Magnetic stray field in the cavern

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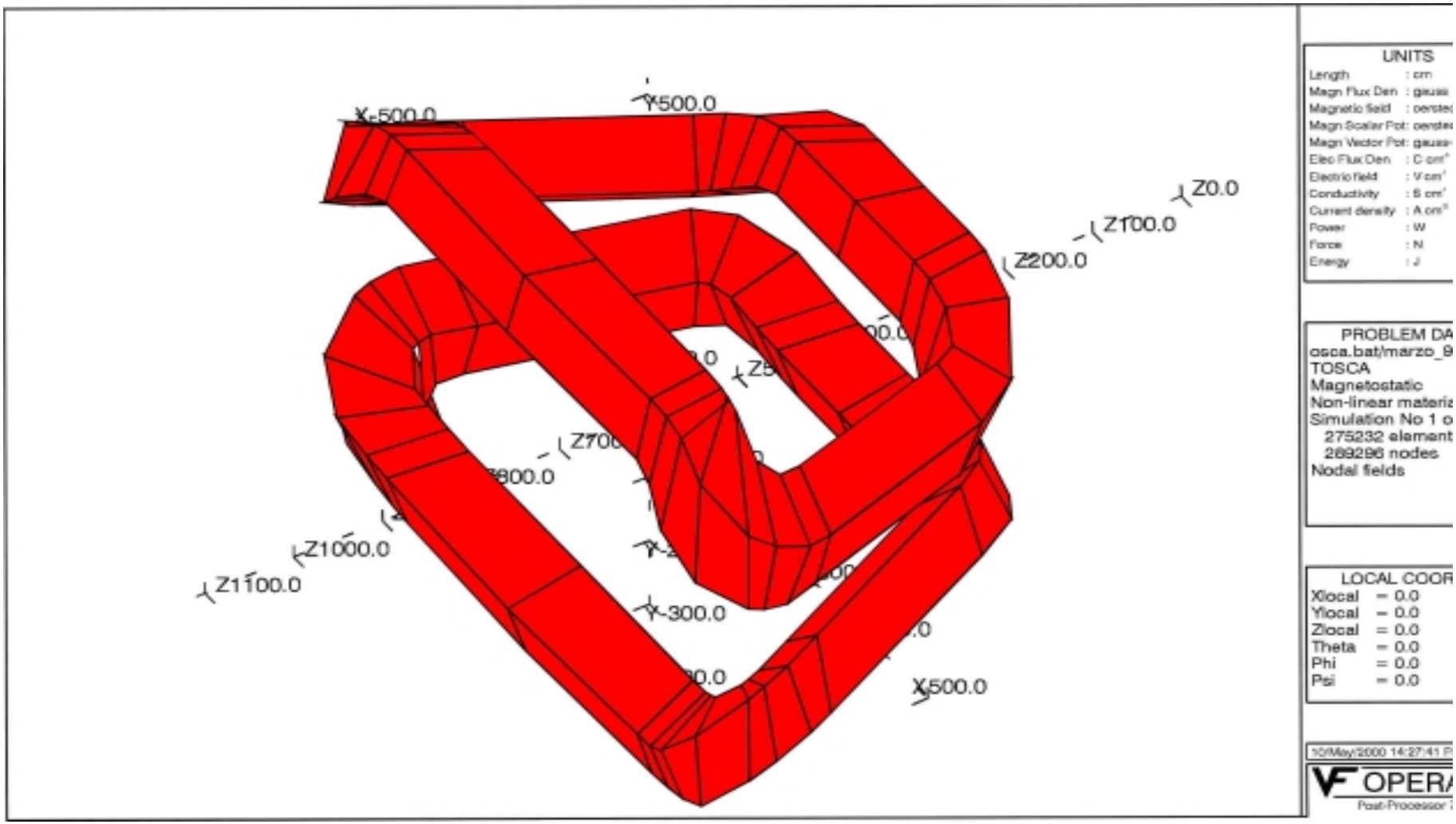
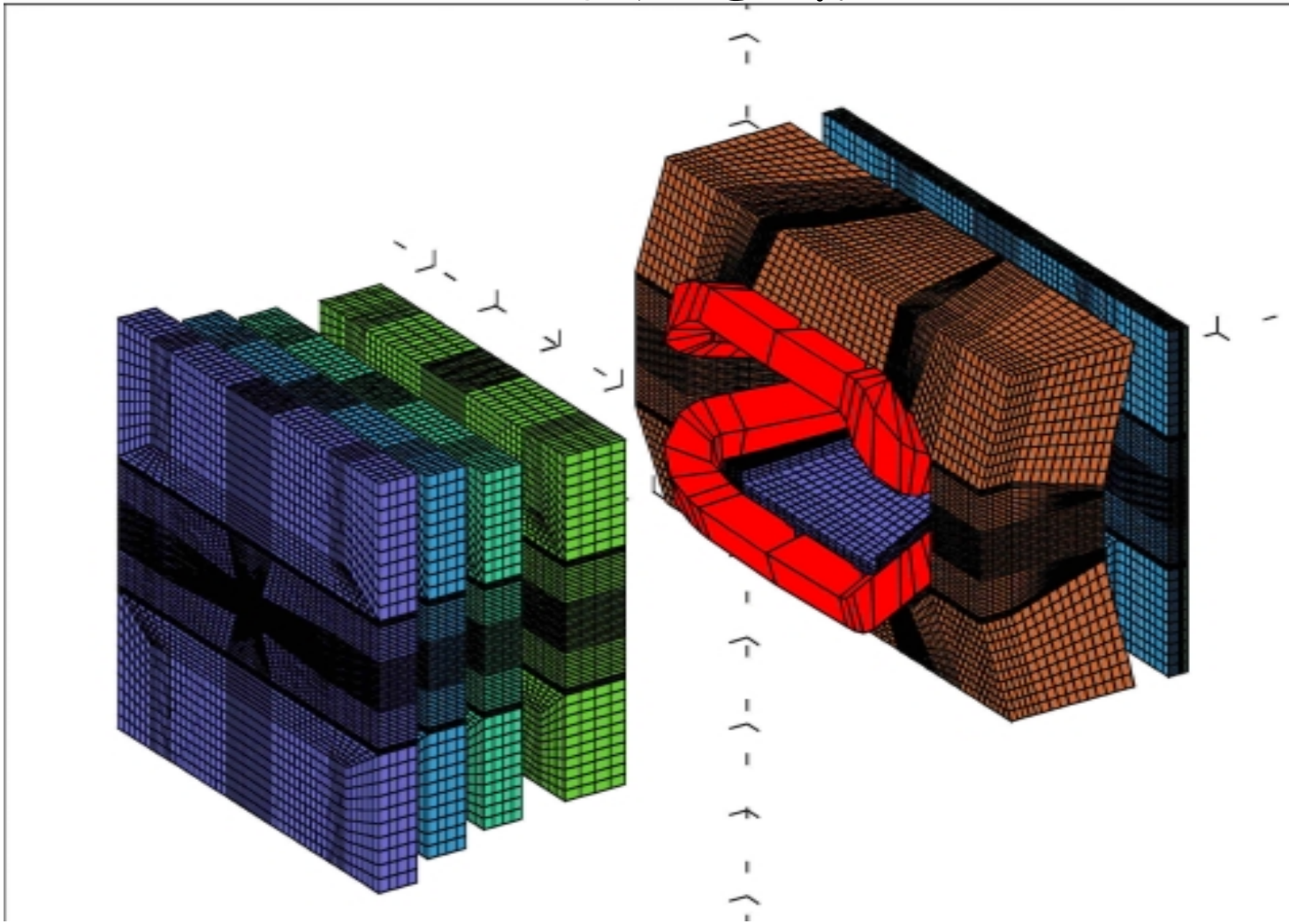
Table 1: Magnet Characteristics

