LINAC STUDY 12.10.1983-18.10.1983

Objective : Is it possible to accelerate deuterons in Linac II ?

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Results

Initially, a proton beam was produced to verify the correct functioning of the Linac after the maintenance and power failures at the beginning of the week.

Using proton source settings, a beam was produced up to the first beam stopper at about 380 kV. This gave approximately 100 mA in IM2 but with bad transmission towards IM4 (hole in beam). Opening AP1 and AP2 to 50 mm resulted in a maximum of transmission towards IM4 approaching 100%. It is of interest to note that a similar phenomena was observed in Linac I with the slit BA11.

This beam was then sent into the Linac with the bunchers off and a small current was observed in IM7. Raising Tank 1 level to 2100 (command) instead of 1850 increased the current in IM7 to 17 mA. A Corlin and Corleb using proton values increased the current to approximately 30 mA with around 90 mA in IM6. For further tests, Tank 1 level was reduced to 1950 to avoid the risk of tank breakdown.

After some problems with the RF in Tank 2 it was decided to keep this tank as a reference and to maintain it on proton settings. A broad maxima of current in IM9 could be found as a function of the phase of Tank 1 (range 90° from fixed phase of tank). Using BH1 and IM15 as a spectrometer the beam energy after Tank 3 was found to be from 30 MeV (proton equivalent) downwards. Within the range of the variable phase shifter of Tank 3 no 50 MeV could be found.

Starting a systematic search over the total phase range of Tank 3 quickly gave a fixed phase of 00 and a beam of 50 MeV in IM15 the magnitude of which was critically dependent on the levels of Tanks 2 + 3. Proton levels were found to be the optimum.

The resultant beam was measured in the new measuring lines and the results are attached to this note. Linac settings were as follows:

Source - proton operation setting.
HT - 397 kV.
LEBT - proton focusing; apertures 50 mm.
Bunchers - off.
RF Tank 1 - level 1950; fixed phase, proton; variable phase 65°.
RF Tank 2 - proton settings.
RF Tank 3 - level proton; fixed phase 00; variable phase 3.07°.
Tank focusing - proton.
Hebt focusing - proton.

Beam current (from log)

IM2	IM6	IM7	IM9	IM10	
122	89	24	17	16	mA

Manual optimization of the LEBT focusing (small variations relative to the proton values) eventually gave the following values which are compared with the last production run in Linac 1.

	IM2	IM6	IM7	IM9	IM10	
Linac 2	125	95	28	21	21	(log)
Linac 1	120	42	13	12	11	(photo)
	BM2	BM11	BM21	BM41	BM46	

Due to lack of time, no real effort was made to use the bunchers, but initial indications were of an improved transmission between IM6 and IM7.

Conclusion

It is possible to accelerate deuterons fairly easily in Linac 2. However, considerable effort will be needed to optimize the Linac for regular D^+ (or α) operation.

Suggested future studies

Future studies should be carried out with an adequate presence of all experts in the various subsystems of the Linac. The following could be a programme of measurements.

1) LEBT emittance measurements and computation of matching.
2) Tank RF optimization.
3) Tank focusing optimization.
4) Optimization with bunchers and HT.
5) α production with a stripper between AP1 and AP2.

N.B. The logs are retained in a file named "Deuterons in Linac 2".

As a final test, slits AP1 and AP2 were closed separately and the beam current in IM4 observed.

