Overview of Main Linac Beam Dynamics areas that need to be better examined and better documented

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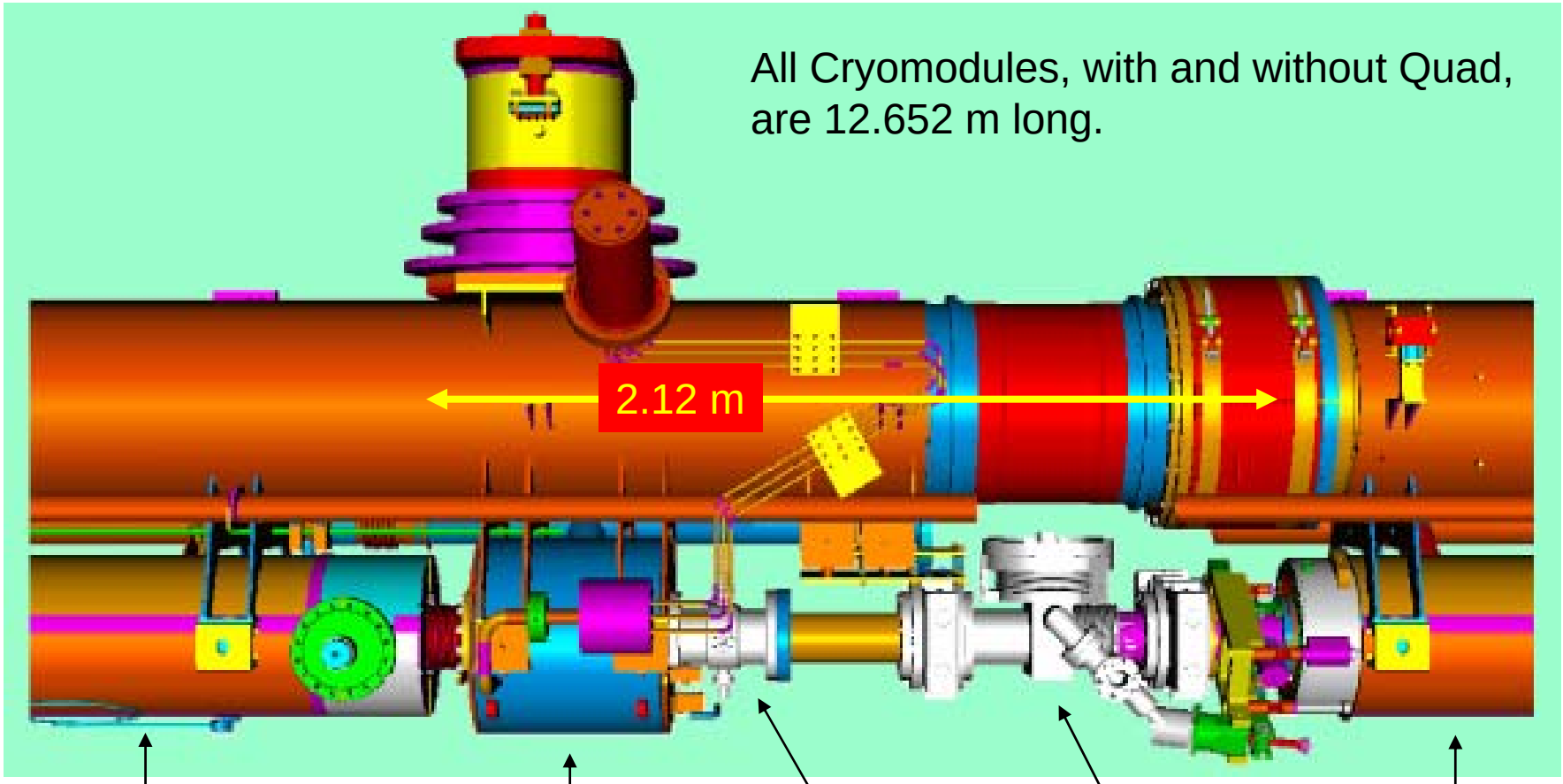
Quad Package in Every Third Cryomodule

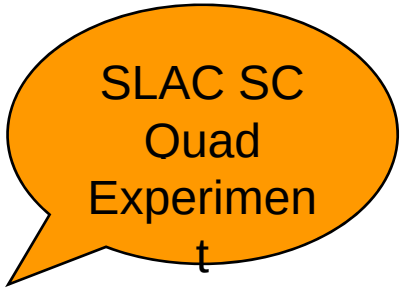


(1) Quad Package Design

- Reexamine Choice of Aperture Size
  - Spoilers to limit damage from beam loss
    - Currently cavity irises are smallest aperture
  - Impact on wakes and cryo heat load
- Finalize bpm design and resolution requirements
- Work with Wakefield group to verify efficiency of HOM absorbers to limit 2K cryo-loading
- Compile specs on quad and correctors (or movers ?) – much work has been done at FNAL

