

Baseline11:

- Updating the linac design
- Role of the warm section



Steve Peggs

What is “Baseline11”?

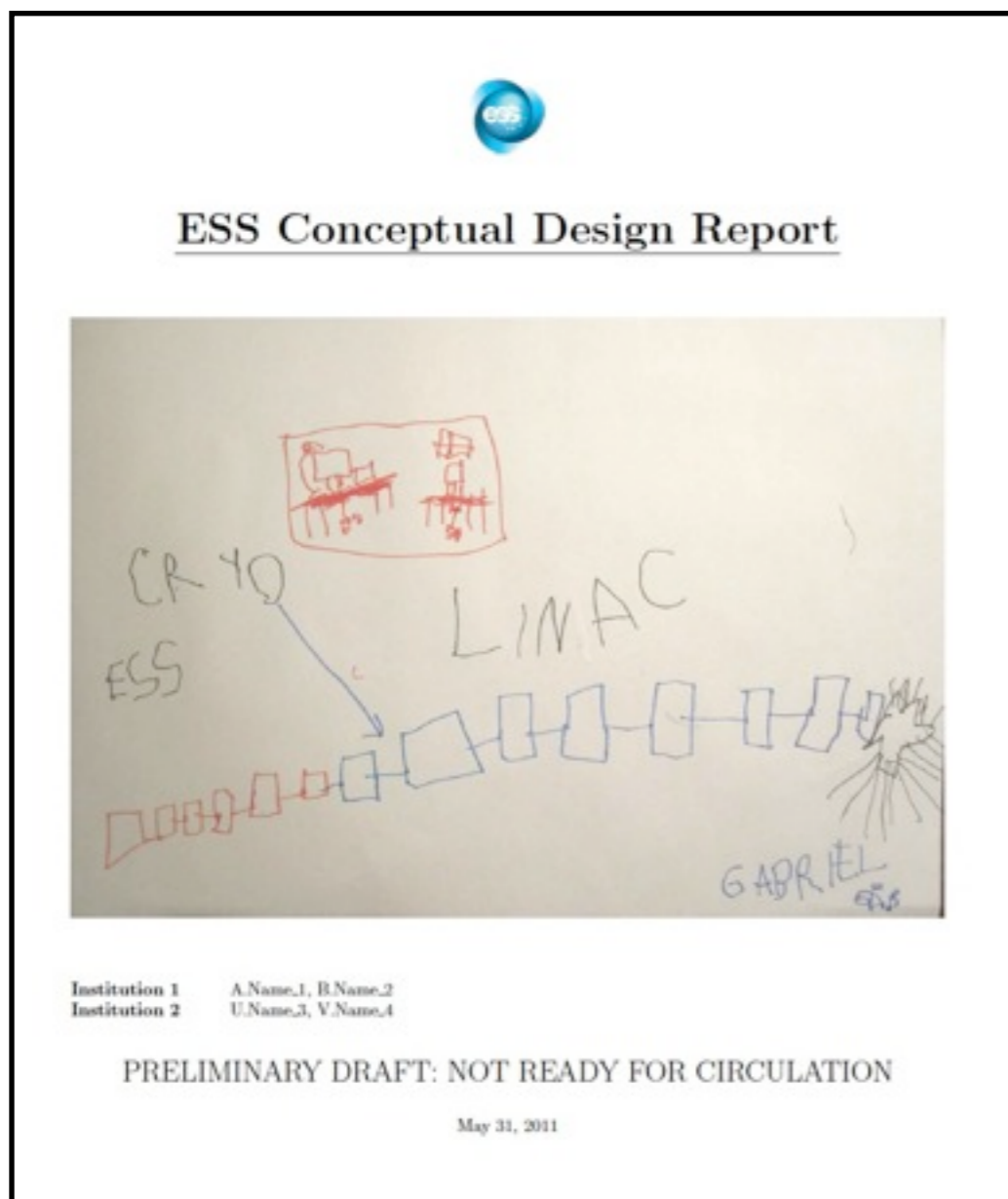
“**Baseline11**” will be a **snapshot** of the ESS design, including Target, Instruments, buildings et cetera, taken (~)Dec 31, 2011

It will be a (quite) **comprehensive, complete & self-consistent** technical reference, including:

- **Conceptual Design Report** (pointing at Technical Notes)
- Drawings & figures
- Parameter lists (with updates) & tables
- **Change Control Board** documentation
- Linac layout & optics, **end-to-end**
- New BLED database
- et cetera

CDR Ch 4: Accelerator

CCB request a first draft by Sept 23!



4 Accelerator

Accelerator parameters and design choices

Beam Physics

Beam-line lattice and dynamics

Tolerances and correction systems

Beam power limitations

Operational considerations and reliability

Beam losses and collimation

Normal conducting linac

Spoke superconducting linac

Elliptical superconducting linac

High Energy Beam Transport

RF systems

Power generation

Power distribution

Low-Level RF

Normal-conducting linac

Superconducting linac

Higher Order Modes

Cryogenic systems

Cryomodules

Vacuum systems

Beam instrumentation

Magnet systems

[quads, dipole corr, HTS bends ...]

