陽子リニアックの概要

1998年5月27日 T. Kato

1）構成　イオン源＋LEBT ＋ RFQ(3 MeV)＋ MEBT ＋ DTL(50 MeV)＋ HEBT ＋ SDTL (58 MeV)

----> 将来は200又は400 MeVまで増強

2）特徴

- 高い周波数　324 MHz（従来201 MHz）
- クライストロン2.5 MWピーク（従来3極管又は4極管）
- 大強度　ピーク電流　30 mA、平均電流200 μA（従来10 μA）
- RFQの採用（従来はコッククロフト750 keV直流加速器）
  - PISL (π-mode stabilizing loop)
- 新しい収束方法（equipartitioning）
- 新しい加速管構成ーーー＞分離型DTL（SDTL）
- 新しい四極電磁石の製作法を採用　（栄型電鋳製作法）
- 新しい高周波チョッパーの採用

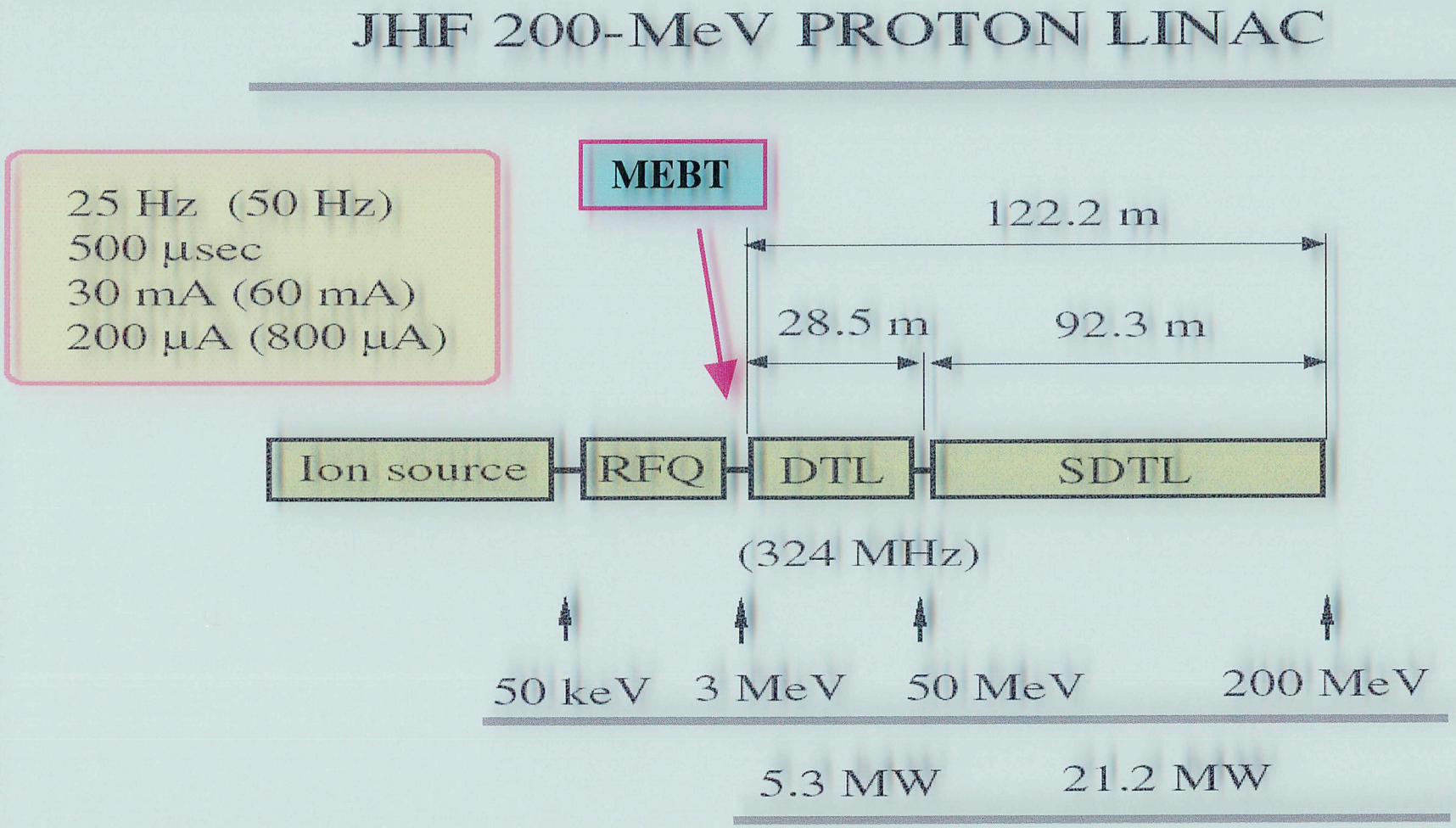
ドリフトチューブリニアック（ＤＴＬ）基本寸法　DTL-1-ver-2　980525　　LI-1

