CTF3 Pre-Injector Beam Line

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Beam line Configuration

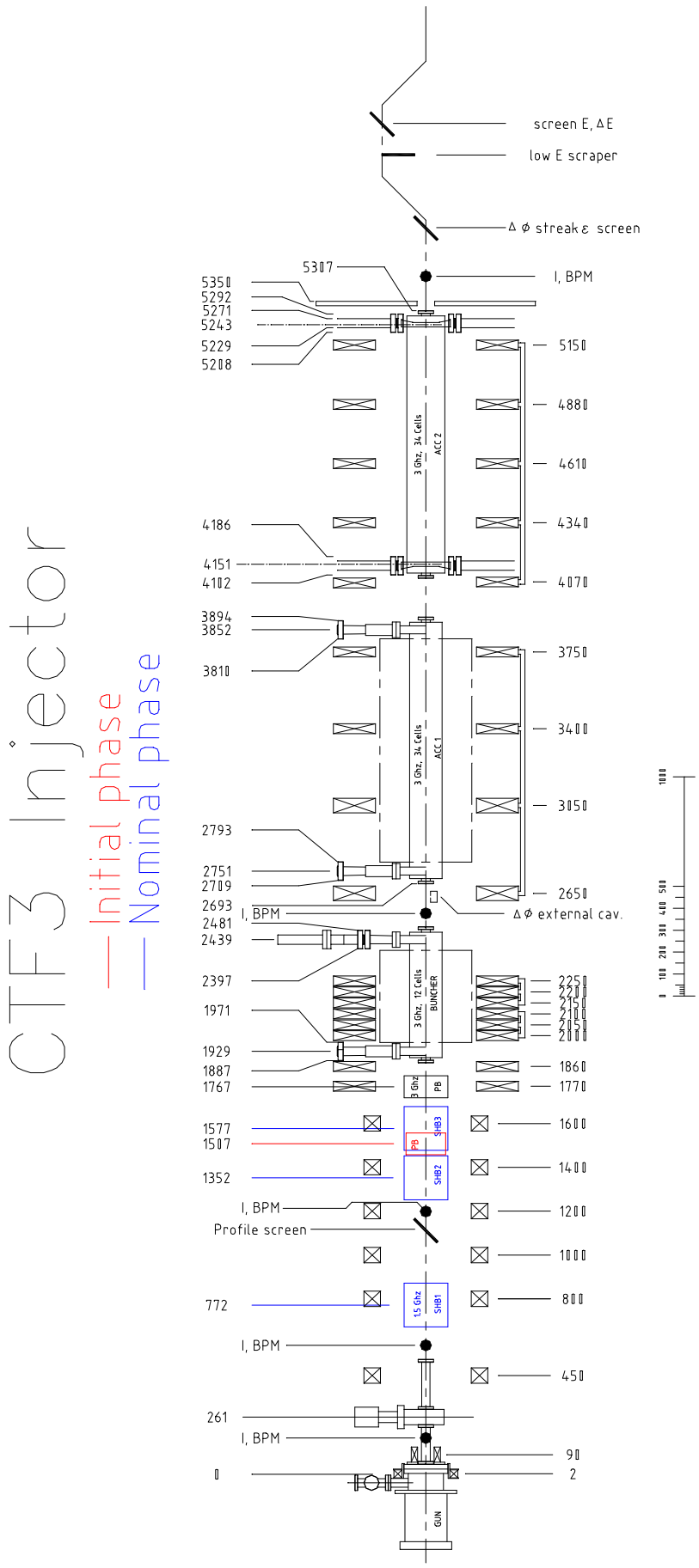
