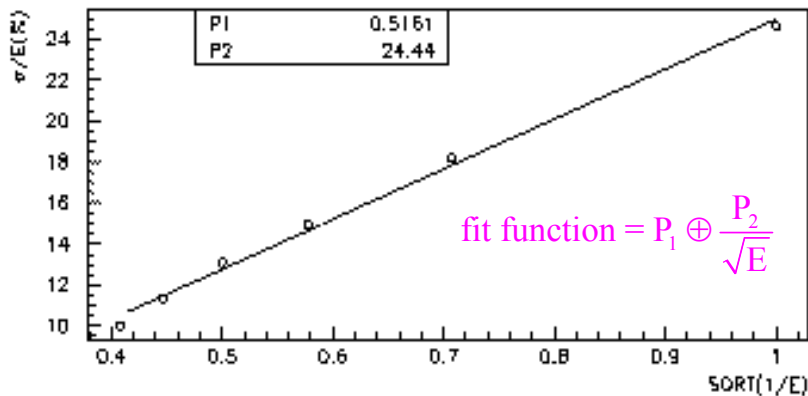
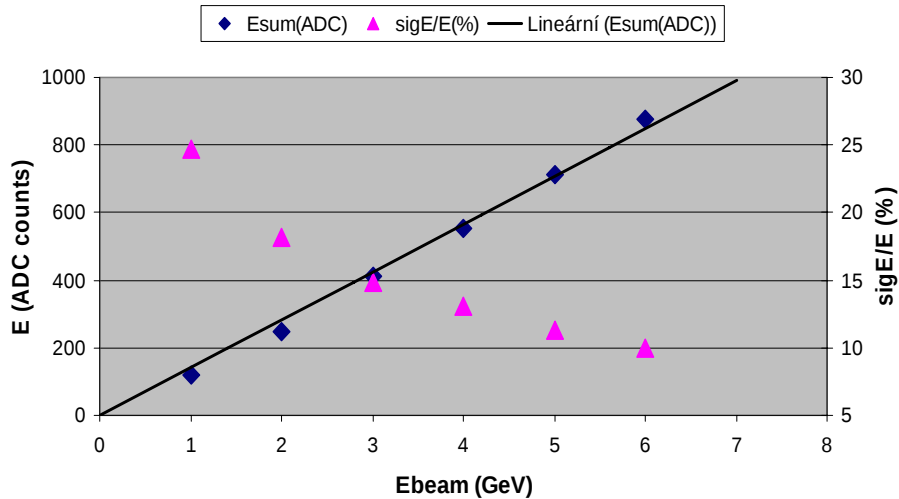


Planes instrumented with APD's for 1m³ PPT –HCAL-CALICE

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Energy resolution with APDs



- Good linearity, small systematic deviation in the slope (beam not in the tile centre?)
- No estimate of systematic error yet

- Energy resolution comparison:

Fit values for	PM	APD	MC
P_1	0.1 ± 0.2	0.5	0.4 ± 0.2
$P_2(\%)$	21.0 ± 0.4	24.4	17.1 ± 0.1

SiPM values similar to PM values

- reasons for worse resolution:
 - noise of APD
 - lower tile light yield (estimate: 17 ph.e./tile)
 - tile alignment (alignment with beam)
 - calibration

Solution

- APD, (APDg) tested with (3) preamps and best available scintillation tiles + WLS fibers.
- Insensitive to high magnetic fields
- Available Tile + WLS systems and arrangements for:
 - 1 APD in each tile
 - 3 Tiles on 1 APD

