DAΦNE TECHNICAL NOTE

INFN - LNF, Accelerator Division

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Note: **V-11**

MAIN RING ARC PUMPING SYSTEM

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The results obtained in the U10B experiment[1] show that the effective desorption coefficient, η, of 1.5 10^{-6} is achieved after a dose of 10^{25} photons per quadrant. This dose requires only 100 hours of conditioning at a current of 200 mA - an easy task!

Similar ηs are routinely measured in operating machines, for example:

η <1 10^{-6}	at E = 1.7 GeV (Daresbury)
η = 5 10^{-7}	at E = 200 MeV (XLS)
η = 1÷2 10^{-6}	at E = 2.5 GeV (X-Ray Ring)

To achieve 5.5 A current operation, a pumping speed of 1.8 10^{4} liters/s is required[1] in each arc. This pumping speed is supplied by:

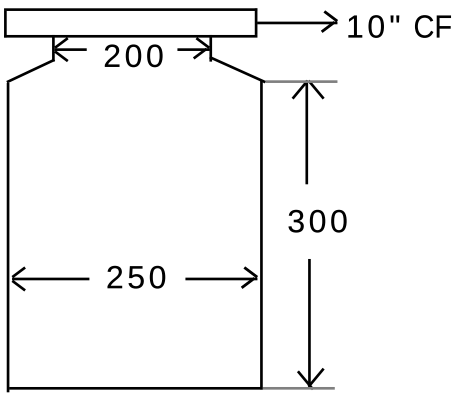
a) Nine 220÷250 l/s ion pumps which yield a pumping speed of 180÷200 l/s when connected to the chamber through a conductance shown in Drawing X1.

b) Nine stainless steel vessels connected to the chamber via 10" conflat flanges (20 cm opening) having a conductance of 3000 l/s for N_2.

In order to achieve S = 2000 l/s at the input of the pumps the Ti film must have a minimum speed of 6000 l/s.

We give 2 examples:

Example I



C = 3000 l/s

Area < 2500 cm^2

S = 3 10^{4} l/s
at sticking coef. k = 1

S = 6 10^{3} l/s
at k = 0.2

Example II (see Drawings X1, X2)

C = 3000 l/s
Area ≈ 4000 cm^2
S = 4.7 10^4 l/s at k = 1
S = 6000 l/s at k = 0.12

The gas load of 4.2 10^{-5} Torr l/s is removed as follows:

10% by SIPs (9x200 l/s) 4 10^{-6} Tl/s

90% by TSPs (9x2000 l/s) 3.8 10^{-5} Tl/s.

Stainless steel vessels housing TSP cartridges will be heavily sandblasted, groved or etched to give a large surface area. If possible they should be fired at high temperature to remove hydrogen before the flanges are welded to them, as they will be heated during each sublimation. They will be glow discharge cleaned using the TSP cartridge filament after the machine has been assembled.

The constants used in calculations and the resulting TSP parameters are listed in Table I for the above two examples. A Blazer TSP cartridge USP-063 containing 3 filaments (6 g of Ti) seems to be well suited for their application but other cartridges could be used.

Comments:

1. It should be stressed that the high installed ion pumping speed will be sufficient for conditioning of the rings and will permit stored beam operation up to 0.5 A.

2. Sublimation will be used for higher beam operation (above 0.5 A) and to speed up conditioning if necessary. Intervals between Ti flashes and the amount deposited will be governed by stored current.

3. Since we will have almost 100 TSPs in the machine, the flashing of Ti filaments will take several hours with no beam. Air cooling of TSP vessels by 3 small fans may be required during deposition. No water cooling is used.

4. Since the ion pumps are located below the absorbers, substantial number of photoelectrons would mask their true pressure readings[2]. A copper screen will be inserted between the pumps and the chamber.

4. Beside the installed glow discharge electrodes, TSP filaments will also be utilized during in-situ glow discharge.

5. This large vacuum system appears to be conservative even for 5.5 A beam operation, because by the time 5.5 A are reached, η will drop below 1 10^{-6}. Its greatest asset will be a rapid recovery of operating pressure after an intervention into the vacuum chamber or after an accident.