Potential upgrades

Lindroos

Rathsman

Danared

Gammino

Bousson

Devanz

Pape-Møller

Ruber

Molloy

Hees

Hees

Jansson

Lindroos

Parameters

5	MW	beam power
2.5	GeV	protons (H ⁺)
2.86	ms	pulses
14	Hz	rep rate
704	MHz	RF frequency
< 1	W/m	beam losses
> 95%		availability

<http://esss.se/linac/Parameters.html>

Ongoing evolution

ESS Parameter Tables

Table	Date	Status	Table owner
High level parameters	18-Apr-11	Active	CCB
Lattice and Accelerator Science	22-Jun-11	Active	H. Danared
Ion source	16-Dec-10	Active	L. Celona
Low Energy Beam Transport	16-Dec-10	Active	L. Celona
Radio Frequency Quadrupole	15-Dec-10	Active	B. Pottin
Medium Energy Beam Transport	15-Dec-10	Active	I. Bustinduy
Drift Tube Linac	1-Dec-10	Active	A. Pisent
Spoke resonators	16-Dec-10	Active	S. Bousson
Elliptical cavity linac, low beta	16-Dec-10	Active	G. Devanz
Elliptical cavity linac, high beta	16-Dec-10	Active	G. Devanz
High Energy Beam Transport	17-Nov-10	Active	S. Pape-Møller
Target	22-Nov-10	Active	S. Peggs
Infrastructure Services	22-Nov-10	Active	J. Eguia
RF Systems	22-Nov-10	Active	R. Ruber

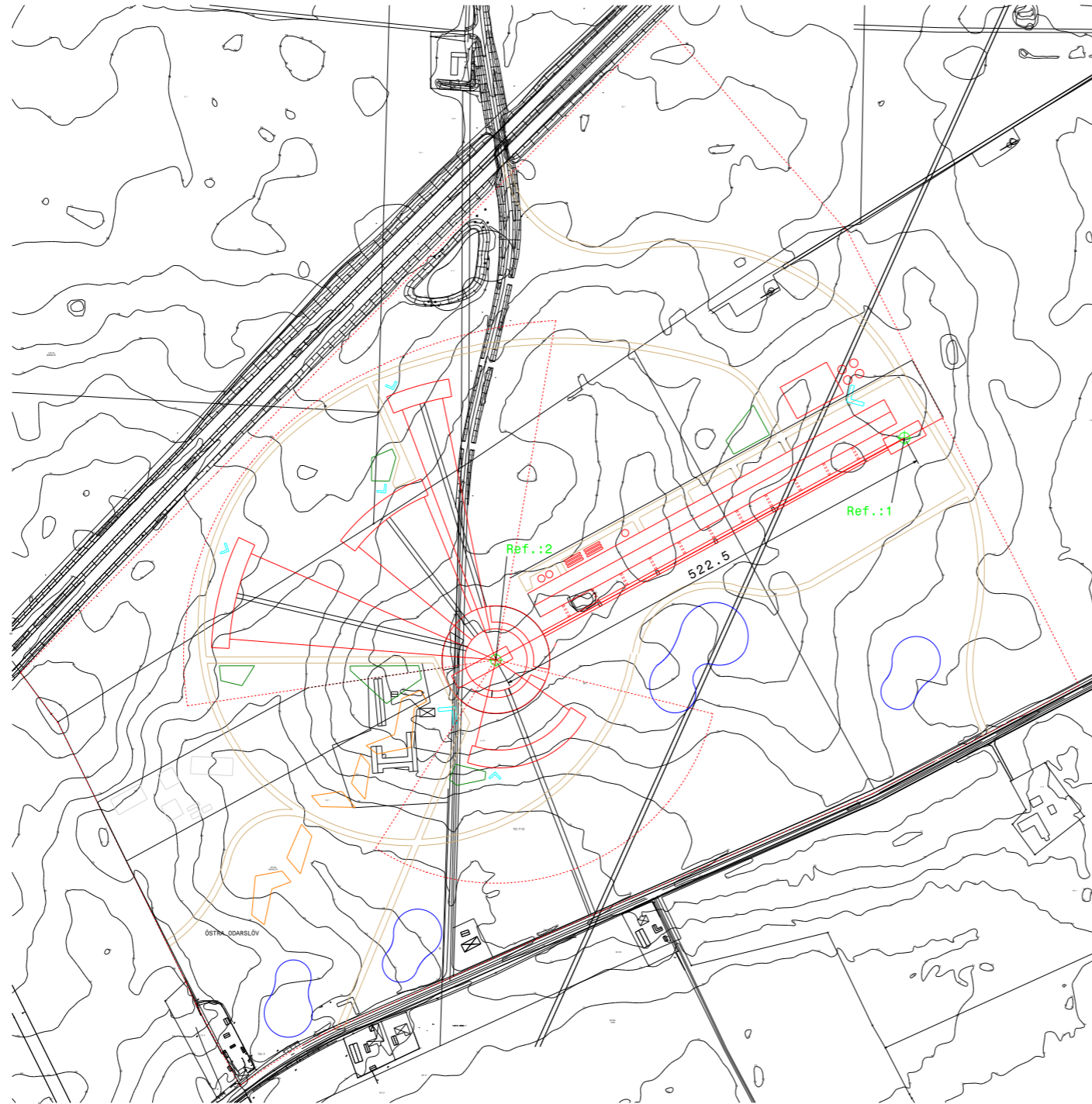
....of

- 1) values,
- 2) table ownership,
- 3) validators
- 4) [list of tables]
- 5) [CCB processes]

Tables (and their parameters) can have the status "Draft", "Active", or "Obsolete"


[Template parameter table](#) (xls).

