

R4998 tests in B field

Conventional PMTs shielding

- ❑ TOF0 PMTs requires no shielding, aside 1 mm μ -metal due to small B field ($B \ll 50$ Gauss, Kevin private communication)
- ❑ TOF1/2 even after the 100 mm global iron shielding needs some additional shielding to use conventional PMTs (as $B_{//} \sim 200-300$ G, $B_{\perp} \sim 1000$ G)

Advocated solutions:

◆ Solution A ("Ghislain cage"): extra shield (50 mm) connected with joints to first shield (100 mm) and local shielding of PMTs (μ -metal only if 420 mm hole)

◆ Solution B: no-extra shield but heavy local shielding of PMTs a la D0 (test results reported in MICE-NOTE-DET-201)



B field with one 100 mm iron shield (current design)



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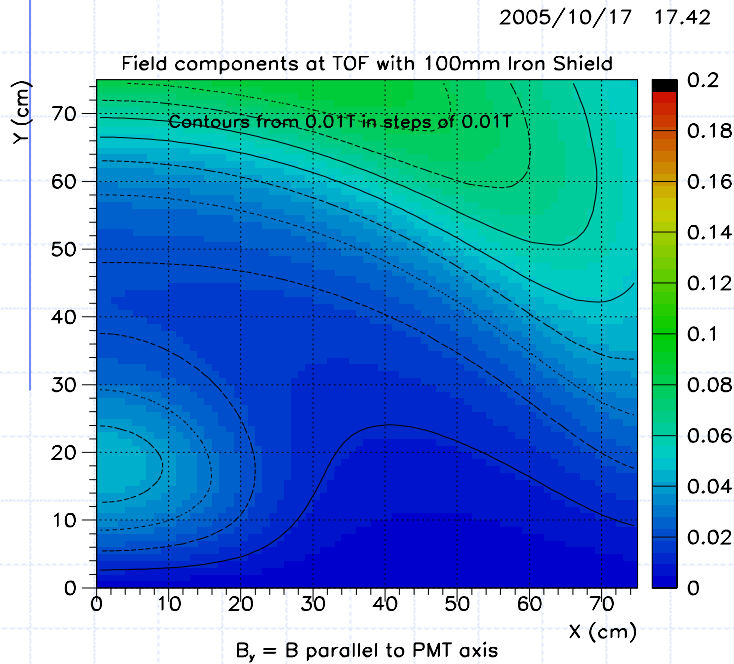


Figure 4: B_{\parallel} at the position of TOF2 with the 100 mm iron shield.

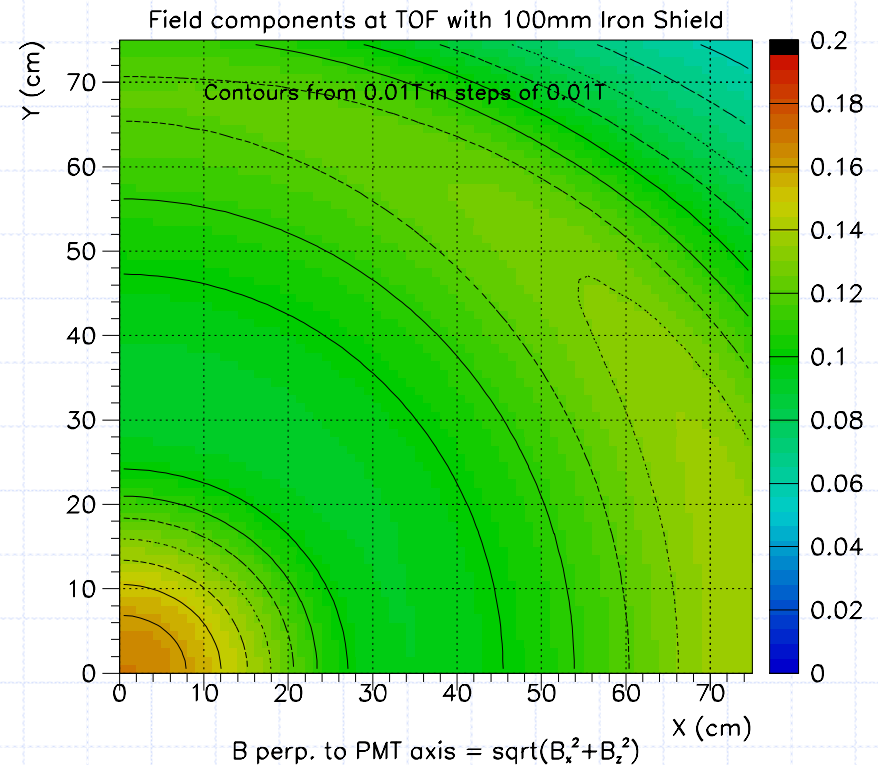


Figure 5: B_{\perp} at the position of TOF2 with the 100 mm iron shield.