Magnetic Parameters	
Bending power	$\int B\,dl$ = 4 Tm (10 m track length)
Non-uniformity of $\int B\,dl$	≤ ± 5% in acceptance (hor.: ±300 mrad, vert.: ±250 mrad)
Excitation current	NI = 2 x 1.3 MA
Electric power dissipation	P_e = 4.2 MW
Stored magnetic energy	$W_m \approx 32$ MJ
Inductance	L ≈ 2 H
Coil and Current	
Coil construction (two coils)	15 mono-layer pancakes per coil
Total number of turns	N = 2 x 225
Conductor material	Aluminium E-Al-99.7
Conductor cross-section	50 mm x 50 mm
Cooling water channel	Ø = 24 mm
Conductor length	$L_C \approx 290$ m per pancake
Current in conductor	I ≈ 5.8 kA
Current density	$j \approx 2.9$ A/mm^2
Total resistance	R = 125 mΩ
Total voltage drop (two coils)	U ≈ 730 V
Cooling	
Cooling requirements	All pancakes in parallel
Total water flow	$\phi \approx 125$ m^3/h
Pressure drop of cooling water	$\Delta p \approx 10$ bar @ ΔT = 30 °C
Mechanics	
Steel quality of yoke	EN S235JRG, (old norms: Fe360B, St37-2
Outer yoke dimensions	Hor x vert x beam: 11m x 8 m x 2.6 m
Useful wedged aperture (upstream ==> downstream)	hor: 2.6 m ==> 4.2 m vert: 2.2 m ==> 3.5 m
Total magnet length in beam direct.	$L_m \approx 5$ m
Weight of yoke	$M_y \approx 1450$ tons
Weight of coils	$M_c \approx 2 \times 25$ tons