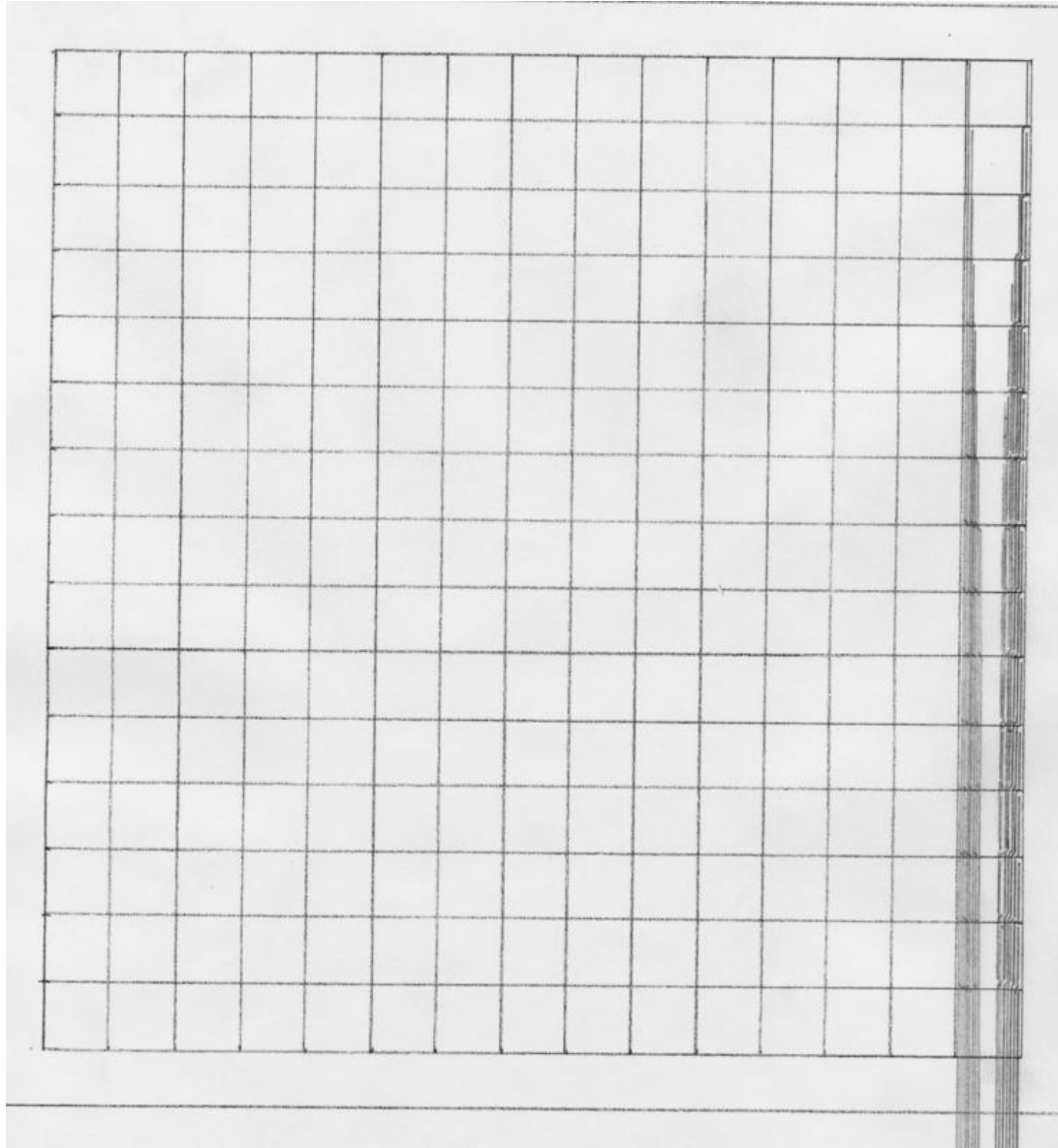
Material for 3 tile sizes

30 x 30mm - 900 tiles $(30 \times 30)/1\text{m}^2$ (x3) = 2700 tiles
for 3 planes - 900 APD
scintillating fibres – 2070m
calibration fibres – 2070m

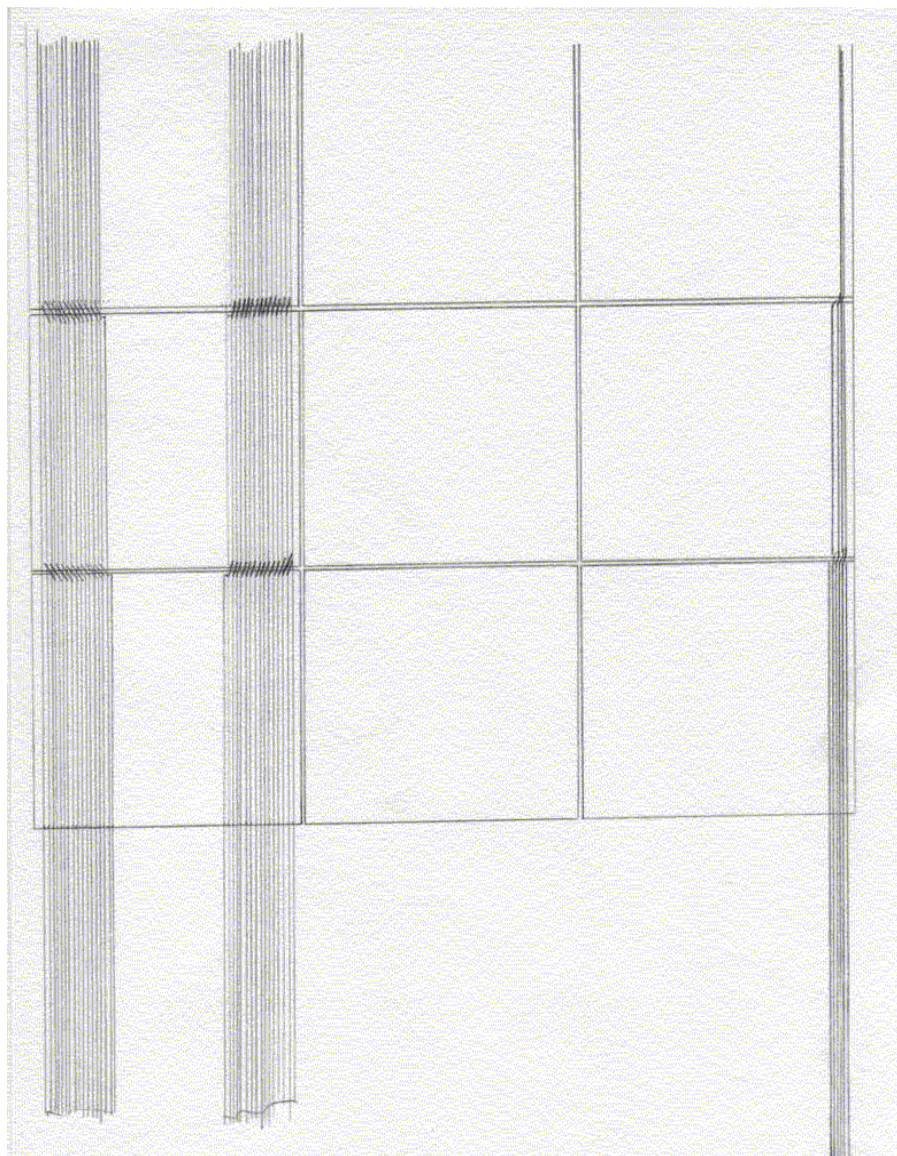
60 x 60mm - 225 tiles $(15 \times 15)/1\text{m}^2$ (x3) = 675 tiles
for 3 planes – 225 APD
scintillating fibres – 550m
calibration fibres – 550m

