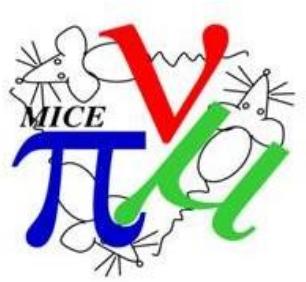


TOF plans and commisioning

M. Bonesini
Sezione INFN Milano Bicocca

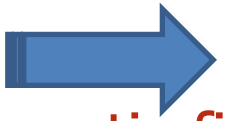
Outline

1. TOF status
2. TOF1 for STEP IV
3. The cage ``saga”
4. Conclusions

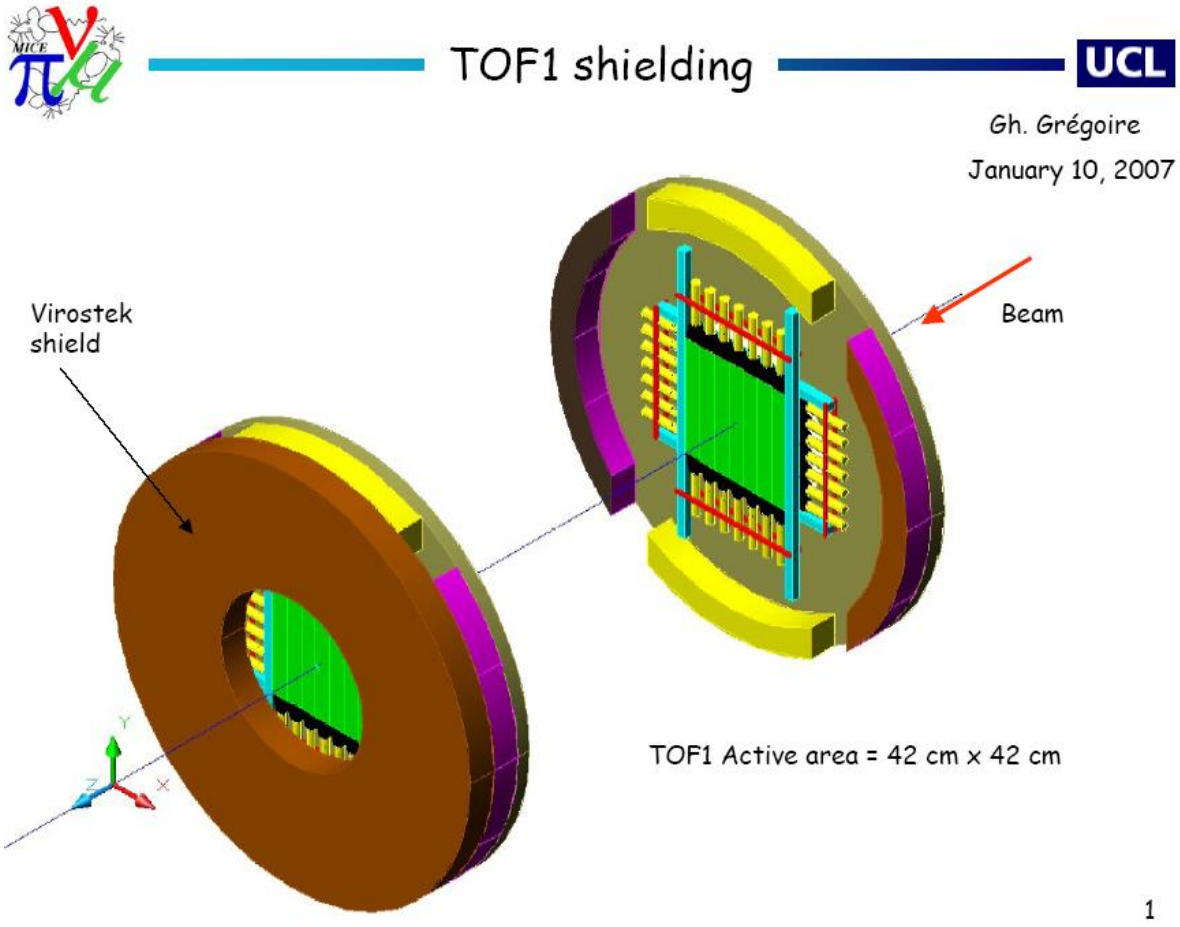
1. TOF system maintenance

- No major problems since 2009 (installation date …)
- Minor HW intervention on HV system (common with KL) end of last year

