

SHMS Design and Engineering

April 10, 2002

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Overall SHMS

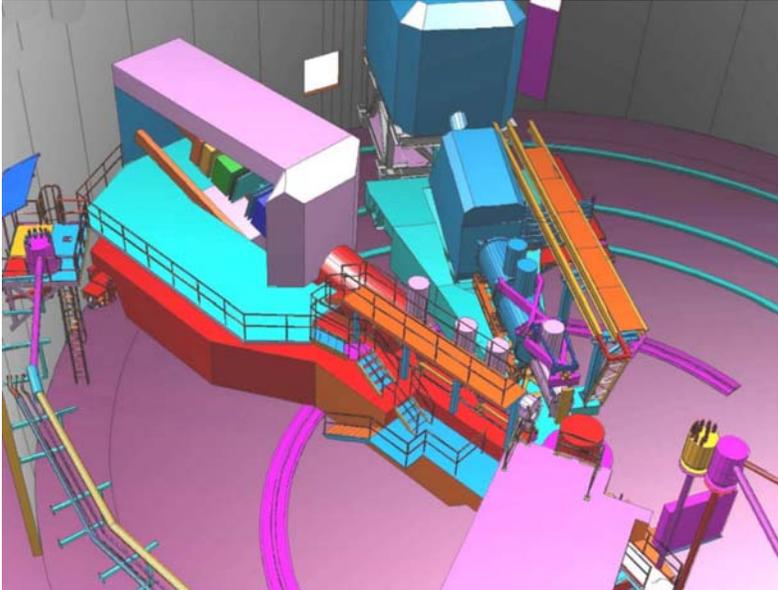
Q1 at 8.6 T/M

QD35 combined function magnet

Support structure

Immediate future work for the CDR

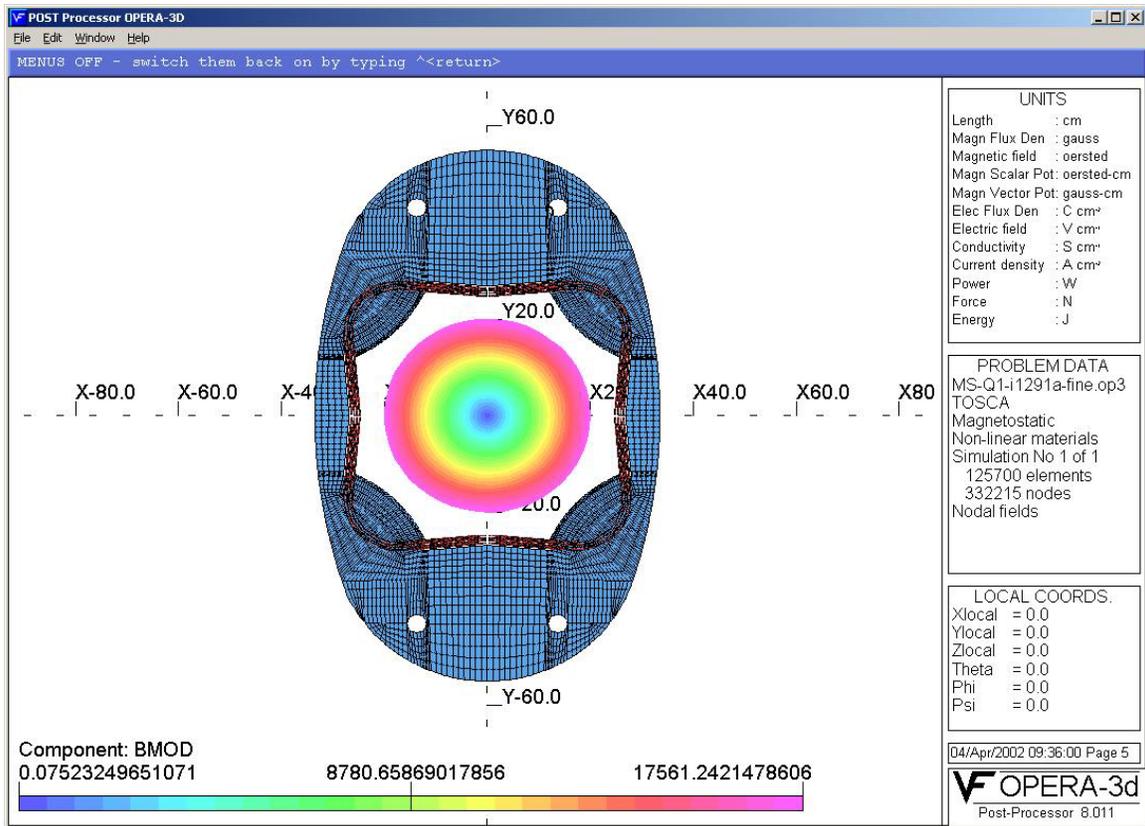
SHMS General arrangement



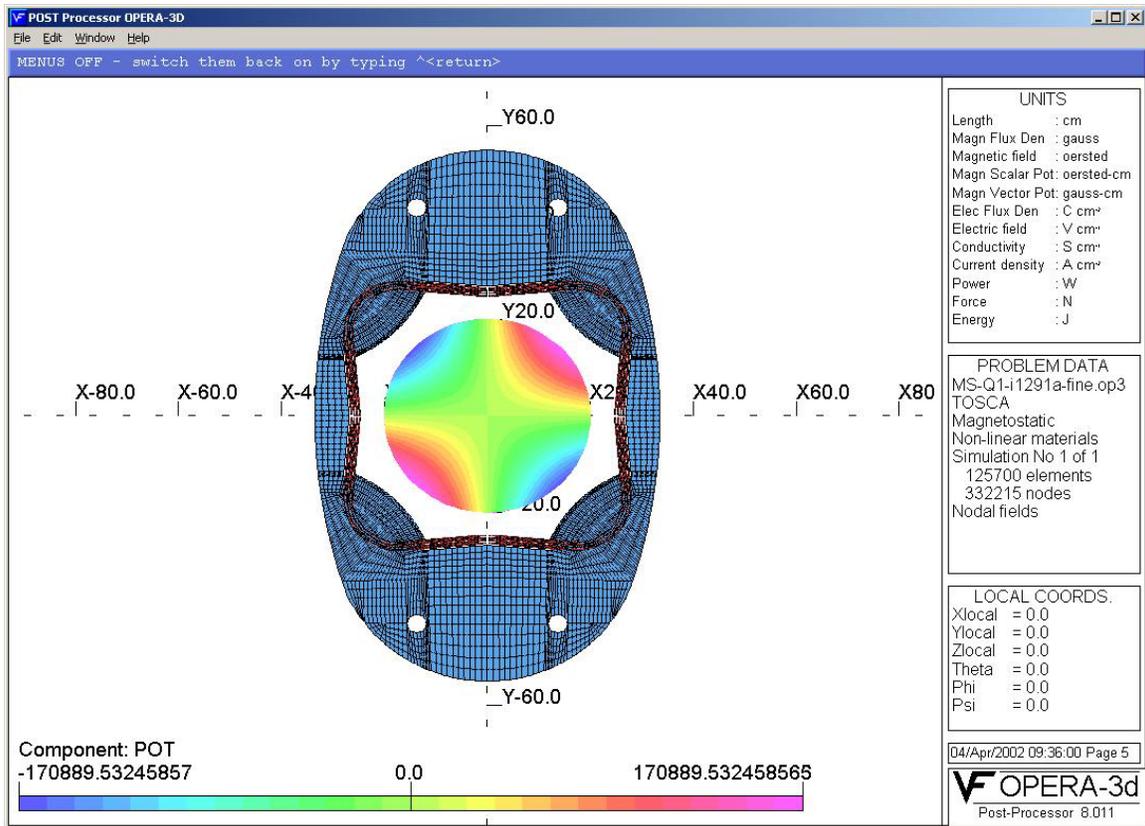
Q1 Quad at 8.6 T/M

Q1 comparison between HMS at 1010 amps and SHMS at 1291 amps

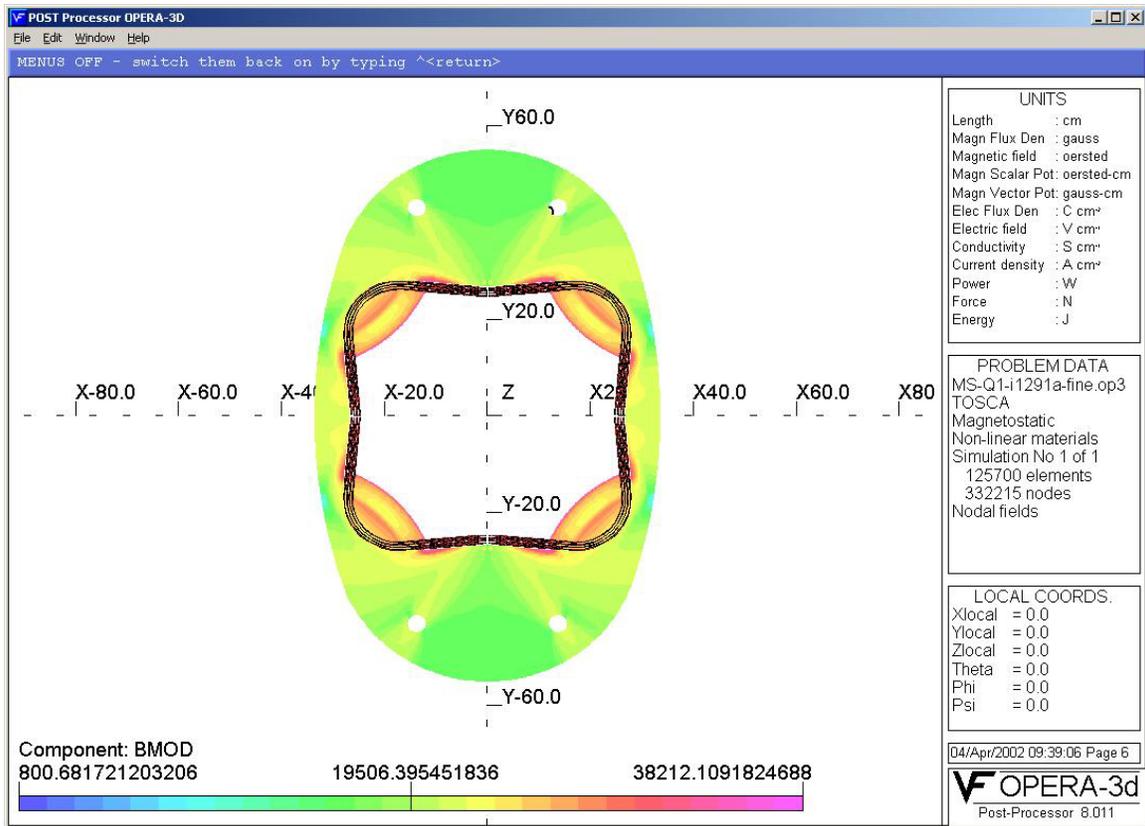
I Amps	1010	1291	27.8%
B(pole) T	1.776886	2.14717651	20.8%
Gradient T/m	7.10754	8.588706	20.8%
Field In Fe T	3.720082	3.821211	2.72%
Coil Forces N (s1)	Fx 28,571 Fy -7,465	44,062 -12,604	54.2% 68.8%