Gun – optics and status

Beam line optics and expected beam parameters

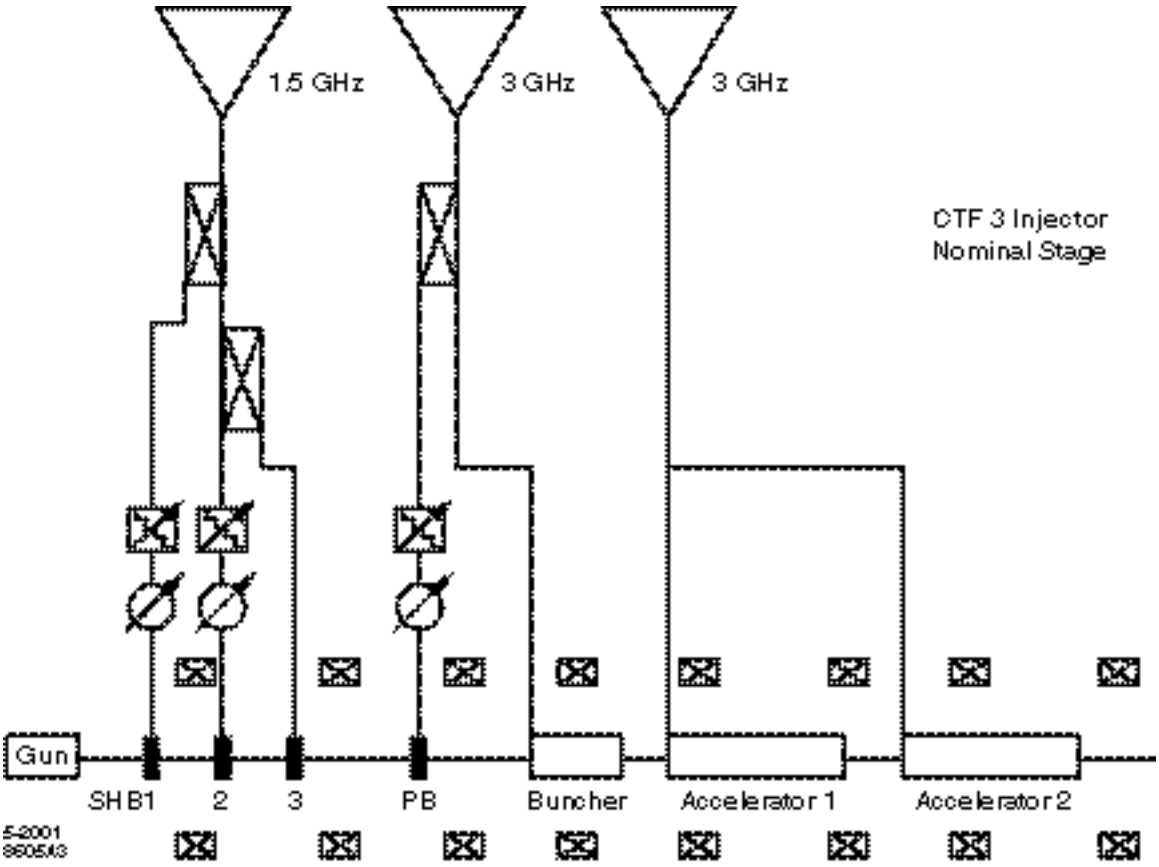
Strengths for Bunchers, Accelerators and magnets