NT	ENERGY	BETA	CELL	TANK length	PC*1.3	PBEAM (30mA)	PTOT30 (30mA)	PTOT60 (60mA)	DRIFT SPACE in βλ	SPACE	STARTP	ENDP	START & END CELL	
	MeV			cm	MW	MW	MW	MW		cm	cm	cm		
	3.000	.0797												
1	19.744	.2019	76	992.397	1.061	.502	1.563	2.065	1	18.678	.000	1011.076	1	76
2	36.762	.2719	43	944.546	1.173	.511	1.684	2.194	1	25.155	1011.076	1980.777	77	119
3	50.348	.3149	27	733.484	1.064	.408	1.471	1.879	0	.000	1980.777	2714.261	120	146
			146	2670.428	3.297	1.420	4.718	6.138		RFDRIVE only (theoretical)=			2.54 MW	

200-MeV LINAC PLAN

- Design summary
- Construction issues

The JHF 200-MeV Proton Linear Accelerator



Main parameters

	DTL	SDTL	
Frequency	324	324	MHz
Injection energy	3.0	50.06	MeV
Output energy	50.06	200.0	MeV
Accelerating filed	2.5 - 2.9	3.9 - 3.6	MV/m
Stable phase	-30 ~ -26	-26	degree
Length (structure only)	27.04	65.9	m
Number of tank	3	31	
Number of cell	150	155	
Number of klystron	3	14 (16)	
Rf driving power	3.92	17.4	MW
Total rf power (30 mA)	5.33	22.0	MW
Total length		122.3	m
Total power (30 mA)		27.3	MW
Peak current		30	mA
Beam width		500	μsec
Repetition rate		25 (50)	Hz
Average current		200	μA

DTL parameters (1)

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
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

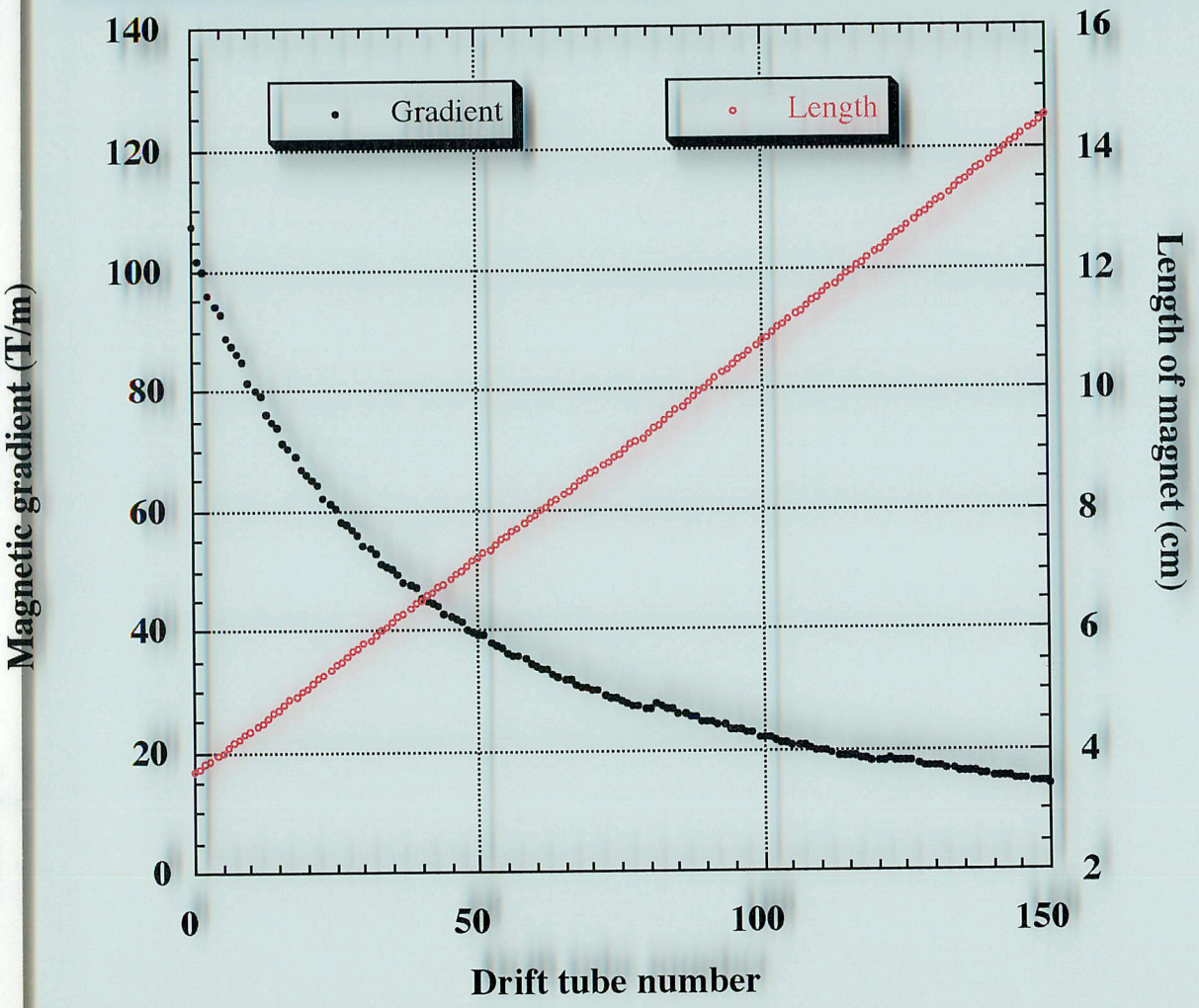
DTL parameters (2)

