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1 GeV リニアック検討資料

1 GeV LINAC DESIGN NOTE

題目 (TITLE) Parameters of JHP 200-MeV proton linac (mod-2)

著者 (AUTHOR) T. Kato

概要 (ABSTRACT)

200 MeV JHP 線型加速器のパラメーターPLA-96-2とその他の資料を合わせたもの。基本的には96-2 と同じ。

KEY WORDS:

Ion source, RFQ, DTL, CCL, Magnet, Monitor, Beam Dynamics,
Transport, Vacuum, Cooling
Klystron, Low level rf, High power rf, Modulator
Control, Operation, Radiation, Others

高エネルギー物理学研究所 KEK

設備検討用資料　　961119　T. Kato

Table * Parameters of the JHP 200-MeVproton linac.

Injection energy	3.0 MeV	
Output energy	202.5 MeV	
Frequency	324 MHz	
Total length (structure only)	92.9 m	(27.0 + 65.9)
Total length (including drift space)	122.9 m	(28.5 + 2 + 92.4)
Total rf driving power	21.3 MW	(3.9 + 17.4)
Total rf power (30 mA)	27.3 MW	(1.4 + 4.6 + 21.3)
Total rf power (60 mA)	33.3 MW	(2.8 + 9.2 + 21.3)
Number of klystrons	19	(1 + 3 + 14 + 1)
(includes for RFQ and debuncher)		
Debuncher parameters	1 - 1.5 MV , drift length=30 m	

Total length (Ion source + RFQ + DTL + SDTL + Debuncher)

10 + 122.9 + 30 + 2 = 164.9 m

RFQ

Frequency	324	MHz
Injection energy	50	keV
Output energy	3	MeV

DTL

Frequency	324	MHz
Injection energy	3	MeV
Output energy	50.06	MeV
Number of tank	3	
number of cells	150	
Total length	28.51	m
Rf driving power (*)	3.92	MW
Beam power (30mA)	1.41	MW
Beam power (60mA)	2.82	MW
Total power (30mA)	5.33	MW
Total power (60mA)	6.74	MW
Number of klystron	3	
Acceptance		
Ax		
Ay		
Az		
Focusing method	Equipartitioned focusing	
Stabilization	Post-stabilized	

DTL Tank number	1	2	3	
Injection energy	3.0	19.196	35.407	MeV
Output energy	19.196	35.407	50.058	MeV
Tank length	10.36	8.87	7.81	m
Number of cells	80	41	29	
Rf driving power (*)	1.16	1.36	1.40	MW
Beam power (30mA)	0.49	0.49	0.44	MW
Beam power (60mA)	0.98	0.98	0.88	MW
Total power (30mA)	1.64	1.84	1.84	MW
Total power (60mA)	2.08	2.33	2.28	MW
Accelarating field	2.5	2.7	2.9	MV/m
Stable phase	-30	-26	-26	
Drift space	4	3	0	$\beta\lambda$
	0.737	0.742		m

* including a factor of 1.3

SDTL

Frequency	324	MHz
Injection energy	50.058	MeV
Output energy	202.488	MeV
Number of tank	31	
number of cells	155	
Structure length	65.9	m
Total length	92.4	m
Rf driving power (*)	17.4	MW
Beam power (30mA)	4.6	MW
Beam power (60mA)	9.2	MW
Total power (30mA)	22.0	MW
Total power (60mA)	26.6	MW
Number of klystron	14	
Accelerating field	3.86	MV/m
Energy gain	2.86 - 1.92	MeV/m
Drift space (**)	0.67-1.03	m
Transverse acceptance		
Ax		
Ay		
Az		

(*) including a factor of 1.2.

(**) shorter length is possible.