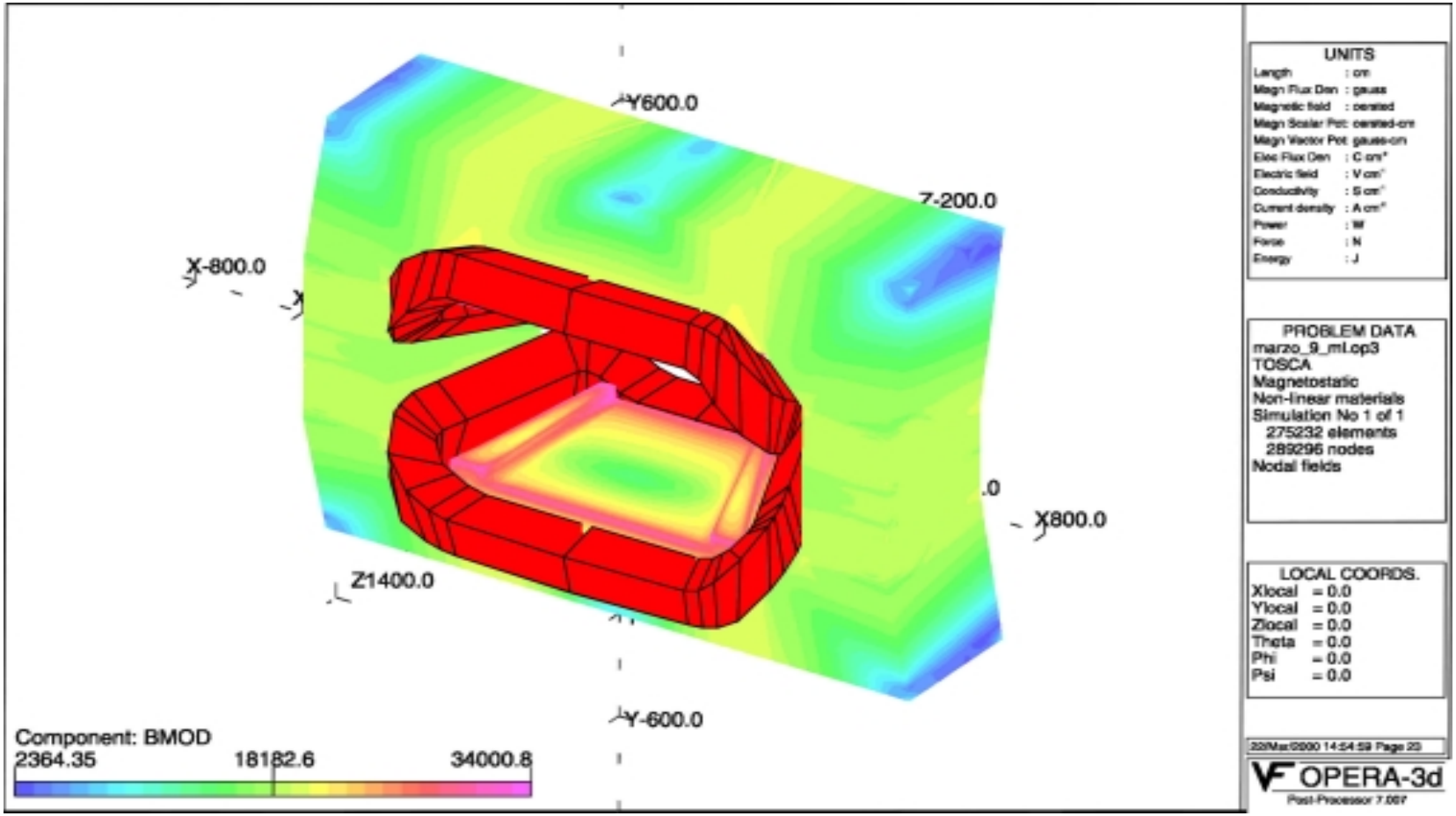
Perspective view of the coils



Tosca 3D model



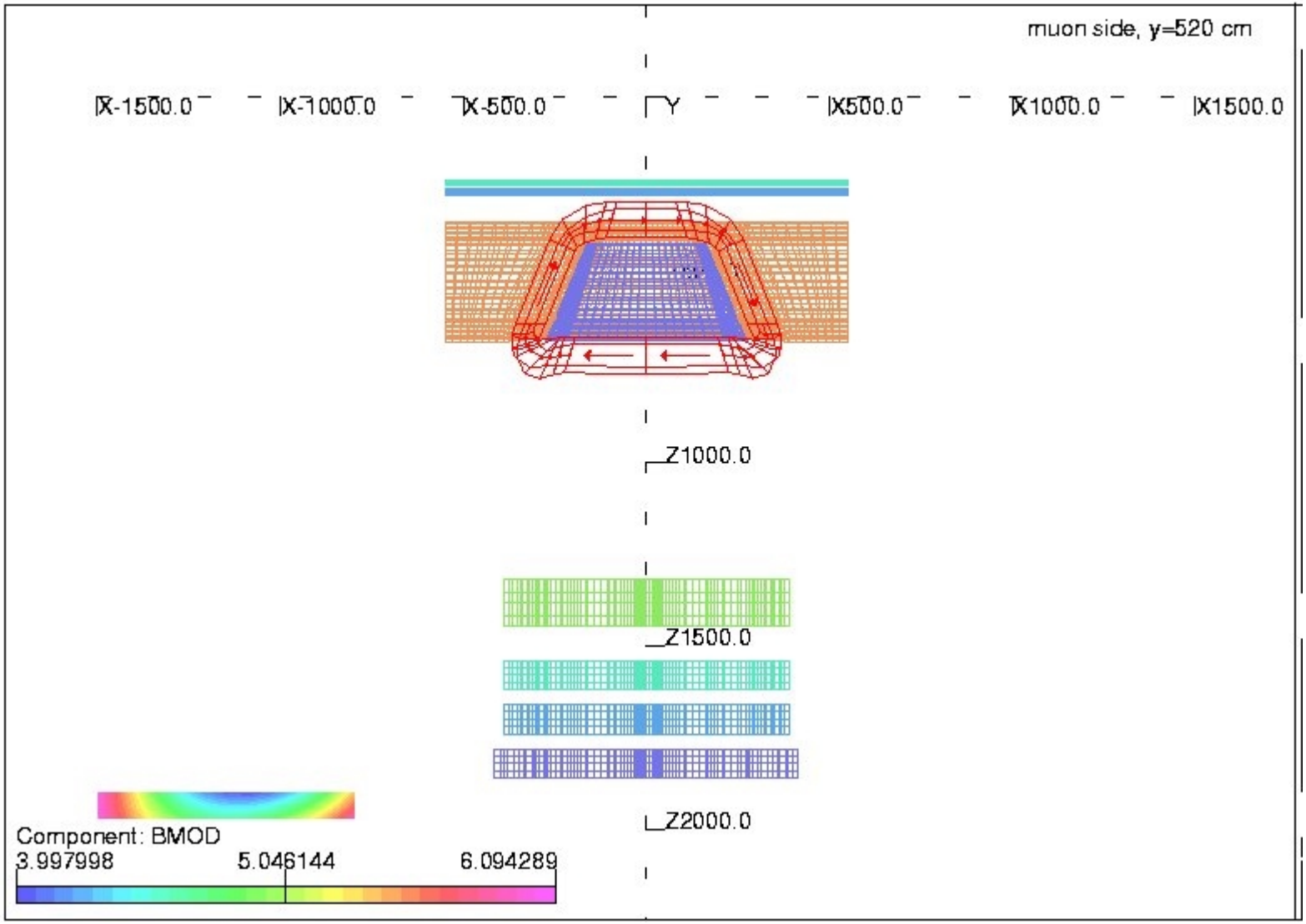
Magnetic field level at the iron yoke