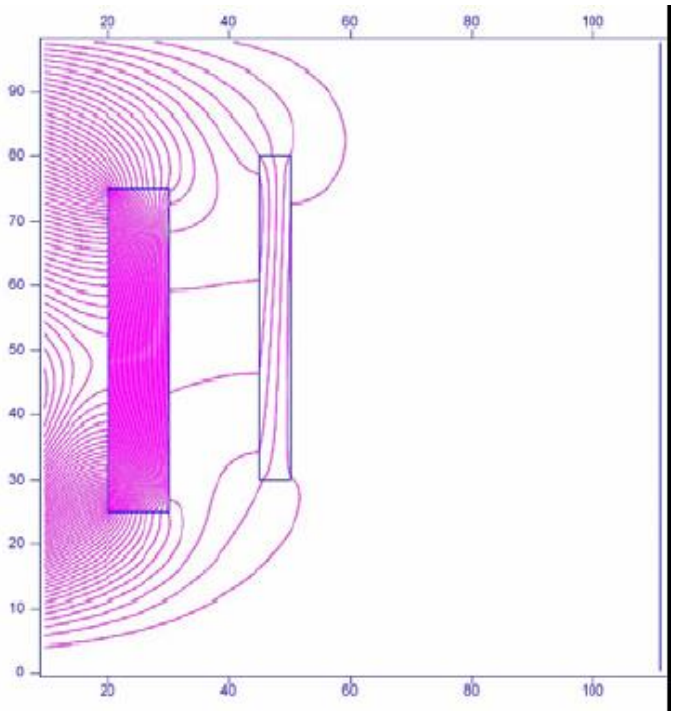
Perspectives for STEP IV run

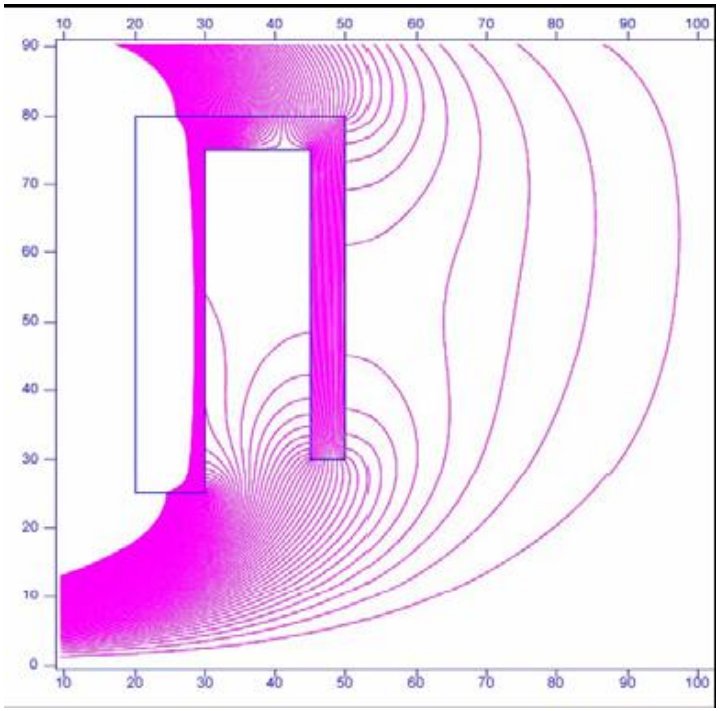
- TOF2 + KL have a local shielding  no problems foreseen from fringe magnetic fields
- TOF1 seems NOT to be shielded anymore by the so-called cage: PRY added, not right MC simulations, …
- I will remind just of few points of the cage-saga before going on