TABLE I

		Ex. I	*Ex. II*
1 monolayer }	Torr l/cm2	1.5 10^{-5}	
	Ti atoms/cm^2	5 10^{14}	
Gas load per pump	Torr l/s	3.8 10^{-6}	
Roughness		4	
Gas absorbed	monol./cm^2	20	
Area	cm^2	2.500	4.000
Ti evaporated per flash }	monol.	800	
	mg	80	128
Interval between Ti flashes	days	7.5	12
Total gas pumped	Torr·l	2.8	4.6
Number of Ti flashes*		75	47
5.5 A operation	24 hr days	560	
* 6 g of available Ti			

Things to do

The design of the TSP discussed in this note is based on data obtained by many investigators which provide a good first step. However, since the TSP is so important for achieving 5.5 A beam current, it is imperative to construct the pump described in Drawing X3 with the pumping capacity given in Example II. Since η will be substantially lower by the time 5.5 A operation is required, capacity reduced by a factor of 2, i.e. > 2 Torr·l, should be sufficient. The initial pumping speed is easily obtainable as previously checked on the existing INFN set-up.

Three things have to be investigated:

1) Large surface area (roughness) obtained by triangular grooves, corrugations, sandblasting, etc.

2) Length of Ti filaments to uniformly cover large areas.

3) Number of Ti filaments in the TS cartridge with total available Ti $\approx 6 \div 10$ g per cartridge.

Since 100 units will be purchased, a specific unit to fit DAΦNE should be designed.

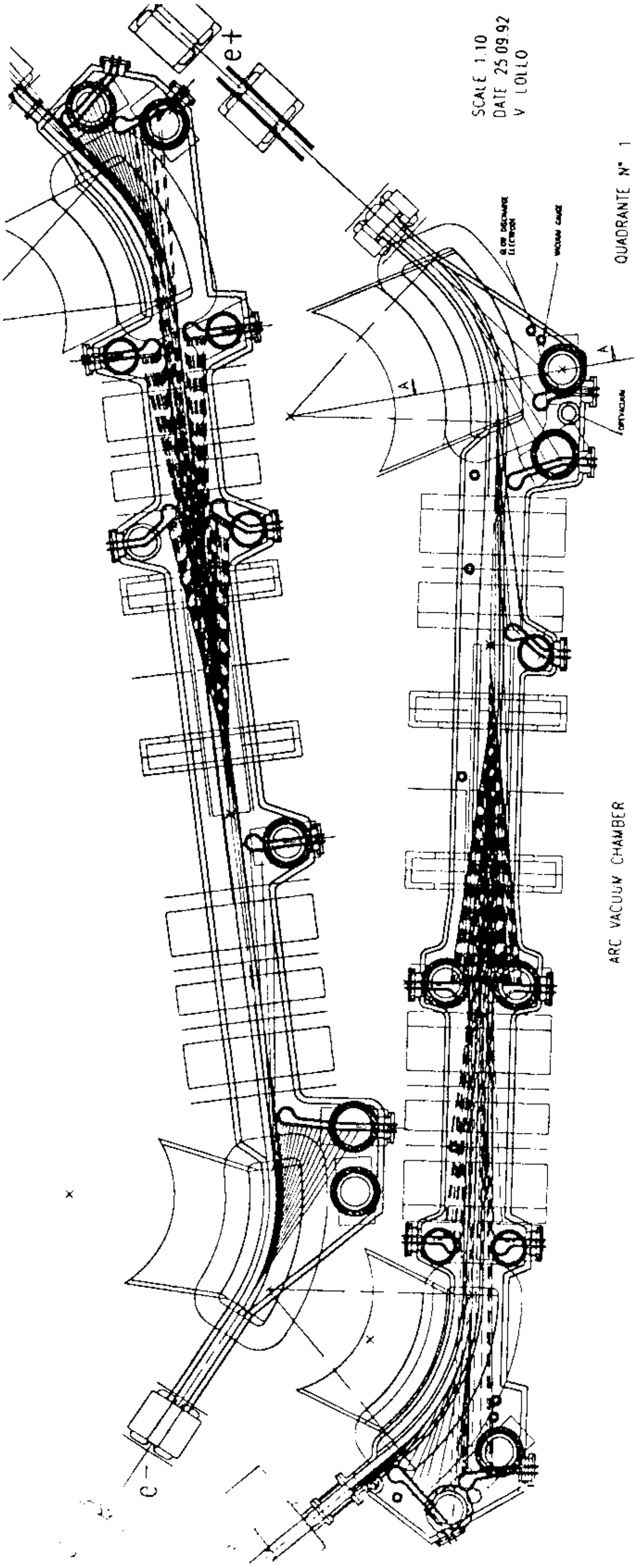
Acknowledgments

I would like to thank Pina Possanza for her professional preparation of this note and for her generous help with everything.