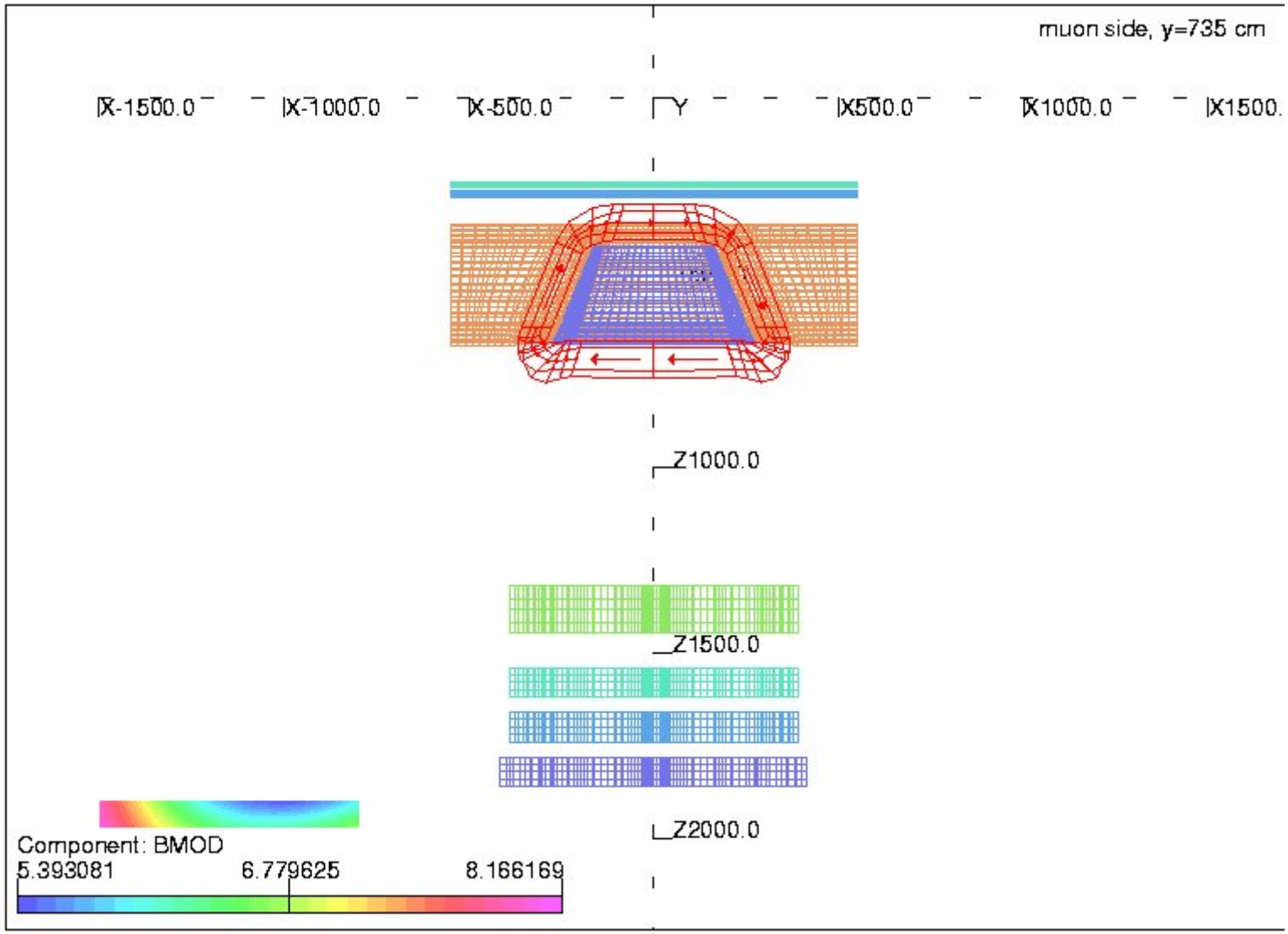


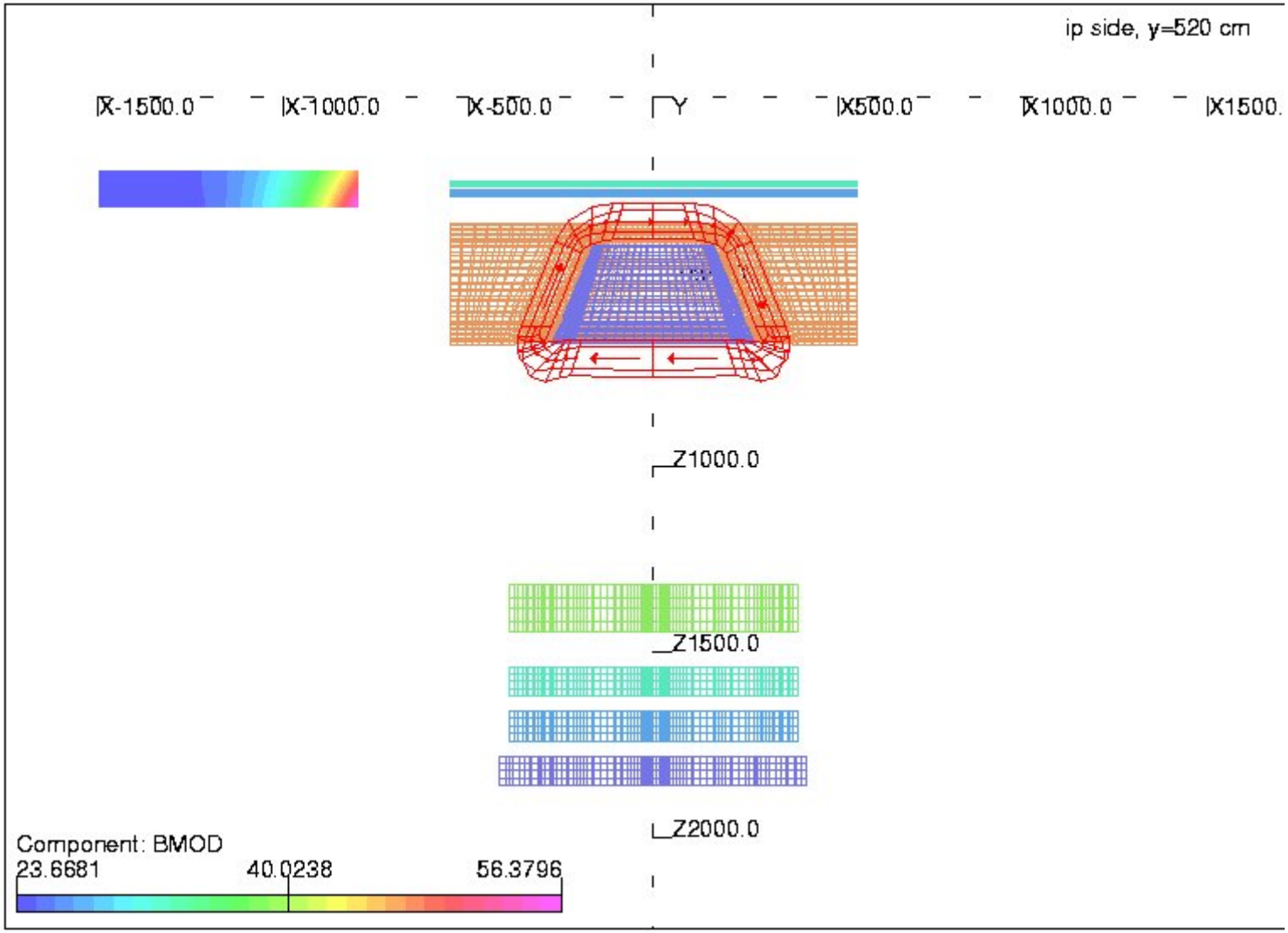
regions of interest for fringe field

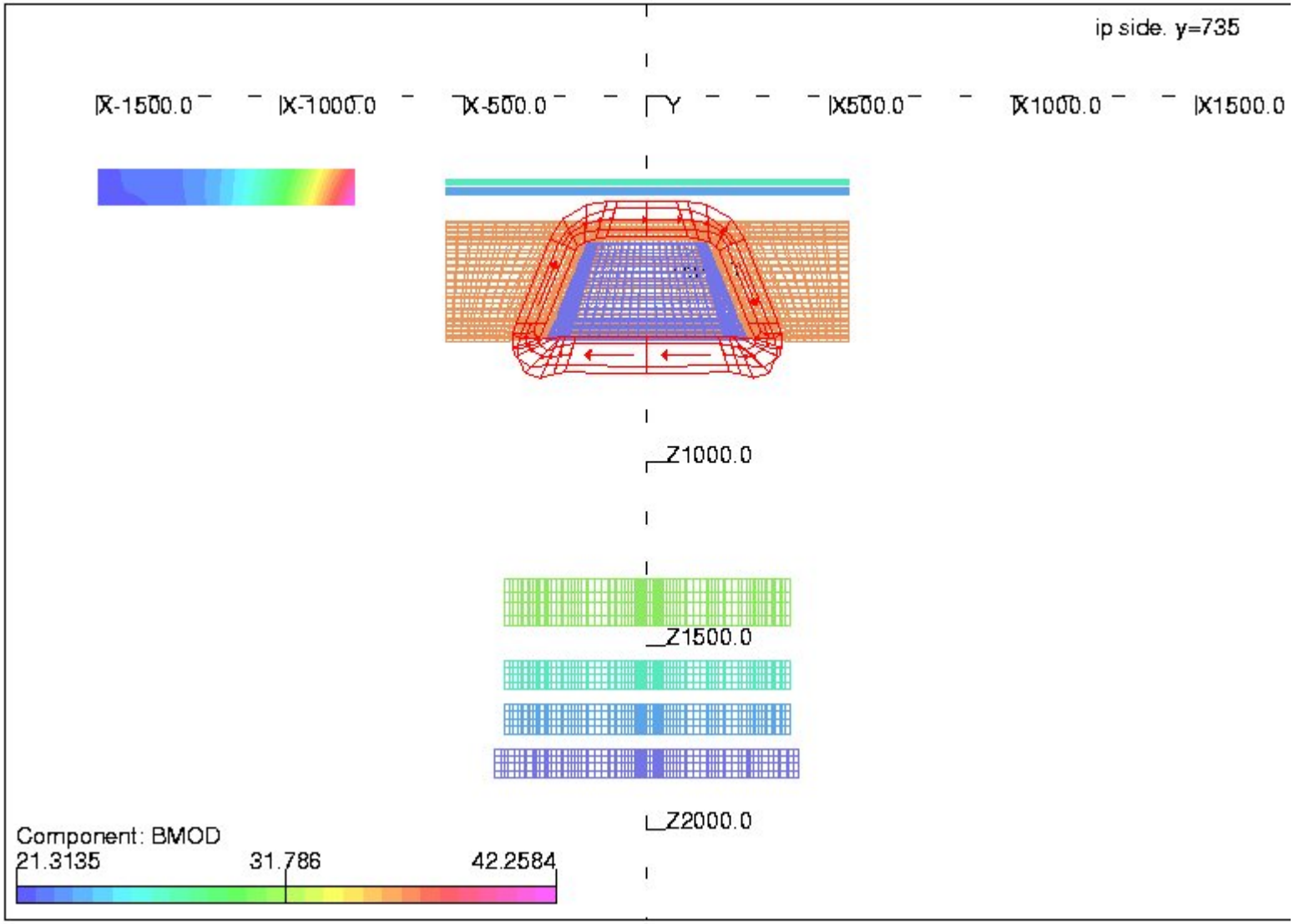