A remind of the cage saga



G. Gregoire Shield



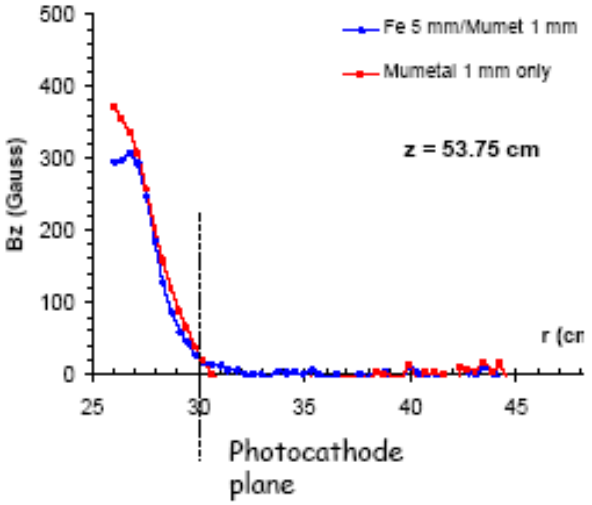


From presentation by ***G. Gregoire*** at PC-224

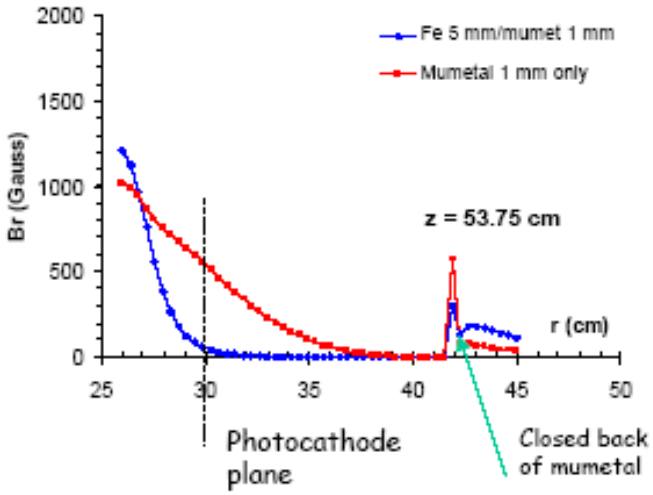
➔ Close outer gap between to discs; thicker 2nd disc (50mm)

Somewhat more complex – engineering / mounting TOFs….

Field components along PMT axis



Radial component for middle PMT



Longitudinal component for middle PM

It is seen that:

- The **radial** component remains very weak since the cage structure did already the whole job
- The **mumetal alone** is clearly not sufficient to get an acceptable **longitudinal** component.

Central hole diameter = 600 mm

1-mm mumetal only

At the end we were forced to have a cage for TOF1 … [we, as TOF group, were NOT in favour of it]: it added complications to HW

The cage phantom hings around

What to do ?

- PRY seems to reduce fringe fields anywhere at <25 Gauss. If so we are fine, maybe redo TOF1 support using ``rollo guides" to fix it on bars hanging out of Q9 [to have some freedom]

If not …

- Change PMT readout (sensitive to fields) to SiPMT-array readout (insensitive to B fields)
  - Pros: no problem whatever B field you may have up to several Teslas (insensitive to any MC bug)
  - Cons: it will be a completely NEW detector
- See if local shielding (as TOF2) may be used with present R4998 PMTs
  - Pros: Same detector as before
  - Cons: you have to rebuilt the detector mechanics
- Other solutions ???