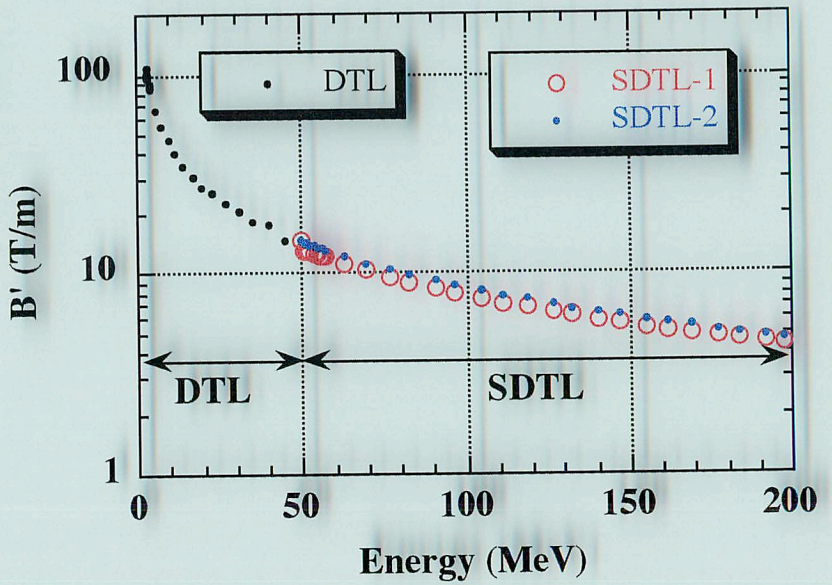
DTL Tank number	1	2	3	
Tank length	10.36	8.87	7.81	m
Number of cells	80	41	29	
Tank diameter	56	56	56	cm
Bore diameter	1.3	2.2	2.6	cm
Num. of full-DT&Q-mag	79	40	28	
Q-mag for drift-space	3	2		
Num.of half-DT&Q-mag	2	2	2	
Number of post	40	40	28	
Number of tuner	10+2	8+2	8+2	*depend on unit L
Number of rf coupler	2	2	2	
Number of rf monitor	13	13	11	

