KL Status Report

Basically same slides of :

http://hep04.phys.iit.edu/cooldemo/vc/vc97/vc97_tortora_emcalklupdate.pdf

with few important updates

KL detector numerology

- KLOE-like constructive technique based on gluing grooved 0.3 mm thick lead sheets with 1 mm diameter scintillating fibers

- KL is $\approx 90 \times 90$ cm^2, 4 cm thick, realized by assembling pre-built modules 132 mm wide and read-out by 42 PMTs (recovered from HARP)

- Weight $\approx$ 150 kg

Procurements for EMcal

- Last november-december the available 2006 funds have been addressed to the following shopping list of items:
  - KL Modules construction at General Tecnica (external firm)
  - Purchase of CAEN TDC V1290 (2 modules , 64 channels)
    - *temporarily transferred from KL to TOF2 project*
  - Purchase of CAEN ADC V1724 (18 modules , 144 channels)
    - *12 modules temporarily transferred from SW to TOF system project*

N.B. : presently we assume and wish a common readout chain for TOF and KL based on almost identical components

Work in progress on KL detector

- Modules Construction under way (3/7) at General Tecnica
  - *Funding problems for supervision and checking job by INFN technicians to overcome …*

- Prototyping and Testing of Stretcher board
  - *Carrying out by Ilko and Jean-Sebastien in the final readout framework*

- Experimental Study of Local PMT Shielding
  - *Built prototypes for test in magnetic field*
  - *Solenoid built by Maurizio at Milano for common tests with TOF*

- Design of mechanical support and movement
  - *PMT local shielding integrated in the supporting structure*
  - *Compatibility with downstream shielding, TOF2 , SW …*

Study of Magnetic Shielding Configurations, D0 Note 2706

" Scintillator tiles readout by Hamamatsu R647 , 71 mm long , 13 mm diameter "

Configuration 1

Magnetic shielding is provided with:

- Mu-metal cylinder
  0.5 mm thick, 89 mm long
- **Rectangular block** of soft steel (1020)
  38×38 mm^2 , 89 mm long

- transverse to tube axis field
  has no effect up to ~900Gs

- field parallel to the tube affects PMT
  - **10% gain loss at ≈ 300Gs**
  - **20% gain loss at ≈ 700Gs**

