Open Midplane Dipole R&D Program

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LARP Dipole Review at BNL

Topics

- Goal
- Hardware -- existing & to be built
- Schedule – high level milestones
- R&D with LBL subcoils
- R&D with BNL coils
- Cost of conductor
- Financial support
- Interaction with 12T CC program

Goal

By the end of FY07, design, build, and test a proof-of principal (POP) magnet to assess the feasibility of using an open midplane dipole in an upgrade of the LHC IRs.

POP Key Features

- ∫Bdl, with operating margin
- Quench protection system
- Aperture for beams
  - Horizontal > vertical, needed much more at the downstream end of the magnet
  - Ability to achieve desired field quality
- Aperture for beam losses
  - Heating, radiation damage
- Finite impact on LHC cryo system

Plans

- Quick start on a key issue: assemble LBL subcoils in an existing BNL fixture to study the performance of a magnet with an open midplane. FY05
- R&D with POP magnet: design-specific, fixture and technology-independent coils – test, iterate as needed. FY05 – FY07.

R&D with LBL subcoils (1)

- Support structure: Add spacers & longer bolts to existing BNL common coil fixturing
- Instrumentation: voltage taps molded into coils + (if feasible) strain gauges
- Turnaround between tests (e.g., to adjust preload) < 2 weeks
- Want to complete tests in FY05.

R&D with LBL subcoils (2)

- Test with at least two configurations:
  - No midplane gap – to check all features of assembly (e.g., splices, preload) except gap
  - Finite midplane gap with azimuthal support set so that coil strain ~ strain in POP coil
- Vary preload by changing shim thickness
  - Can change preload in all 3 dimensions

Open Midplane POP Dipole

- Plan: initial test, iterate mechanical structure and/or coils, retest
- Test results available by fall, 2007
- Will use either R&W or W&R coils as necessary and/or appropriate. If coils are W&R, will copy existing methods to make them.

Conductor Cost

- Magnet length chosen to preserve the option to use W&R coils
- Oven ~ 1m $\Rightarrow$ magnet total length ~$\frac{1}{2}$ m.
- Conductor is ~ $100k (unloaded) per coil set (coil set = 1 magnet). Buy 2 sets plus 0.5 set spare.

Financial Support

- Present LARP budget for dipole design (3 institutions):
  - FY05: $203k
  - FY06: $2501k
  - FY07: $2072k
- Base program support of dipole work:
  - FY05: $200k

FY05

- Assemble, test LBL subscale coils
- Complete conceptual design by Mar 05
  - Begin detailed coil, coil tooling design
- *Design* task: $547k
  - test POP summer 07 ⇒ fast start on design
- *Build/test* task: $73k + n*$40k
  - n = # cold tests after 1st one
- Available: $203k LARP + $200k base

FY06

- Order Nb_3Sn Oct 1, '05
  - 9 months to delivery of cable
- Begin detailed of design cold mass tooling, top hat, dewar on Oct. 1, '05
- *Design* task: $1156k
- *Build* task: $559k
- Above costs are BNL only.
- Funding: $2501k LARP + base

FY07

- Order cold mass parts, tooling, dewar
- Fabricate parts, assemble, test magnet
- *Design* task: $854k
- *Build/test* task: $748k (1 ass'y, 1 test)
- Above costs are BNL only.
- Funding: $2072k

Common Coil (12T) results may affect R&W/W&R choice

- Issues:
  - Stability of cable with high R_I (due to use of Mobil 1 during cable reaction)
  - Bend strain sensitivity
- Common coil tests:
  - Coils w. J_c ~ 2000 A/mm^2 (MJR) ~ May 05
  - Coils w. J_c ~ 3000 A/mm^2 (RRP) ~ fall 05