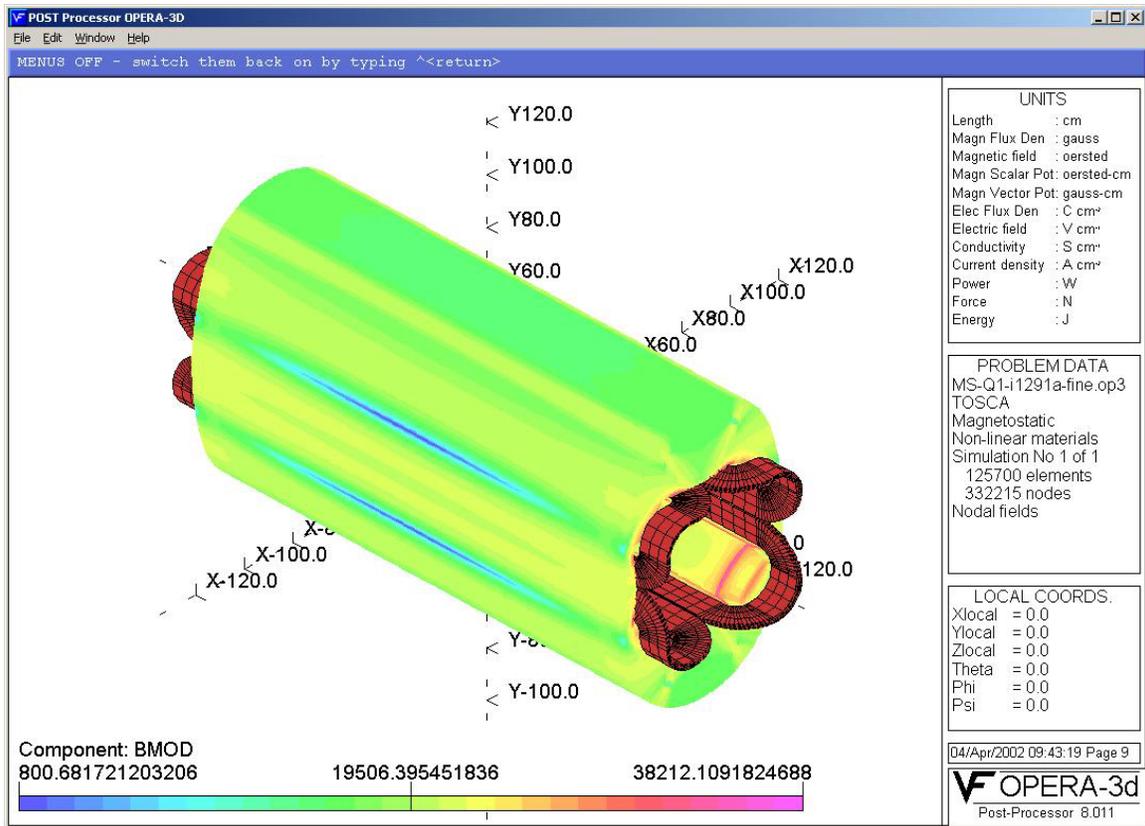
Q1 BMOD in aperture



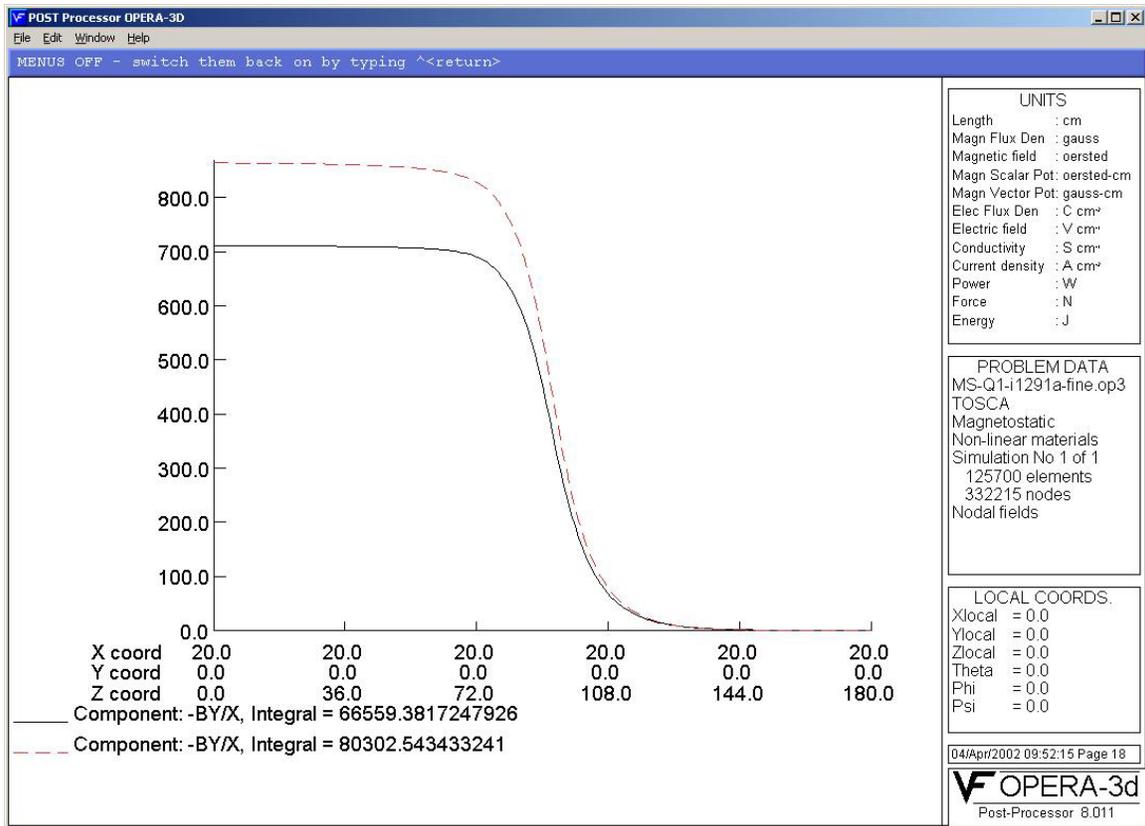
Q1 Potential in aperture



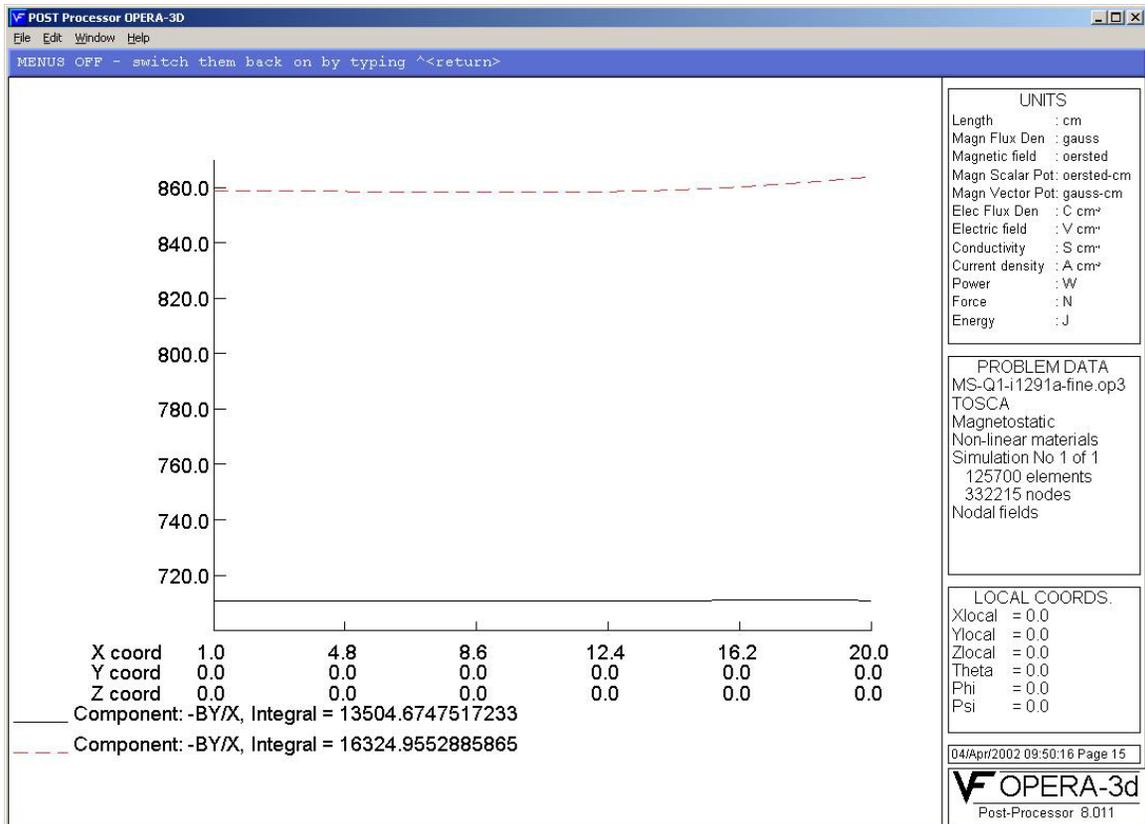
Yoke saturation BMOD in mid plane



Yoke saturation BMOD



Q1 gradient comparison along Z



Q1 Gradient comparison

QD35 combined function magnet

SHMS QD 35 magnet parameters

Combined function QD 35 cm warm bore

NI dipole 2.50×10^6 amp turns 11,000 amp/cm² 4 sector - cosine theta

