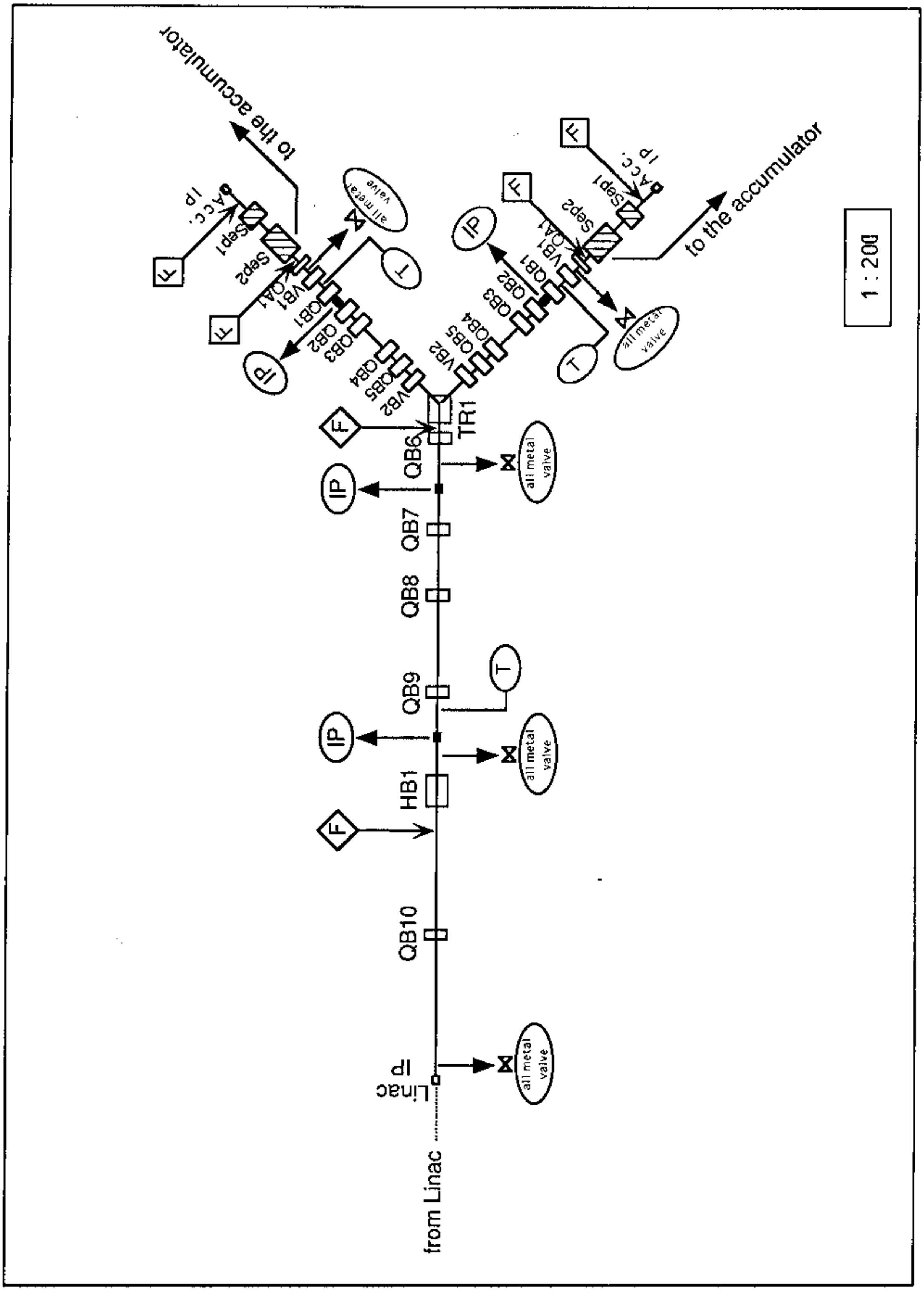

Fig. 1 - DAΦNE Transfer Lines.

Since the beam passes through the chamber only once, no special precautions have to be taken when components of different dimensions are joined together. Here easy welding and machining will be the main consideration.