References

[1] H. Halama, C. Vaccarezza, to be published.
[2] H. Halama, C.L. Foerster, NSLS Technical Note # 325 (1989).

X1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SCALE 1:10
DATE 25.09.92
V LOLLO
QUADRANTE N° 1
ARC VACUUM CHAMBER
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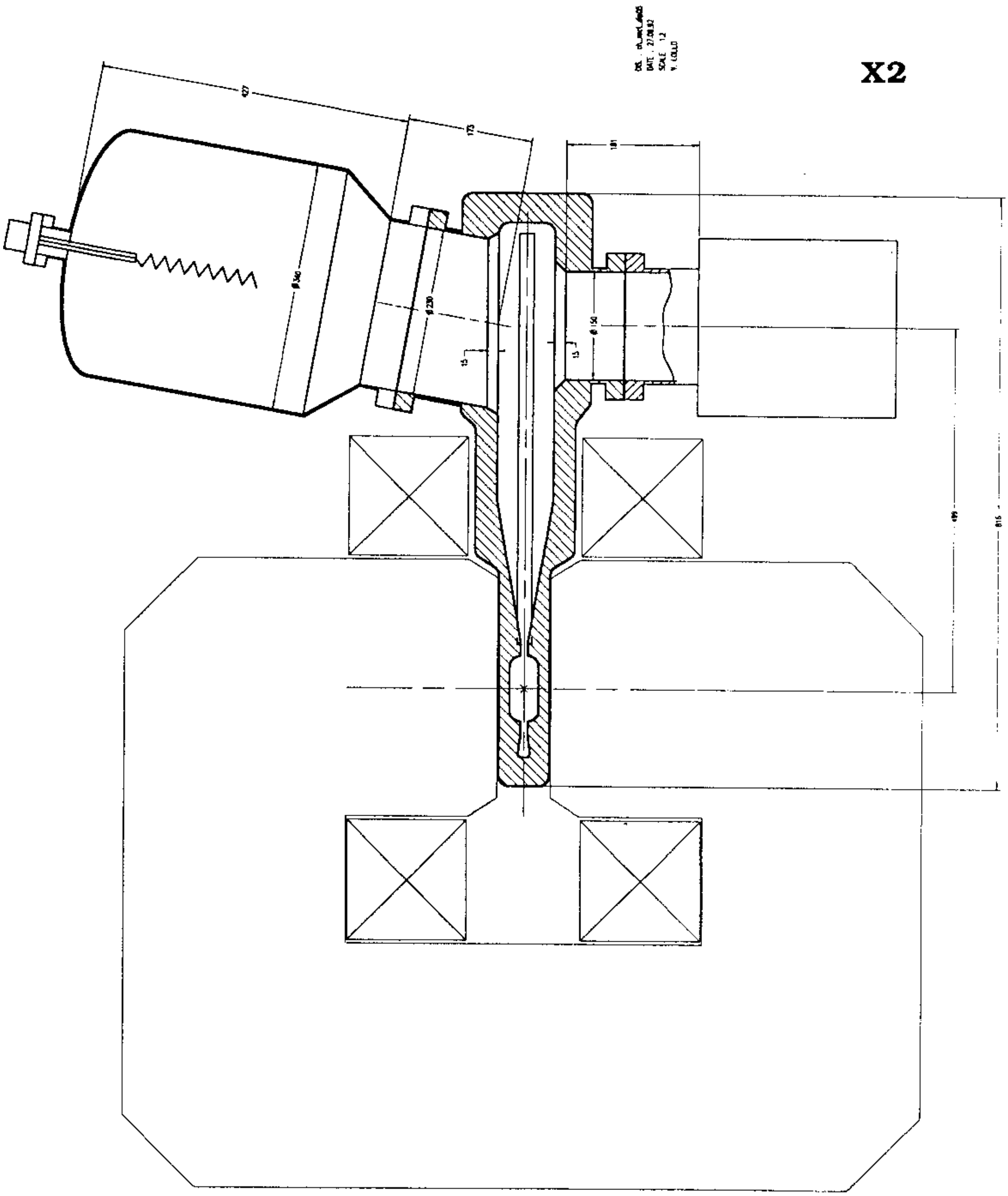
X2



X3