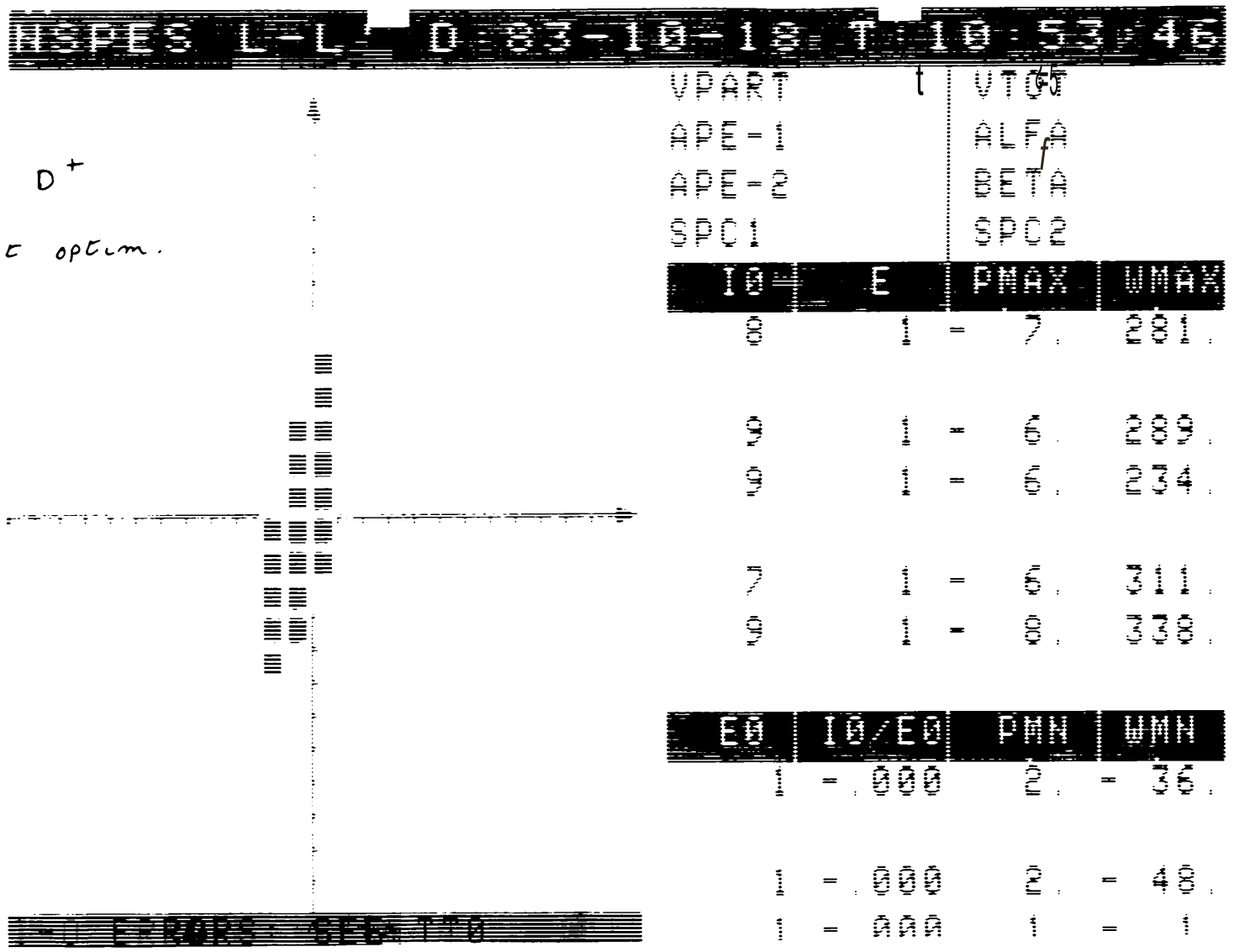
AP2 ΔH losses commence at 25 mm but only about 4% loss at 20 mm.
AP2 ΔV losses also commence at 25 mm with about 20% loss at 23 mm.
AP1 ΔH losses commence at 30 mm with about 20% loss at 23 mm.
AP2 ΔV losses commence at 35 mm with about 25% loss at 23 mm.

With all slits at proton settings (AP1-23, AP2-19) the loss in IM4 was of the order of 50%.

C.E. Hill

Distribution

Linac Group
Liste PPC
F. James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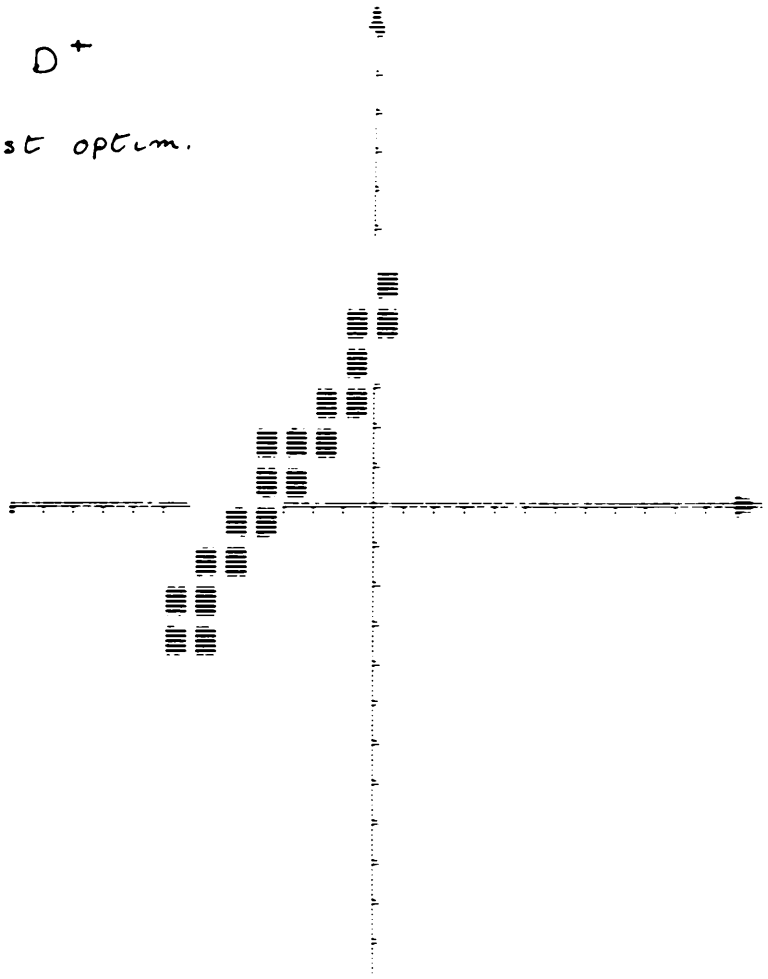
VPART
APE=1
APE=2
SPC1
VTOT
ALFA
BETA
SPC2
I0 E PMAX WMAX
8 1 = 7. 281.
9 1 = 6. 289.
9 1 = 6. 294.
7 1 = 6. 311.
9 1 = 0. 330.
E0 I0/E0 PMN WMN
1 = .000 2. = 36.
1 = .000 2. = 40.
1 = .000 1 = 1
D+
first optim.