The chamber will be welded wherever possible or desirable. Otherwise conflat flanges with Cu gasket will be used creating an all metal UHV system. The location and the size of the flanges will be decided during detail design stage. Thin wall chambers, reinforced with bonded carbon fibers, will be required for the pulsed magnets. Calculations are in progress.

b) Pumping speed and pressure calculations

The vacuum chamber will be divided into four sections separated by all metal gate valves. Only thermal outgassing will be considered since synchrotron radiation desorption is negligible. With a conservative value of q_D = 1×10^{-11} Torr l/s cm^2 and a total, (all the four sections), degassing surface A= 85719 cm^2 the thermal gas load turns out to be:

$$Q = q_D \times A = 857 \times 10^{-9} \text{ Torr l/s}.$$

Hence, for a pressure of 1×10^{-8} Torr, the required pumping speed is

$$S = Q/P = 85.7 \text{ l/s}.$$

To calculate the pressure in every section the average conductances (see Table I) are needed following the scheme reported in Fig. 2.

Table I*

C1 (l/s)	2.01
C2	2.46
C3	11
C4	1.93
C5	.71
C6	1.93
C7	.71

* These values are based on the transfer lines design reported on DaΦne Techn. Note I-3.

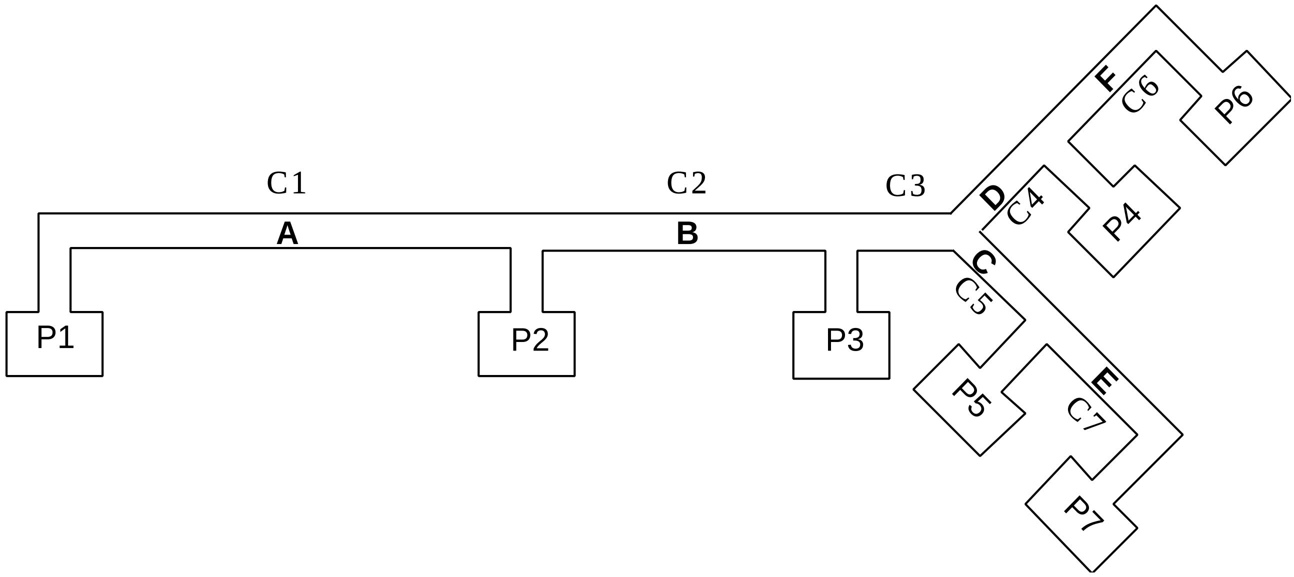

Fig. 2 - Schematic drawing of the transfer lines vacuum system.

With a pumping speed of 120 l/s for each pump the pressure right close the pumps is $\leq 1\text{x}10^{-9}$ Torr. Taking into account the pumping speed of each couple of pumps close to the points A,B,C,D,E,F and the relative conductances we obtain:

P(A) ~ 3 $\text{x}10^{-8}$ Torr

P(B) ~ 3 $\text{x}10^{-8}$ Torr

P(C) ~ 2 $\text{x}10^{-8}$ Torr

P(D) ~ 4 $\text{x}10^{-8}$ Torr

P(E) ~ 4 $\text{x}10^{-8}$ Torr

and these values would not affect at all the operating pressure of Linac, accumulator and main ring.

Conclusions

The vacuum system presented will contain the following components:

4 all metal valves

5 120 l/s ion pumps

6 flags (min)

3 Instrumentation T
- CC gauge
- Pirani gauge
- all metal roughing valve

Additional pressure information will also be provided from ion pump current read-outs.

Each section between roughing valves will be initially evacuated by dedicated portable roughing station containing a TMP and a dry backing pump.

I intend to thank Dr. H. Halama for his help and enlightening discussions.