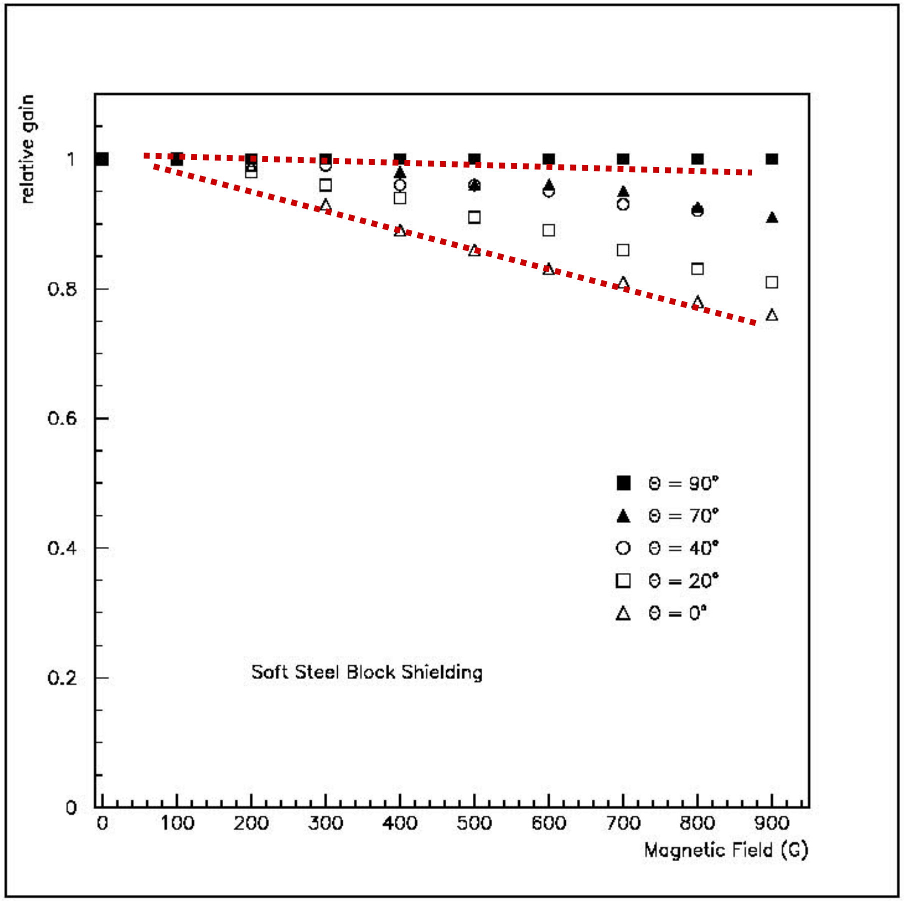


Figure 2: The relative PMT gain as a function of magnetic field strength for various angles of orientation using a soft steel block for shielding plus a single thick μ-metal shield.

Study of Magnetic Shielding Configurations, D0 Note 2706

" Scintillator tiles readout by Hamamatsu R647 , 71 mm long , 13 mm diameter "

Configuration 2

Magnetic shielding is provided with:

- Mu-metal cylinder
  0.5 mm thick, 89 mm long
- **Thick cylinder** of soft steel (1020)
  6.2 mm thick , 89 mm long

- transverse to tube axis field
  has no effect up to ~900Gs

- field parallel to the tube affects PMT
  - **10% gain loss at ≈ 100Gs**
  - **45% gain loss at ≈ 200Gs**

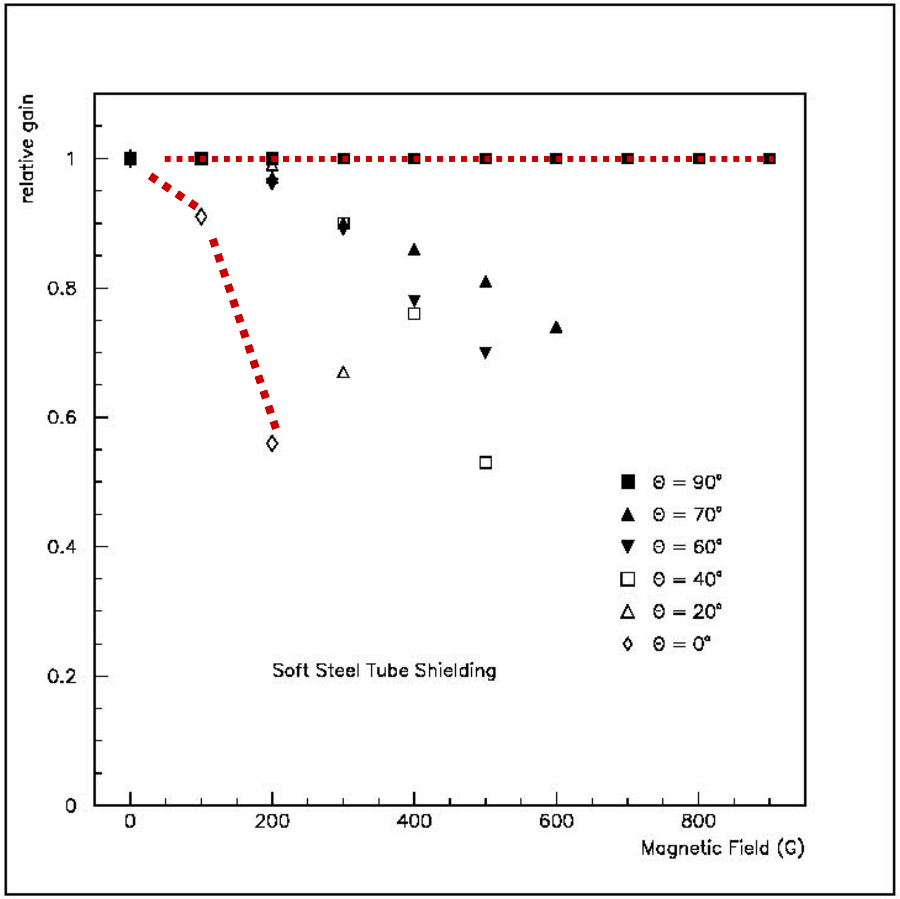


Figure 4: The relative PMT gain as a function of magnetic field strength for various angles of orientation using a thick soft steel tube plus an inner layer of μ-metal.

