



**US LHC Accelerator Research Program**  
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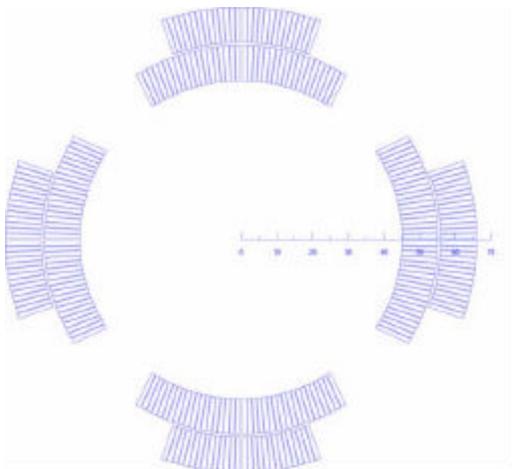
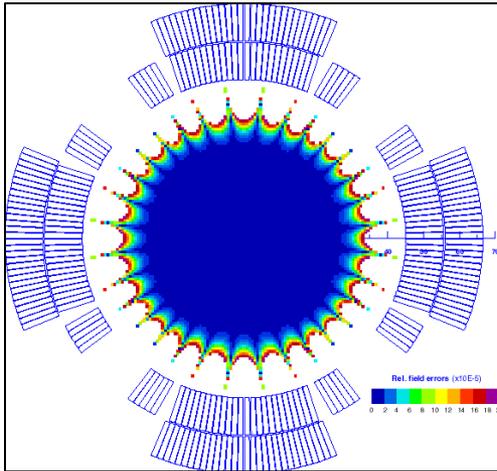
# TQ2a based studies and Design Optimization

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## TQ2a



### Coil:

- 2-layer shell-type
- Inner-layer with/without wedges
- Inner-layer pole glued into the coil

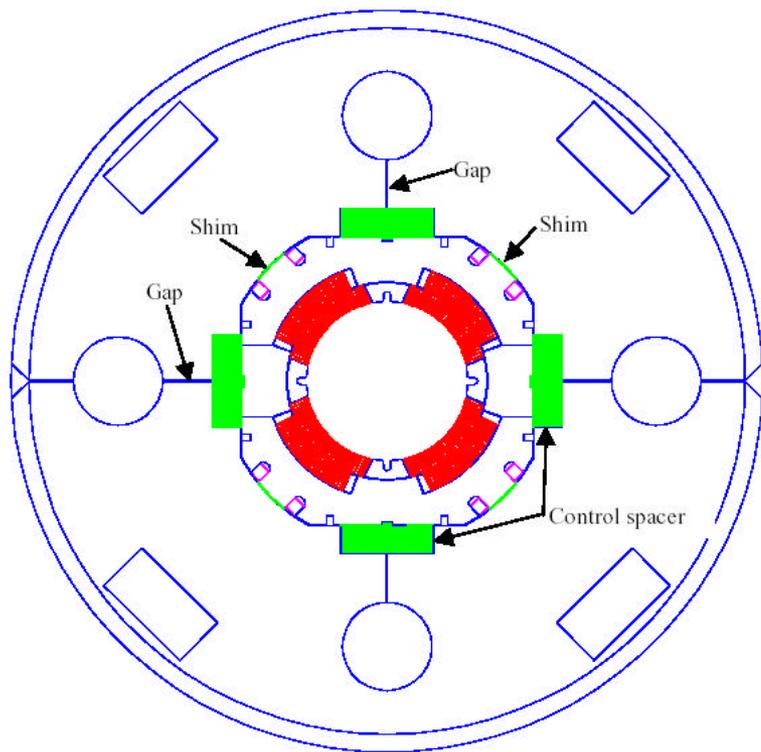
### Cable:

- Strand –  $\text{Nb}_3\text{S}_n$ , 0.7 mm
- Number of strands – 27
- Keystone angle – 1 deg/ 1.3 deg
- Width – 10.05 mm
- Thickness – 1.26 mm

Insulation: 0.125 mm S2-glass sleeve



## TQ2a



TQ2a cross-section

Modified MQXB collar blocks with outer-layer poles for coil alignment. Inner-layer poles are glued into the coil.