NI quad 1.41×10^6 amp turns 4000 amp/cm² 2 sector - cosine 2 theta

Bend strength 12.09 T.M Central field 3.5 T Eff length Dip 3.45 M

Quad strength 11.20 (T/M)M Gradient 3.39 T/M Eff length Quad 3.3 M

dB/B ~ dG/G 1×10^{-3}

LOA 5.0 M 3.2 M OD

Yoke 1010 steel 240 K# warm iron (1.2 M by 1.0 M outer radii - ellipse)0.6 M inner radius ,4.2 M long

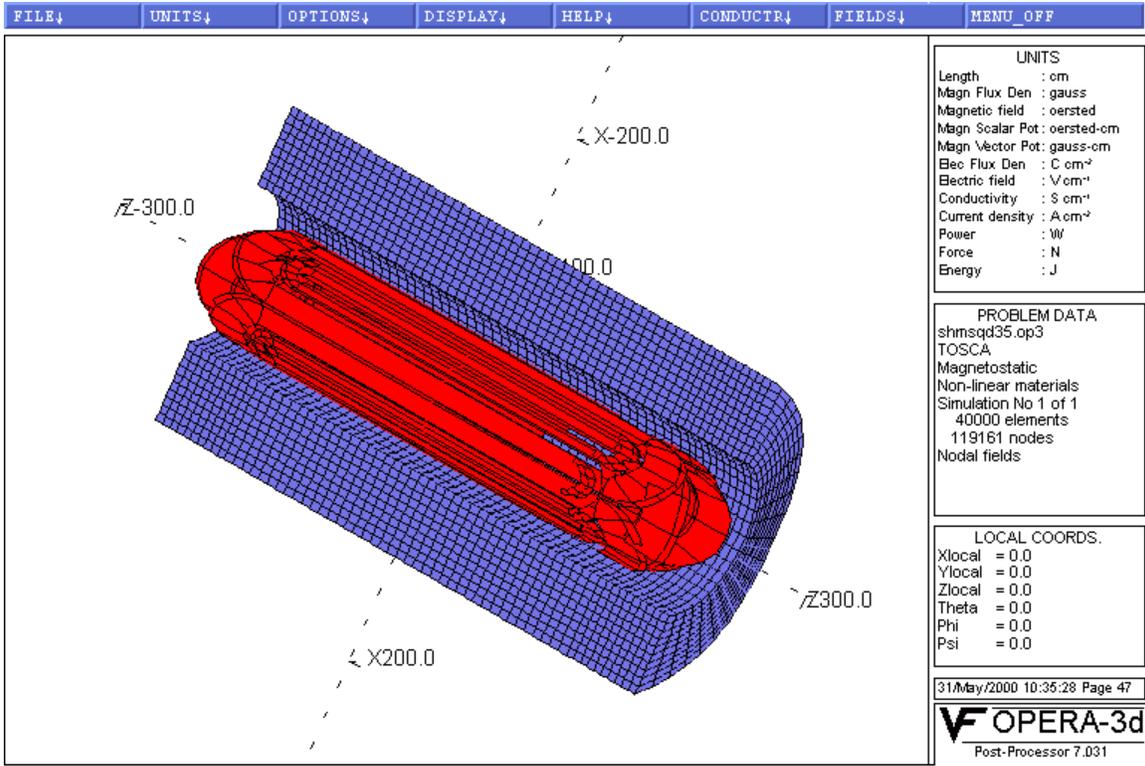
Coil and cryostat 40 K# St.Stl 5.0 M Long ,0.6 m outer radius ,0.35 M inner radius