Diagnostics for tuning and beam quality verification

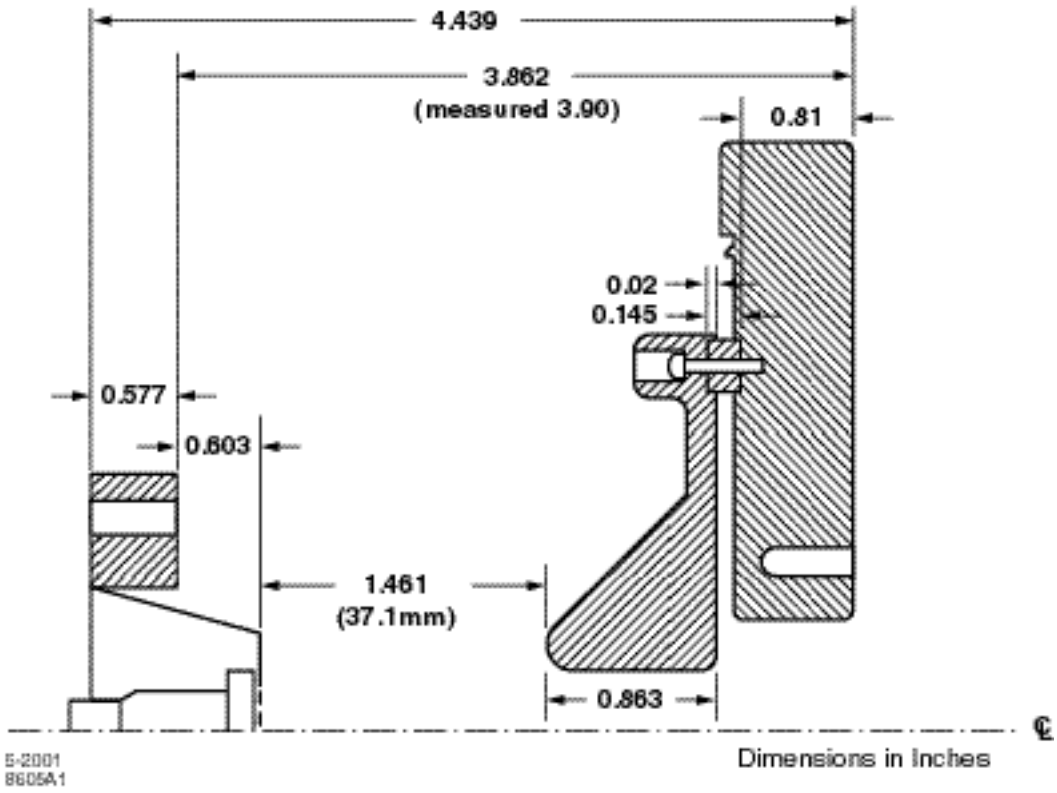
Conclusions


CTF3 Injector
Initial phase
Nominal phase
screen E, ΔE
low E scraper
Δ φ streak ε screen
5307
I, BPM
5350
5292
5271
5243
5229
5208
5150
4880
4610
4340
4070
3 Ghz, 34 Cells
ACC 2
4186
4151
4102
3894
3852
3810
3750
3400
3050
2650
3 Ghz, 34 Cells
ACC 1
2793
2751
2709
2693
I, BPM
Δ φ external cav.
2481
2439
2397
1971
1929
1887
1767
2250
2210
2170
2130
2090
2050
2010
1860
1770
3 Ghz, 12 Cells
BUNCHER
3 Ghz
PB
1577
1507
1352
PB
SHB3
SHB2
1600
1400
I, BPM
Profile screen
1200
1000
772
1.5 Ghz
SHB1
800
I, BPM
450
261
I, BPM
90
0
2
GUN
1000
800
600
400
200
0

CTF3 Injector RF Power distribution system , Nominal Phase



Gun Anode – Cathode Geometry



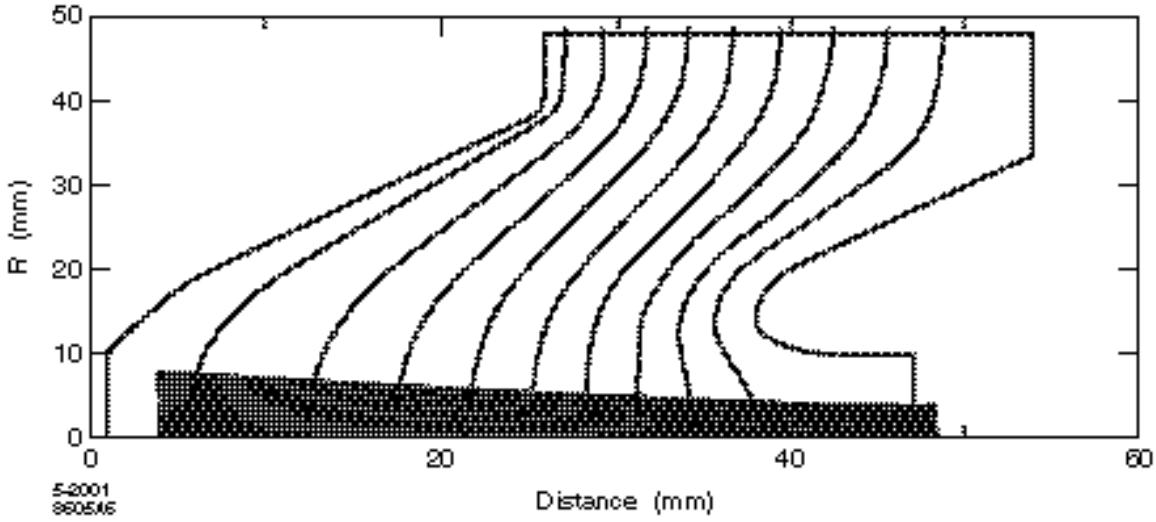
The gun is one of the spare Thermionic guns from SLAC originally built for Boeing by Ron Koonts, now on loan to CERN

The gun was modified at SLAC for the CTF3 Anode Cathode configuration and High Voltage processed up to 160 KV in January 2000, before shipping to CERN with a spare cathode already installed.