End-to-end location - fixed!



Note:
SWEREF coordinates

Ref.:1 Accelerator start
X: 134692.1
Y: 6179297.63
Ref.:2 Target station center
X: 134233.00
Y: 6179048.00

 EUROPEAN SPALLATION SOURCE	This drawing is ESS-S property. It can't be reproduced or communicated without our written agreement.		DRAWING TITLE	
			CPL Licensing	
	DRAWN BY	DATE	DRAWING NUMBER	
	HHN	2011-05-20	D0-00006	
CHECKED BY	DATE	SIZE	DESIGN LOCATION	REV
PRL	2013-05-20	A0	ESS-LUND	2.1
APPROVED BY	DATE	SCALE	1:1	WEIGHT(kg) XXX
XXX	XXX	VIEW		SHEET 1/1

(Cold) slots being established

Low Beta Cryomodule		(Table Owner name)			date		2011-06-26-
Parameter	Unit	Value	Integrated Value	Status	Date	Validator	Comment
	Low beta cryomodule flange to Quadrupole	mm	250.000	250.000		2011-06-22-	
Block of One Mechanical element	Half_Quad (H/V)	mm	200.000	--		2011-06-27-	
	Steerer (H/V)	mm	0.000	--		2011-06-27-	
	BPM (H & V)	mm	0.000	--		2011-06-27-	Five-Cell/Geometric Beta = 0.70
	Half_Quad (H/V)	mm	200.000	650.000		2011-06-27-	
	Quadrupole to Cavity Iris	mm	400.000	1050.000		2011-06-22-	
	Cavity active	mm	744.778	1794.778		2011-06-22-	
	Cavity Iris to Cavity Iris	mm	400.000	2194.778		2011-06-22-	
	Cavity active	mm	744.778	2939.557		2011-06-22-	
	Cavity Iris to Cavity Iris	mm	400.000	3339.557		2011-06-22-	
	Cavity active	mm	744.778	4084.335		2011-06-22-	
Cavity Iris to Cavity Iris	mm	400.000	4484.335		2011-06-22-		
Cavity active	mm	744.778	5229.114		2011-06-22-		
Cavity Iris to Quadrupole	mm	400.000	5629.114		2011-06-22-		
One Mechanical element	Half_Quad (V/H)	mm	200.000	6029.114		2011-06-27-	
	Steerer (V/H)	mm	0.000	--		2011-06-27-	
	BPM (H & V)	mm	0.000	--		2011-06-27-	
	Half_Quad (V/H)	mm	200.000	--		2011-06-27-	
	Quadrupole to low beta cryomodule flange	mm	250.000	6279.114		2011-06-22-	
	Center to Center of Cavity	mm	1144.778	1144.778		2011-06-22-	