Stored Energy 11.0 MJ

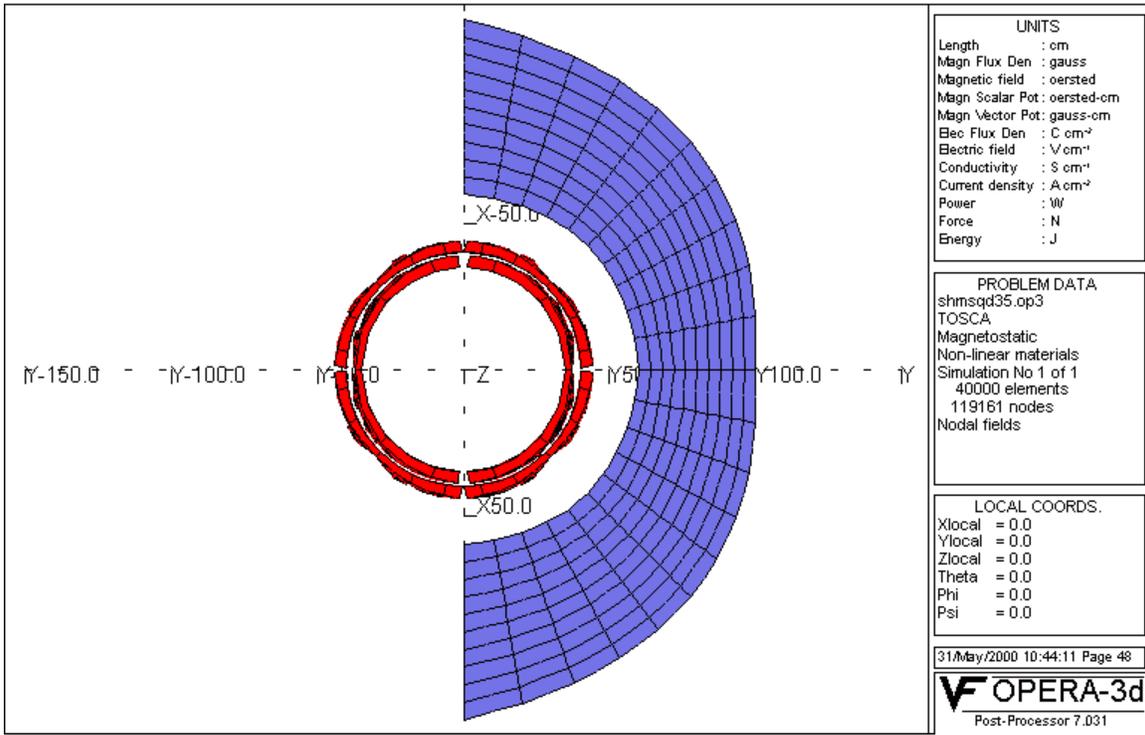
Peak force density on dipole coil 40,000 #/in peak pressure 3390 psi

Peak force density on Quad coil 11,000#/in peak pressure 1290 psi

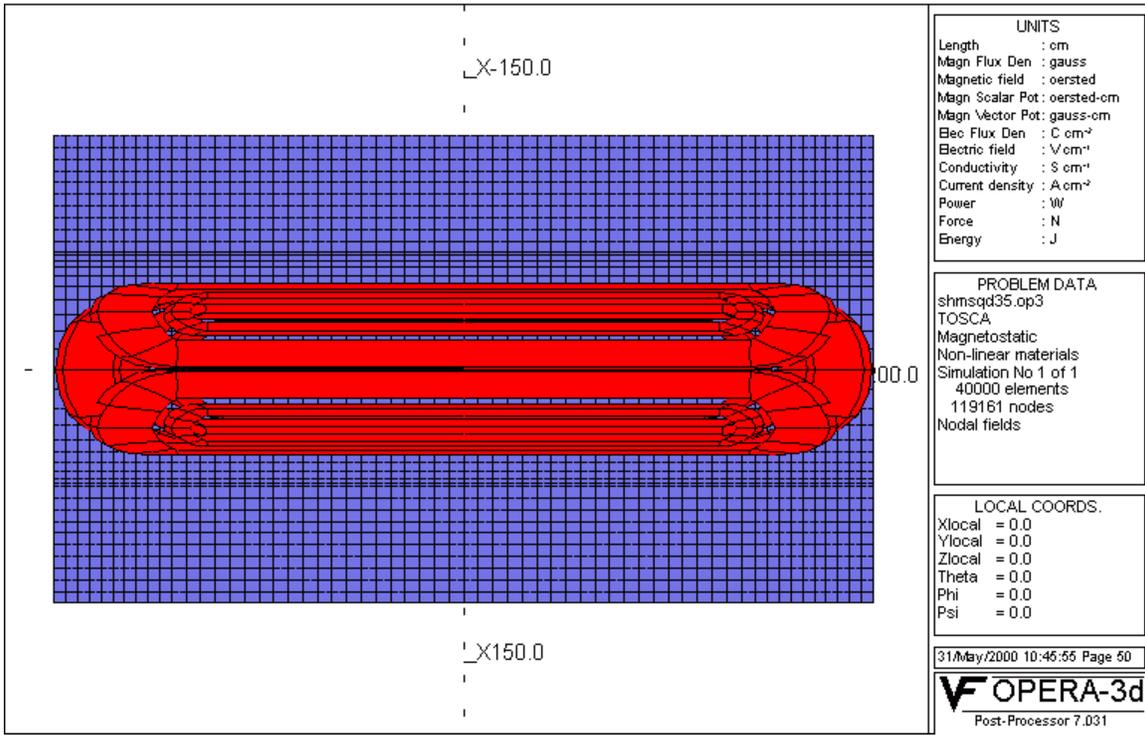
Total "pressure" 4600 PSI , effective vessel thickness at 12 KSI is ~ 7 inches .



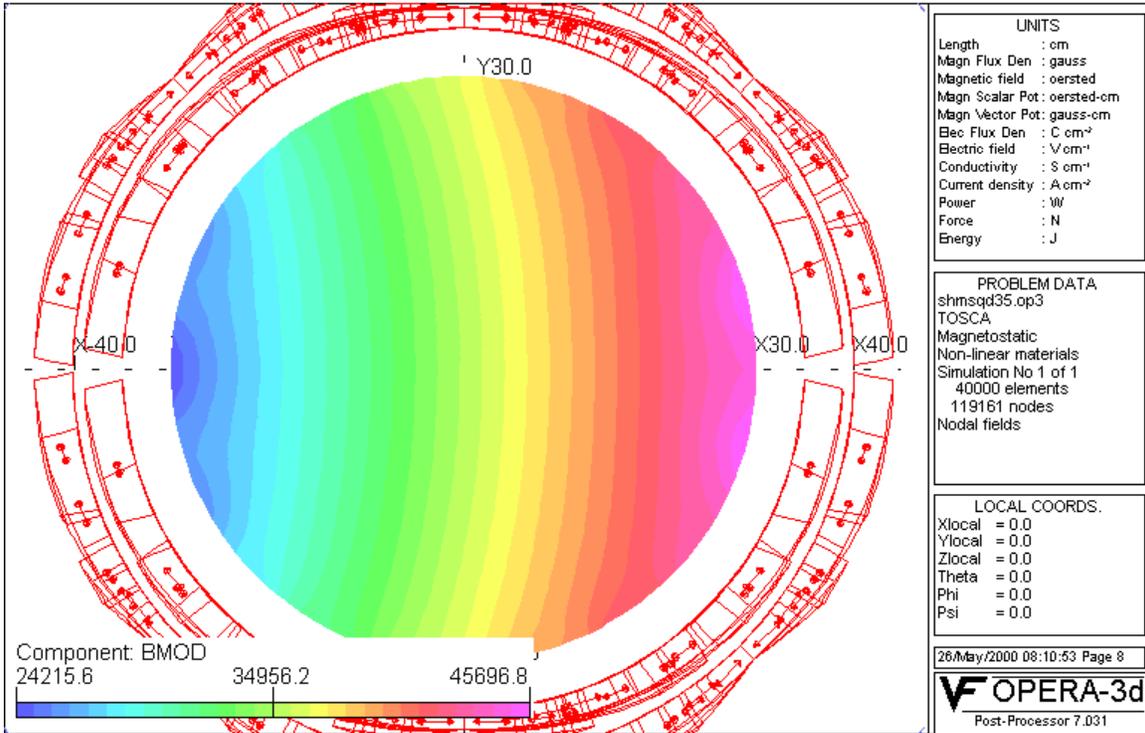
Cutaway with beam left side of yoke removed.
 Orientation is with bend field horizontal
 Perspective angle is such to make the image appear ~ as installed