Magnetic Shielding for PMTs of KL

- From D0 tests we learn that the gain loss is much more dependent on the axial angle for the tube than for the block shielding configuration.

They claim:

" … the increased volume of the rectangular block geometry provides substantial permeability for containing the magnetic flux and indicates that the volume of highly permeable media is a crucial element in the shielding effectiveness"

-To perform a resolving measurement (because tipical available simulations refer to PMT's cylindrical shielding) some prototype of shielding have been built and planned to be test in a magnetic field provided by a solenoid built on purpose at Milano-Bicocca.

- Encouraging preliminary results have been obtained by Maurizio:
a nominal field of $\approx$ 400 G is reduced to $\approx$ 20 G inside the iron block ($\approx$ 4 cm from the edge).

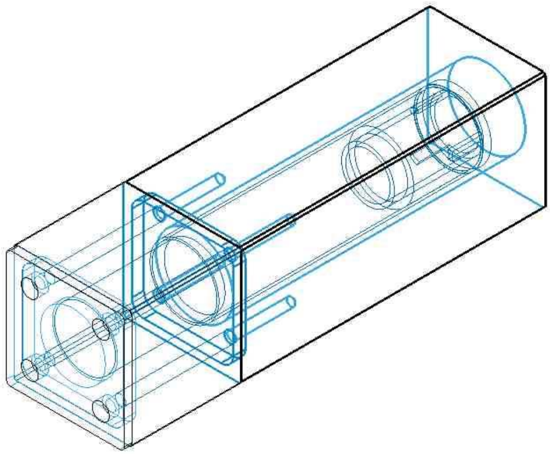
-Prototypes of PMT local shielding have been built and tests will be done soon.

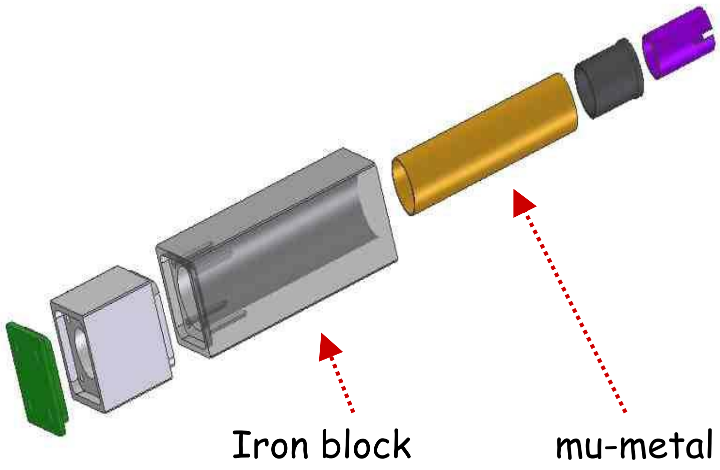
- The gain in expertise will be very useful to design the local PMT shielding for both (TOF2 & KL) , testing also time performance loss.

PMT shielding tests

- The sensitivity to shielding geometry is a relatively new aspect.
  Recent 2D simulation results show that an additional PMT local shielding made of iron + mu-metal layers is needed to keep very low stray field :
  http://hep04.phys.iit.edu/cooldemo/pc/pc236/pc236_gregoire_tof1shielding.pdf
  but only cilindrical PMT shielding is taken into consideration.