- electronics racks on balconies (*)
- side or top of sub-detectors (*)
- rich1 and rich2 locations

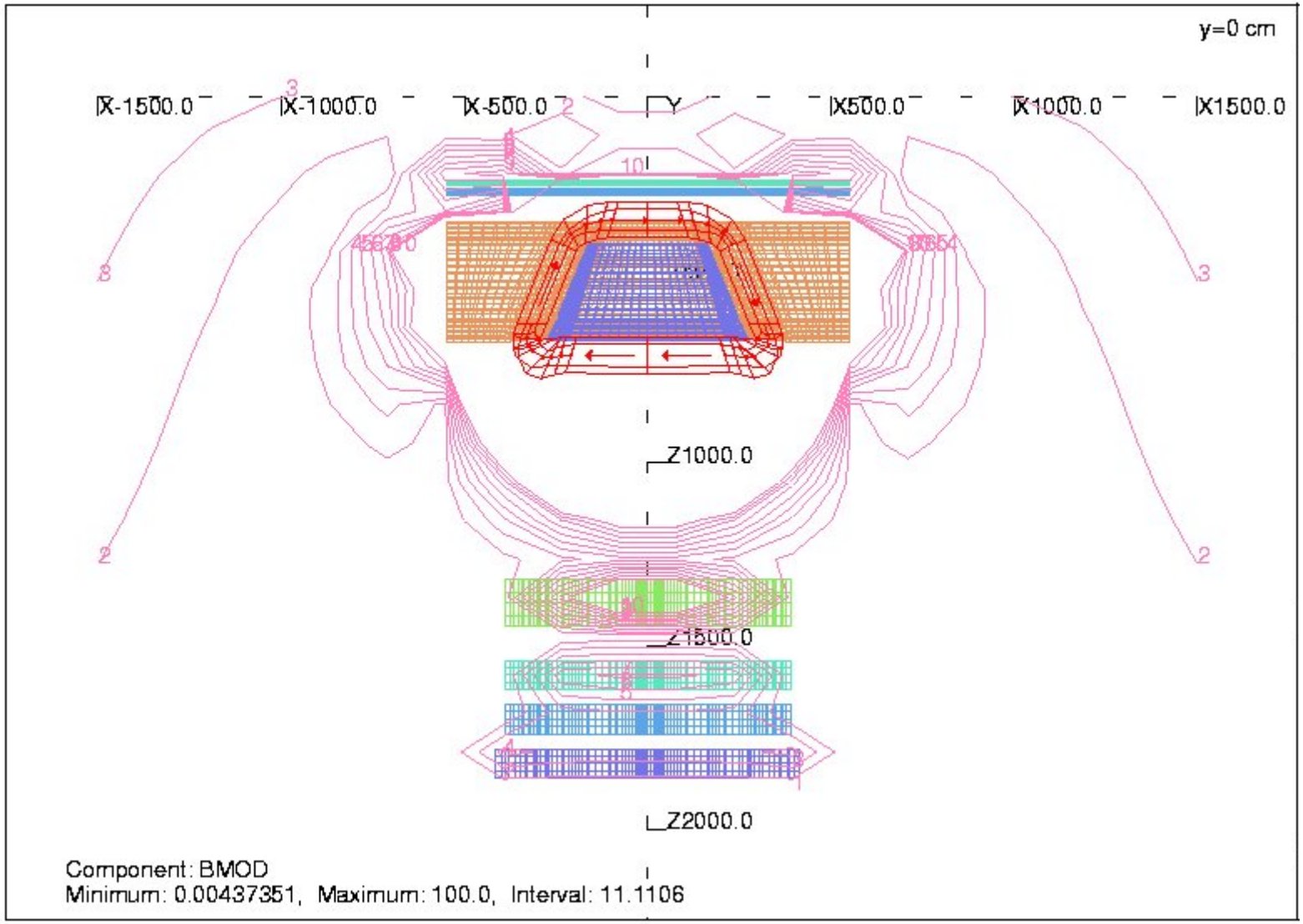
* According to LHCb note 2000-015, V.Talanov