Radial yoke cut per lamination to provide symmetrical load.

Control spacers for collared coil alignment and yoke motion control.

Four shims at the midplanes to control coil-yoke interference.

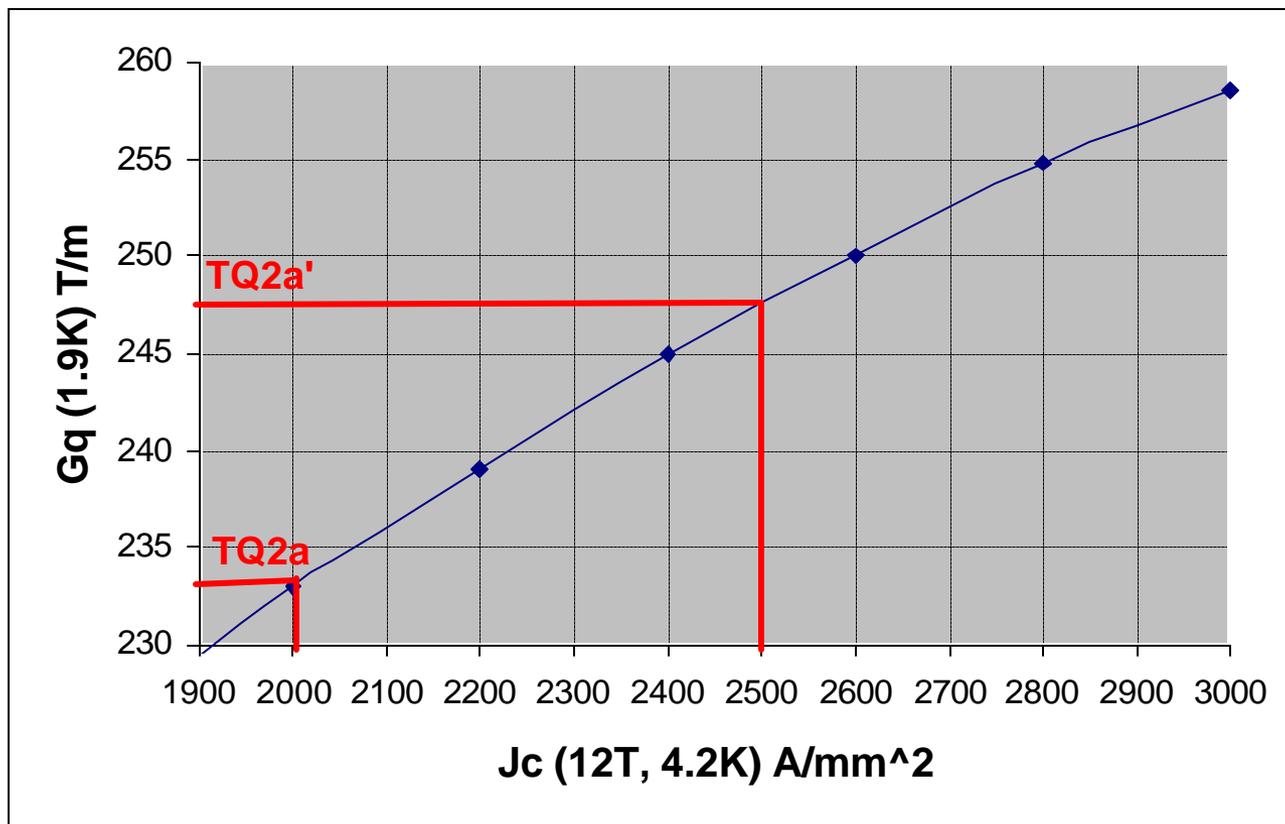
10 mm thick stainless steel skin.

Coil pre-stress remains below 70MPa (100 MPa before the spring back) through all stages of magnet production and operation.

The first TQ2a magnet will be completed in March of 2006. FY06 will provide an opportunity to refine and increase our understanding of this design before beginning the TQ2b.