Solyak: Summary of Preliminary Magnet Studies

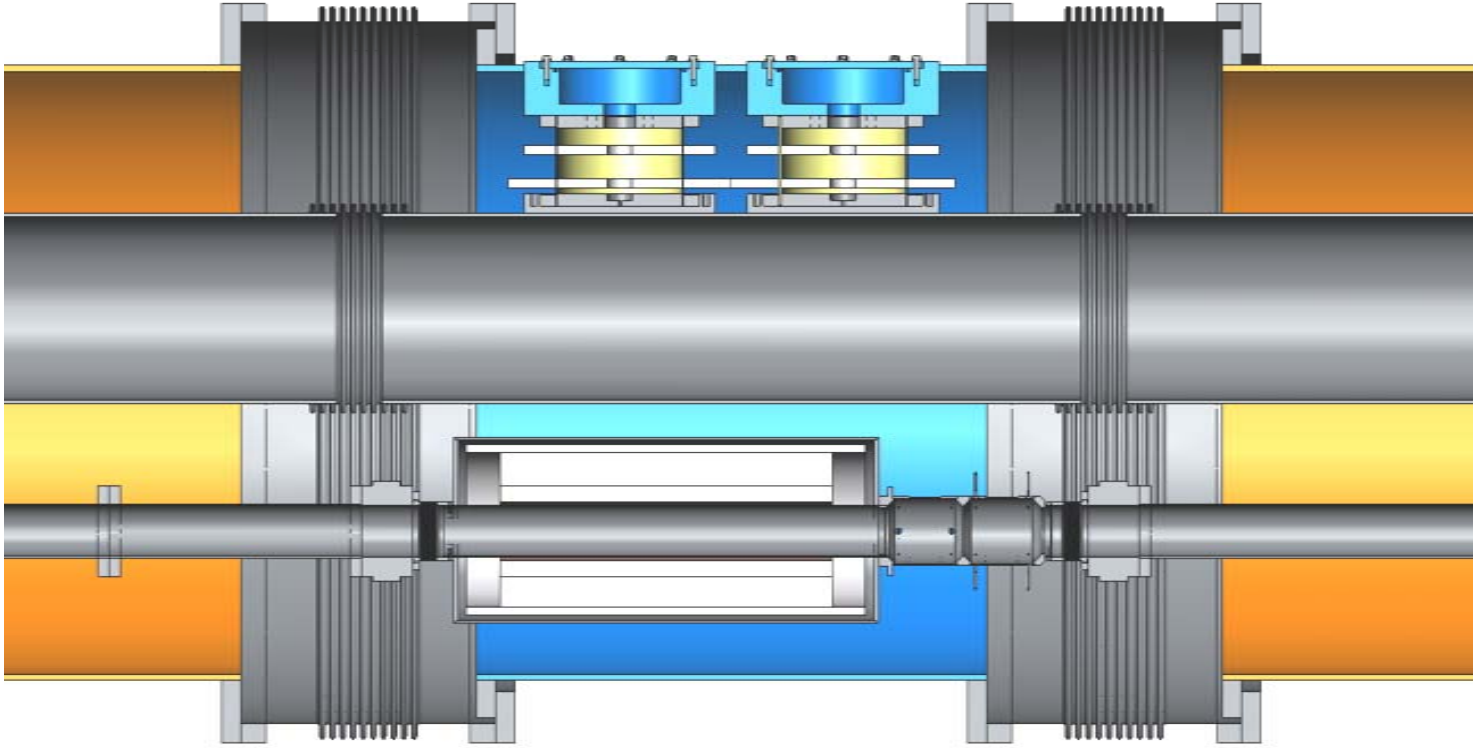
- Linac superconducting magnets are feasible
- Design work started. Magnet design review April 5, 2007.
- R&D and prototyping are needed to confirm the specified performance and efficiency
- *Main issues:*
  - Optimal quadrupole configuration
  - Integrated field range (high:low)
  - Magnetic center stability during –20% field change
  - Combined or stand alone correctors ?
  - Fringing fields in SCRF areas from magnet package
  - Effective current leads



Solyak: Quad Package in Separate Cryostat Option?

Benefits: Independent from CM, better alignment, vibration stability, easy upgrade to 1TeV.

But …Not in RDR baseline design. R&D postponed.



(2) Static Tuning

- Huge effort in this area with many codes developed, but
  - All assume same errors: can these be improved/worsened or offset locally. Need more realistic error length scales.
  - Not clear what limits emittance growth from being further reduced (in theory and practice)
  - Need for tuning ‘bumps’ (last resort of scoundrels)

Error	with respect to	value	$\Delta\gamma\epsilon_y$ [nm]
Cavity offset	module	300 μm	0.2
Cavity tilt	module	300 μradian	< 0.1
BPM offset	module	300 μm	400
Quadrupole offset	module	300 μm	0
Quadrupole roll	module	300 μradian	2.5
Module offset	perfect line	200 μm	148
Module tilt	perfect line	20 μradian	0.7

(3) Installation and Operation

- Long-range alignment
  - Spec for initial linac ‘straightness’ and slow ground motion
- Trajectory control
  - FB and magnet response times based on GM models
- Energy control
  - Measuring the beam energy profile and matching the quad lattice
  - Regulation of the beam energy at the end of the linacs
- Emittance monitoring
  - Diagnostics (single laser wires separated by 2.5 km)
- Backgrounds and machine protection
  - Halo, SR, MP, dark currents, spoilers and beam abort

(4) Wakefield/Cavity Topics

- Wake offset due to FPC/HOM antennae intrusions
- HOM absorber versus beam pipe losses
- Simulation of multi-cavity trapped modes
- Simulation of first/second band dipole mode properties and dipole mode data analysis
- Design of a lower R, E field and B field cavity with 60 mm irises
- Multipacting simulations in couplers and HOMs
- Surface magnetic field enhancement due to cell-to-cell misalignments

References

- RDR Chapter 2.8: Emittance Preservation and Luminosity Stabilization
- Main Linac RDR web page
  - http://www.linearcollider.org/wiki/doku.php?id=rdr:rdr_as:main_linac_home
- Accelerator Physics weekly meetings
  - http://ilcagenda.linearcollider.org/conferenceDisplay.py?confId=2133
- Accelerator Physics RDR web page
  - http://www.linearcollider.org/wiki/doku.php?id=rdr:rdr_ts:accelerator_physics
- PT's rough cut at Work Packages
  - http://www.slac.stanford.edu/~quarkpt/EDRPlan