My old transparency at RAL CM16

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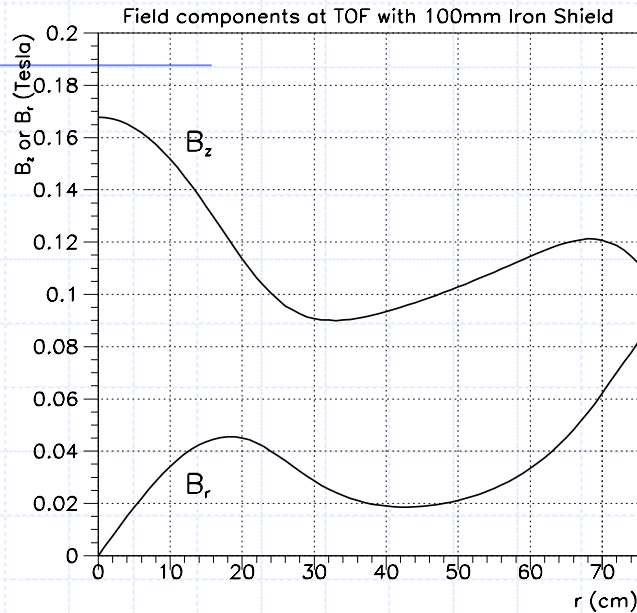


Figure 6: Radial and longitudinal field components at TOF2 ($z=664$ cm) as a function of r with 100 mm thick iron shield.

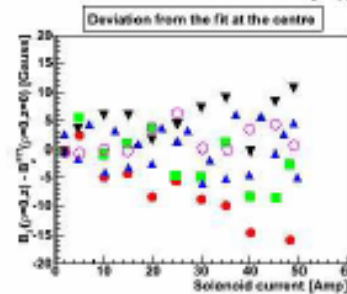
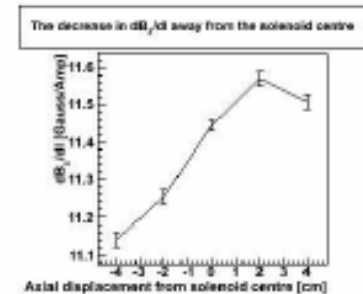
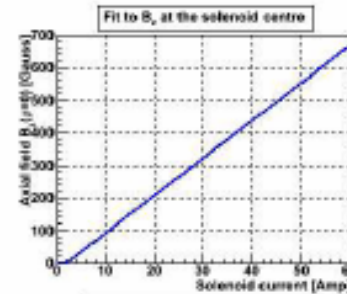
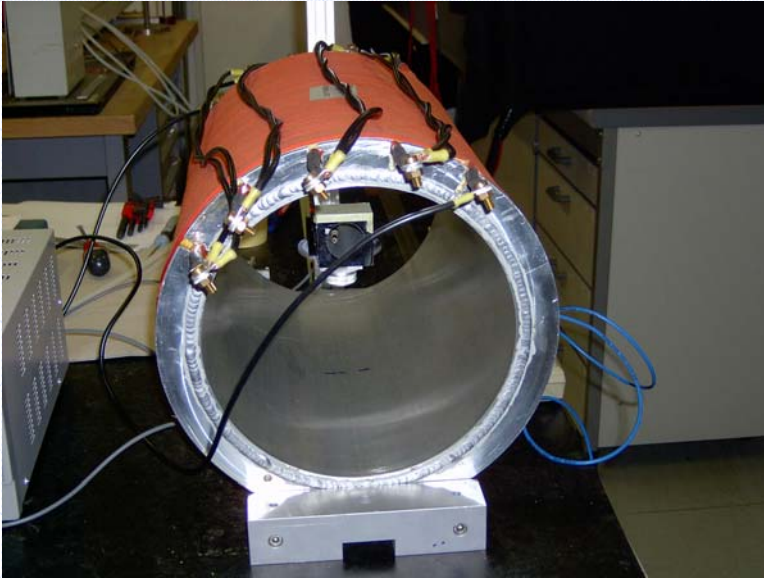
B field is ~ 200-300 G //; ~ 1000 G \perp at $r=30-35$ cm (PMTs position)