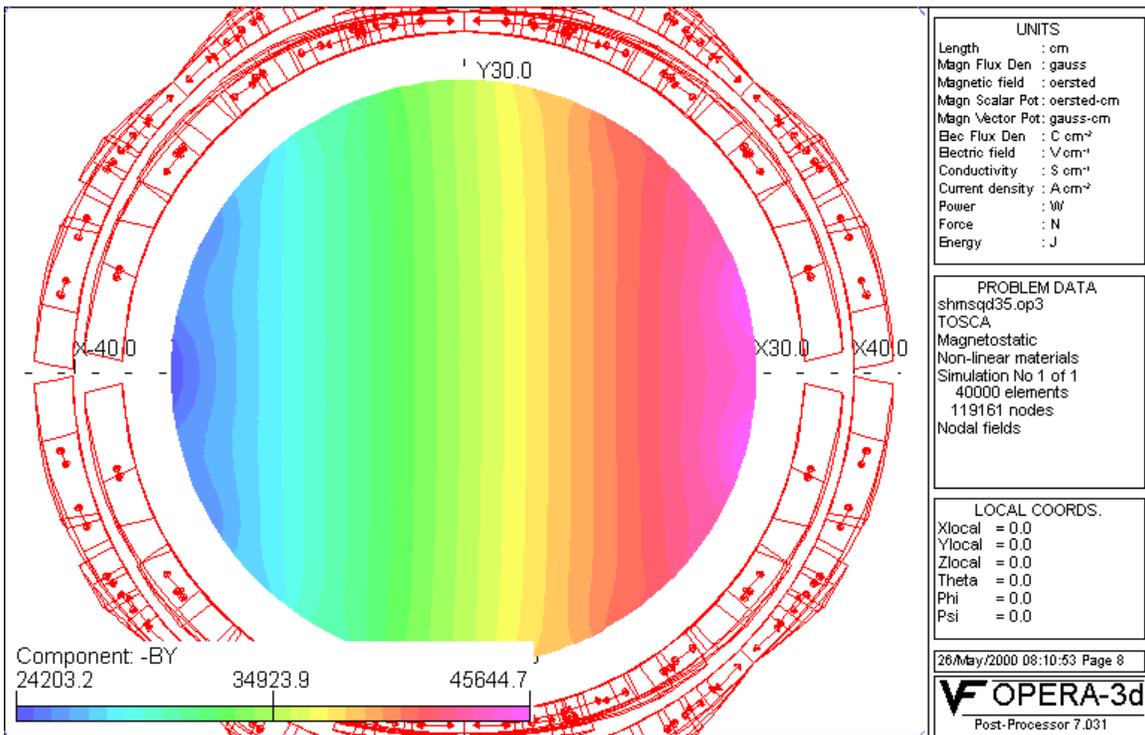
End view, bend field horizontal, beam left half of yoke removed



Sideview, bend field horizontal ,looking beam right, beam left yoke half removed



BMOD in Mid Plane – gauss

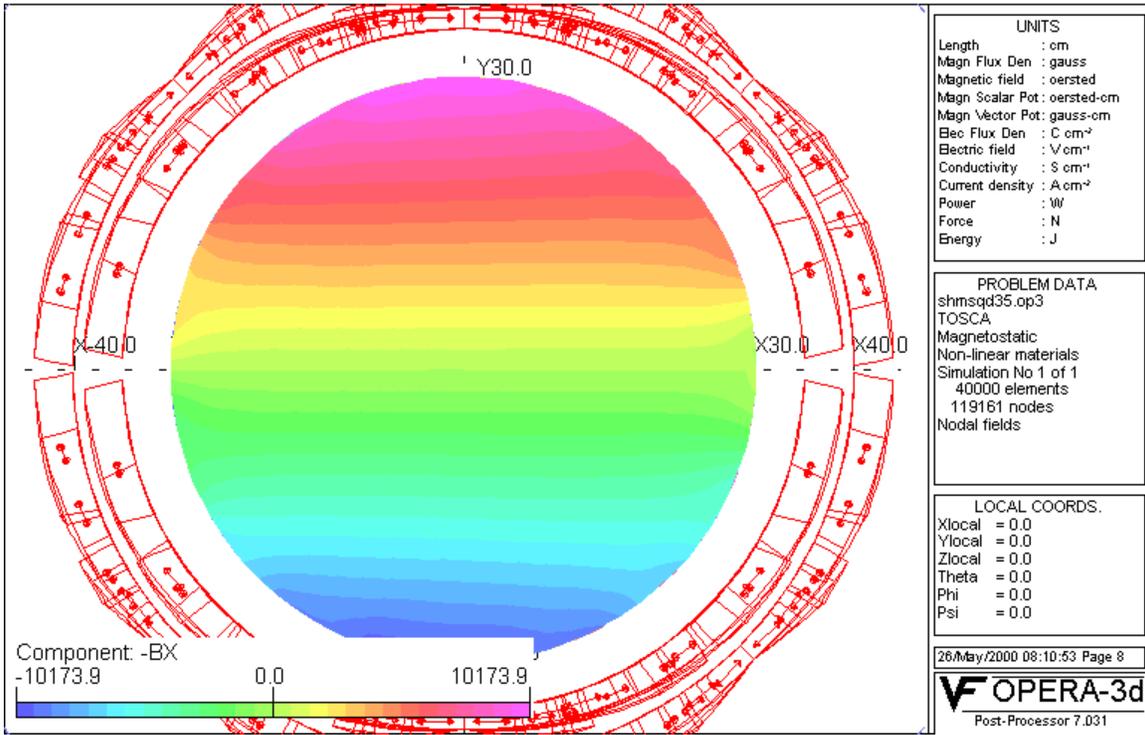


UNITS	
Length	: cm
Magn Flux Den	: gauss
Magnetic field	: oersted
Magn Scalar Pot	: oersted-cm
Magn Vector Pot	: gauss-cm
Elec Flux Den	: C cm ⁻²
Electric field	: V cm ⁻¹
Conductivity	: S cm ⁻¹
Current density	: A cm ⁻²
Power	: W
Force	: N
Energy	: J

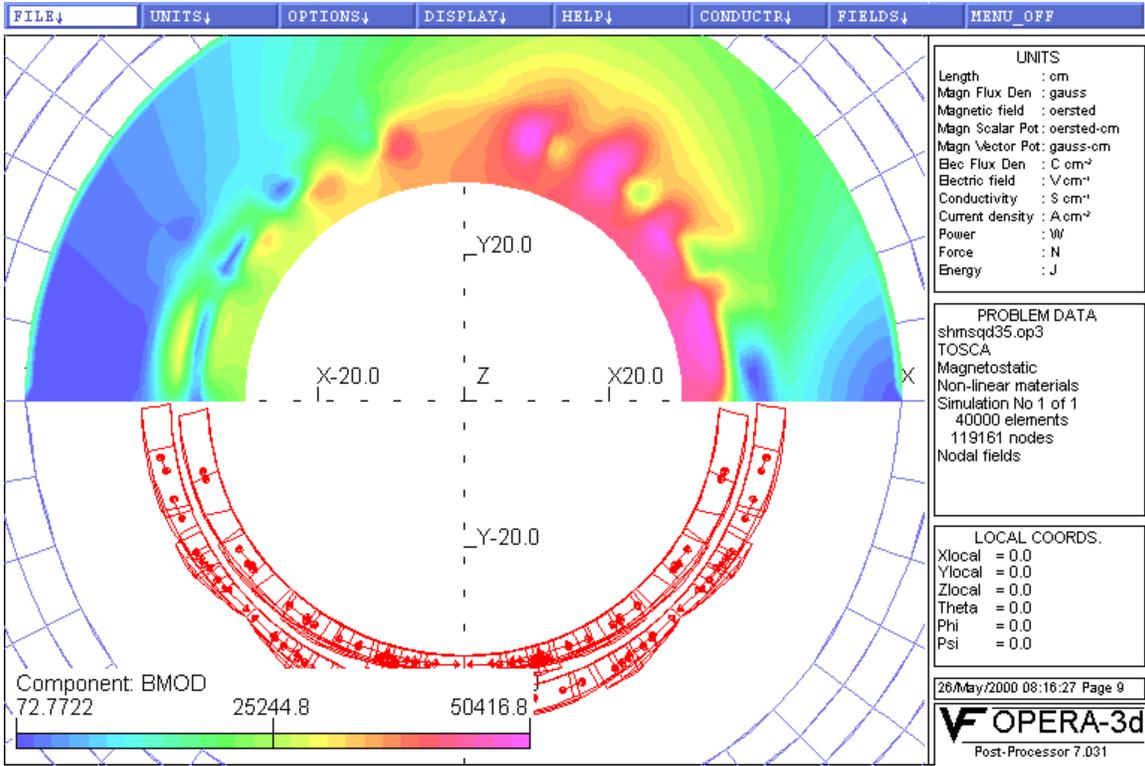
PROBLEM DATA	
shmsqd35.op3	
TOSCA	
Magnetostatic	
Non-linear materials	
Simulation No 1 of 1	
40000 elements	
119161 nodes	
Nodal fields	