# Gradient vs. $J_c$



- MJR used in TQ2a has  $J_c$  of 2000 A/mm<sup>2</sup>.
- RRP could be used for the TQ2a' at 2500 A/mm<sup>2</sup>, increasing the gradient 245-250 T/m



## Objectives of 2<sup>nd</sup> TQ2a (TQ2a')

**Task: Build another TQ2a short model identical to the previous magnet, except using RRP strand**

### Objectives:

1. Provide verification of viability of cross section and mechanical structure.
2. Demonstrate reproducibility of design and technology.
3. Refine/improve manufacturing techniques.
4. Test higher  $J_c$  strand material in same cross section, reaching higher Field/Gradient and Lorenz force level
5. Optimize preload.



## Alternate Option

**Task:** Build another TQ2a short model identical to the previous magnet, except using RRP strand, cable with 1.3 degree keystone angle and no wedges in the inner layer.

### Objectives:

Same as above except this approach would allow a simpler cross section, with less parts, to be tested.

Implementation of this task is contingent upon test results of cable with 1.3 degree keystone angle.



# TQ2a' Schedule

ID	Task Name	Start	Finish	2006											
				S	O	N	D	J	F	M	A	M	J	J	A
35	<b>TQ2a'</b>	<b>Mon 10/10/05</b>	<b>Thu 9/28/06</b>	[Gantt bar from Oct 2005 to Sep 2006]											
36	<b>TQ2a' coil parts</b>	<b>Mon 10/10/05</b>	<b>Wed 3/29/06</b>	[Gantt bar from Oct 2005 to Mar 2006]											
37	TQ2a' coil parts procurement	Mon 10/10/05	Wed 3/29/06	[Blue Gantt bar from Oct 2005 to Mar 2006]											
38	<b>TQ2a' coil fabrication</b>	<b>Thu 3/30/06</b>	<b>Wed 8/9/06</b>	[Red Gantt bar from Mar 2006 to Aug 2006]											
39	TQ2a' coil winding	Thu 3/30/06	Wed 5/24/06	[Blue Gantt bar from Mar 2006 to May 2006]											
40	TQ2a' coil react & impreg	Thu 4/20/06	Wed 8/9/06	[Blue Gantt bar from Apr 2006 to Aug 2006]											
41	<b>Assembly</b>	<b>Thu 8/10/06</b>	<b>Thu 9/28/06</b>	[Red Gantt bar from Aug 2006 to Sep 2006]											
42	Coil Assembly	Thu 8/10/06	Mon 8/21/06	[Blue Gantt bar from Aug 2006 to Aug 2006]											
43	Collaring	Tue 8/22/06	Tue 8/29/06	[Blue Gantt bar from Aug 2006 to Aug 2006]											
44	Yoke	Wed 8/30/06	Tue 9/5/06	[Blue Gantt bar from Aug 2006 to Aug 2006]											
45	Skin	Wed 9/6/06	Wed 9/13/06	[Blue Gantt bar from Aug 2006 to Aug 2006]											
46	Final Assembly	Thu 9/14/06	Thu 9/28/06	[Blue Gantt bar from Aug 2006 to Aug 2006]											



## Milestones - Further TQ2a Development

### FY05

- Fabricate R&D 1.3 degree cable: LBNL 07/01/2005
- Test 1.3 degree cable: FNAL 09/01/2005

### FY06

- Order parts: FNAL 10/01/2005
- Procure parts FNAL 02/01/2006
- Fabricate Cable LBNL 03/15/2006
- Begin coil winding FNAL 04/01/2006
- Wind and cure coils: FNAL 06/01/2006
- React and impregnate coils: FNAL 08/01/2006
- Assemble magnet: FNAL 09/30/2006

### FY07

- Test magnet: BNL+FNAL 11/15/2006



# Cost

**TQ2a with 1.0 cable      TQ2a with 1.3 cable**

TQ1a/2a coils		
Analysis		\$10,000
Tooling		
Parts	\$38,117	\$16,000
Fabrication	\$58,200	\$58,200
TQ2a Magnet		
Analysis		
Tooling		
Parts	\$51,057	\$51,057
Fabrication	\$108,900	\$108,900
<b>FNAL Totals</b>	<b>\$256,274</b>	<b>\$244,157</b>

Costs do not include cable or cable insulation.