- I doubt it can be shielded with individual PMTs shields, preserving good timing properties**

- this point to 2nd shield, but we will try to test PMTs "exotic shieldings" by building a 400 G lab solenoid**

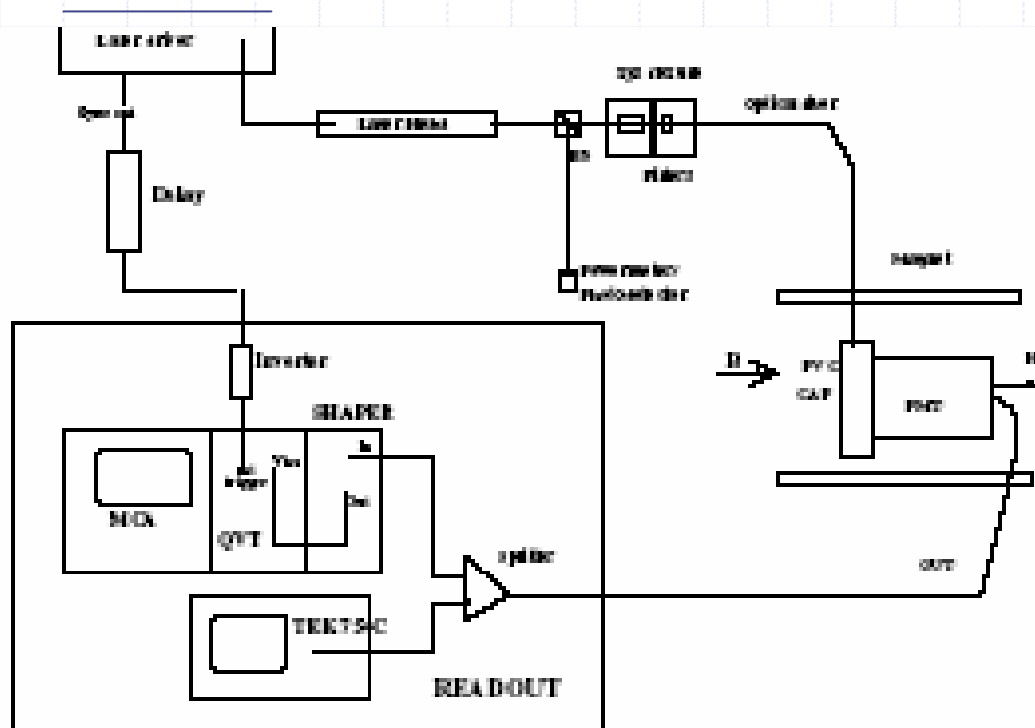
BUILT: coil with 5 windings for fields up to 700-800 G