A **slot** is a **removable, replacable composite object**

.... **or** (ambiguously?) the place **where one would go**

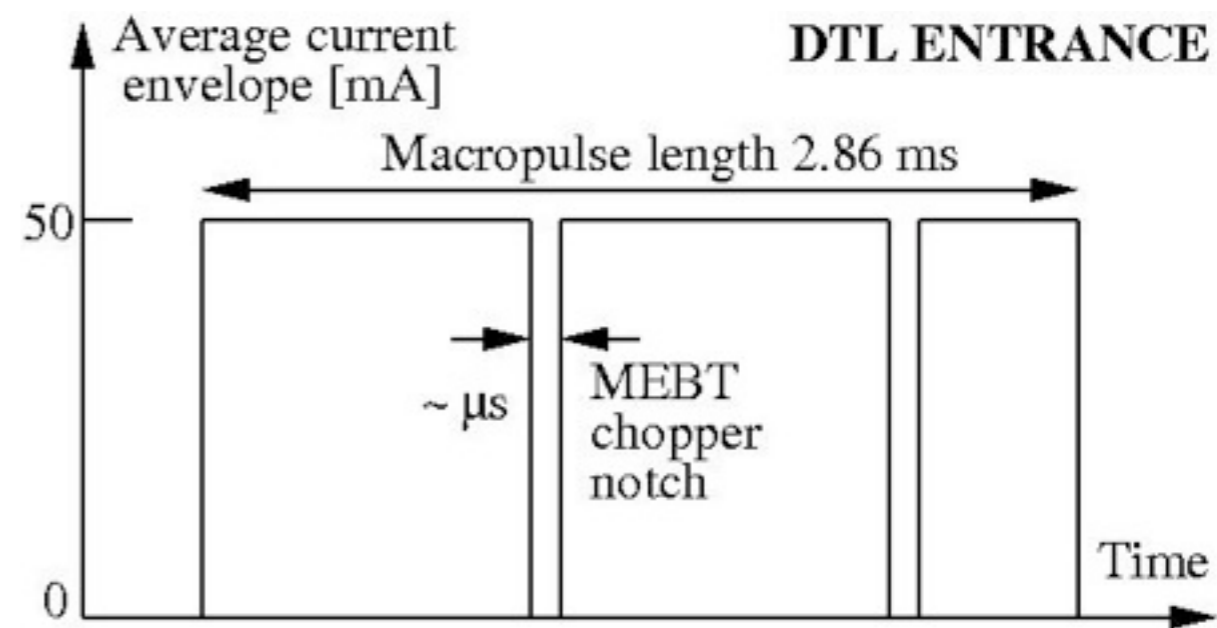
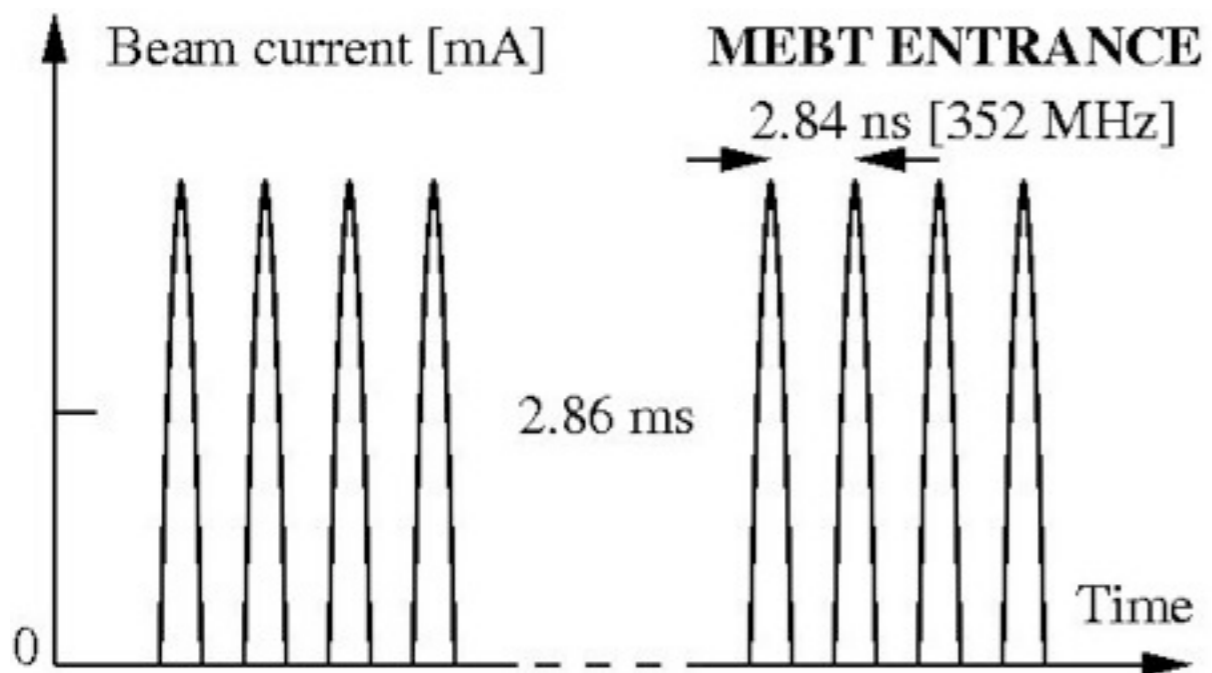
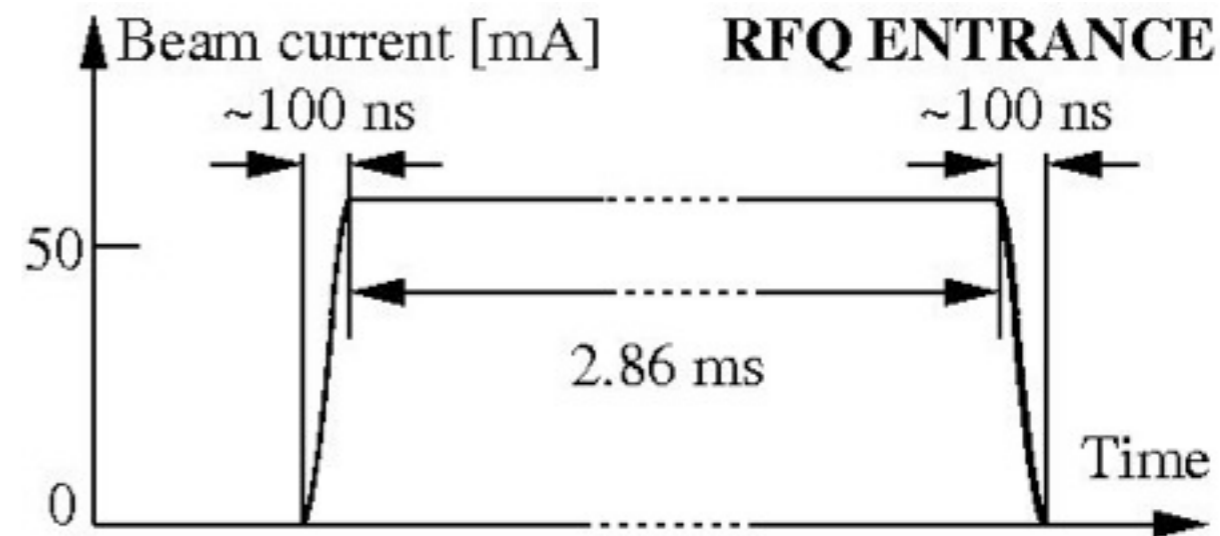
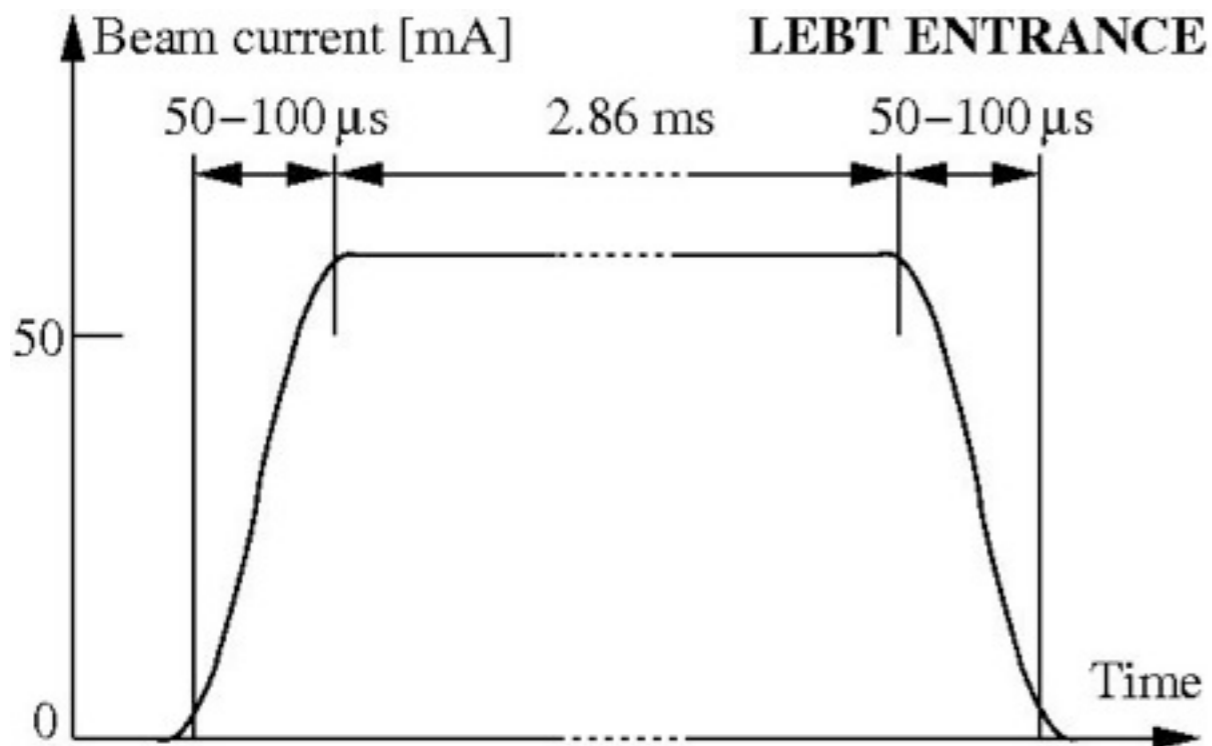
Slots eventually become instantiated,