NSPES V-V' D:83-10-18 T 11: 6: 6



D^+

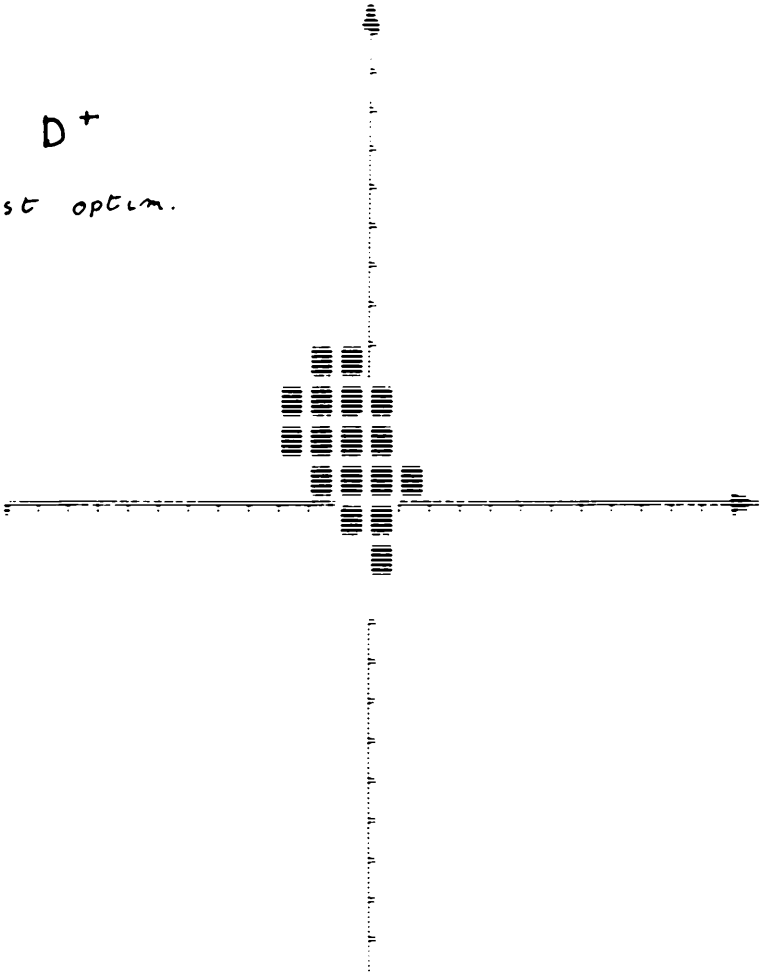
first optim.

VPART	VTOT
APE-V	ALFA
BH1	BETA

I0	E	RMAX	AMAX
7	2.9	7.5	1.39
8	3.1	7.9	1.46
8	2.5	7.2	1.26
7	2.4	7.2	1.29
8	3.1	7.1	1.39

E0	I0/E0	RMN	AMN
7.4	0.9	-6.8	- 0.0
7.2	1.0	-7.0	- 0.0
8.1	0.9	-7.4	- 0.1

NSPES H-H' D:83-10-18 T:11:11:47



D^+

first optim.

VPART		VTOT	
APE-H		ALFA	
BH1		BETA	

I0	E	RMAX	AMAX
0	3.0	4.1	0.01
10	3.2	4.3	0.00
10	3.5	4.6	0.05
9	2.4	3.1	0.91
7	3.6	4.3	0.70

E0	I0/E0	RMN	AMN
6.3	1.3	-1.3	0.3
6.6	1.5	-1.0	0.4
7.0	1.2	-1.5	0.3