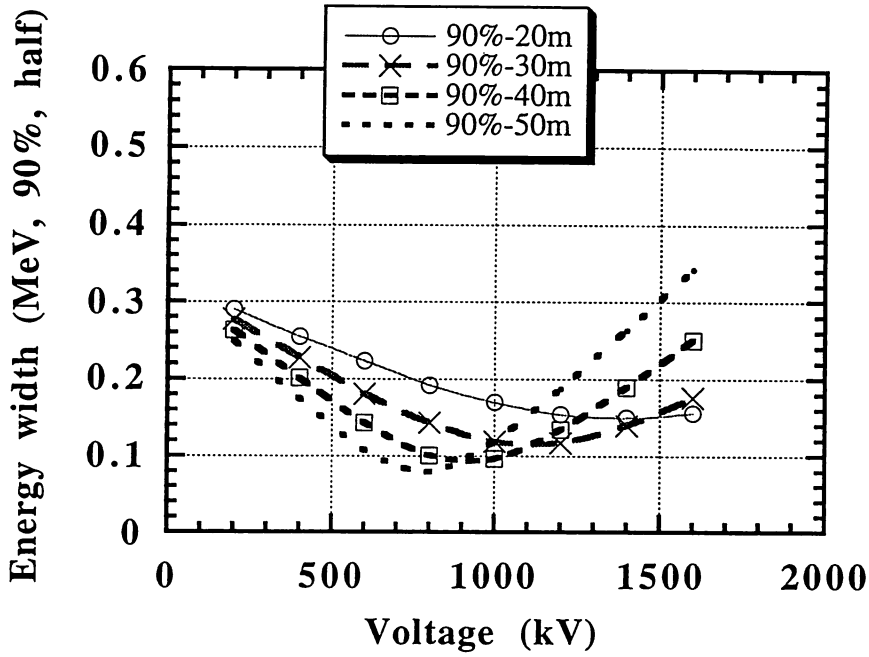

Fig. * Energy width of the output beam as a function of debuncher voltage and the drift spaces between the exit of the linac and the debuncher. An ideal accelration in the SDTL is assumed.

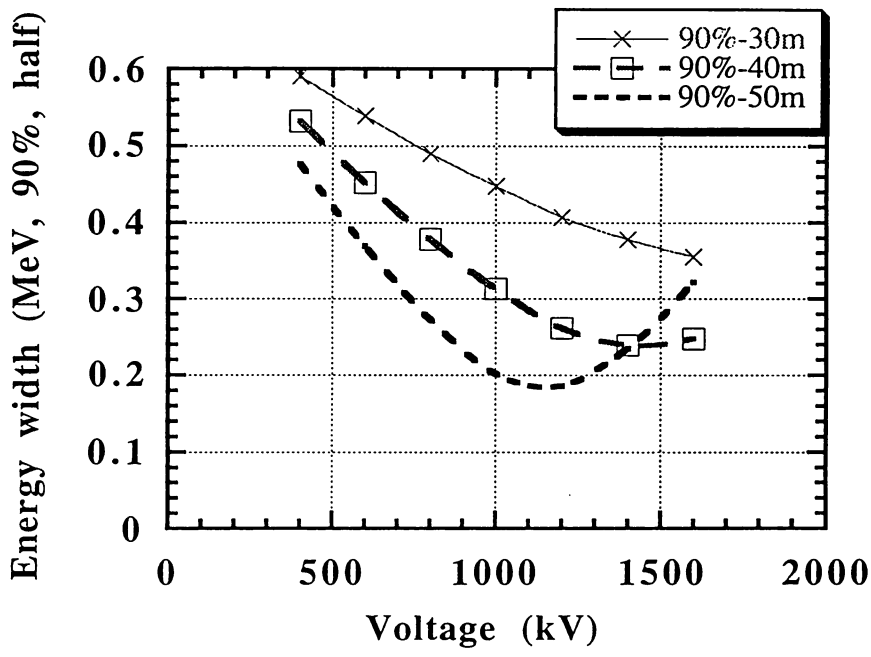

Fig. * Energy width of the output beam as a function of debuncher voltage and the drift spaces between the exit of the linac and the debuncher. An injection phase deviation of 10 degrees into the SDTL is assumed.