Gun Characteristics

Beam simulations in anode cathode region conducted with E-GUN

CTF3 gun ray trace from EGUN. 5 A, 140 kV grid limited mode.

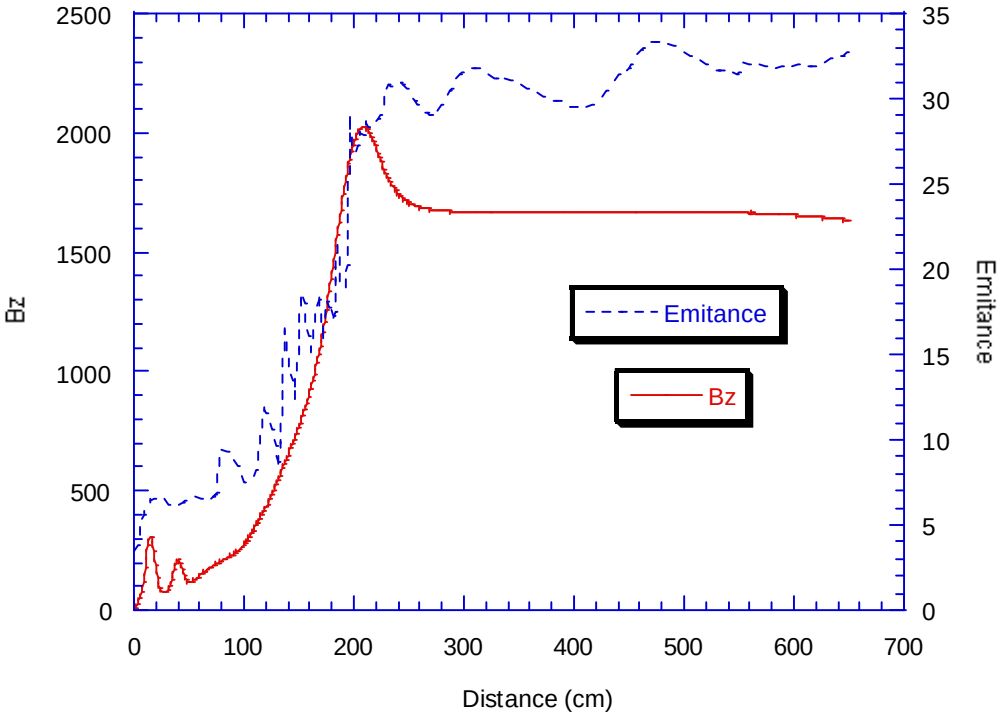


Electron Beam Parameters of the CTF 3 Gun.

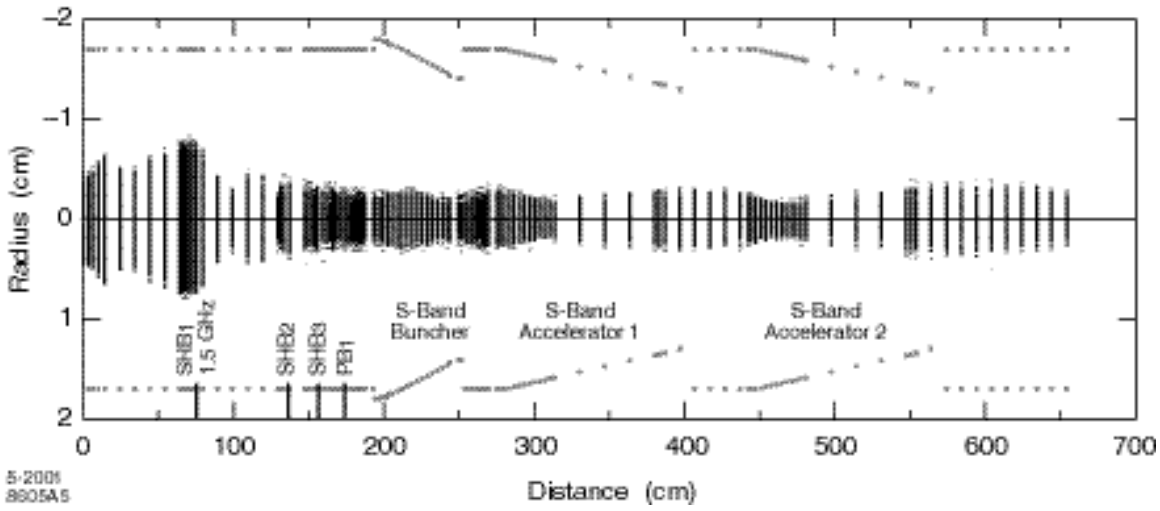
Parameters CTF3 gun # 1					
I	5	7	9.3	10.4	Amp
V	140	140	140	150	keV
$\varepsilon_{edge,N}$, incl. thermal and grid effects	26	20	13	14	mm - mrad

