Summary of 6D vacuum rf meeting 2

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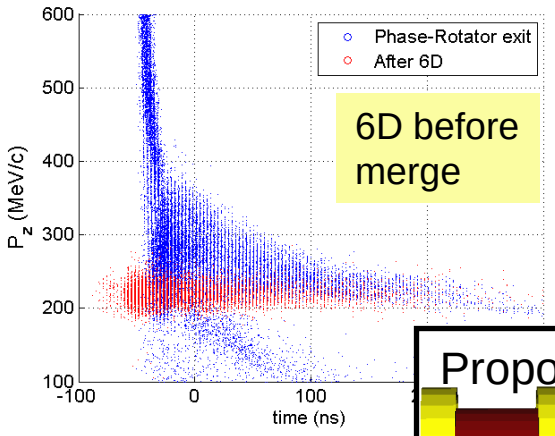
MAP Friday Meeting
November 8, 2013

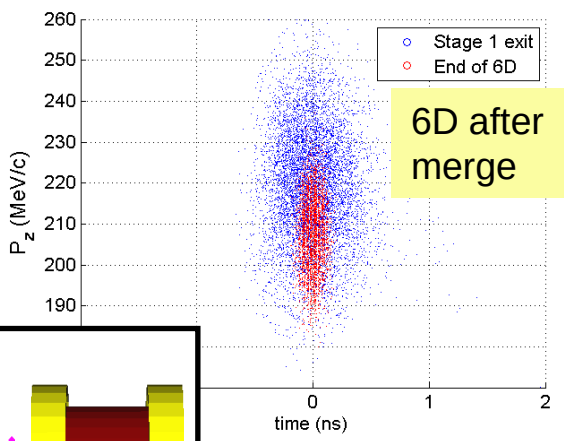
Highlights

- MAP management has requested a single option with ‘end to end’ simulation from phase-rotation to final cooling.
- Rob requests that the simulation should, as far as possible use MAP standard codes such as G4BL and/ or ICOOL
- At this point we have:
  - A complete ICOOL simulation of a Rectilinear channel that takes the beam from the phase-rotation to the start of the merge
  - A 6D merge, using output from the above
  - A complete ICOOL simulation of a rectilinear channel using the bunch-merger output, to emittances of 0.32 mm (trans.) and 1.6 mm (long.) which are near the baseline requirements for a Muon Collider