LOCAL COORDS.	
Xlocal	= 0.0
Ylocal	= 0.0
Zlocal	= 0.0
Theta	= 0.0
Phi	= 0.0
Psi	= 0.0

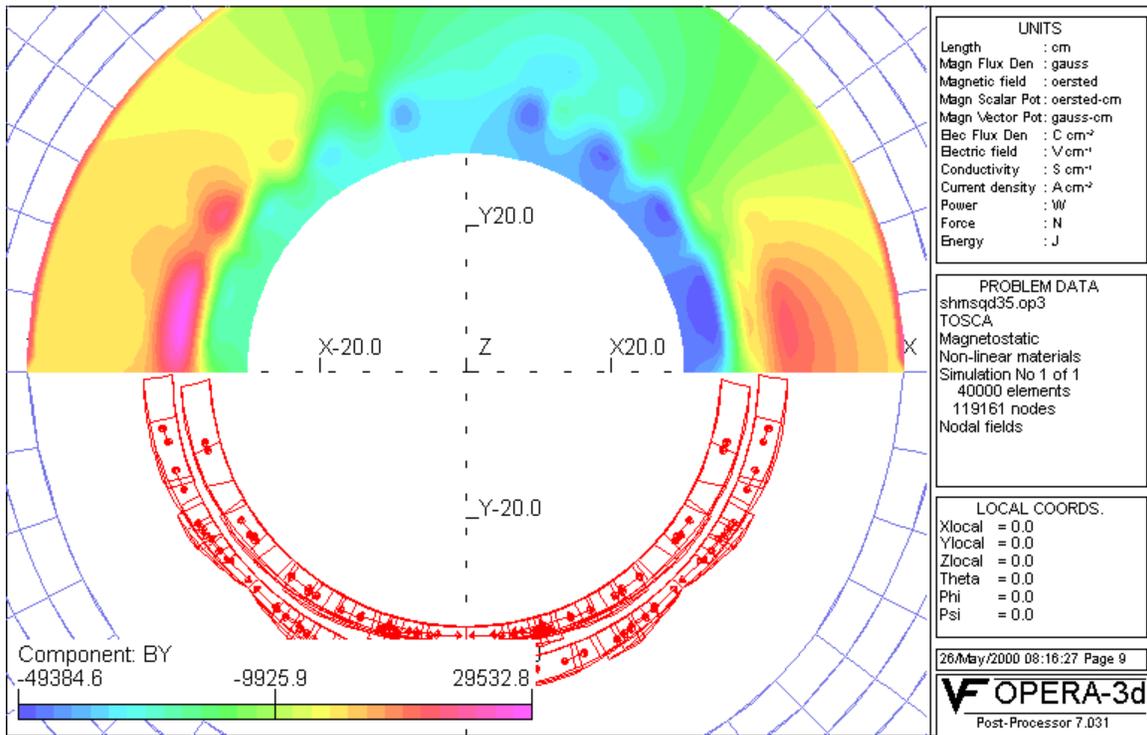
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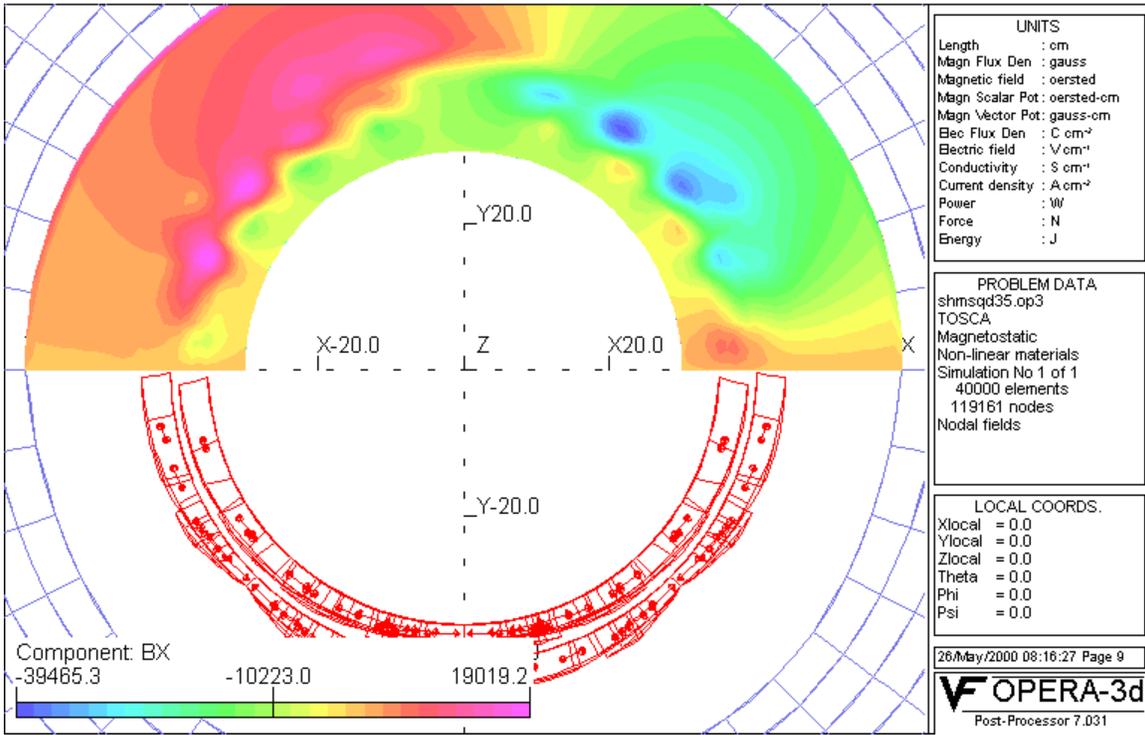
Bx in midplane – gauss