Electron Beam Characteristics as Simulated with PARMELA

Longitudinal Magnetic Field and Emittance, Nominal Phase

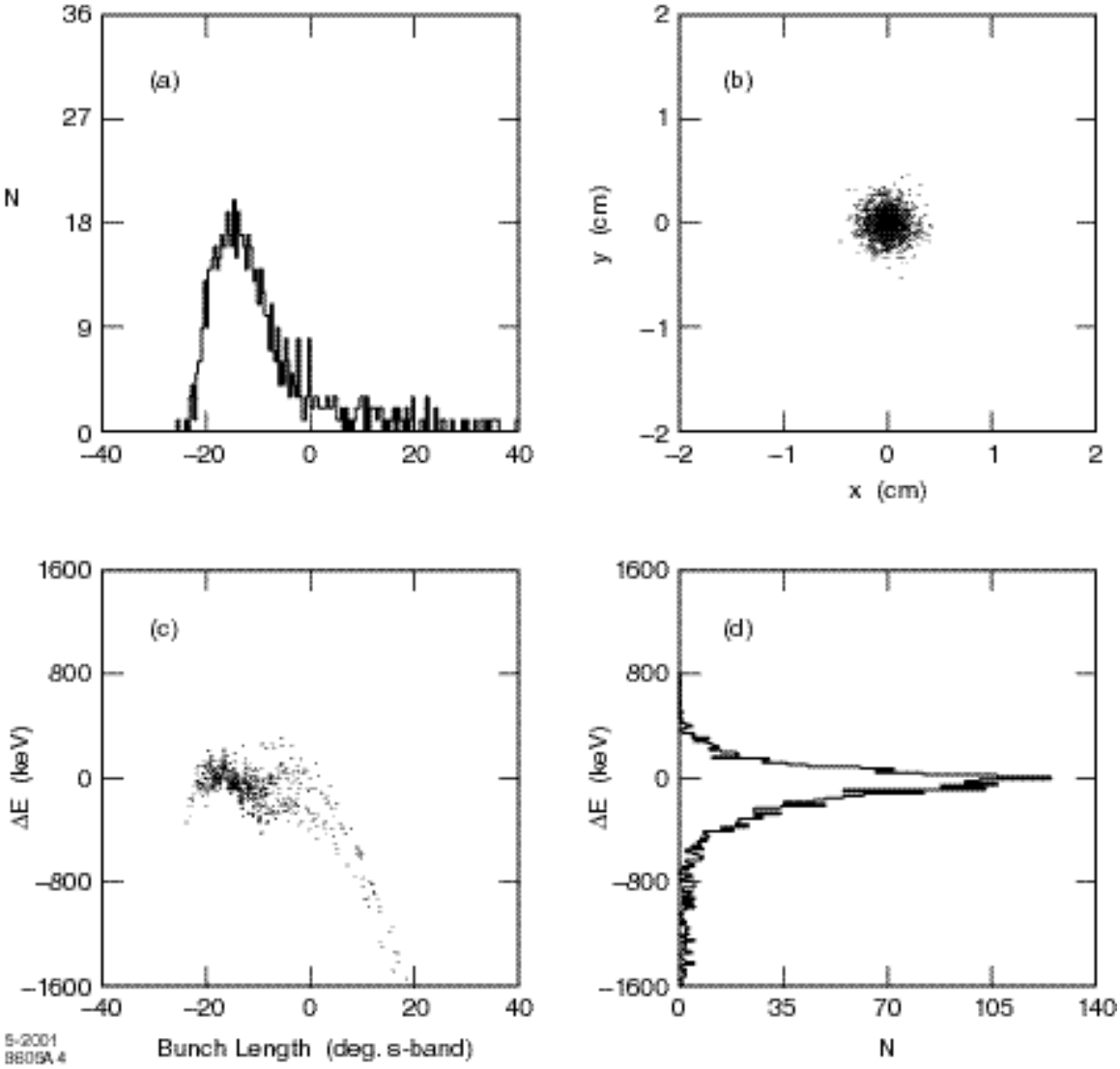


The Beam Envelope, Nominal Stage



Electron Beam Characteristics as Simulated with PARMELA

Single Bunch Parameters



Simulated Electron Beam Characteristics and RF Parameters

Electron Beam Parameters at End of Accelerator 2.

Parameters	Unit	Nominal / Initial Target	Simulation End Acc. 2
Beam Energy	MeV	~20	17.2 / 17.5
Beam Current in 20°	A	3.5	3.5
Charge per bunch in 20°	nC	2.33 / 1.2	2.33 / 1.2
Allowed charge in Satellite	%	<7 / -	8 / -
Bunch Length (FWHM)	ps	< 12	12
Emmittance, N, rms	mm-mrad	< 100	35 / 50
Energy spread (single bnch, fwhm)	MeV	< 0.5	0.5 / 0.3

Buncher s and Accelerator s Parameters

RF Structure Parameters	Unit	Nominal / Initial
RF Fundamental Frequency	GHz	2.99855
SHB Frequency (Nominal phase)	GHz	1.5
SHB Gap voltage no. 1, 2, 3 (Nominal phase)	KV	20, 20, 20
PB Gap voltage (Nominal phase)	KV	52
PB Gap voltage no. 1 and 2 (Initial phase)	KV	14, 30
17 Cell Buncher gradient (w/ Beam Loading)	MV/m	8.4 to 10.8
RF Peak Power into TPV Buncher	MW	35
Accelerator Gradient Cell 1, 27, 34 (w/ BL)	MV/m	11.4, 0.5, -6.8
RF Peak Power into accelerator	MW	35

CTF3 Solenoid Strengths and Parameters per Power Supply
Excluding Voltage loss in the power cables

Name	type	Nturn	R (mW)	I* (A)	Imax** (A)
Bucking coil	NLCTA	169	350	8	20
Gun Lens***	NLCTA	320	1360	9	10
S1	Tesla Eng.	64	39	95	200
S2	Tesla Eng.	64	39	70	200
S3	Tesla Eng.	64	39	70	200
S4	Tesla Eng.	64	39	70	200
S5	Tesla Eng.	64	39	187	200
S6	Tesla Eng.	64	39	187	200
S7	CERN	72	48.4	195	200
S8	CERN	72	48.4	195	200
S9-11	CERN	72	145.2	263	200
S12-14	CERN	72	145.2	173	200
S15-18	CERN	108/72	242.2	657	700
S15-18	CERN	72	242.0	611	700

Note:
*** I is the expected current needed in the solenoid from the simulations**
**** Imax is current I would like to have available for added margin taking into account coil limit (as in lens) or power supply limit as in S7 and S8**
***** the data is for NLCTA lens. If possible I would like to add 30% more turns to this lens by adding 3 more layers in the vertical direction.**
****** Power lost in the cable s from PS to coil are not included. Power should be kept to a minimum length specially for the high current case.**

Conclusion

The CTF3 preinjector beam line including from the gun to the end of the second accelerator section has been designed for both the Nominal and the Initial phase operation

All bunching and accelerating Gradients have been Defined.

All solenoid strengths and shapes have been defined.

All diagnostics for tuning and characterizing the beam have been defined

The gun is already transferred to CERN from SLAC. The HV and electronics system is being designed at LAL

The traveling wave buncher and accelerator sections exist or are in manufacturing stage.

The prebuncher and the subharmonic bunchers detailed design is under way at CERN and LAL

The solenoids are at the drawing stage at CERN and soon will go out for manufacturing bids.

The detailed design of the diagnostics is under way at CERN

It remains to define the vacuum pumping and monitoring points on the beam line

It remains To design the steering magnets once all the other details are sufficiently defined and drawn on the beam line drawing.

It remains to include the actual SHB and PB electric fields once these are designed. (Currently we use sign waves, and this is not a bad approximation so we expect no surprises

I want to thank the many people at CERN, LAL, and SLAC who have contributed to this work.