DAΦNE TECHNICAL NOTE

INFN - LNF, Accelerator Division

Frascati, Nov. 12, 1991

Note: **V-10**

MAIN RING VACUUM SYSTEM UPDATING # 2

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INTRODUCTION

Referring to the note V-5 by Henry Halama, we will give here some further consideration and information about the storage ring vacuum chamber components (pumps, valves, gauges, and so on),

GAS DESORPTION

We will repeat here the gas desorption rates due to synchrotron radiation.

Considering a vacuum chamber sector composed by two bending magnets and one wiggler, we have:

- 10^{21} phot/sec per sector, at full current (5.5 Amp.)
- desorption efficiency of 2×10^{-6} mol/phot, for CO.
- gas load Q = 3×10^{-5} torr·liters/sec per sector. (1 mol/sec = 3×10^{-20} torr·liters/sec).
- pumping speed S = Q/p = 3×10^{4} l/s per sector.

PUMPING SPEEDS FOR THE DESORBED GASES

Carbon monoxide

This gas is efficiently pumped by Titanium sublimators. A 20 cm diameter connection between sublimator and Aluminum chamber will give a pumping speed of 3000 l/s. Thus a total of 10 sublimators per sector are needed.

Hydrogen and methane

Hydrogen can be effectively pumped and it does not give problems for the beam life time due to its low atomic number.

Methane is not pumped by sublimators. A very high desorption rate, at the beginning of the conditioning, is cited in the literatures: 1/4, 1/5 of that of CO. At the end of the conditioning (let us say 10^{25} photons) a factor 1/10 or 1/20 is that of CO. This means that a pumping speed of 1000 l/s or more is needed for CH_4, per sector.

Six 230 l/s triode ion pumps per sector seem to be necessary. In Fig. 2 the design of the vacuum chamber of one sector with 16 ports (8 up and 8 down), 200 mm I.D., would be the best solution, giving, as said, 6 ports for ion pumps and 10 for sublimators.

We are referring to Titanium triode ion pumps since they efficiently pump methane (vendors will be requested to provide the pumping speed versus pressure, for methane, for their products). The possibility to have an accumulation of methane during the initial conditioning must be taken into consideration; if necessary, other kinds of pumps could be added.

DISTRIBUTED ION PUMPS

Along the vacuum chamber of the sector we are considering a slotted partition which separates the "beam chamber" from the region where pumps, absorbers and so on, will be located. A 1 cm high slot will have a conductance of more than 1000 l/s/meter. This means that the pressure, in the beam area, is not significantly improved with a distributed ion pump (or a NEG) inside the bending magnet, considering that the pumping speed of those pumps is of the order of 100 l/s/meter, and the total dipole magnet is only 8.8 meter long.

SYNCHROTRON RADIATION

The goal is to have all the photons produced by circulating beams to be intercepted by photon absorbers. In the present vacuum chamber design (see Fig. 2), 10% of the synchrotron radiation from bending magnets hits the vacuum chamber walls. The insertion of another absorber, between magnet and wiggler, could eliminate this problem. Another sublimator can also be placed close to this absorber. This will result in having a quasi-constant pressure profile along the sector, since the gas sources are just on the pumps (remember that the thermal outgassing is low compared to that one produced by light). This new absorber configuration is under design.

LABORATORY TESTS

The following two important tests must be performed as soon as possible (let us say within June 1991).

1) TSP. Sublimation rates and other important parameters must be studied. (A sublimator + a gas inlet system + a total pressure gauge will be necessary).

2) Glow discharge system. In this case the vacuum system is more complicated with respect to the point 1). The process parameters must be assessed.

We will present more details in future notes.

LOCATION OF THE VACUUM COMPONENTS ALONG THE RINGS

The following list, together with the Figs. 1 and 2, will depict the number and the position of the components needed on the vacuum chamber. Injectors, RF Cavities and interaction sections will have a dedicated vacuum system which will be considered in future notes..

Regarding RF cavities, we adopt the solution of having two valves on each side: in this way cavities can be moved under vacuum without venting the ring.

Similar consideration shall be applied to the interaction regions.

Followings are legends and quantities of the pumps and instrumentations:

- TIP = Titanium ion pumps;
- TSP = Titanium sublimation pumps;
- IG = Ion gauges;
- RGA = Residual Gas Analysers.