SDTL parameters

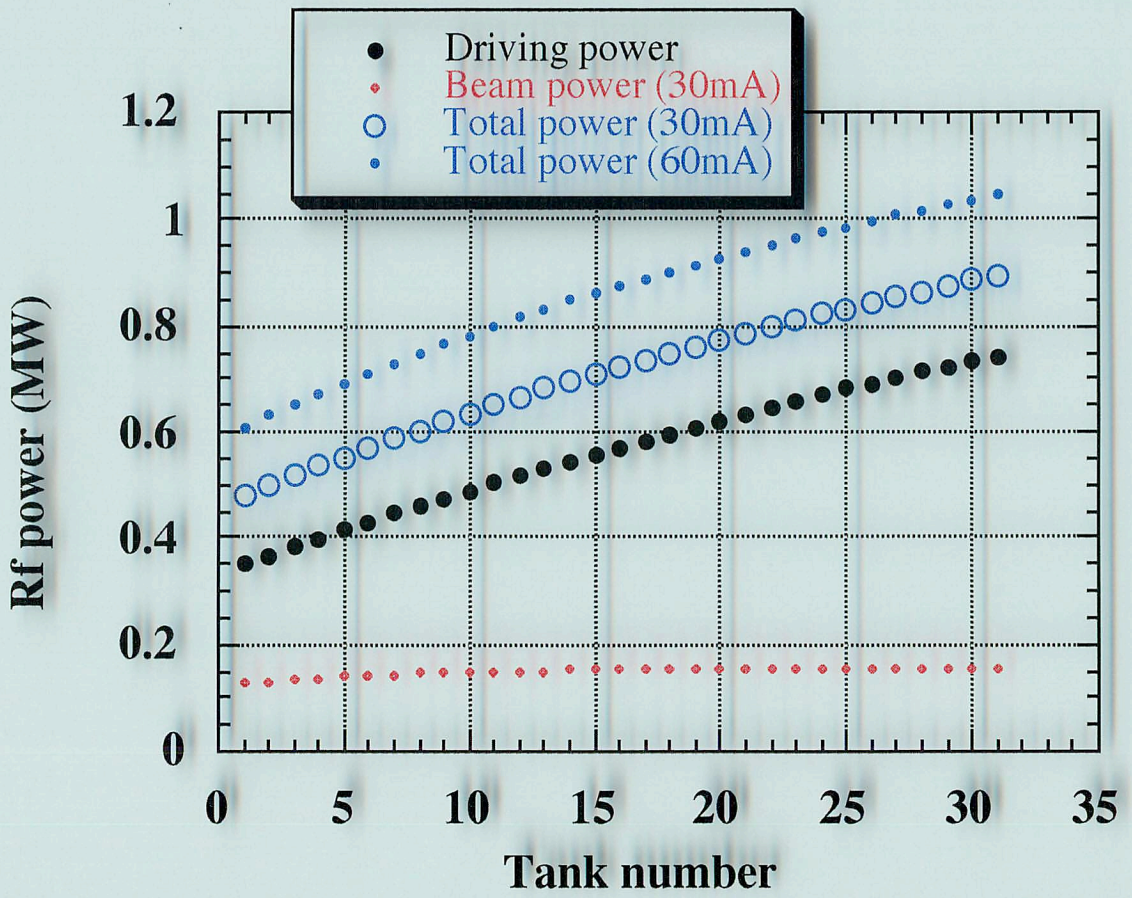
Tank length	1.48 - 2.61	m
Number of tank	31	
Number of cell in a tank	5	
Rf driving power	0.35 - 0.64	MW
Total rf power (30 mA)	0.48 - 0.78	MW
Accelerating field	3.86 - 3.6	MV/m
Stable phase	-26	degree
Tank diameter	52	cm
DT diameter	9	cm
Bore diameter	3	cm
Number of rf couper	31	
Number of tuner (fix)	62	
Number of auto-tuner	31	
Number of rf monitor	93	

Focusing magnet





SDTL RF power



RF power

	Pc	Ptot (30mA)
DTL-1	1.16	1.64 MW
DTL-2	1.34	1.85
DTL-3	1.40	1.84
SDTL-1	0.72	0.97
SDTL-2	0.78	1.05
SDTL-3	0.84	1.12
SDTL-4	0.90	1.19
SDTL-5	0.96	1.25
SDTL-6	1.02	1.32
SDTL-7	1.07	1.37
SDTL-8	1.13	1.43
SDTL-9	1.18	1.48
SDTL-10	1.23	1.54
SDTL-11	1.21	1.51
SDTL-12	1.26	1.55
SDTL-13	1.23	1.52
SDTL-14	1.26	1.56
SDTL-15	1.29	1.58
SDTL-16	0.64	0.78