Behaviour in B field of R4998 PMTs

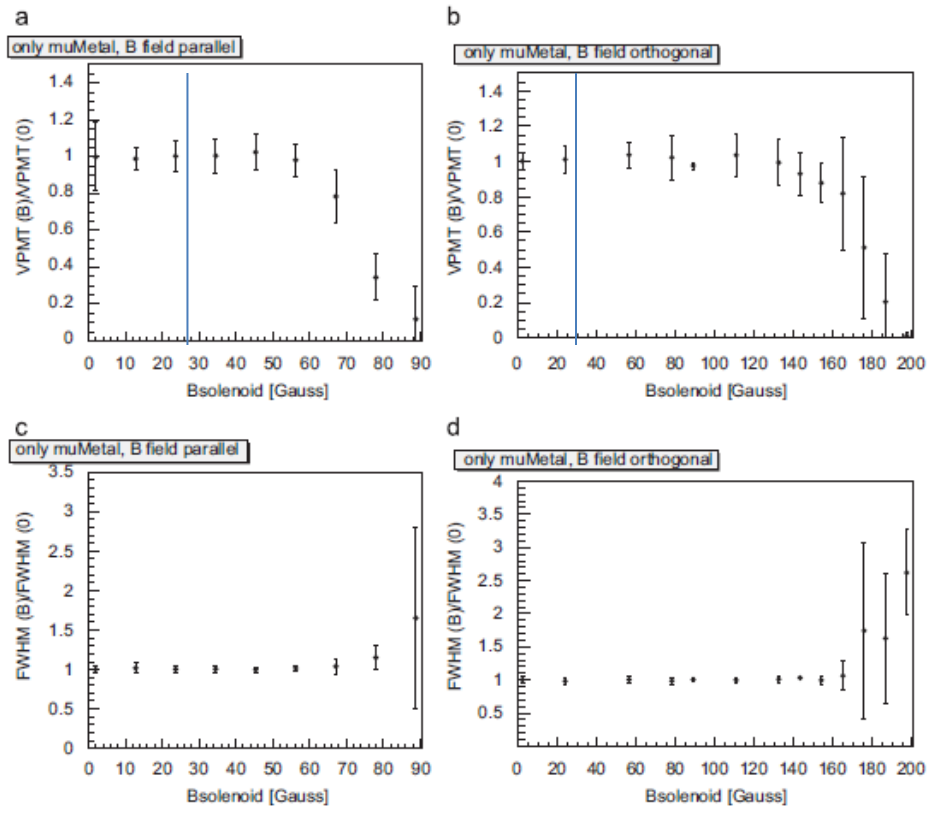


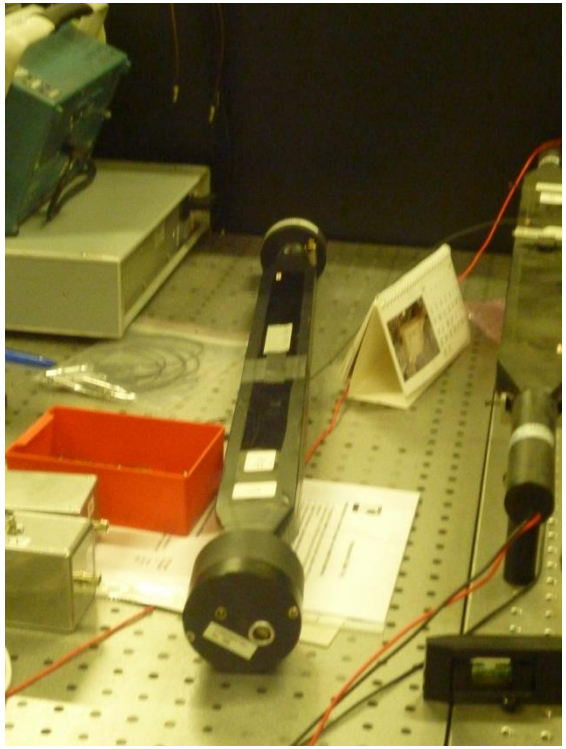
Fig. 7. Signal ratio at field B and $B=0$ G and FWHM ratio at field B and $B=0$ G for the timing difference, measured as $\Delta t = t_{START} - t_{STOP}$ with only the mu-metal shielding 1 mm for the PMTs. Left panel: longitudinal field, right panel: orthogonal field. The plots show the average and rms for a sample of 10 R4998 PMTs.