- each with its own warts, realistic errors, bar codes, et cet

WARM “**slottification**” is also necessary

- but is unlikely to be complete in 2011 ?

Bunch time structure (straw)



MEBT Action Items, May 4



	Date	Who	Action	Comment
1	Done	All	LEBT includes a slow chopper	
2	Done	All	Bilbao designs RF buncher	Bustinduy
3	Done	All	MEBT includes adjustable collimator(s)	Commiss. tool
4	May	CP/SP	Propose porting RAL MEBT design to ESS	Talk to UK/RAL
5	May+	Bustinduy	Develop MEBT parameter table	
6	June	Peggs	Write a TN on time structure	Define author list
7	June	Plostinar	Summarize chopping options. TN.	Rise times. RFQ
8	June	Bustinduy	Establish MEBT diagnostics w Jansson	CAS. DITANET
9	July	Gammino	Warm linac workshop	
10	July	Iker?	Evaluate J-PARC (& other?) quad technols.	
11	Sept	Ponton	Study LEBT w slow chopping	Rise/fall times?
12	Dec	Comunian	Assemble integrated layout, IS to DTL_end	To Danared
13	Dec	Danared	End-to-end “emittance budget” table	RMS
14	?	BILBAO?	Analyse losses: need MEBT fast chopper?	

MEBT Workshop Recommendations



- 1) Discuss and adopt the “Proposed Spoke Actions”, after presentation of the same by Bousson & Peggs in CCB & TB meetings, May 9 & 13.
- 2) Avoid any linkage between Bilbao and Lund accelerator schedules, eg in spoke resonator testing with beam.
- 3) Explore, by one-on-one visits from “Lund” to Bilbao, potential synergies - eg LLRF, Controls, beam diagnostics - in addition to current ADU and P2B thinking.
- 4) Consider, without urgency, DTL synergies between Bilbao and Lund.
- 5) Mats and Alan Letchford discuss (eg at CAS school) strengthening ties with RAL & Astec South by focusing on the topic of porting the RAL MEBT design to ESS.
- 6) Prioritize evaluating the need, or lack of need, for a fast chopper in the MEBT.

Controls for Warm Linac Systems

(all words by Garry Trahern)



July 5 email to Peggs:

“We only want to emphasize the need for controls integration early on for hardware and software.”