NKL	NTK	N1	N2	NC	WIN	BETAIN	CLENG	TANKLEN	DRIFT	L-total	RF	Pb-30m/	Pt-30mA	Pb-60m/	Pt-60mA	EZERO	WG/m	ZS
1	1	1	5	5	50.06	0.3142	29.2	148.13	90.55	148.13	0.35	0.127	0.477	0.254	0.604	3.86	2.86	75.86
	2	6	10	5	54.3	0.3262	30.3	153.61	93.8	392.29	0.366	0.13	0.497	0.26	0.626	3.86	2.83	75.24
	3	11	15	5	58.647	0.3379	31.4	158.96	96.97	645.05	0.382	0.133	0.515	0.266	0.648	3.86	2.8	74.63
										sum	1.098	0.39	1.489	0.78	1.878			
2	4	16	20	5	63.093	0.3493	32.4	164.17	66.71	906.19	0.398	0.136	0.533	0.272	0.67	3.86	2.76	74.06
	5	21	25	5	67.623	0.3605	33.5	169.24	68.71	1142.1	0.413	0.138	0.551	0.276	0.689	3.86	2.72	73.5
	6	26	30	5	72.233	0.3713	34.5	174.18	70.66	1385	0.428	0.14	0.569	0.28	0.708	3.86	2.69	72.97
										sum	1.239	0.414	1.653	0.828	2.067			
3	7	31	35	5	76.916	0.3818	35.4	178.99	72.56	1634.7	0.443	0.143	0.586	0.286	0.729	3.86	2.65	72.45
	8	36	40	5	81.666	0.3921	36.4	183.67	74.4	1890.9	0.458	0.144	0.602	0.288	0.746	3.86	2.62	71.92
	9	41	45	5	86.473	0.4021	37.3	188.22	76.2	2153.5	0.473	0.146	0.618	0.292	0.765	3.86	2.58	71.39
										sum	1.374	0.433	1.806	0.866	2.24			
4	10	46	50	5	91.33	0.4117	38.2	192.64	77.94	2422.4	0.487	0.147	0.634	0.294	0.781	3.86	2.54	70.88
	11	51	55	5	96.232	0.4212	39	196.94	79.64	2697.2	0.502	0.148	0.65	0.296	0.798	3.86	2.51	70.38
										sum	0.989	0.295	1.284	0.59	1.579			
5	12	56	60	5	101.18	0.4303	39.9	201.12	81.29	2978	0.516	0.149	0.665	0.298	0.814	3.86	2.47	69.9
	13	61	65	5	106.15	0.4393	40.7	205.18	82.89	3264.5	0.53	0.15	0.68	0.3	0.83	3.86	2.44	69.43
										sum	1.046	0.299	1.345	0.598	1.644			
6	14	66	70	5	111.16	0.4479	41.5	209.13	84.44	3556.5	0.543	0.151	0.694	0.302	0.845	3.86	2.4	68.98
	15	71	75	5	116.18	0.4563	42.3	212.96	85.96	3853.9	0.557	0.151	0.708	0.302	0.859	3.86	2.37	68.54
										sum	1.1	0.302	1.402	0.604	1.704			
7	16	76	80	5	121.23	0.4645	43	216.68	87.43	4156.5	0.57	0.152	0.722	0.304	0.874	3.86	2.34	68.11
	17	81	85	5	126.29	0.4724	43.8	220.31	88.85	4464.2	0.583	0.152	0.736	0.304	0.887	3.86	2.3	67.7
										sum	1.153	0.304	1.458	0.608	1.761			
8	18	86	90	5	131.36	0.4801	44.5	223.83	90.24	4776.9	0.596	0.153	0.749	0.306	0.902	3.86	2.27	67.29
	19	91	95	5	136.45	0.4877	45.2	227.25	91.59	5094.4	0.609	0.153	0.762	0.306	0.915	3.86	2.24	66.9
										sum	1.205	0.306	1.511	0.612	1.817			
9	20	96	100	5	141.55	0.495	45.8	230.59	92.91	5416.6	0.621	0.153	0.774	0.306	0.927	3.86	2.21	66.52
	21	101	105	5	146.65	0.5021	46.5	233.83	94.19	5743.3	0.633	0.153	0.787	0.306	0.939	3.86	2.18	66.14
										sum	1.254	0.306	1.561	0.612	1.866			
10	22	106	110	5	151.75	0.509	47.2	236.98	95.43	6074.5	0.645	0.153	0.799	0.306	0.951	3.86	2.15	65.79

	23	111	115	5	156.86	0.5157	47.8	240.05	96.65	6410	0.657	0.153	0.81	0.306	0.963	3.86	2.13	65.46
										sum	1.302	0.306	1.609	0.612	1.914			
11	24	116	120	5	161.96	0.5222	48.4	243.04	97.82	6749.7	0.668	0.153	0.821	0.306	0.974	3.86	2.1	65.14
	25	121	125	5	167.06	0.5286	49	245.95	98.97	7093.5	0.68	0.153	0.832	0.306	0.986	3.86	2.07	64.82
										sum	1.348	0.306	1.653	0.612	1.96			
12	26	126	130	5	172.15	0.5348	49.5	248.78	100.1	7441.2	0.691	0.152	0.843	0.304	0.995	3.86	2.04	64.52
	27	131	135	5	177.23	0.5408	50.1	251.53	101.2	7792.8	0.702	0.152	0.854	0.304	1.006	3.86	2.02	64.22
										sum	1.393	0.304	1.697	0.608	2.001			
13	28	136	140	5	182.3	0.5467	50.6	254.21	102.2	8148.2	0.712	0.152	0.864	0.304	1.016	3.86	1.99	63.93
	29	141	145	5	187.37	0.5524	51.2	256.83	103.3	8507.3	0.723	0.152	0.874	0.304	1.027	3.86	1.97	63.65
										sum	1.435	0.304	1.738	0.608	2.043			
14	30	146	150	5	192.42	0.558	51.7	259.38	104.3	8869.9	0.733	0.151	0.884	0.302	1.035	3.86	1.94	63.37
	31	151	155	5	197.46	0.5635	52.2	261.86	0	9236.1	0.743	0.151	0.894	0.302	1.045	3.86	1.92	63.11
										sum	1.476	0.302	1.778	0.604	2.08			
										Total	17.41	4.57	21.98	9.14	26.55			

SDTL 50-200 MeV 961113 T. Kato

Memo on beam loss assumption 961118 T. Kato

general 5 nA/m/GeV ——> 400 MeV 12.5 nA/m/400MeV L=200 m

2.5 micro A/m

2.5/average 400 = 0.00625

Total beam loss 0.1 % beam loss in simulation 10/10000 or 100/100000

System of 0.1% expected beam loss can be rejected by simulation.

average loss 0.001* 400 = 400 nA/200m = 2 nA/ m/400 MeV

equivalent to 0.8 nA/m/GeV is 1/16 of general value.

local loss 30 %, since there are three transitions 3, 50, 150 or 200 MeV

400 * 0.3 = 120 nA / local spot