



US LHC Accelerator Research Program

bnl - fnal- lbnl - slac

Phase 1 Upgrade Proposals:

Inner Triplet Dipoles

Technical Performance

P. Wanderer

DOE Review

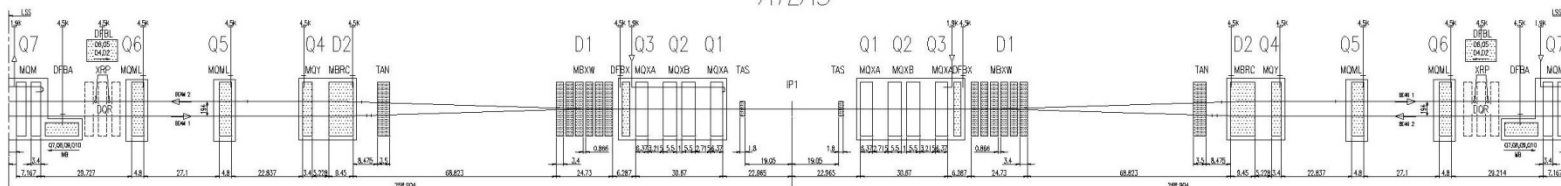
June 20, 2008



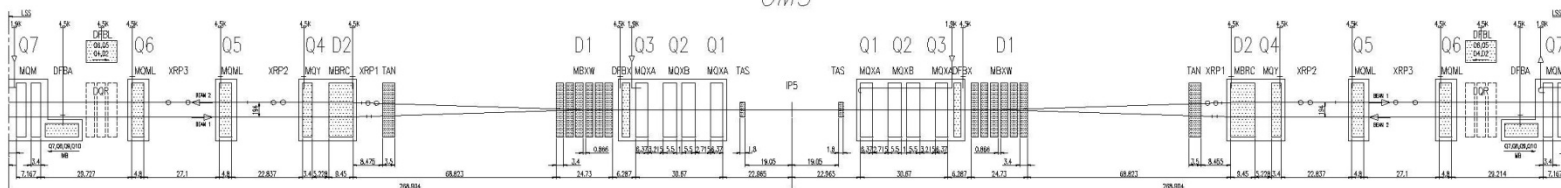
Requirements



ATLAS



CMS



Magnet gap	120 mm
B•L @ injection	1.7 T•m per interaction side
B•L @ top energy	27 T•m per interaction side
Good Field Region	radius 50 mm
dB/B in GFR at injection	$\pm 5 \cdot 10^{-4}$
dB/B in GFR at top energy	$\pm 2 \cdot 10^{-4}$