Used test solenoid

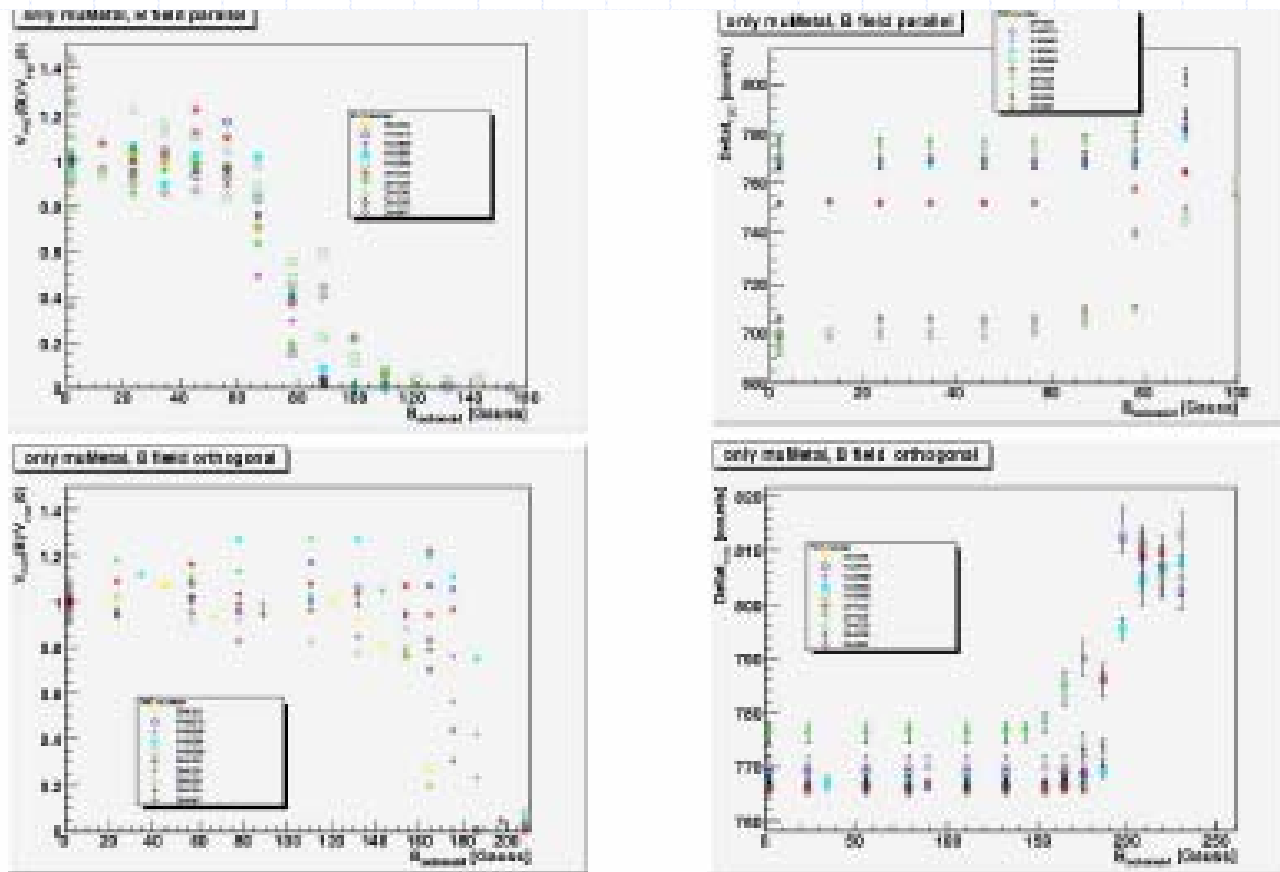


- Laser source (Nichia Blue laser diode + up to 1MHz Avtec fast pulser: signals 100 ps- 2 ns)
- field up to 600 G
- Use of different shieldings: mu-metal only, additional Fe shielding, ...

PMT test system

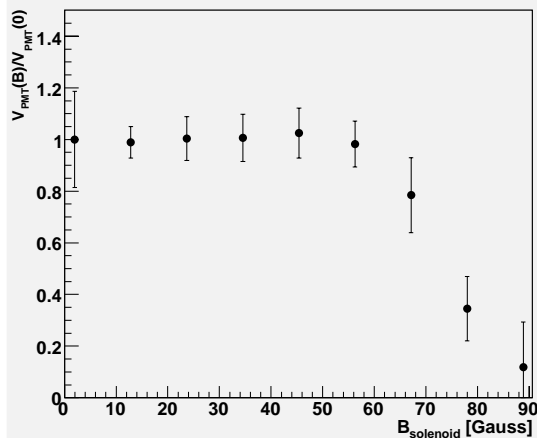


1 mm μ -metal shielding

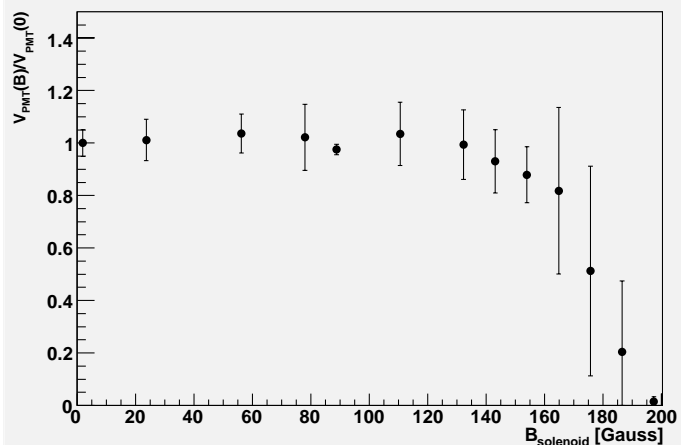


$B_{//} < 60$ Gauss fine; $B_{\perp} < 150$ Gauss fine eventually additional μ -metal or soft iron