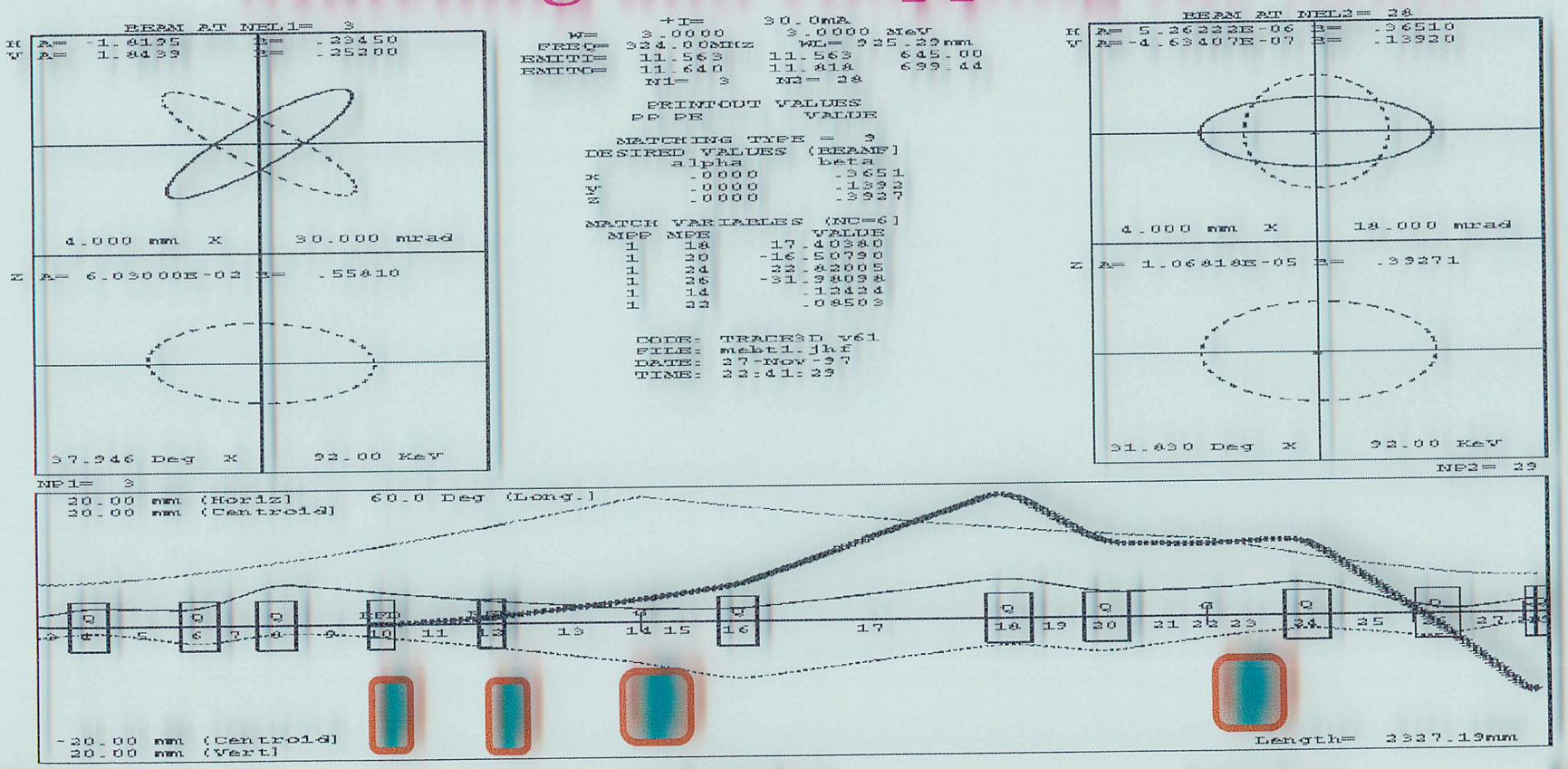
MEBT parameters

Length	2.33	m		
Buncher-1	124	kV		
Buncher-2	96	kV		
Chopper-1	1.4	MV/m	21	kW
Chopper-2	1.4	MV/m	21	kW
Q-magnet *8	48 - 15	T/m		
Q-mag length	6 & 7	cm		