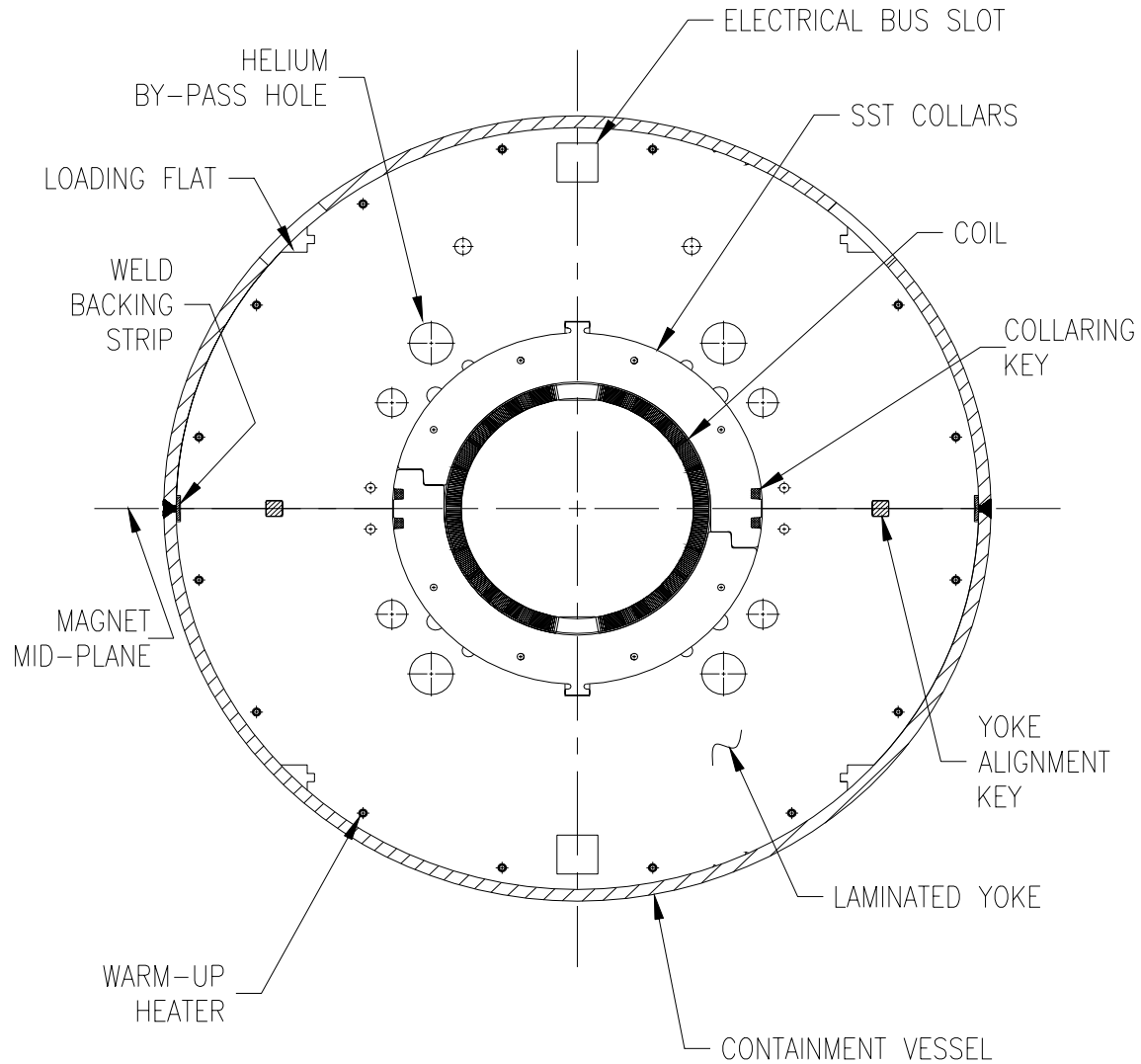


D1 dipoles at IR 1, 5

- LIUWG (LHC IR Upgrade Working Group) report on D1 (21Feb08): replacing present D1 dipoles with superconducting dipoles would have three advantages:
 - Dipole aperture could match quad aperture (~ 110-120 mm)
 - Longer slot length available for crab cavities, other equipment
 - Lower cost than replacement resistive dipoles.
- RHIC DX dipoles:
 - sufficient aperture (180 mm)
 - field (3.6 T, $L_m = 3.7$ m) with two DX = 27 T·m (D1) in one cryostat
 - yoke o.d. = 622 mm [CERN D1 has 570 mm o.d.]
 - $L = 49$ mH, 6.8 kA and
 - 6.8 kA \rightarrow 4.4 T, 1100 kJ stored energy



DX Cold mass cross section





FROM DX TO D1

- Operating field: 4.4 T \Rightarrow 3.7 T
- Redesign: Yoke vertical dimension: 622 mm \Rightarrow 570 mm
 - Lower operating field makes this possible w/o too much flux leakage or saturation
 - See preliminary designs by R. Gupta
- Redesign: Coil ends – reduce tilt of cable w r to beam axis, increase # of spacers \Rightarrow increased mechanical stability
- Field quality (same 2D coil, new yoke)
 - Geometric sextupole, decapole – ok
 - High field (saturation) – holes in yoke for control
 - Injection – measure at lower currents to correspond to LHC injection



Cost and Schedule

- Mike Anerella has prepared preliminary versions of the schedule and cost, assuming FY10 (Oct. 1, 2009) start of construction project.
- Need funds in FY09 to prepare for CD1 and CD2 reviews.
Placeholder: \$600k.
- Additional FY09 funds (i.e., \$18 M total LARP/LAUC budget) would significantly increase schedule contingency. Use to purchase long lead-time items (superconductor, yoke, collars, cold bore tubes, ...).
 - Need CD3a to purchase long-lead items



SUMMARY

- The RHIC DX cold mass needs only two modifications (yoke o.d., coil ends) in order to meet the (not-yet-official) first-order list of requirements for a superconducting D1.
- Moving forward on the needed time scale, within funding constraints, will be a challenge.