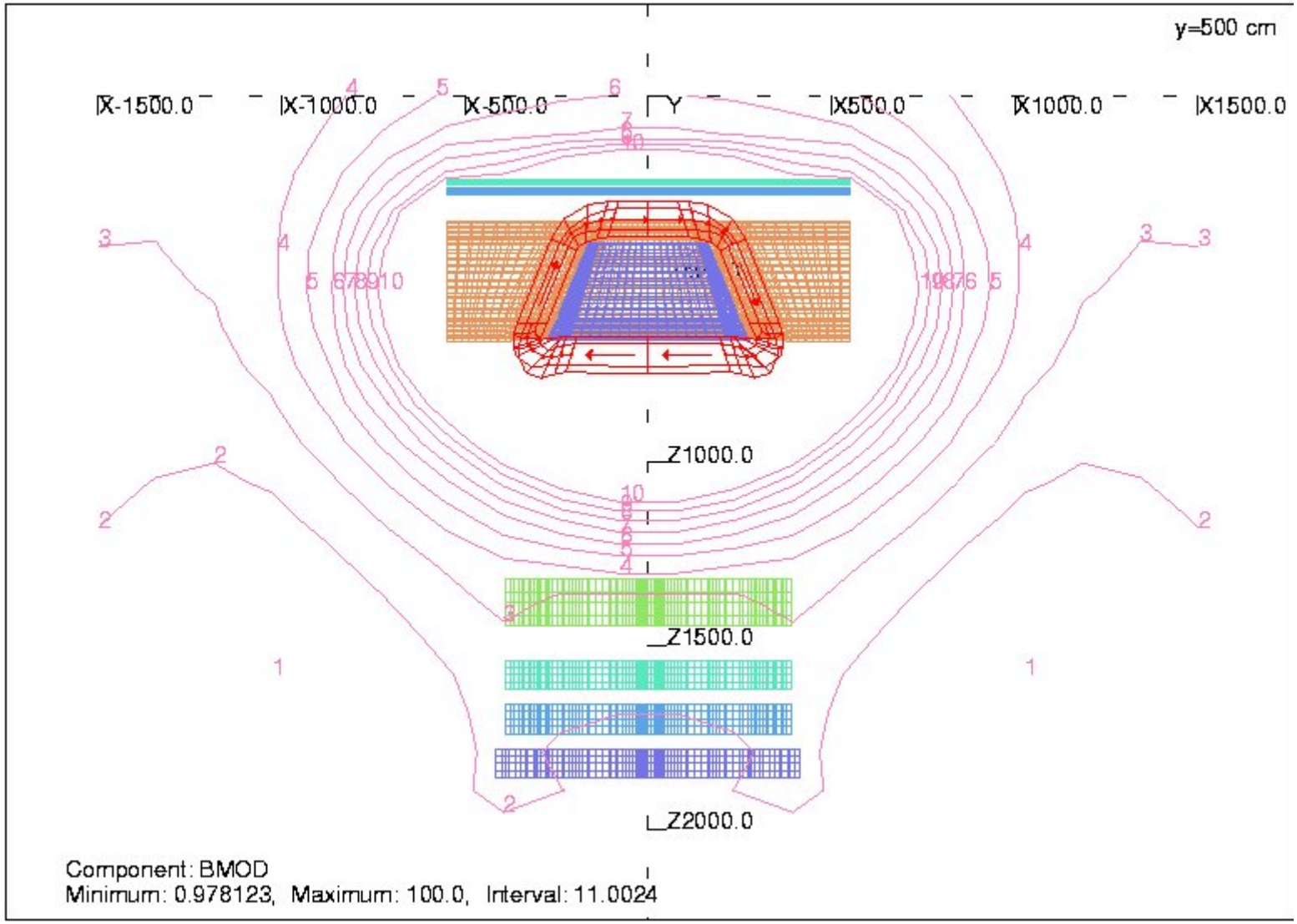

muon side, y=520 cm
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.0
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
3.997998
5.046144
6.094289