TIP

120 l/s, 4 per straight section = 16
230 l/s, 6 per Al chamber = 48

TSP

10 per Al chamber = 80

Total pressure IG Heads

3 per Al chamber	=	24
1 per straight section	=	4
1 per splitting magnet	=	4
Total	=	32

All metal sector valves, with RF contacts

4 per splitting magnet	=	16
4 per RF cavity	=	8
1 per injector	=	2
Total	=	26

All metal right angle valves (fore-vacuum connections)

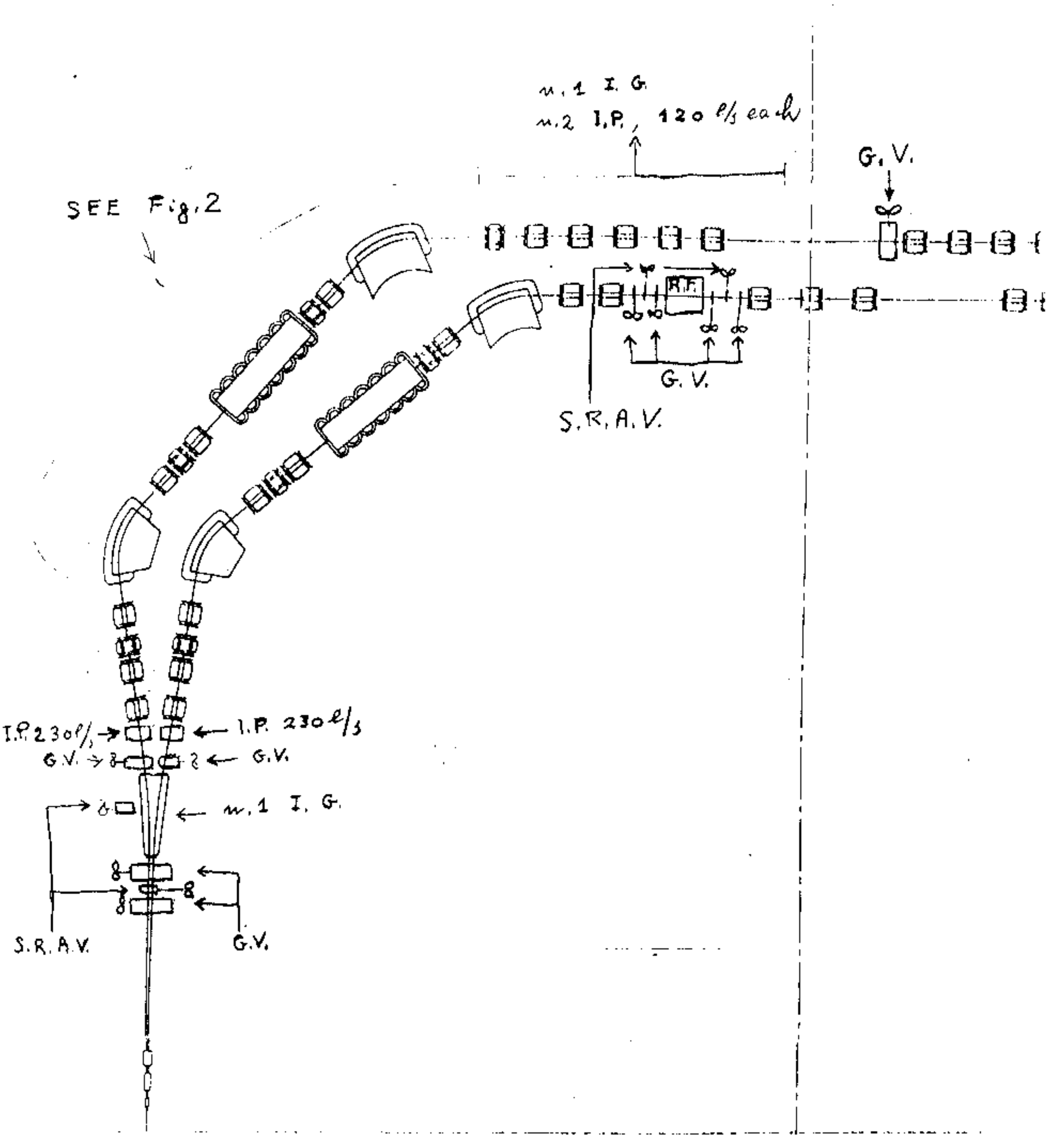
2 small per splitting magnet	=	8
2 small per cavity	=	4
1, 100 mm ID, per Al chamber	=	8