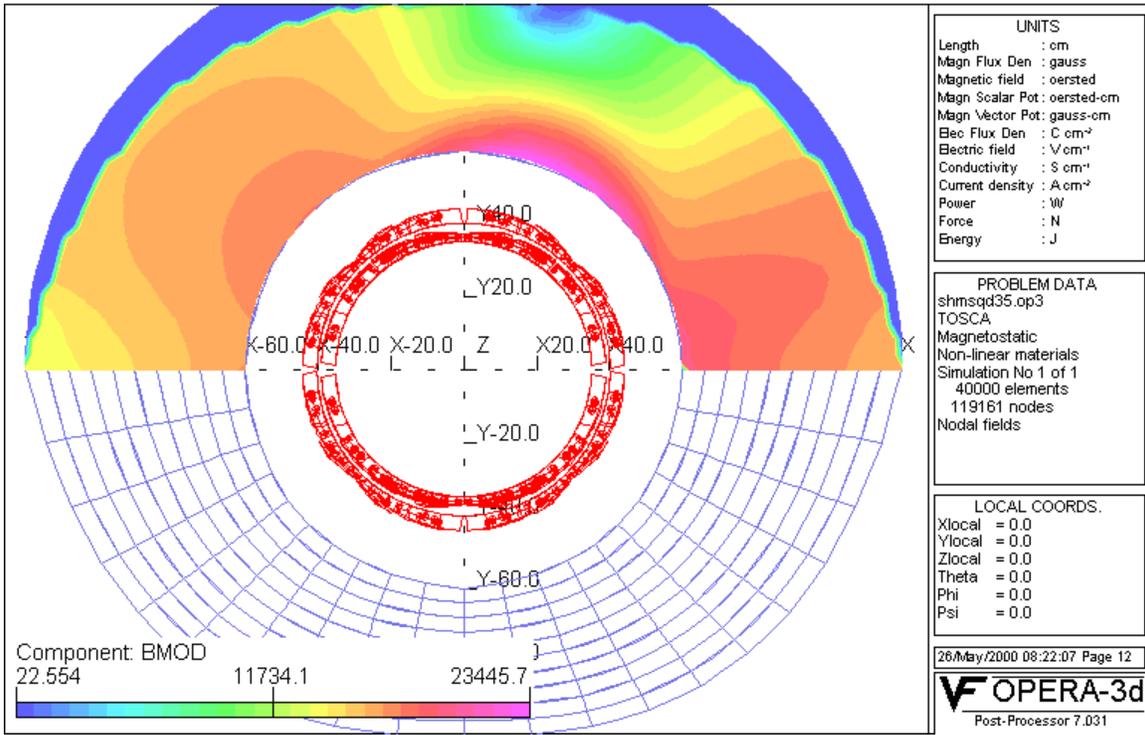
Bmod –gauss – Peak is in quad coil



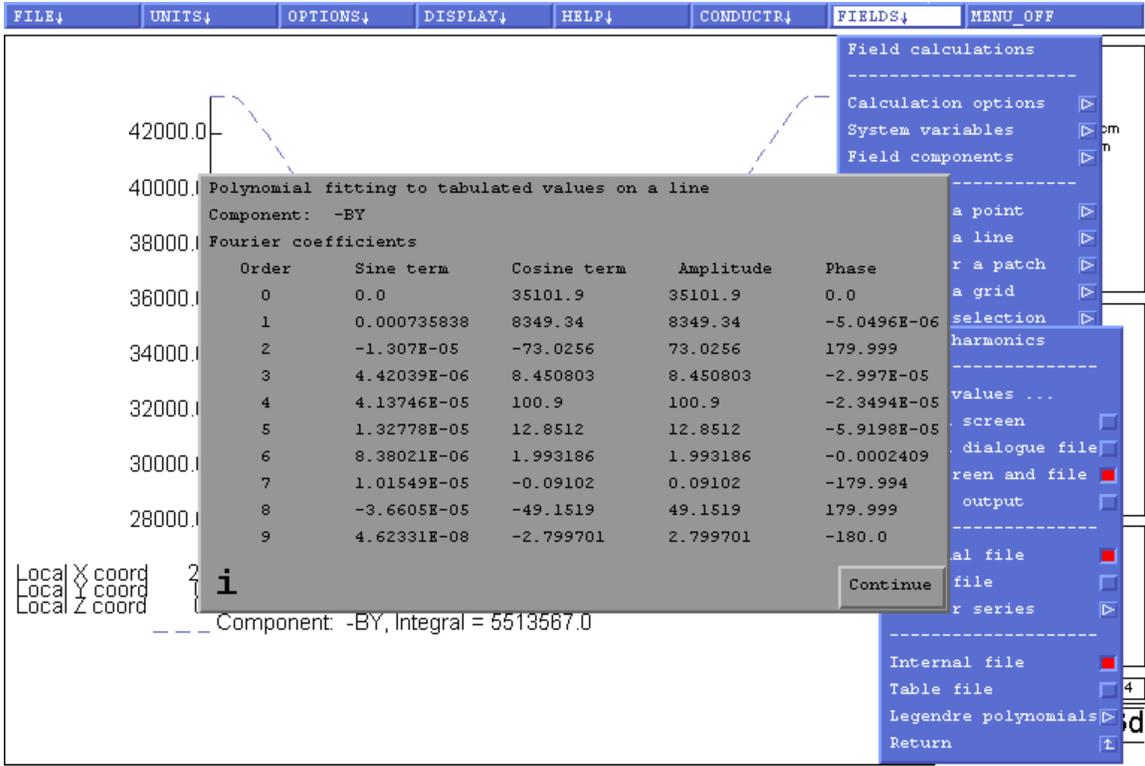
By in coils-gauss – Peak fields are in dipole coil