Beam transport line from RFQ to DTL by TRACE-3D

S. Fu and T. Kato

Matching and chopping the beam

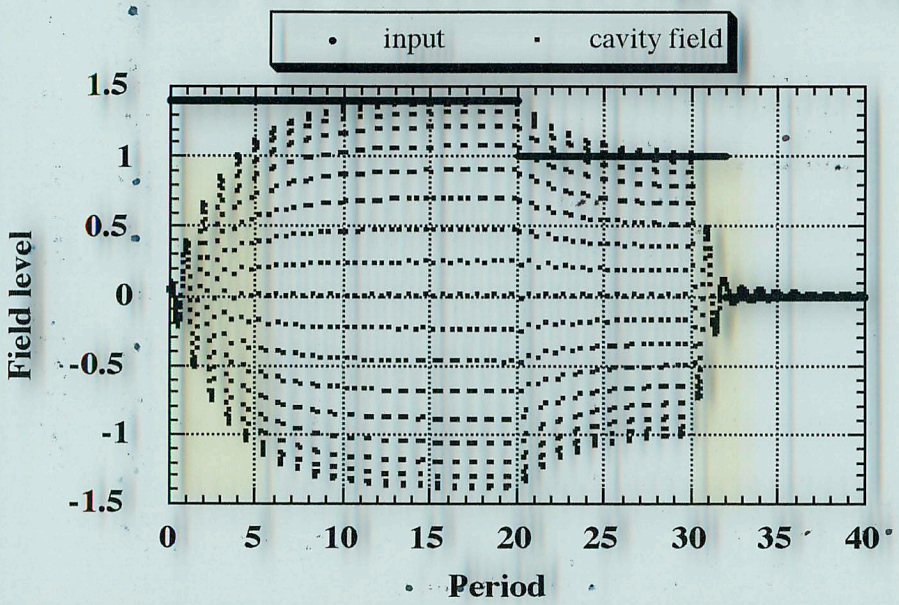


RFQ **chopper** **chopper** **buncher** **buncher** **DTL**

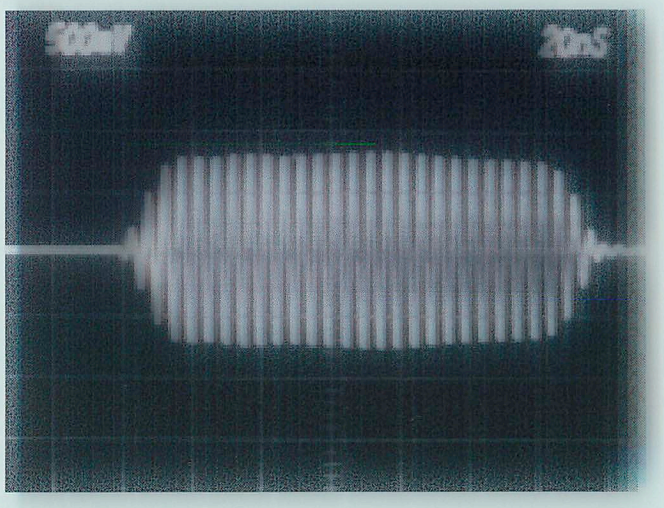
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8

