MEBT lattice status

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FETS meeting at Warwick

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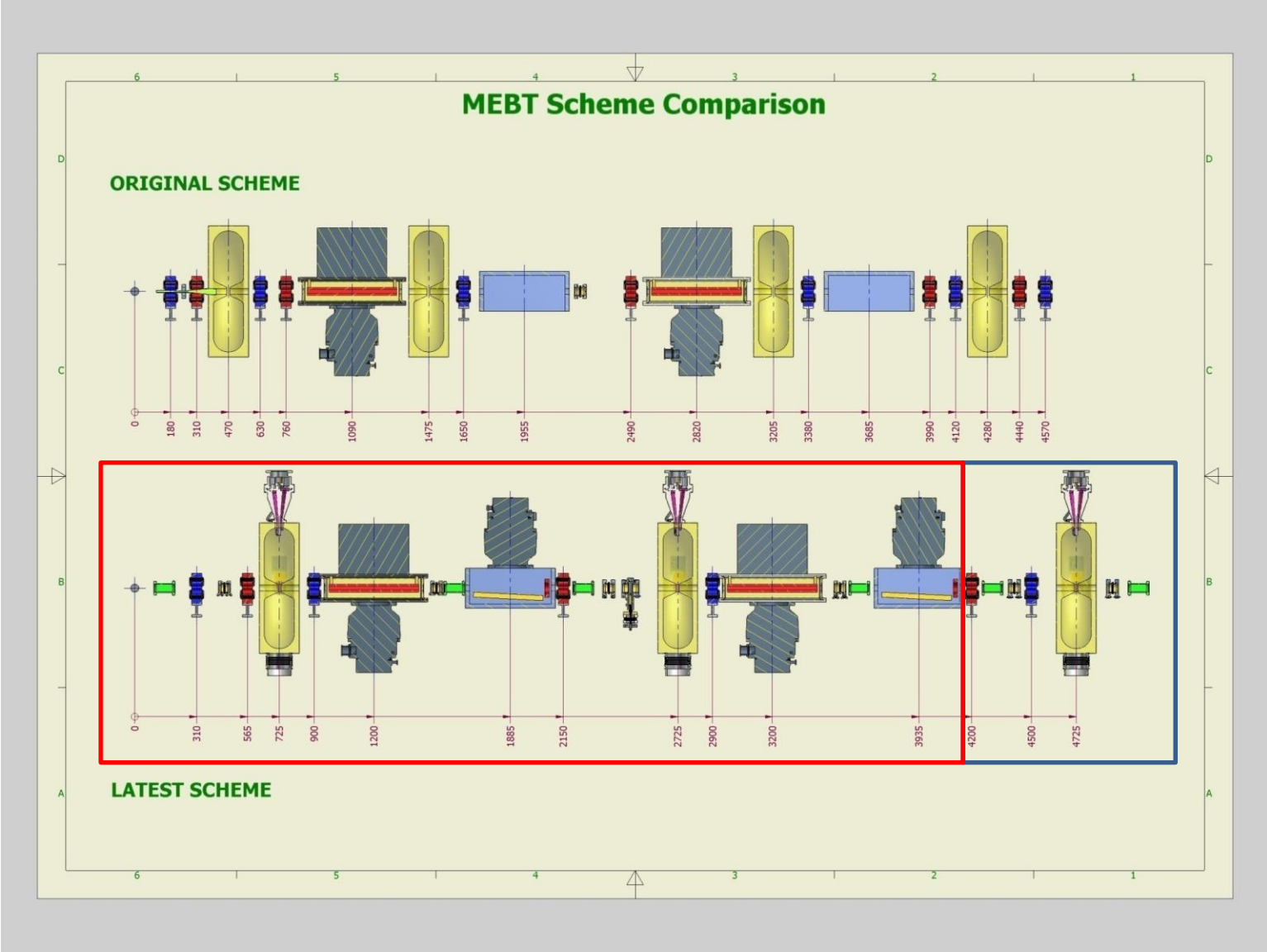
A meeting to decide which MEBT lattice to built has been helt at RAL on the 18th July.