120 x 120mm - 64 tiles $(8 \times 8)/1\text{m}^2$ (x3) = 192 tiles
for 3 planes – 64 APD
scintillating fibres – 160m
calibration fibres – 160m

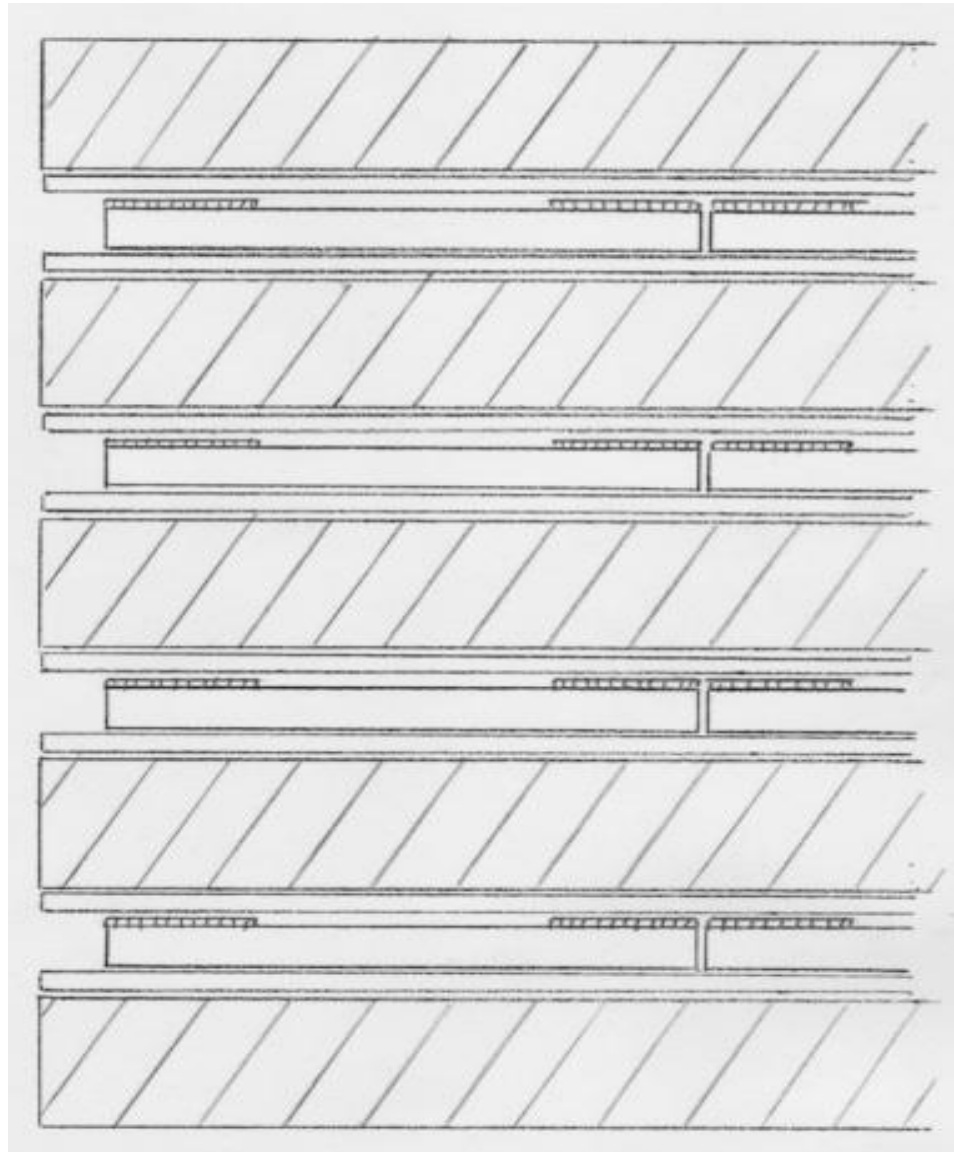
Plane 1m² instrumented with 60x60mm tiles