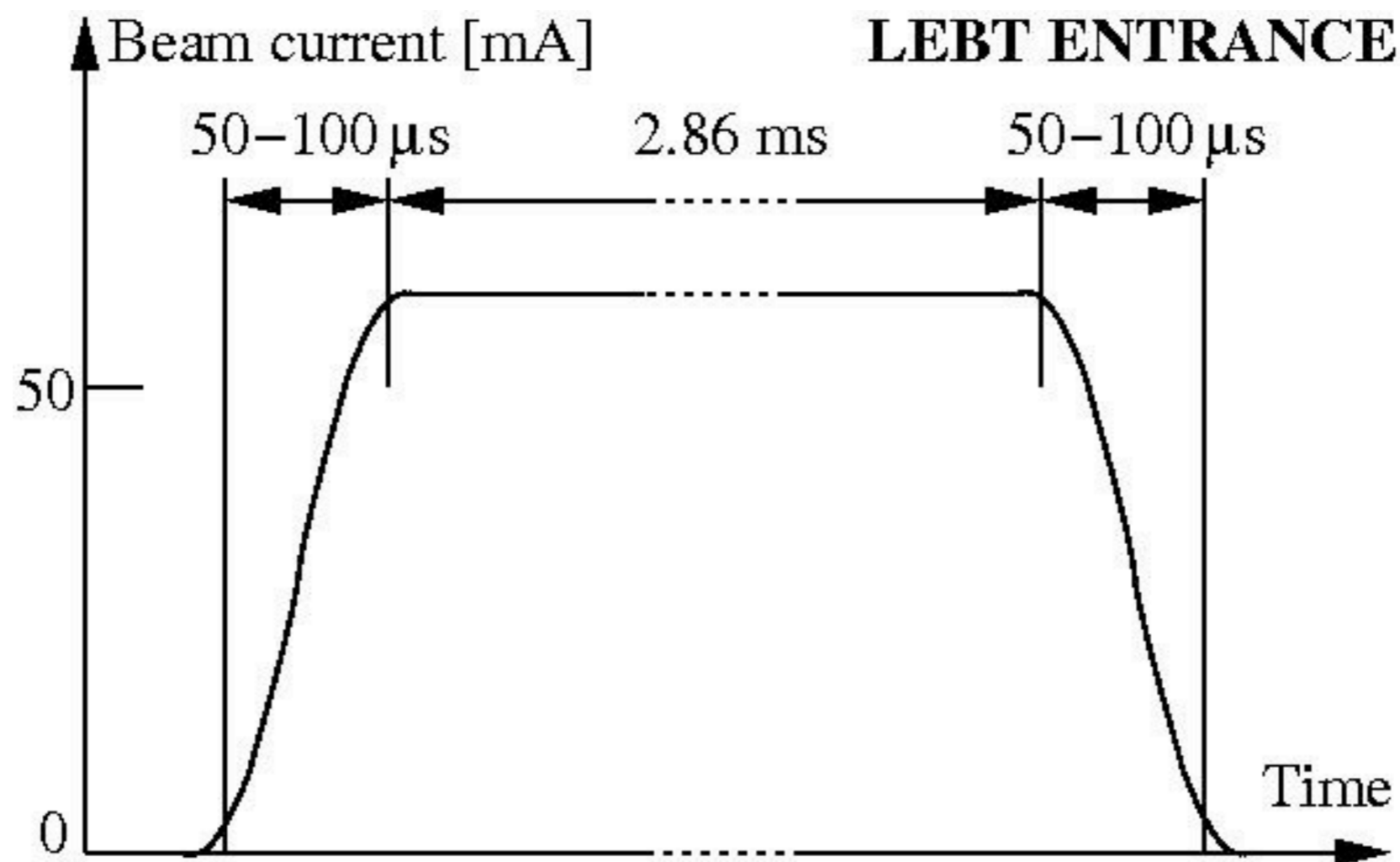
- Control Box = Control System
 - All the infrastructure, services, support ...
- We are ready to integrate!
 - We have the budget and the power
- *Ready when you are!*

Summary

1. **Baseline11** is due Dec 31 this year (first draft **Sept 23 !**)
 - comprehensive, complete & self-consistent
 - CDR with supporting documentation in appropriate formats
2. **Warm parameters** are due to be updated,
 - to be validated “soon” by ADU Technical Board
3. Need “**end-to-end**”
 - warm layout & optics
 - warm simulations
 - **Workshop** (see Danared)
 - [warm slots, incomplete in 2011?]
4. **Action Items**
 - Follow up on MEBT workshop
 - **New ones** from this meeting?
5. **Control Box**: “Ready when you are”