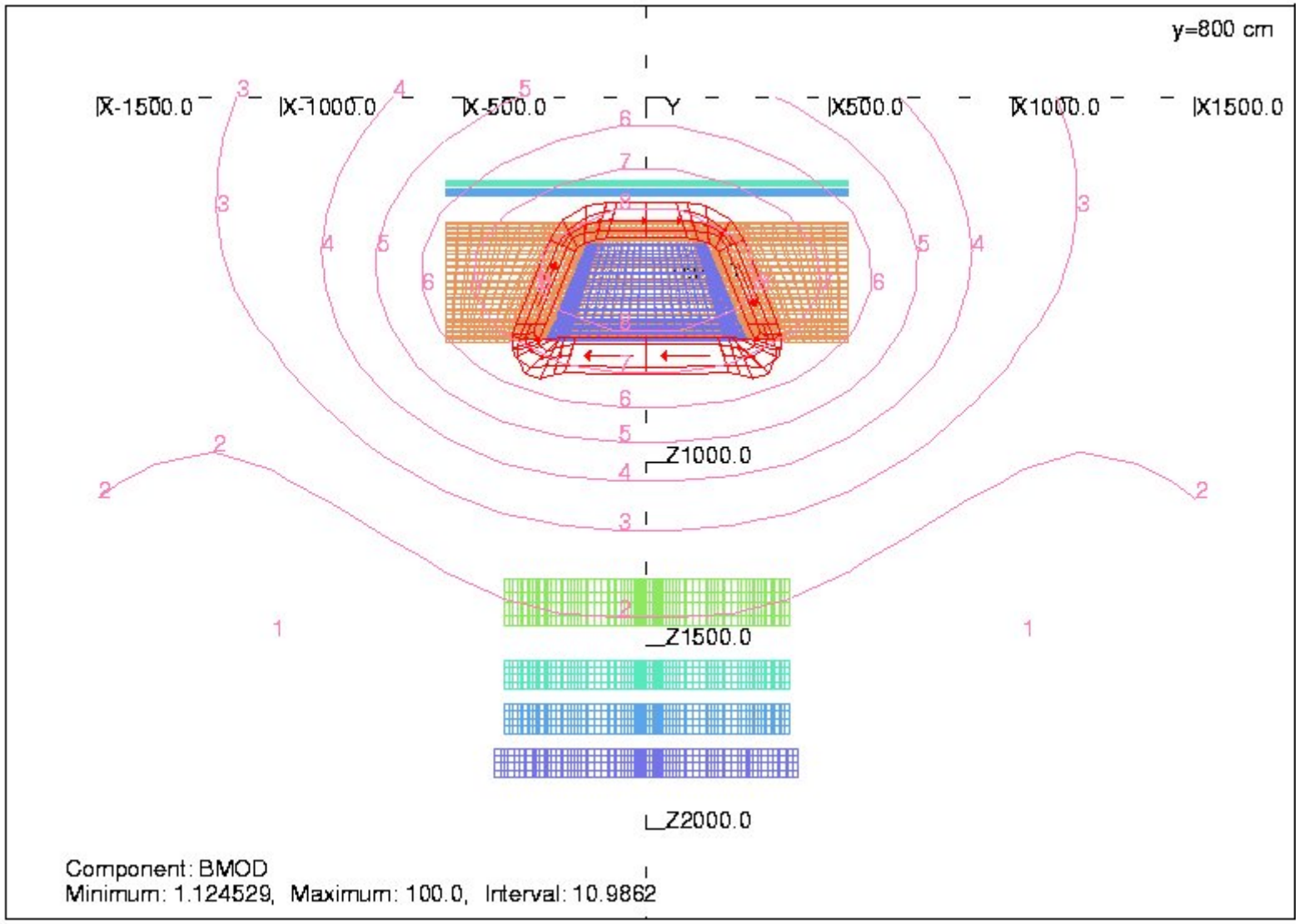

muon side, y=735 cm
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
5.393081
6.779625
8.166169

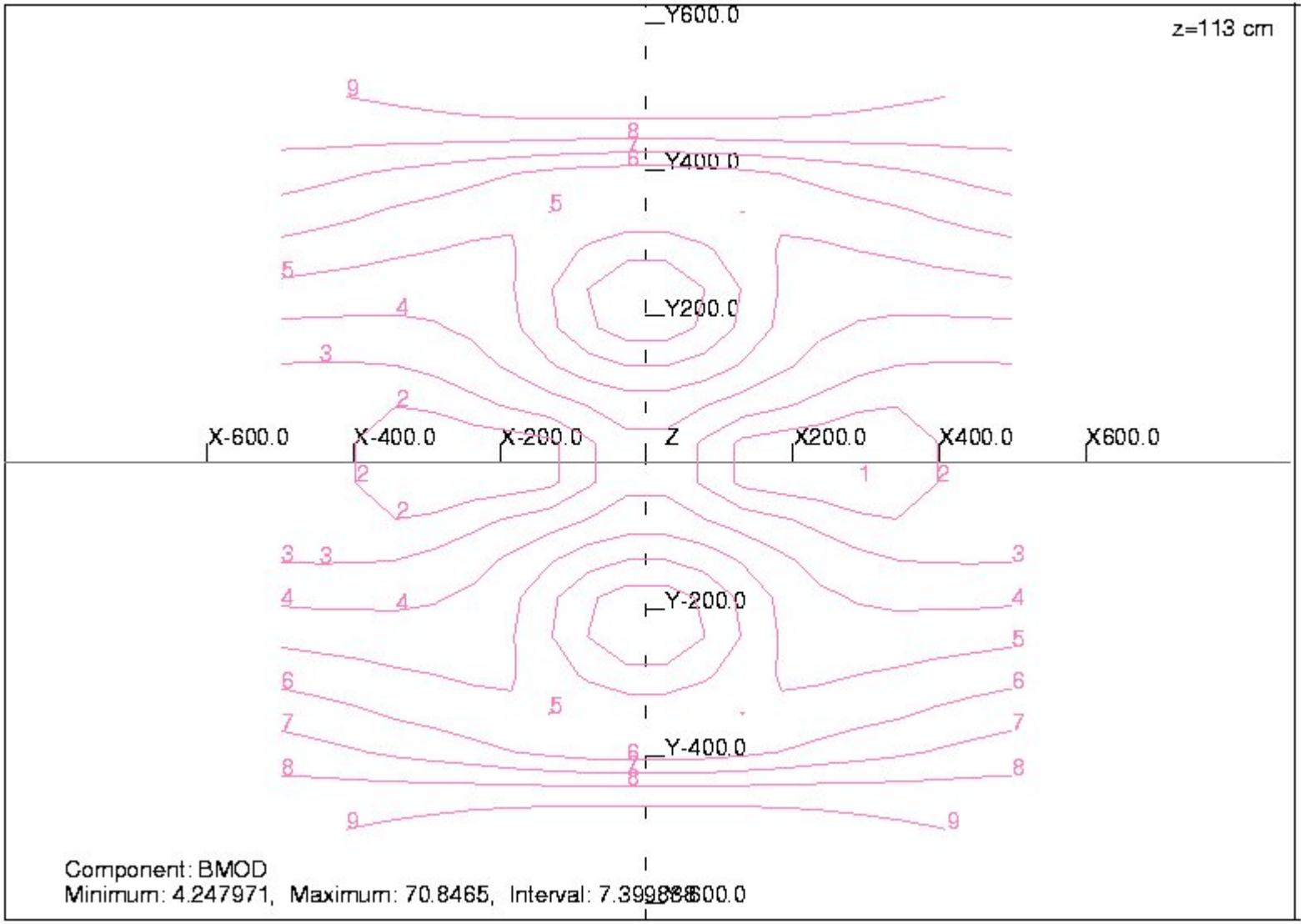

ip side, y=520 cm
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
23.6681
40.0238
56.3796