RGA Heads

1 per Al chamber	=	8

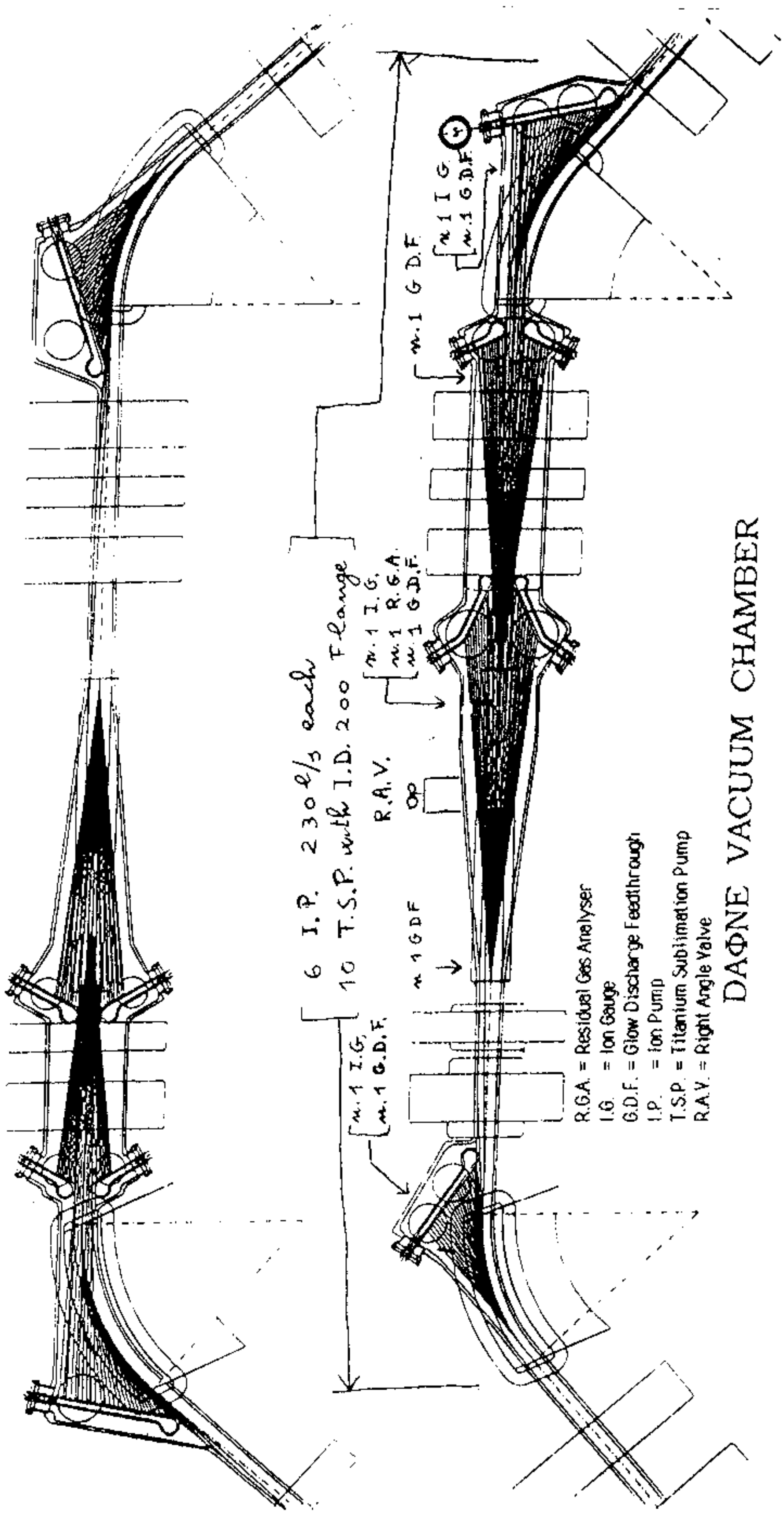
Glow Discharge Feedthroughs

5 per Al chamber	=	40.



S.R.A.V. = Small Right Angle Valve
G.V. = Gate valve
I.P. = Ion Pump

Fig. 1



DAΦNE VACUUM CHAMBER
R.G.A. = Residual Gas Analyser
I.G. = Ion Gauge
G.D.F. = Glow Discharge Feedthrough
I.P. = Ion Pump
T.S.P. = Titanium Sublimation Pump
R.A.V. = Right Angle Valve
6 I.P. 230 l/s each
10 T.S.P. with I.D. 200 Flange
R.A.V.
n.1 I.G.
n.1 R.G.A.
n.1 G.D.F.
n.1 GDF
n.1 I.G.
n.1 G.D.F.
n.1 G D F
n.1 I G
n.1 G.D.F

Fig. 2