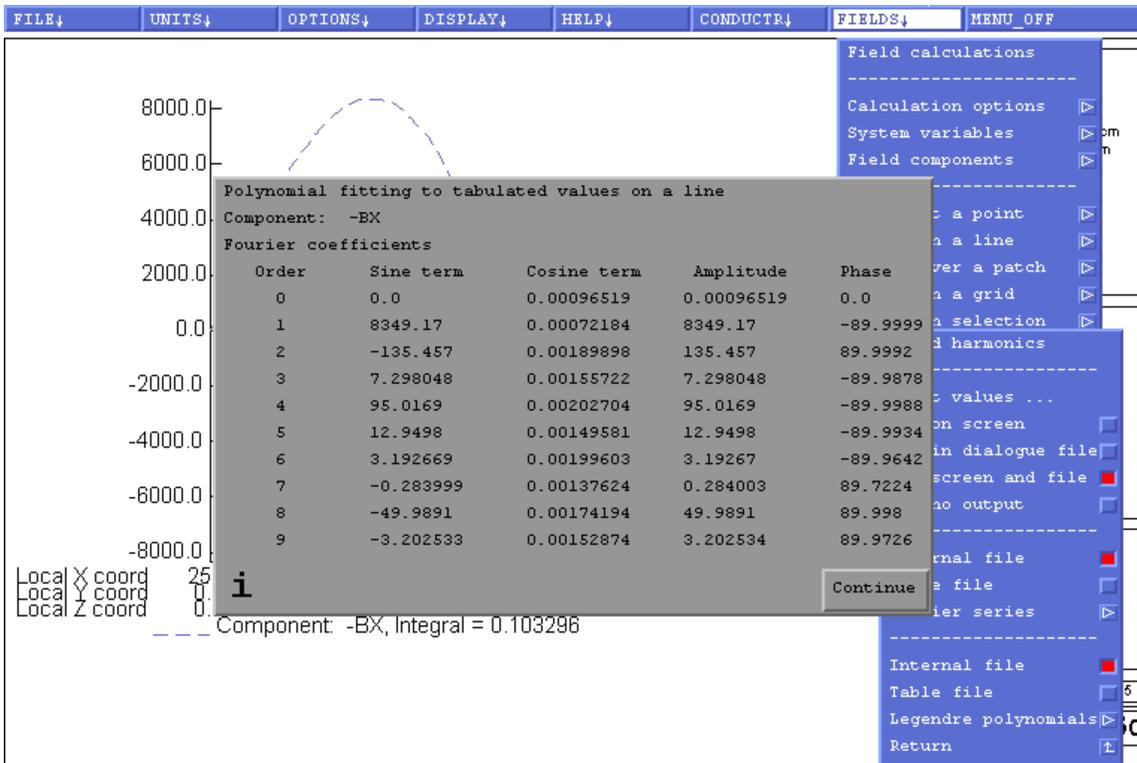
Bx- gauss- peak is in quad coil



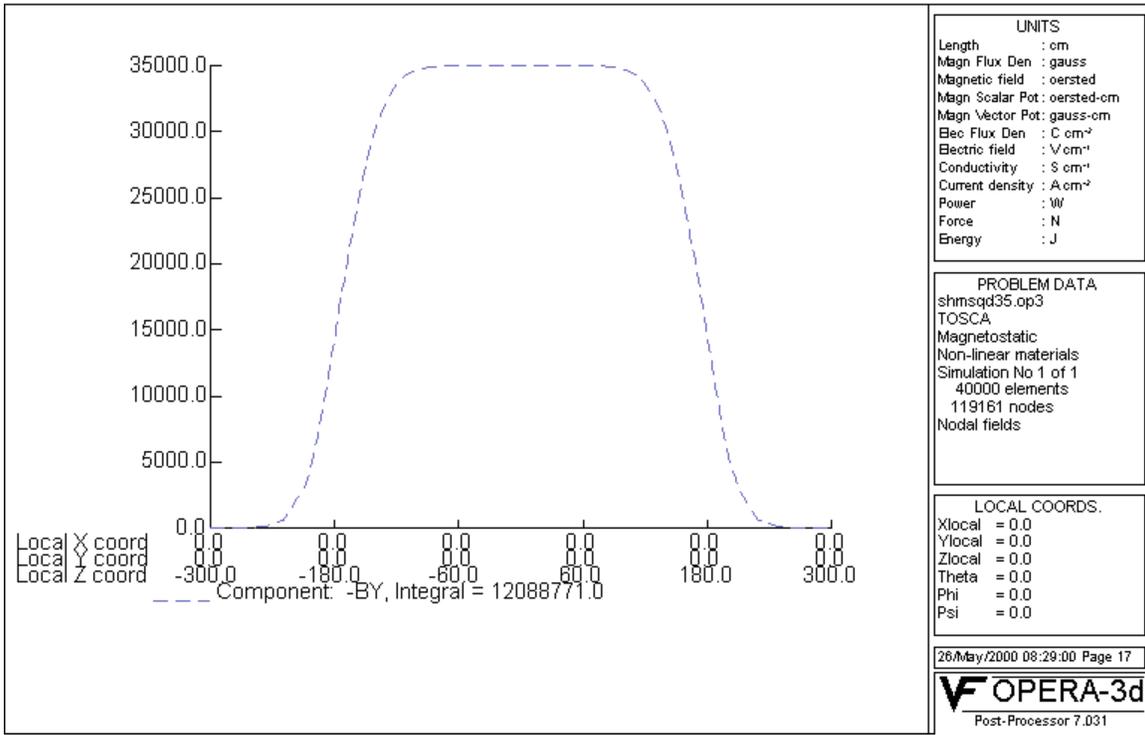
Yoke saturation-Bmod-gauss



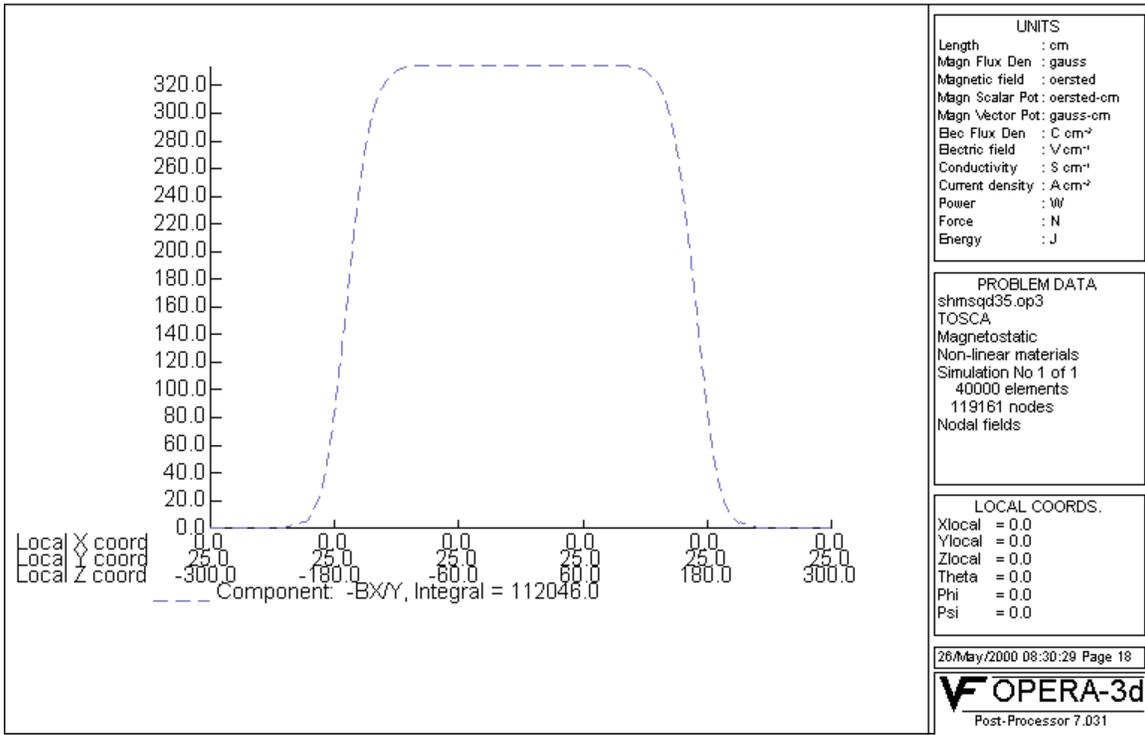
Harmonics at R=25 cm up to n=10



Harmonics up to 10 on $r=25$ cm in Bx



By and integral from -300 to+300



Integral Bx/y from -300 to 300 and gradient at (0,25,0)

Support structure

Original baseline concept used SOS structure and shield house.

Current concept has a similar sized new structure and shield

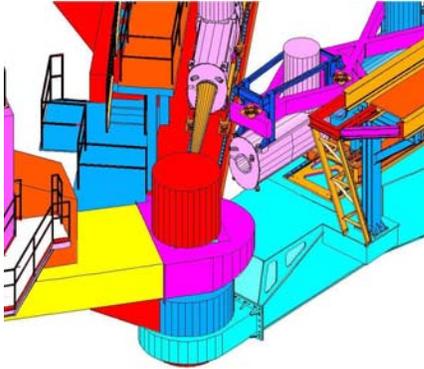
New center bearing and offset pivot connection

New rails

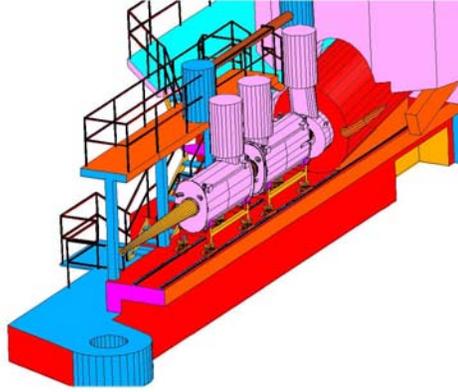
Motion from 5 to 25 degrees

Spectrometer slider to move entire package ~ 2 meters toward pivot for higher solid angle

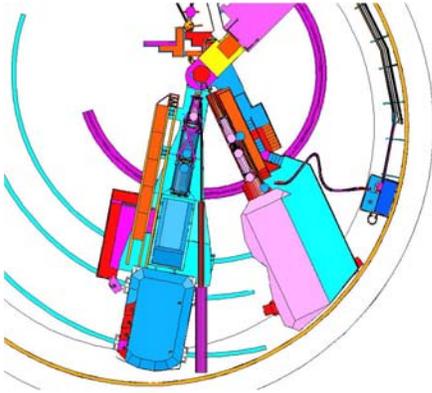
Pivot compatible (so far) with SOS remaining attached and useable!



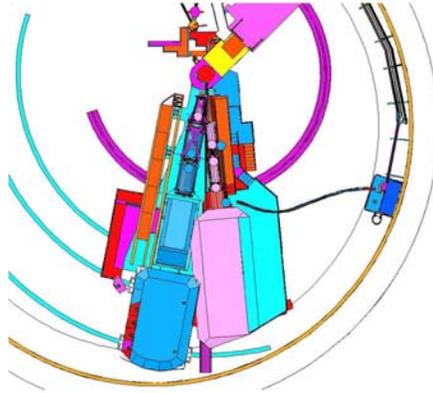
SHMS Pivot



SHMS with slider



SHMS at 25 degrees



SHMS at 5 degrees

Immediate future work for the CDR

Consulting studies of combined function magnet QD30 and Q1 at 8.6 T/M and support structure

Deliverable are engineering feasibility, analysis, preliminary drawings, cost study

Magnetic optimization by JLAB for cost and performance

Prepare a defensible CDR