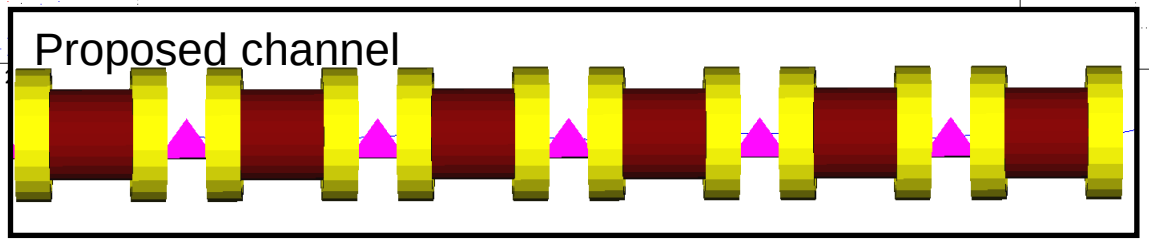
Main Results



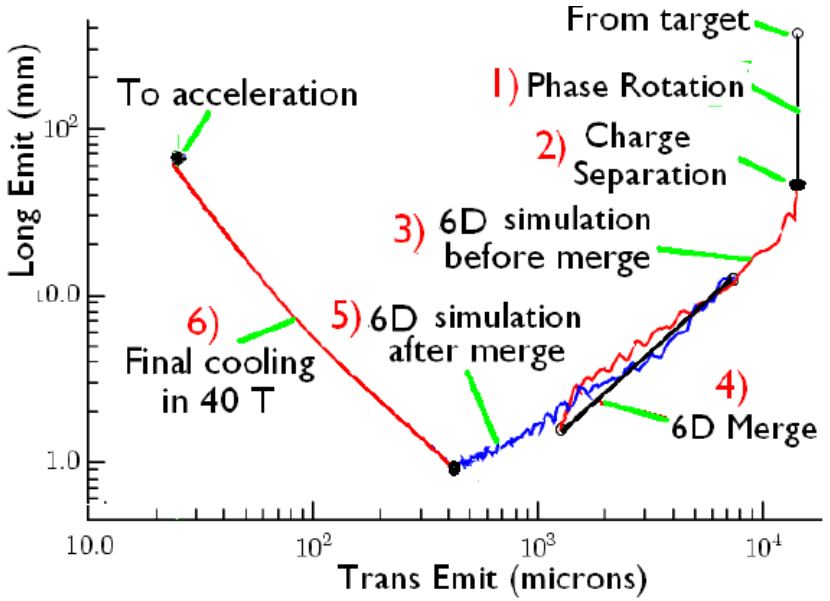
6D before merge



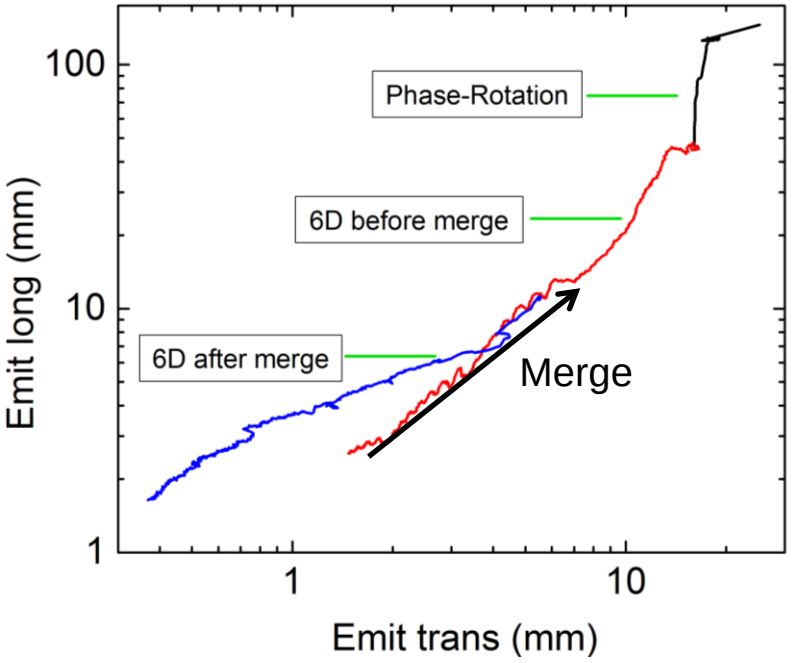
6D after merge



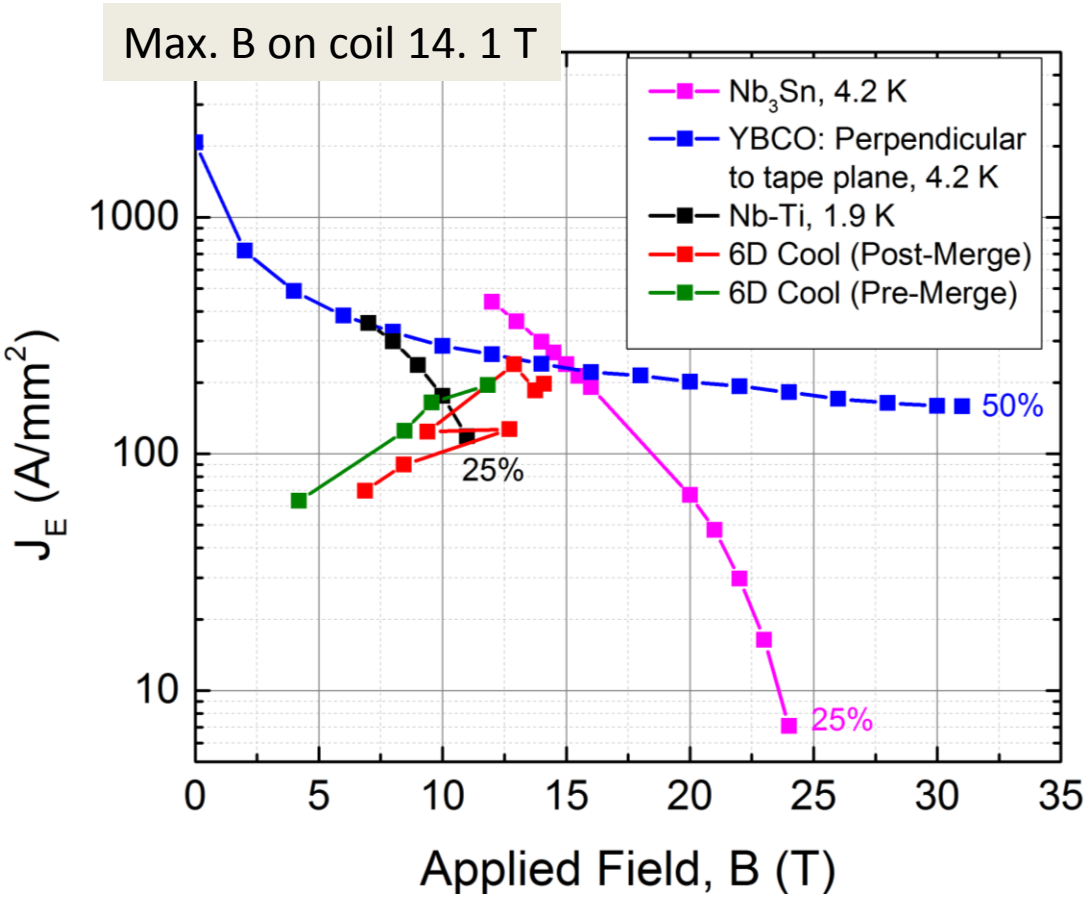
You have seen this million of times before:



NEW: Reproduced from a complete front-end simulation



Magnet Technology



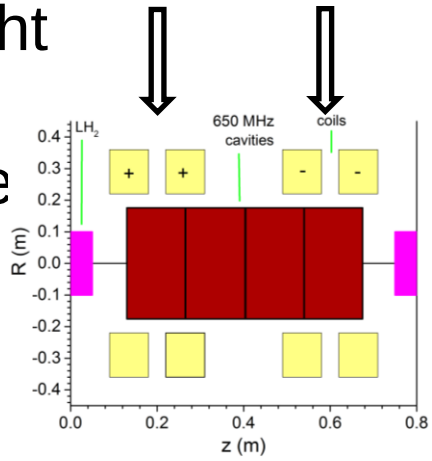
- Good news: Current densities within the critical limits for Nb_3Sn

Reservations & Comments

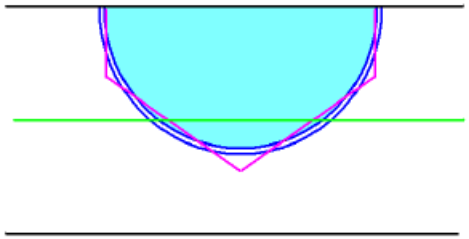
- This is based on a front-end without the chicane.
- It is based on a simulation without charge separator. Cary's simulation have limited statistics but show good transmission and only a small increase on the long. emittance. It is thus reasonable, as Mark suggested, to use high statistics output from the phase rotation.
- Our current option uses 325 MHz at earlier stages and 650 MHz at the later ones. It uses LH2 absorbers for all stages
- We are using non-standard simulation for the bunch merge. This will replaced by Yu Bao's G4BL deck when it is available.
- Although we incorporate some engineering considerations in our lattice designs there will need to be future iterations.

Engineering Questions (post January)

- We have modified the coil designs to allow straight radial waveguides before the merge. Similar modifications will be performed at the post-merge cooler.



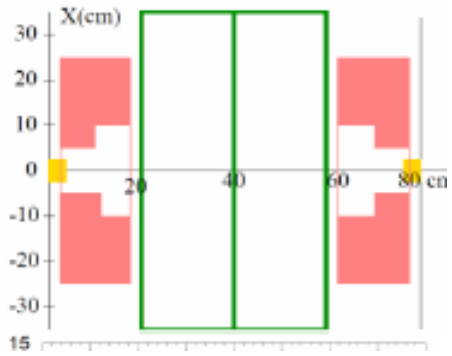
- The initial stages have specified rf windows with 25-30 cm radial apertures and can generate a lot of heating. The required safe Be thicknesses have not been determined.
- Design and spacing for thermal insulation between coils and rf systems
- A plausible design of wedge absorbers
  - Cylindrical shape absorber?



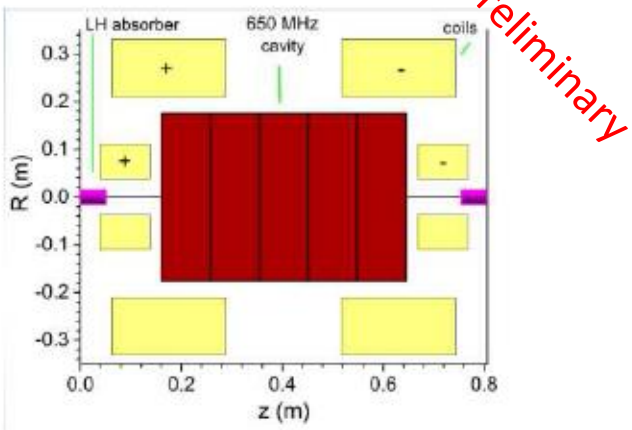
- Determination of needed instrumentation

Engineering Questions

- Coil design in the last stage: Current densities and calculated tension from coil radial forces appear to be within plausible limits for Nb_3Sn conductor. As shown by I. Novitski the axial forces may be creating a problem. In Valeri's last stage design these forces are sufficient to move the conductors axially by 1 mm.
- Alternative options are considered



Valeri's proposal for last stage



Preliminary

Diktys's proposal for last stage

Conclusion (directly from Bob Palmer)

- Diktys reported the first 'end-to-end' simulation of the cooling, merge, and re-cooling, although the merge simulation was not fully 3D, and there are many other reservations.
- Valery continues to study several alternative ideas, but the approximations in his simulation tools do not allow a simple comparison of their performance with the Diktys version. We urge Valery to use G4BL. The fact that we must now move forward with Diktys' scheme does not mean that we cannot adopt more of Valery's ideas in the future.
- We are not now proposing to use an initial Helical FOFO snake that would allow the charge separation to be done later when the emittances are lower. We need more study of the charge separation before the use of this snake can be evaluated.
- We are not now proposing the use of a planar snake, despite its many advantages - it is not yet sufficiently studied or understood

- There are serious engineering questions that are now becoming apparent: rf windows, hydrogen absorber design, super-conducting coil motion, etc. Novitski's presentation was much appreciated.
- We are making real progress.