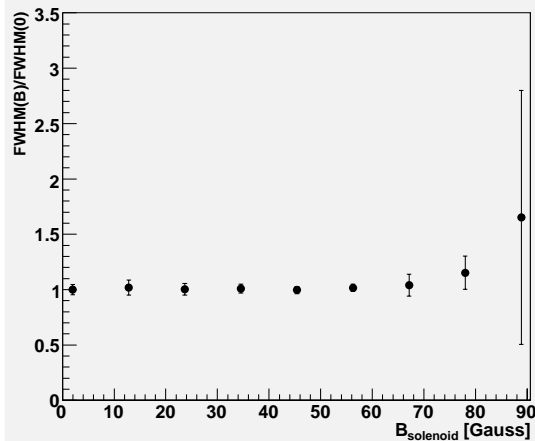
only muMetal, B field parallel



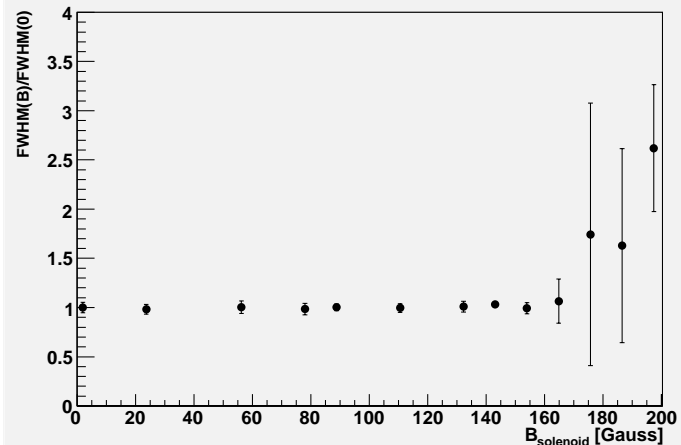
only muMetal, B field orthogonal



only muMetal, B field parallel



only muMetal, B field orthogonal



average of 10 PMTs

Box shielding

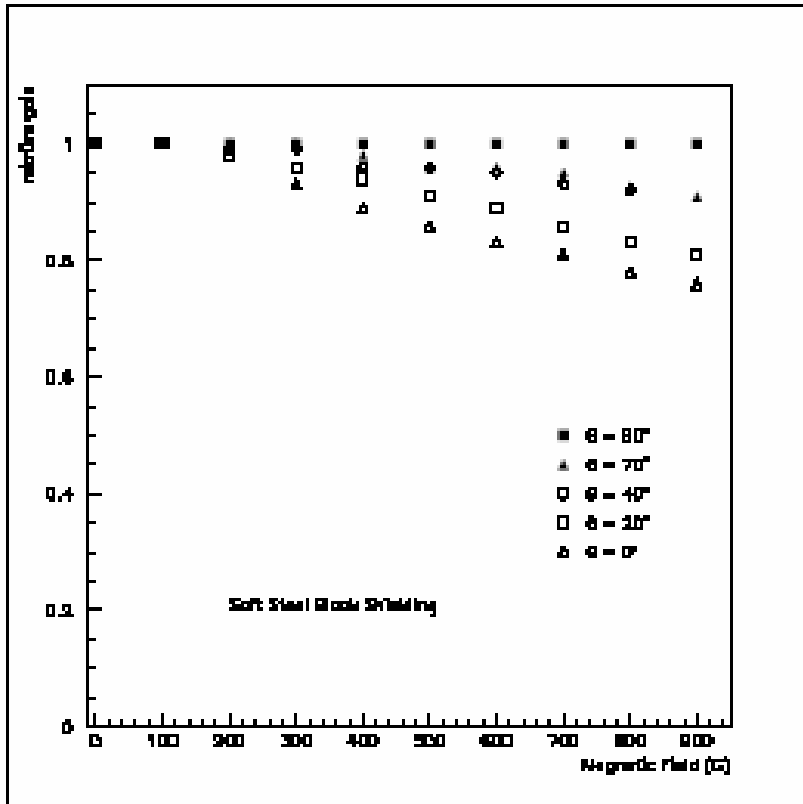


Figure 2: The relative PMT gain as a function of magnetic field strength for various angles of orientation using a soft steel block for shielding plus a single thick μ -metal shield.