- Model of PMT local shielding block





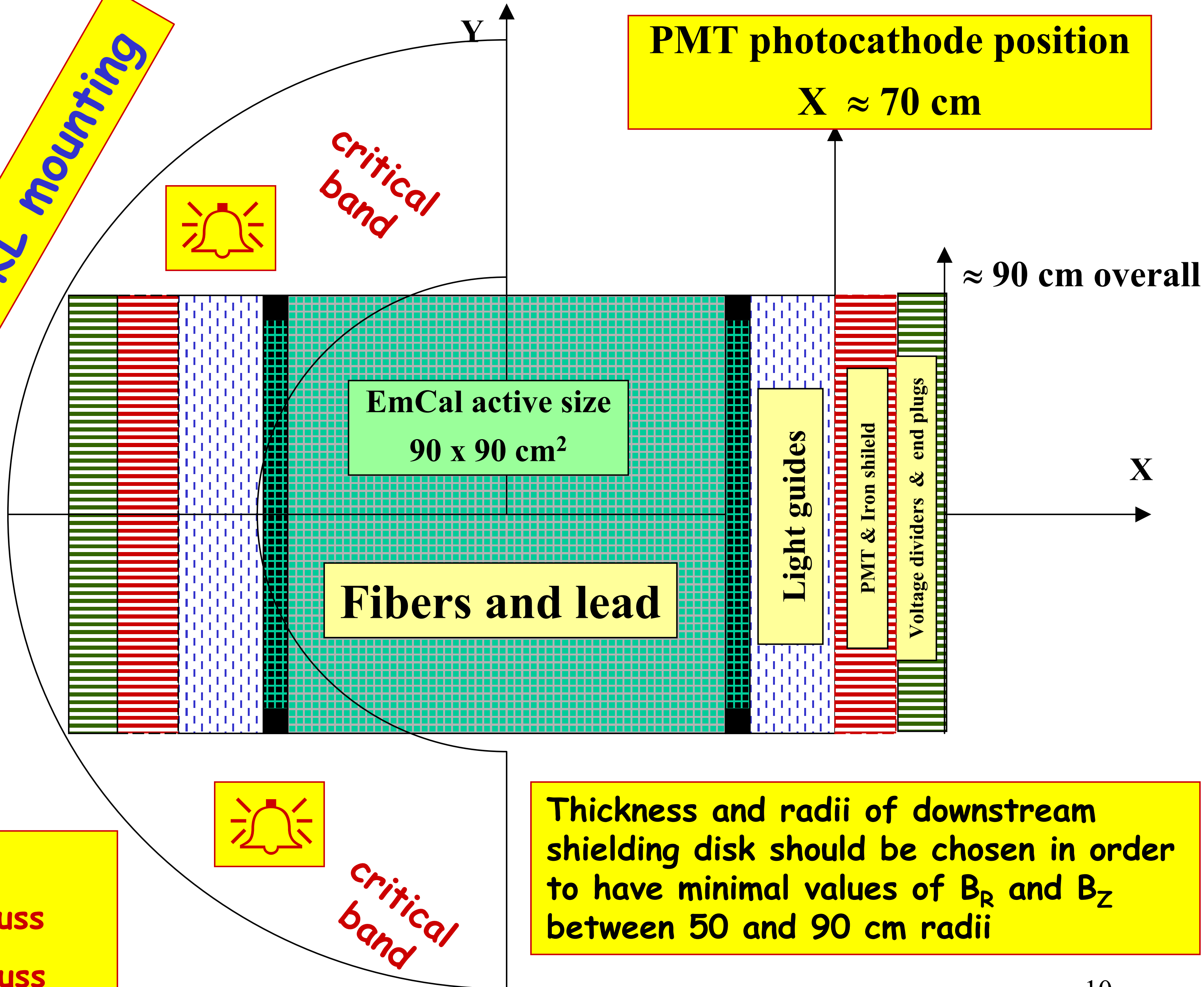
PMT shielding prototypes

- Hamamatsu PMT 1355
10 cm long , 29 mm diameter
- Mu-metal shield
12 cm long , 32 mm int. diam.
- Soft steel block 1
14 cm long , 48 $\times$ 48 mm^2
- Soft steel block 2
14 cm long , 58 $\times$ 58 mm^2
- Double mu-metal shielding
(in preparation)

Goal : reproduce - at least - the D0 test results with HARP phototube

N.B. : Larger diameter tubes, having longer path from photocatode to first dynode, are more affected by the magnetic field

Sketch of KL mounting



Thickness and radii of downstream shielding disk should be chosen in order to have minimal values of B_R and B_Z between 50 and 90 cm radii