List of criteria for a decision on MEBT lattice

1. MEBT particle tracking

To allow for an objective comparison of the two MEBT lattices under discussion we need to compile a list of parameters determined for each lattice under assumption of the same boundary conditions for both.

Therefore, it is required to use the same:

•Input distribution of particles (http://fets.isis.rl.ac.uk/File:GhostinZ.zip)
•Magnetic field distribution for QP (http://fets.isis.rl.ac.uk/File:MEBTquadFieldmap14May.zip)
•Electric field distribution for bunching cavities (http://fets.isis.rl.ac.uk/File:FieldmapFETSMEBTCavitiesAlan.zip)
•Chopping in the vertical direction.

2. Performance comparison

We have to make the comparison keeping in mind the aim of the FETS (to test the choppers and the laser diagnostics) and financial and temporal boundary conditions. The proposed MEBT should therefore only contain elements that are required to demonstrate chopping. The elements useful for the laser diagnostics should be highlighted but considered separately. Specifically, consider removing the last cavity if it does not benefit chopping. As some of the values that will be compared must be seen absolute rather than relative terms a comparison with other projects (SNS, JPARC, Linac4) those should be included in the comparison as well (where possible). Include any values that are readily available and simply omit those that are not.
The following criteria should be included in the comparison with the first 4 in the list rather be presented in graphs and values to allow for a more rigorous analyses.

•Beam transmission
•Beam extinction
•Emittance (growth) transversal
•Emittance (growth) longitudinal
•Peak power in chopper beam dumps 1 and 2 including details of how those values were derived.
•To investigate how sensitive each lattice is likely to be to errors a graph of xmax and ymax normalize to the beam pipe and ideally the sum over those values squared divided by the number of values (steps in the sum like a RMS...)

3. MEBT diagnostic and commissioning – items that require discussion

- Arguments to be prepared ahead of a (yet to be) scheduled meeting on this subject
  - For instance, items to be discussed may include:
    - Which diagnostic elements are available for commissioning.
    - Estimated time required for commissioning / commissioning sequence (with reference to the experiences gained from the LEBT commissioning).
    - Radiation issues for commissioning
    - Consideration of the financial constraints and project delivery deadline.
      - MEBT lattice cost comparison, for example based upon: 20 k£ per cavity, 20 k£ per 5 kW amplifier, 5 k£ per quadrupole

Summary of meeting on 18.07.2013 to reach decision on MEBT lattice

Overview: It was very productive and positive meeting. For the first time we could really compare the two MEBT lattices. We noticed in the comparison and during the discussion that there are a few details missing that will enable a final decision.

The results so far are summarized in the table below. The cases evaluated (green) are:

Case 1: Lattice design B (= Morteza / Juergen) calculated with GPT (Morteza) using ~10 k particles (Ghostin Z) and fieldmaps for quadrupoles and cavities.

Case 2: Lattice design B (= Morteza / Juergen) calculated with GPT (Morteza) using ~100k particles (Ghostin Z100k) and fieldmaps for quadrupoles and cavities.

Case 3: Lattice design B (= Morteza / Juergen) calculated with Tracewin (Ciprian) equivalent WB distribution and fieldmaps for quadrupoles and cavities. Beam dump apertures 1& 2 assumed to be 18 mm in Y but should be 9

Case 4: Lattice design B (= Morteza / Juergen) calculated with Tracewin (Ciprian) using ~100k particles (Ghostin Z100k) and fieldmaps for quadrupoles and cavities. . Beam dump apertures 1& 2 assumed to be 18 mm in Y but should be 9

Case 5: Lattice design A+ (=Mike/Ciprian/ + 50 cm additional for diagnostics [Christoph]) calculated with Tracewin (Ciprian) equivalent WB distribution and fieldmaps for quadrupoles and cavities.