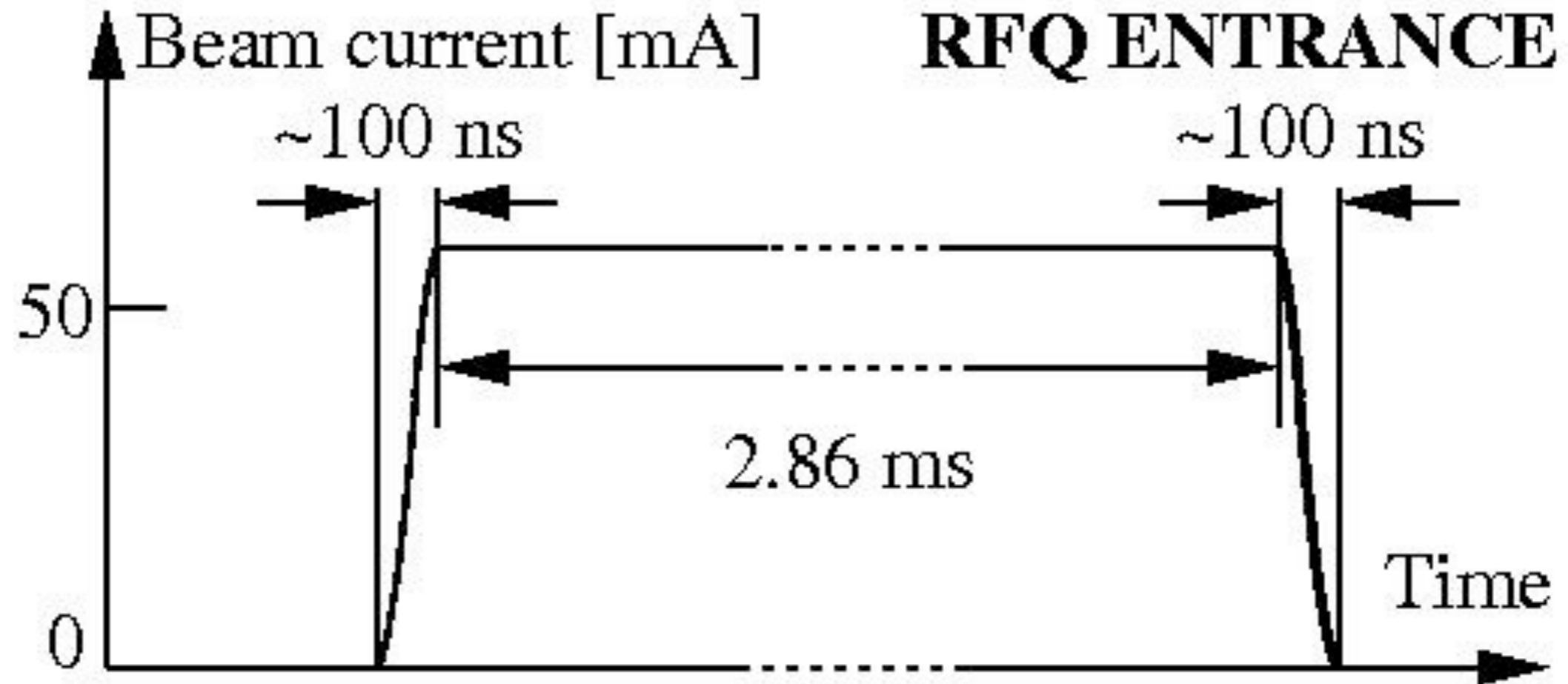
Backup slides

Time structure



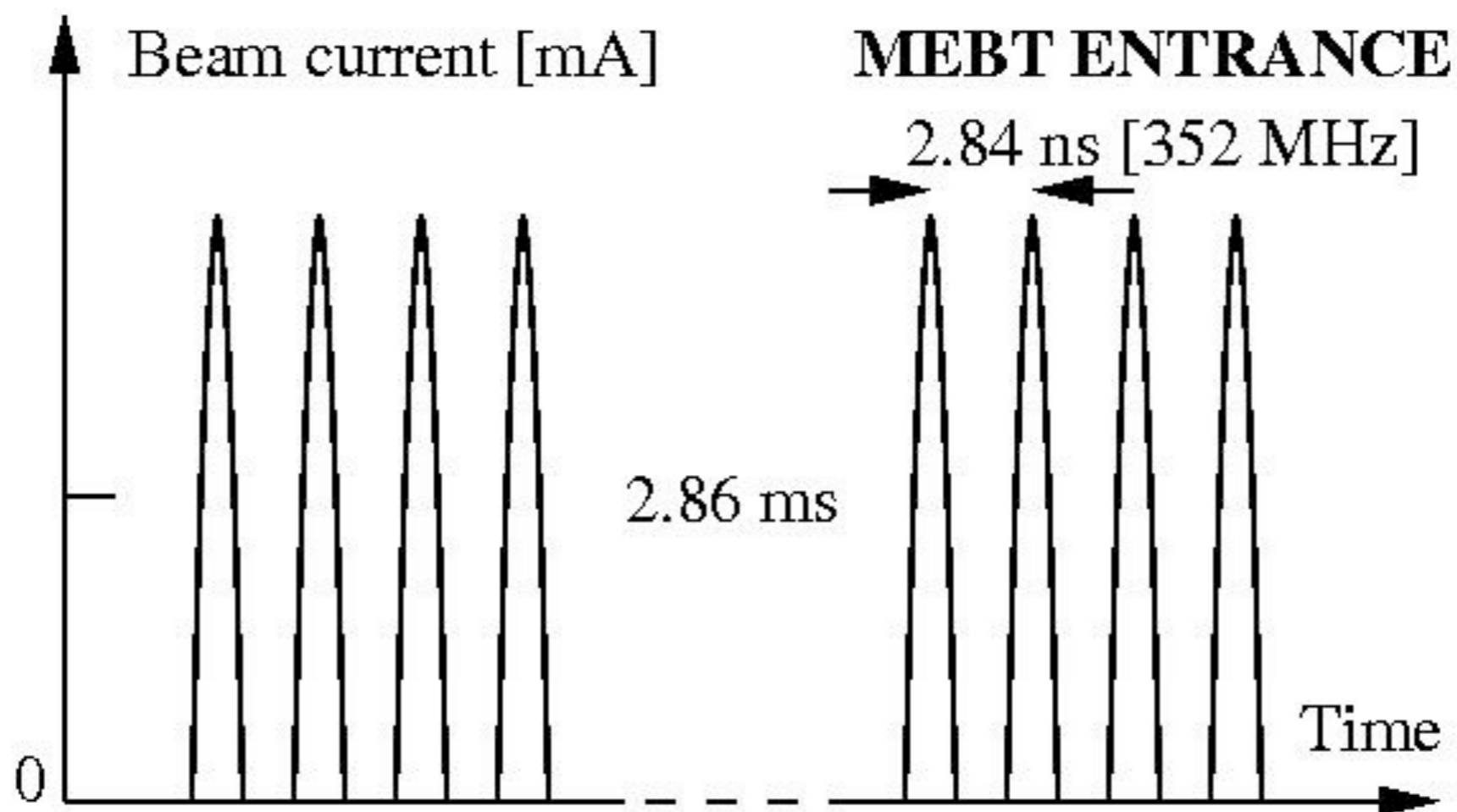
The “natural” rise and fall times out of the ion source need chopping in the LEBT by an order of magnitude.