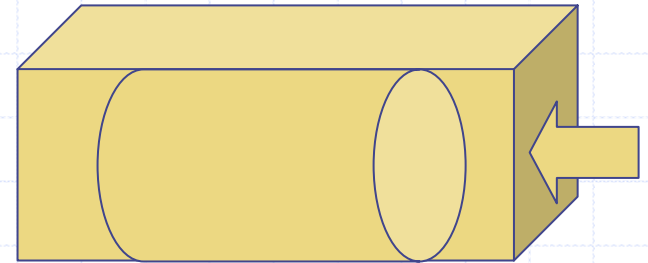
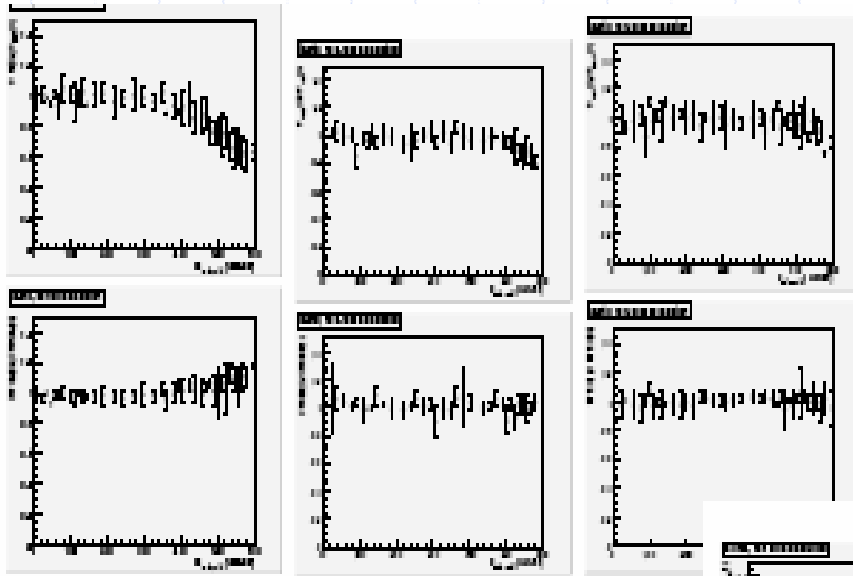
D0 tests (note # 2706) (brought to our attention by Ludovico)

Questions:

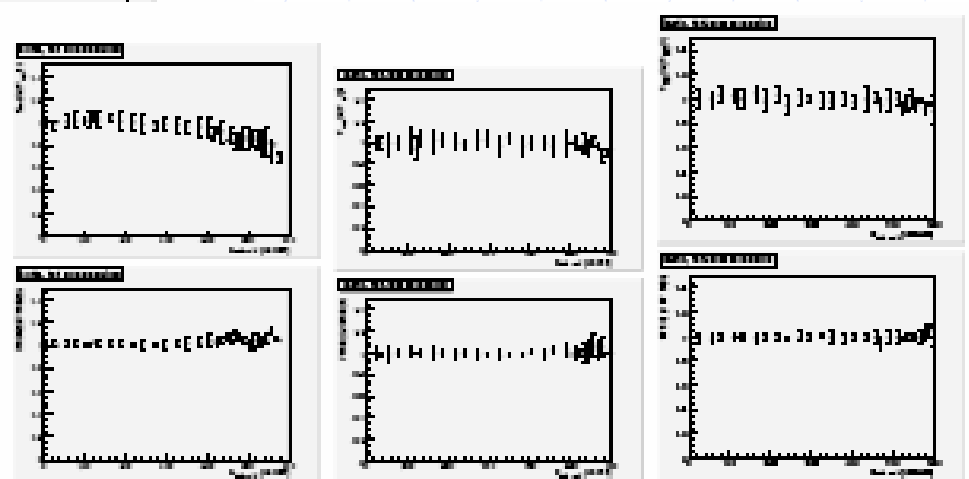
- _It will work for R4998 1" PMTs?
- Tests to be done for Gain + timing