RF deflecting field during transient times

Use rf deflectiong cavity with low loaded Q-valu

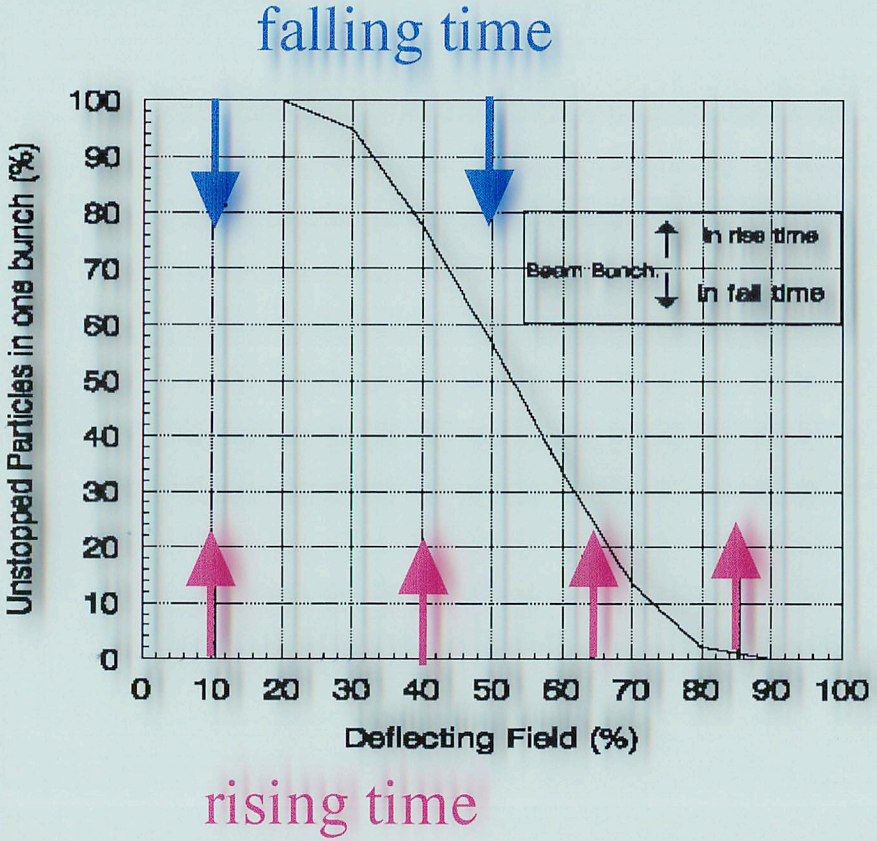


Calculated cavity field with an improved method. The initial amplitude (Em) of the incident power is 1.4 times higher. After some time, Em is adjusted to 1. A rapid phase shift is added at a timing of turn-off. After some time (at about 33-th periods in this figure), the incident power is turned off.

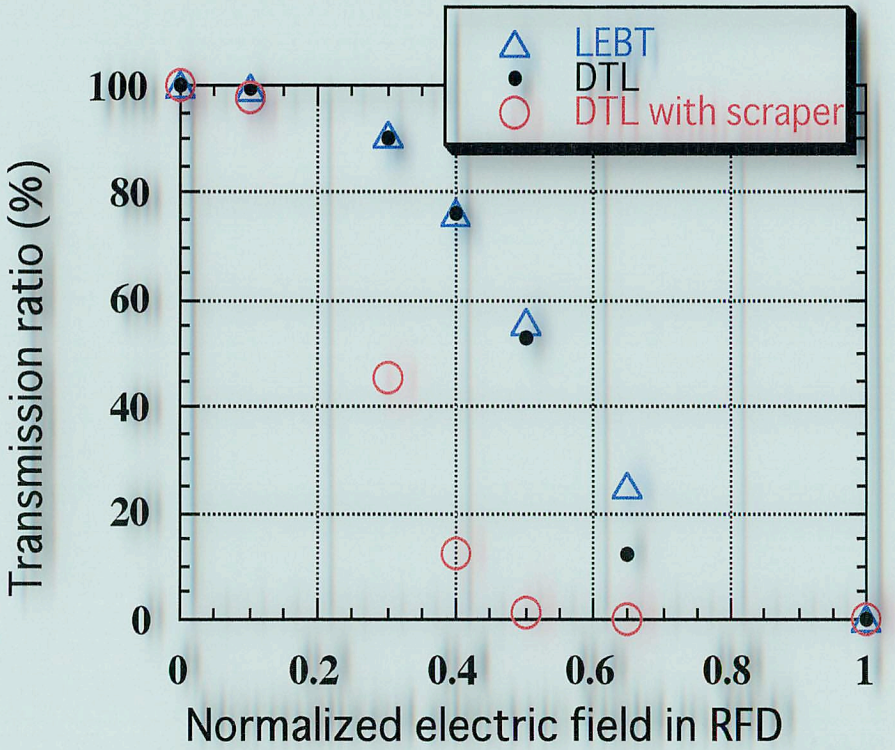


Shape of an rf pulse for the ch cavity, measured in the prelimi experiment at a frequency of 2 peak power is about 8.5 kW. 2(