KL requires

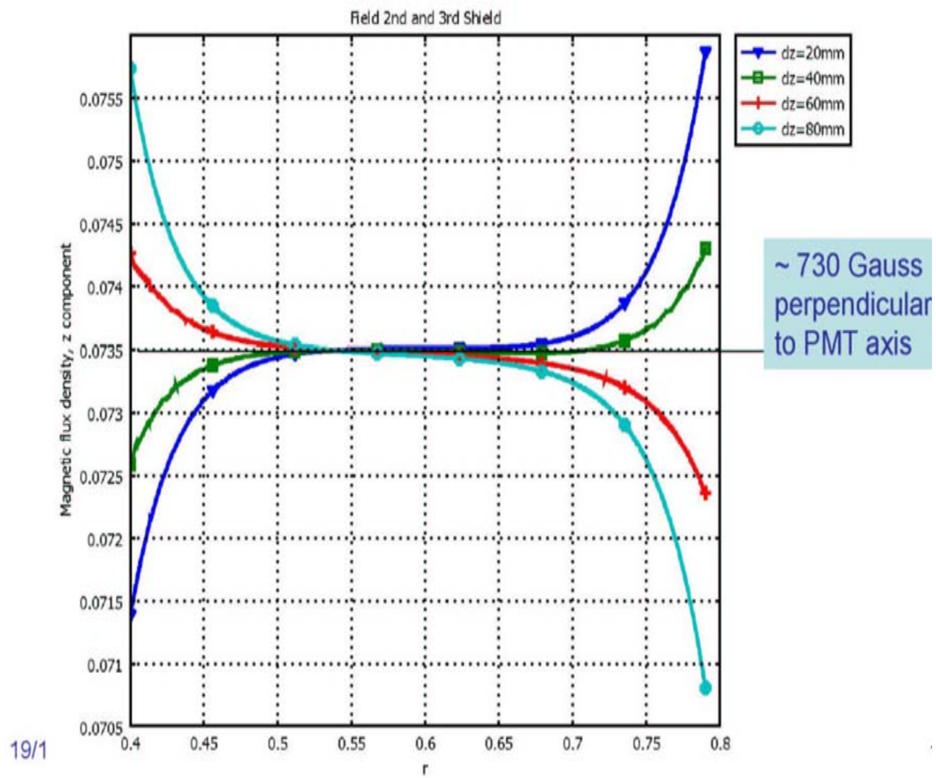
$B_R < 200$ Gauss

$B_Z < 800$ Gauss

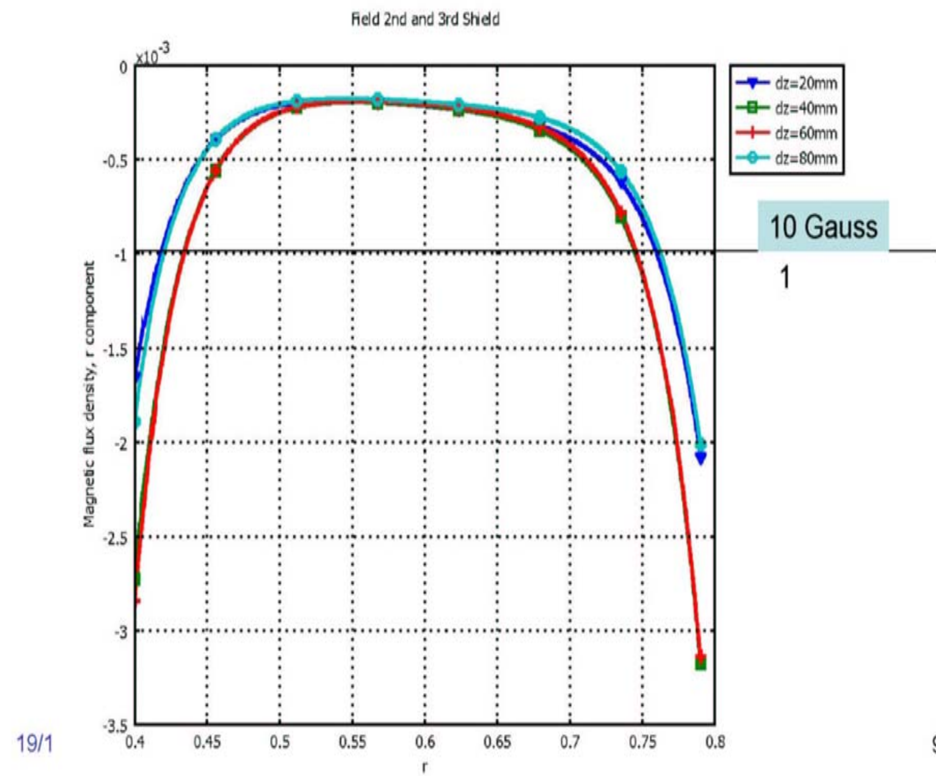
in the critical band

Pages from:
http://hep04.phys.iit.edu/cooldemo/cm/cm16/cm16_cobb_magneticfieldmaps.ppt