See results later

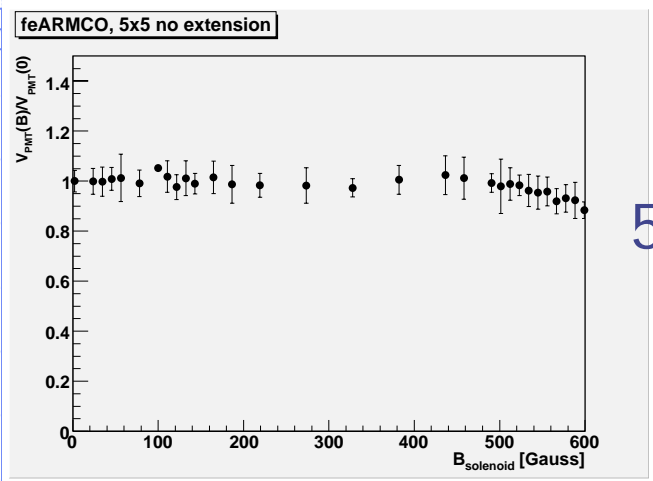
R4998 PMTs: Fe-360 box shielding



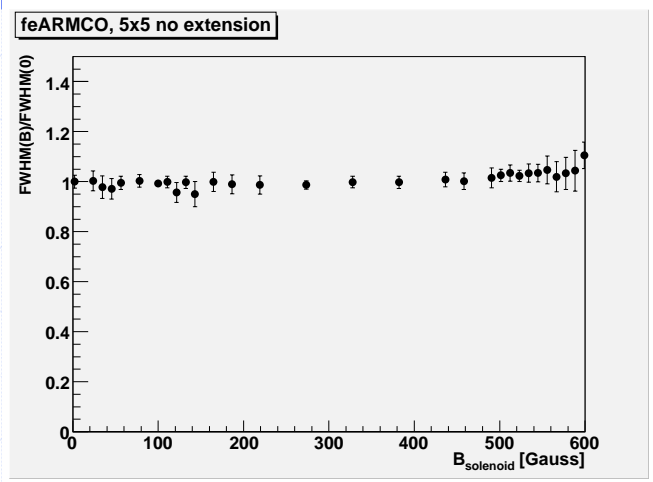
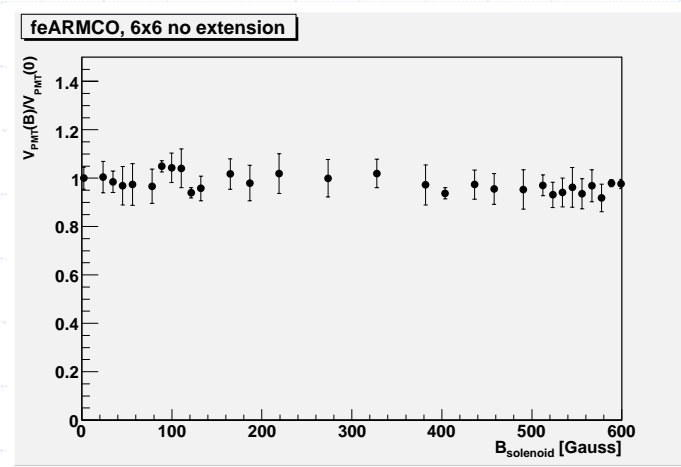
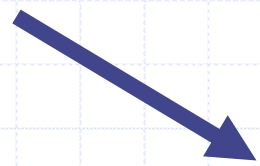
From 5x5 to
6x6 cm²