If fringe field is <25 G we are OK, if not see next slides

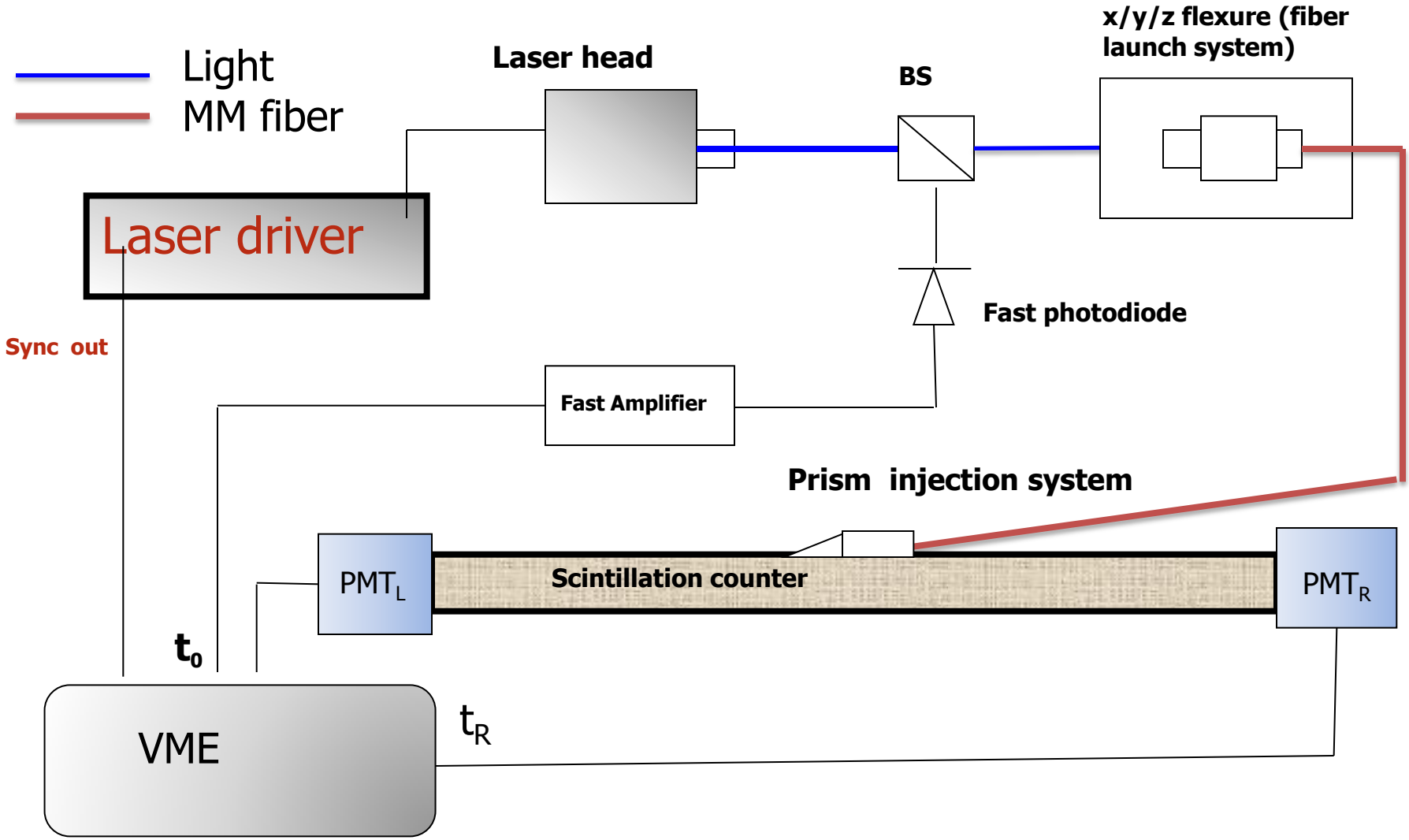
By the way, I think we must have TOF1 on rollo guides to have the possibility to move it further away from SC, if needed

1. A SiPMT array readout solution (presented in CM37)

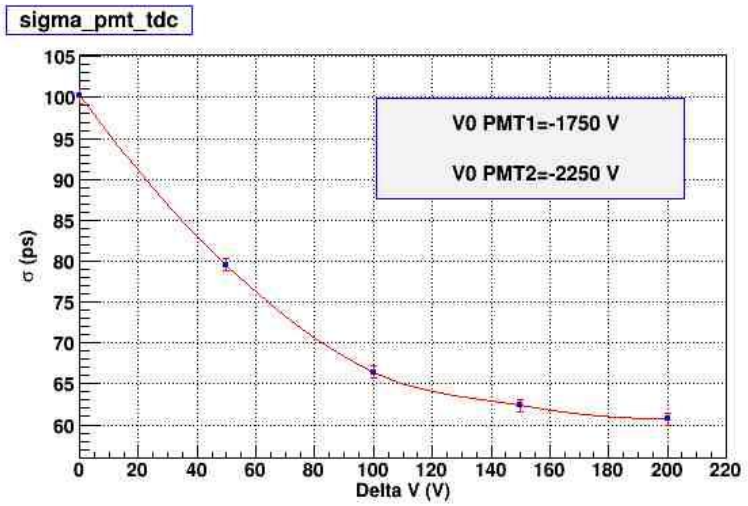
- We were serioiusly concerned with the level of stray magnetic fields in the MICE Hall: bigger than foreseen by GG/JC/… ??
- Study a straight backup solution for present TOF stations, in case of problems : with SiPMT arrays readout (not sensitive to B fields up to few Tesla) replacing conventional PMTs (R4998)
- Idea: just use 2 SiPMT arrays instead of 2 PMTs with the same TOF mechanics layout, lightguides …