Axial (z) field between 2nd and 3rd shield



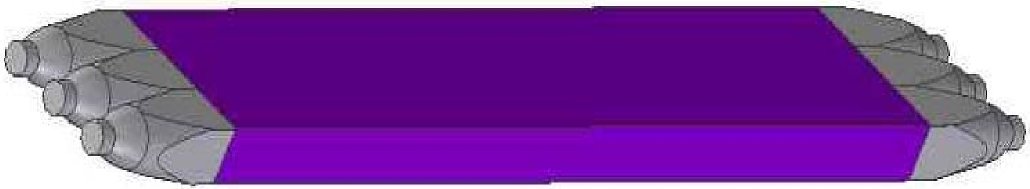
Radial field between 2nd and 3rd shield

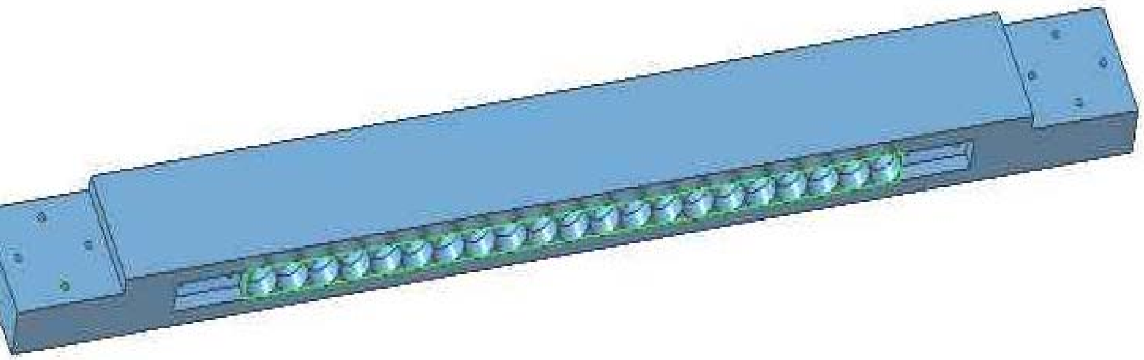


In the scenario with 3 downstream shields (… somewhat less complex for TOF2 mounting wrt the more efficient Ghislain cage option) , **if the "good region limit" is 100 Gauss , as drawn for TOF2 , it seems that a major outer radius would be needed.**