Case 6: Lattice design A+ (=Mike/Ciprian/+ 50 cm additional for diagnostics [Christoph]) calculated with Tracewin (Ciprian) using ~100k particles (Ghostin Z100k) and fieldmaps for quadrupoles and cavities.

Case 7: Lattice design A++ (=Mike/Ciprian/+ 100 cm additional for diagnostics [Christoph]) calculated with Tracewin (Ciprian) using ~100k particles (Ghostin Z100k) and fieldmaps for quadrupoles and cavities.

	Case 1	Case 2	Case3	Case4	Case5	Case6	Case7
Particle loss %	**4.2**		**1.1**		**0.85**		
Extinction 1	**11**				**200**	**200**	
Extinciton 2	**3**						
Emi growth x %	**33**		**15**	**40**	**21**	**34**	
Emi growth y %	**3.03**		**6**	**7**	**20**	**26**	
Emi growth z %	**17**		**3**	**2**	**1.1**	**0.76**	
PPower dump1	**137.8**						
PPower dump2	**137.8**						
APower dump1							
APower dump2							
No cavities	**2 + 1**		**2 + 1**	**2 + 1**	**3 + 1**	**3 + 1**	
RF Power							
No magnets	**6 + 2**		**6 + 2**	**6 + 2**	**10 + 2**	**10 + 2**	
Gradient							
Comment 1	**Number of cavities and magnets are given for Chopper test + LDiagnostics**						
Comment 2							
Comment 3							

The **missing items** / tasks are:

1.Ciprian will derive the power density on his MEBT chopper dump plate. We can then compare this with Morteza's figure of 137w/mm^2 (peak power) 13.7W/mm^2 (time average power). Morteza and Ciprian will also derive a rough estimate of the average (in position = Apower) power density.

2.Ciprian to repeat the case 3 & 4 calculations with the updated size of beam dump apertures (y=+- 4.5 mm) at beam dump end.

3.Morteza will calculate the acceptance of the lattice B and identify if particles that would be lost can be scraped at front of MEBT.

4.Ciprian will provide Pete with the component spacing of his lattice(s) – he has actually modelled two, one with 0.5m extra length for diagnostics and one 1.0m extra length for diagnostics. Pete will produce engineering schematics to determine the space available for diagnostics
5..
6.Morteza to perform a GPT simulation with 100k particles (GhostinZ100k).

7.Scott will check whether 21.5T/m gradient is possible for the given design.

8.Ciprian will check if slightly longer MQP (75 / 80 mm) will be possible for lattice A(+ / ++) Morteza to cross check for lattice B. Decision of further work will depend on 6)

9.Ciprian will increase the voltage on his chopper to improve the number of chopped particles that hit the dump plate.

1.Morteza will adopt this chopper for lattice B (reduce length and increase voltage).

2.Piero will investigate the effort required to do an error study.

The progress of the above items will be **reported on at Warwick** with a view to meeting to choose the **MEBT layout 2 weeks later**.

Other items mentioned that are not directly related to MEBT layout comparison:

- Scraping somewhere in the MEBT may be added if the lost particles are shown to come from the periphery of the beam. Alan was concerned particularly about losing beam inside a rebunching cavity.
- Once a MEBT layout has been chosen we need to decide what sort of error analysis is done. Ciprian can do this in TraceWin, Morteza cannot do this in GPT. Scott tabled doing a simpler envelope error analysis in Trace3D. This will determine the sensitivity of the MEBT layout to misalignments and will guide the alignment accuracy required by the engineering team.
- Pete to confirm beam pipe diameter through the quadrupoles.
- Idea of having one rebunching cavity with a larger bore (and hence larger power supply) has been rejected. CERN has gone this way to reduce losses.
- Agreed that the chopper and chopper beam dump internals are decoupled from their enclosing vessels. As soon as the ‘active’ lengths of the choppers and chopper beam dumps have been agreed we can progress the vessel designs.