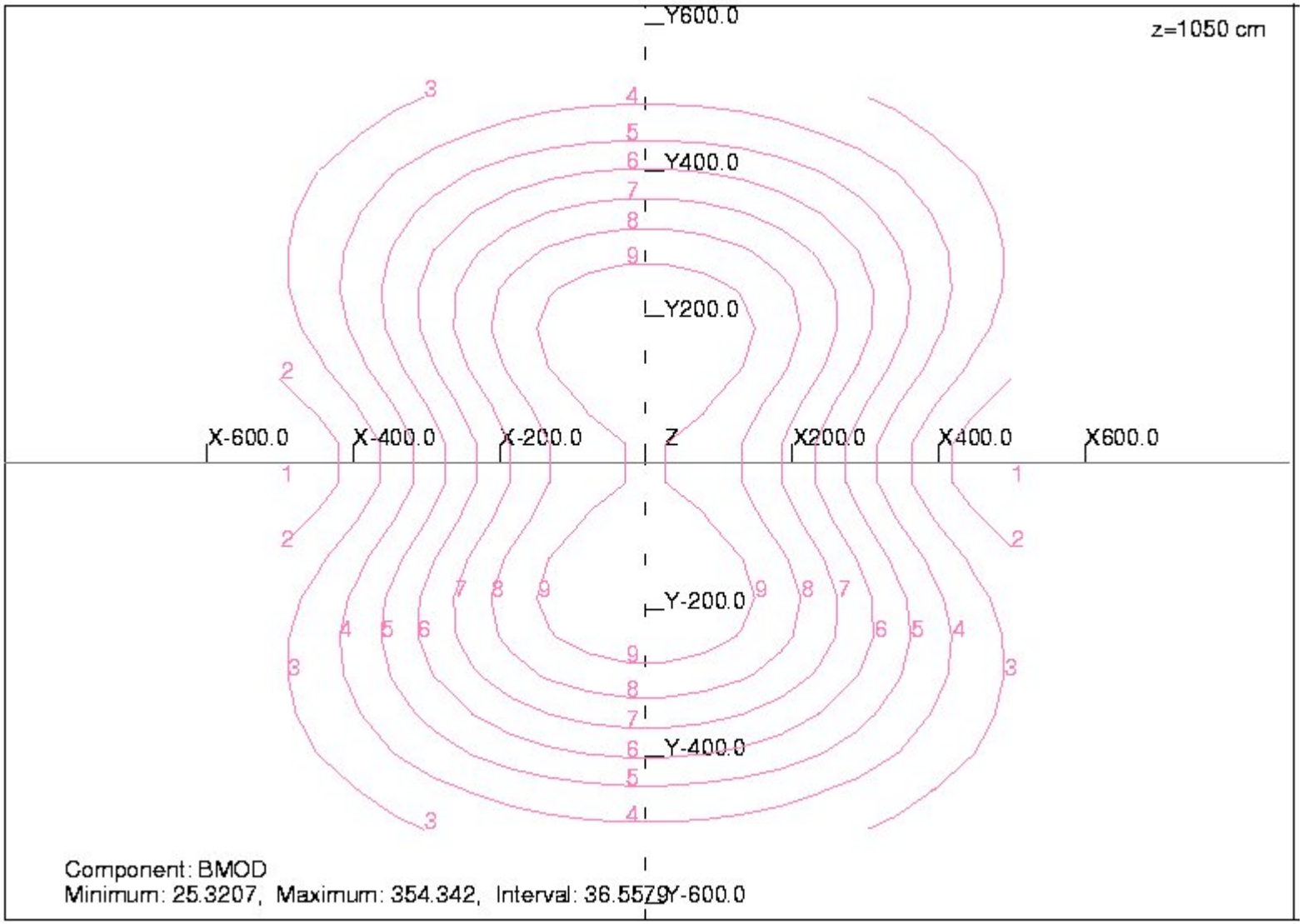

ip side. y=735
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.0
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
21.3135
31.786
42.2584


y=0 cm
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.0
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
Minimum: 0.00437351, Maximum: 100.0, Interval: 11.1106


y=500 cm
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.0
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
Minimum: 0.978123, Maximum: 100.0, Interval: 11.0024


y=800 cm
X-1500.0
X-1000.0
X-500.0
Y
X500.0
X1000.0
X1500.0
Z1000.0
Z1500.0
Z2000.0
Component: BMOD
Minimum: 1.124529, Maximum: 100.0, Interval: 10.9862


Y600.0
z=113 cm
Y400.0
Y200.0
X-600.0
X-400.0
X-200.0
Z
X200.0
X400.0
X600.0
Y-200.0
Y-400.0
Component: BMOD
Minimum: 4.247971, Maximum: 70.8465, Interval: 7.399888
Y-600.0


Y600.0
z=1050 cm
Y400.0
Y200.0
X-600.0
X-400.0
X-200.0
Z
X200.0
X400.0
X600.0
Y-200.0
Y-400.0
Y-600.0
Component: BMOD
Minimum: 25.3207, Maximum: 354.342, Interval: 36.5579

Out of sub-detectors

B_{mod}	M3, at $z = 18.2$ m	M2, at $z_{av} = 17.0$ m	M1, at $z_{av} = 15.8$ m	Hcal, at $z_{av=} 14.1$ m
< 20 G	x,y=4 m	x,y=4 m		
< 50 G			x,y=4 m	
< 100 G				x,y=4 m

conclusions

- The magnetic field level is below the 100 G level in the considered regions outside of sub-detectors
- the magnetic field level is below the 100 G level at the balconies
- at RICH2 location the field is about 130 G
- the stray field shall have to be measured as it will depend on the actual iron distribution inside the cavern - some margin should be provided.