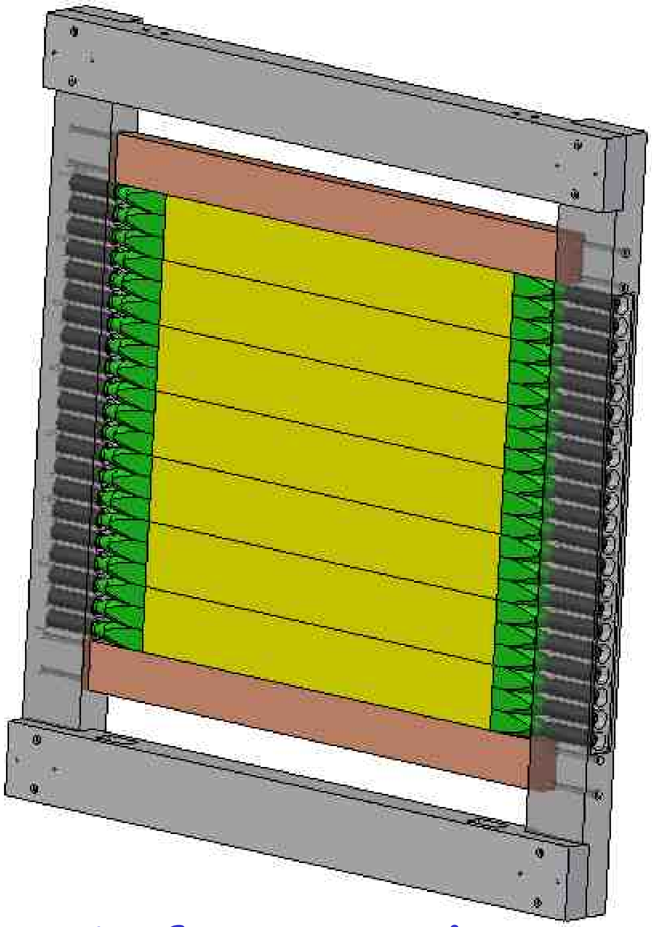
KL - Assembling

Single module ≈ 20 kg





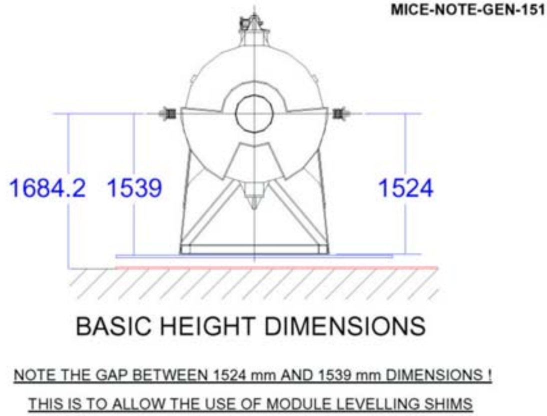
Shielding bar ≈ 100 kg

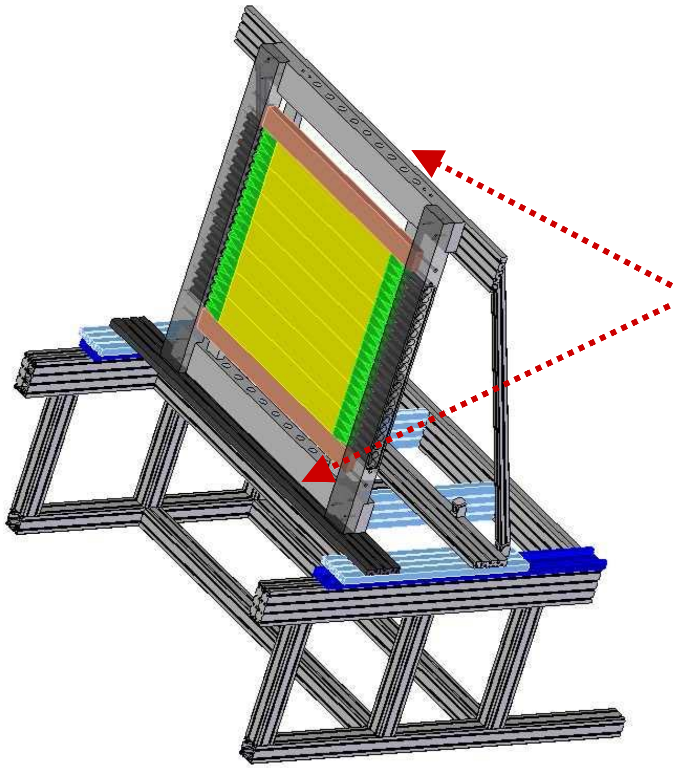


KL framework

KL - Installation

- ✓ KL support can slide in Z direction
- ✓ The global support can slide in both X & Z directions; adjustable in Y
  - ➢ to match:
    - the beam height (as quoted in MICE note 151)
    - width of downstream shield (not yet defined)





Arranged beforehand to match PMT shielding of a crossed scintillators plane in front or at the back of KL

Conclusions

- **Work on KL construction is fairly progressing**
  - Module production under way
  - Recovery of materials (would be) completed (PMTs, HV, Discriminators)
  - FADC ordered
  - PMTs Shielding & Detector Assembling design is close to be finalized
- What's missing
  - Shapers and FTDC , … it would not be a big problem ….
  - Materials for detector assembling and installation
  - Costruction of PMTs shielding integrated in the supporting structure
  - Miscellanea (signal & HV cables partially recovarable, patch panels ….)
- What's the bottleneck
  - Present lack of funds for consumable and domestic travels
- Which are the main problems
  - Zero funding is not a threat anymore , it's the reality of facts for FY2007
  - Lack of approval would compromise our concrete contribution to MICE

… on the way to be overcome …