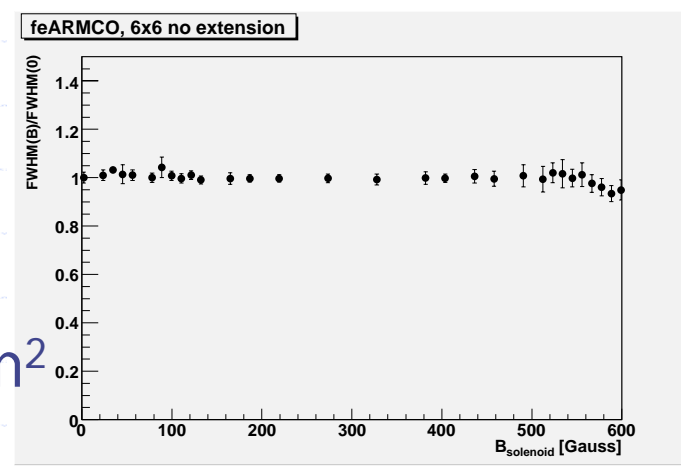
Pure steel ARMCO



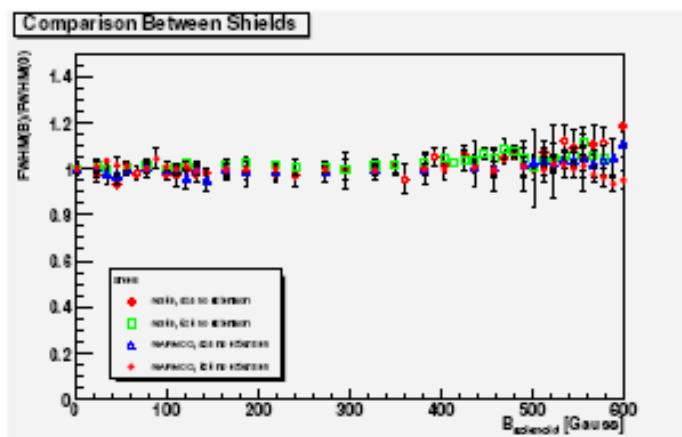
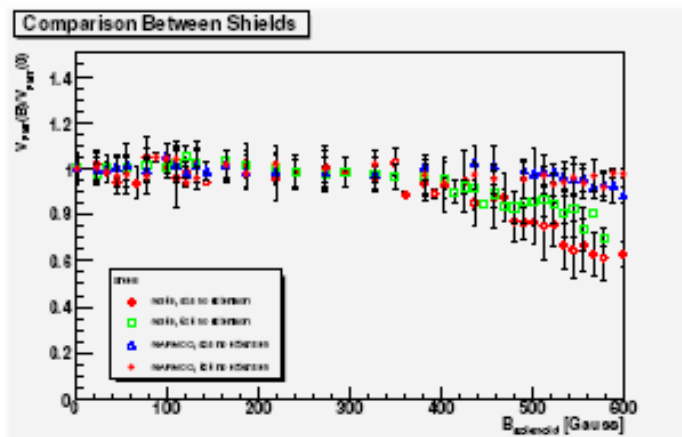
5x5 cm²



6x6 cm²



Comparison between shields



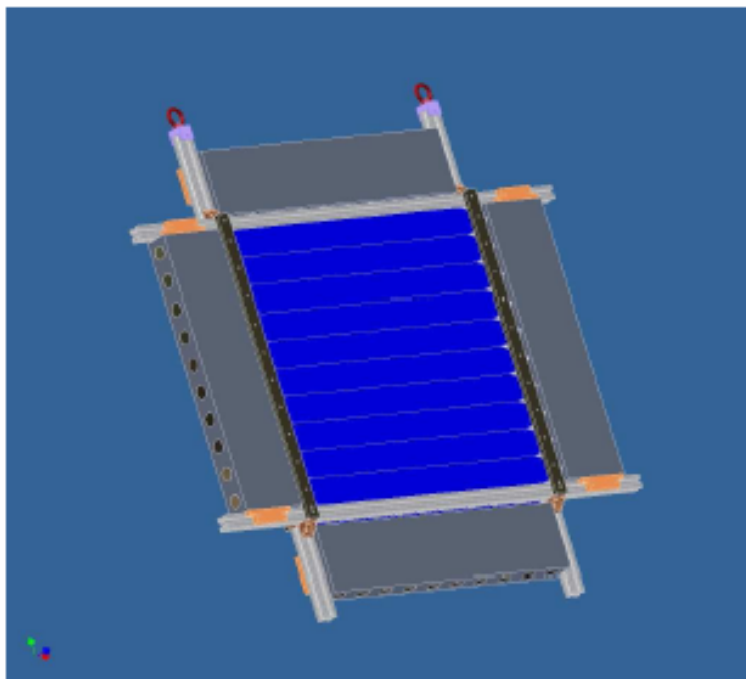


Fig. 18. CAD drawing of TOF2 with local shieldings for PMTs, using a single bar of ARMCO 6 cm thickness for each side.

Sketch of TOF2 local shielding

1. Final design to be dictated by shielding + mechanics
2. A final single PMT shielding will be tested before production of local shielding

Conclusions

- ◆ PMTs shielding with massive Fe blocks of pure steel ARMCO seems adequate
- ◆ some extra work needed for mechanics of TOF2 (work together with Roma3 mechanics shop)