2) into RFQ



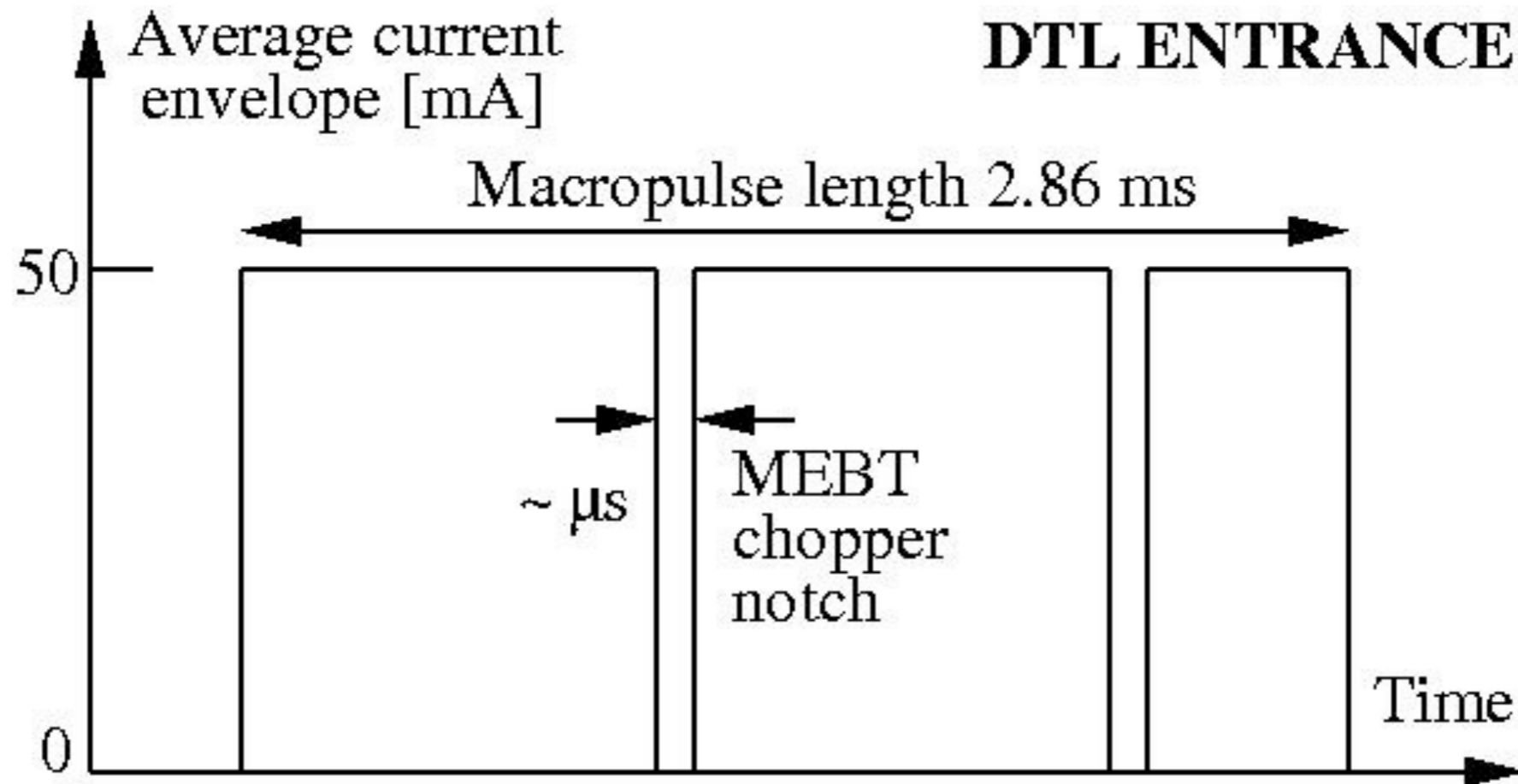
Chopped rise and fall times into the RFQ are ~100 ns ??

3) into MEBT



RFQ bunches the beam into narrower bunches than shown here.

- What length ??



MEBT chops microsecond notches into individual macropulses (if asked)

- this allows strong ferrite kickers to ramp up/down
 - provides flexibility, eg for parasitic extraction of 1% of the beam
- **bunch-by-bunch chopping is not necessary**

A “**supercycle**” of **N macropulses** repeats itself ad infinitum

- an identical “**strength vector**” applies to every macropulse
- the supercycle is occasionally tuned