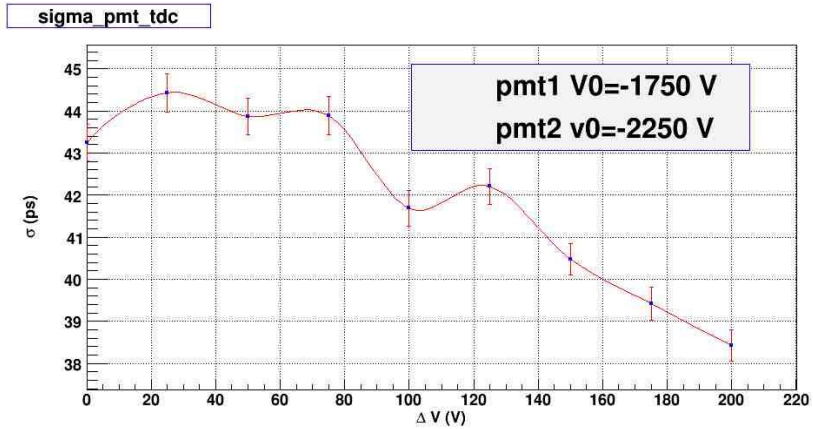
Experimental lab setup



Results with conventional PMTs (as benchmark)



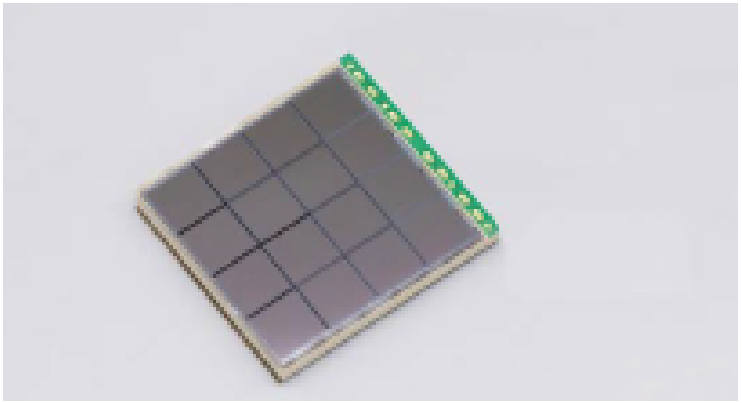
Very low laser light intensity (1 MIP or less)



Standard laser light intensity (2-3 MIP)

$V_{op} = V_0 + \Delta V$

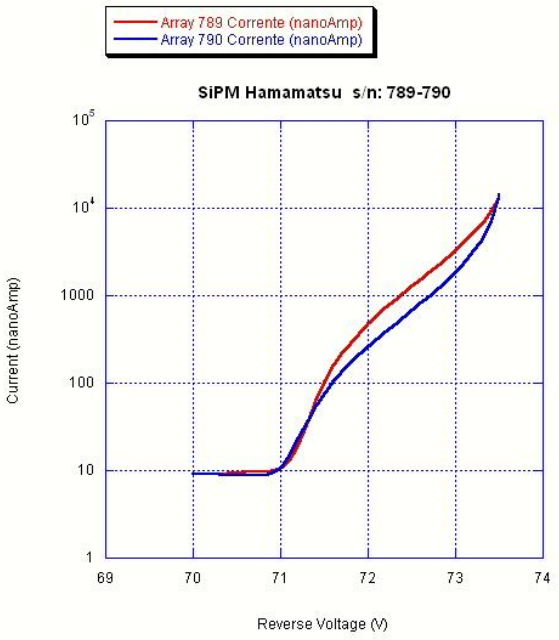
Results with Hamamatsu S11828-3344 Arrays