Analysys of unstable-beam behavior in the DTL



Micro bunch during transient periods



Transmission ratio through MEBT and DTL vs. RFD field during transient periods

変更事項

- **SDTL all two-tank drive configuration**

number of klystron RFQ+ DTL-3
+ SDTL - 14 + debun-1 + LAB =20
---> 22

K ギャラリーの space の余裕は

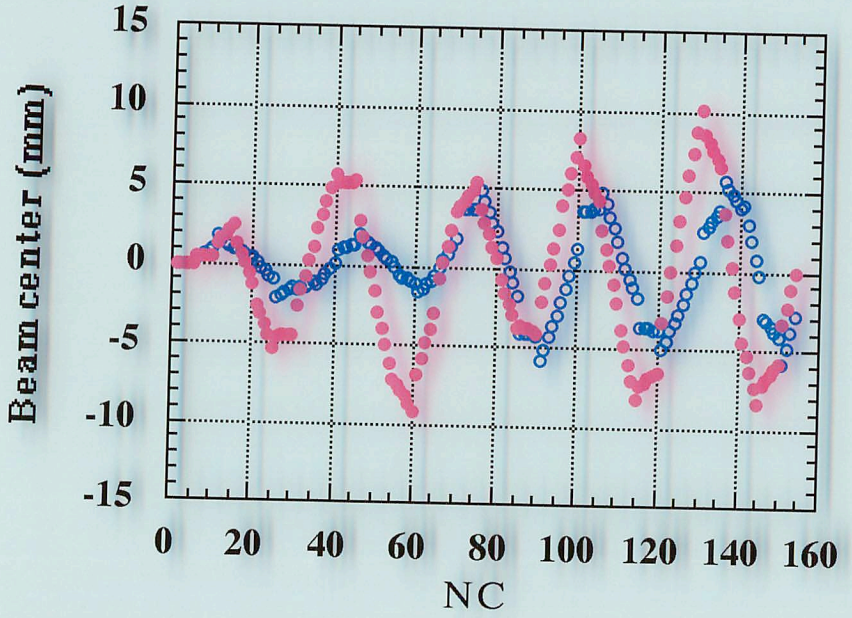
merits

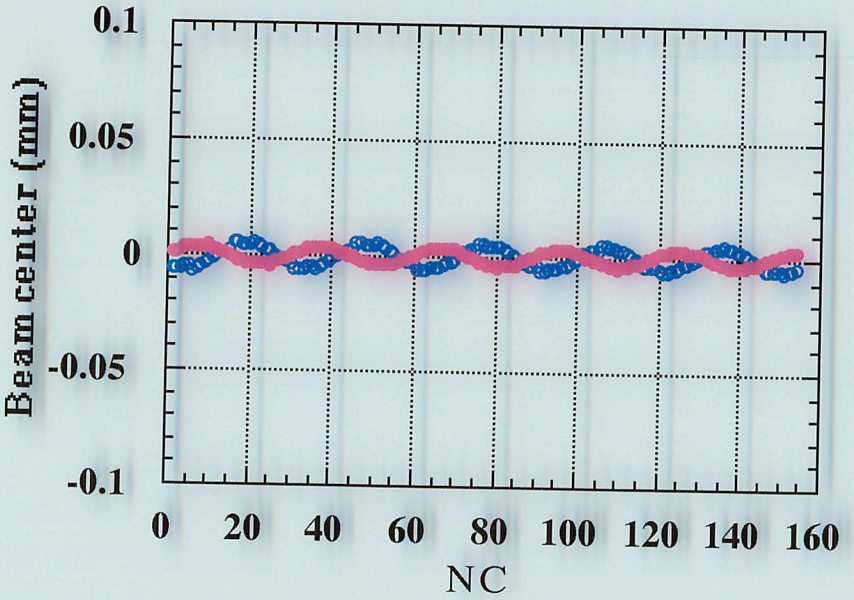
---- beam loading
---- rf dividing
---- tuning flexibility

MEBT

- 最近の変更点
  - buncher 1 ----> 2台
  - length 1.5 ----> 2.3 m
- chopper cold test -----> July end
- final design for buncher and chopper
- bending magnet in the mid point
- design of beam dump
- solid-state power amp. for chopper

全体の整列の検討





SDTL Q-mag:
+- 0.3 mm ramdom error
rms 0.16mm

SDTL Q-mag:
no error

課題

- 四極磁石のタイプ
  - A, B, C --------> DTサイズが変わる
- タンク製作法
- 全体の整列はレーザーでよいか
- 高エネルギーＳＤＴＬのモード分布