Monolithic MPPC array in SMD package
S11828-3344M

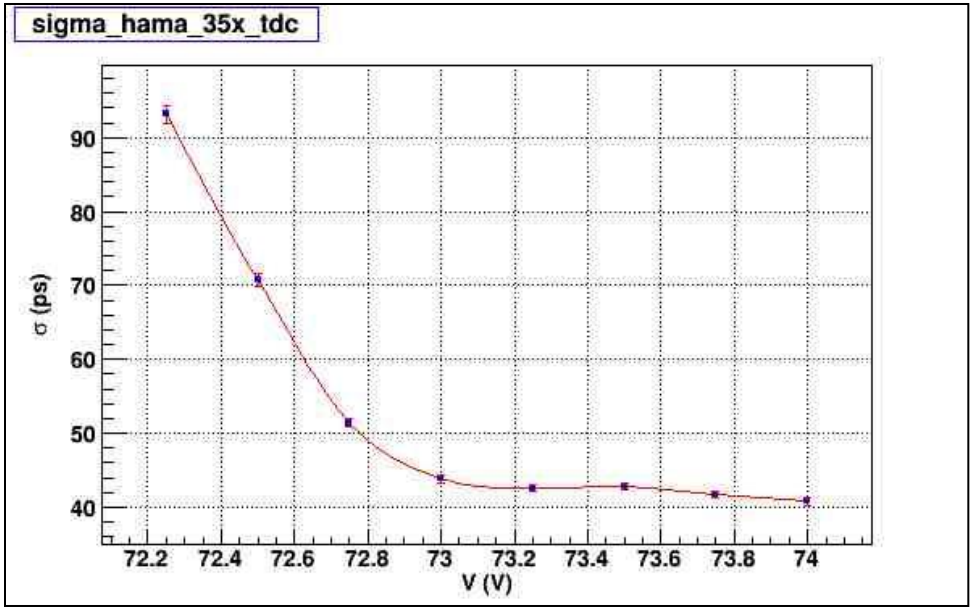
Features

- Monolithic array: 16 ch (4 × 4 array)
- Nonmagnetic package
- Effective active area: 3 × 3 mm²/ch
- Pixel pitch: 50 µm
- Allows multiple devices to be arranged in a buttable format



SiPMT I-V characterisation
(our characterisation)

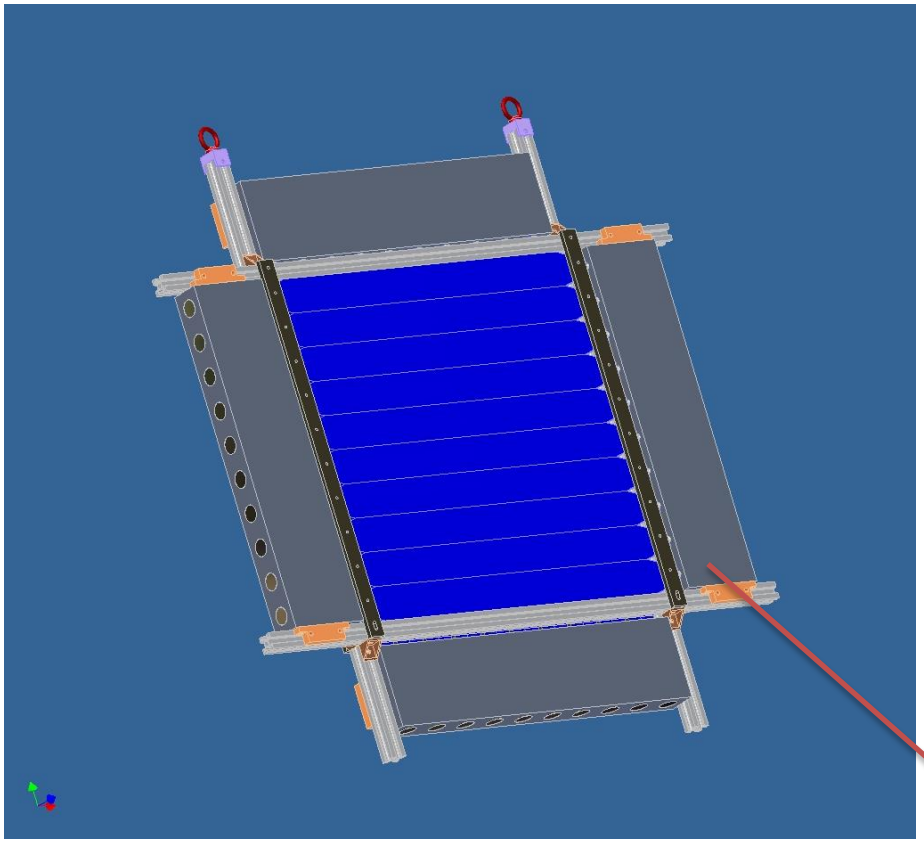
Results with Hamamatsu S11828 Arrays



Standard light intensity

We foresee soon tests with Hamamatsu S12642 arrays, TSV package , where better results may be expected

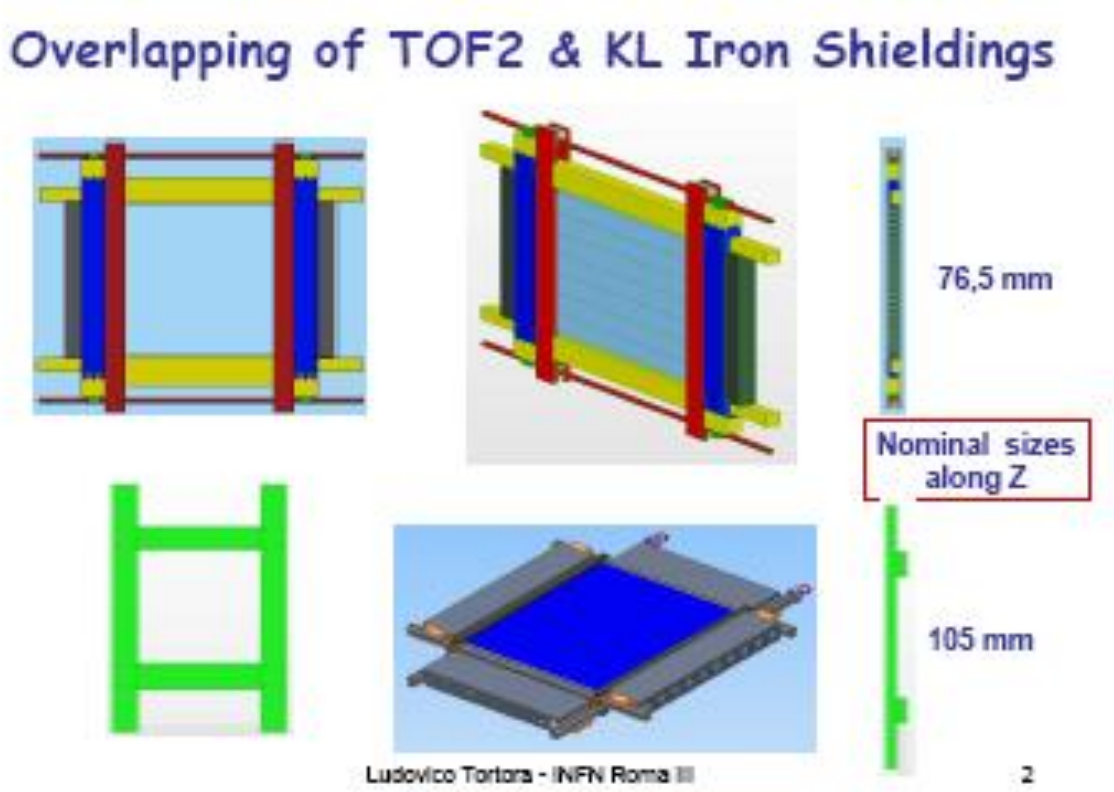
2. TOF1 local shielding



- Not clear if it will work at TOF1 position
- Not clear if present mechanics may be fitted

~30 Kg

Some details on local shielding



Conclusions

if residual fringe field after PRY is < 25 G all is fine; if not see below:

- SiPMT arrays may be a good replacement for fast PMTs in scintillator time-of-flight system
- but for a working detector a lot of engineering is needed to fit inside the present mechanics framework
- A more quick solution may be local shielding as in TOF2

Pros: same detector as before, limited amount of work to do it

Cons: no HW funding for INFN upgrades (it must go on CF budget, mechanics work on external firm …), work to be done

REQUEST: before any decision we need a full and validated simulation of the shielded TOF1 detector (CAD model may be provided)