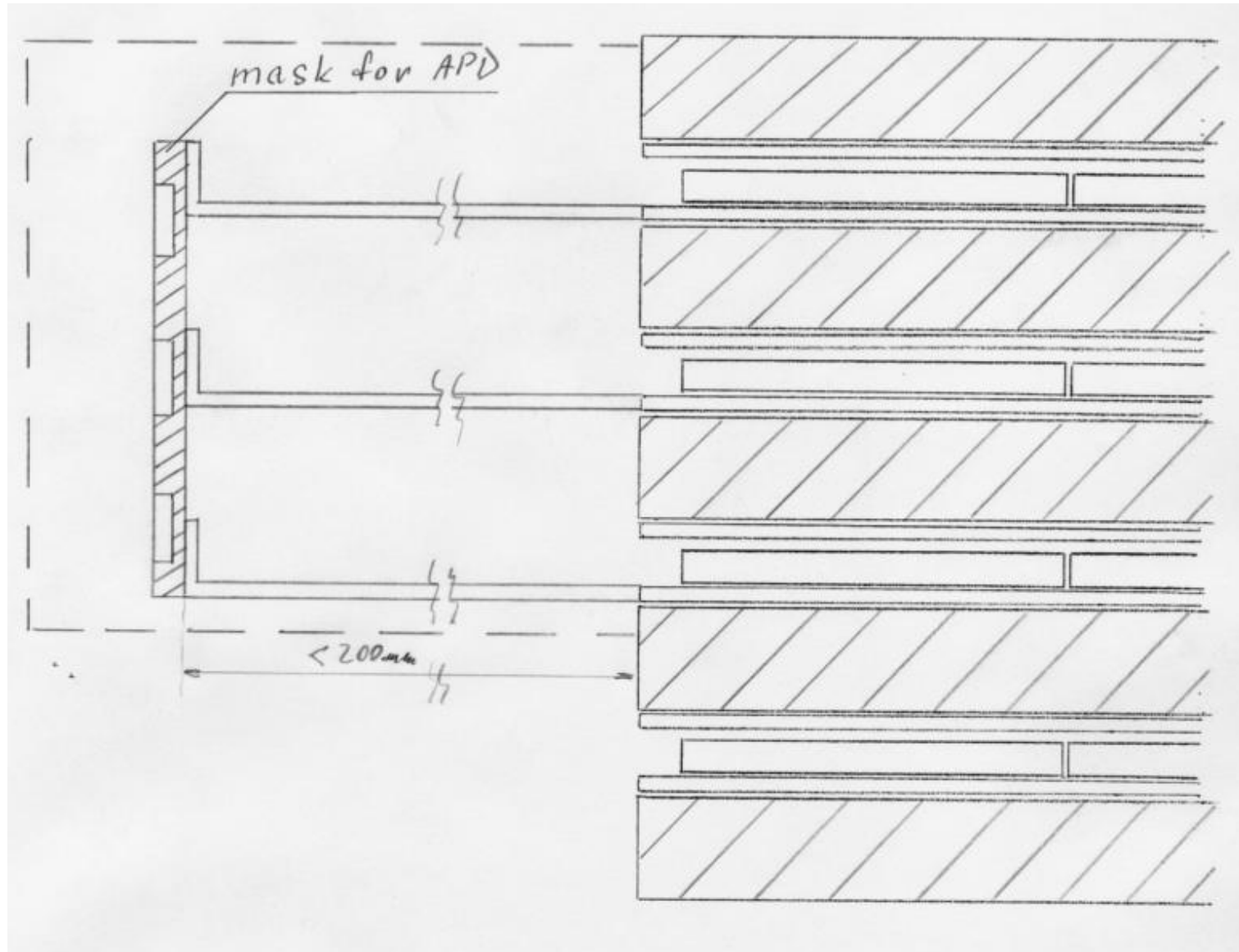
Detail of one row



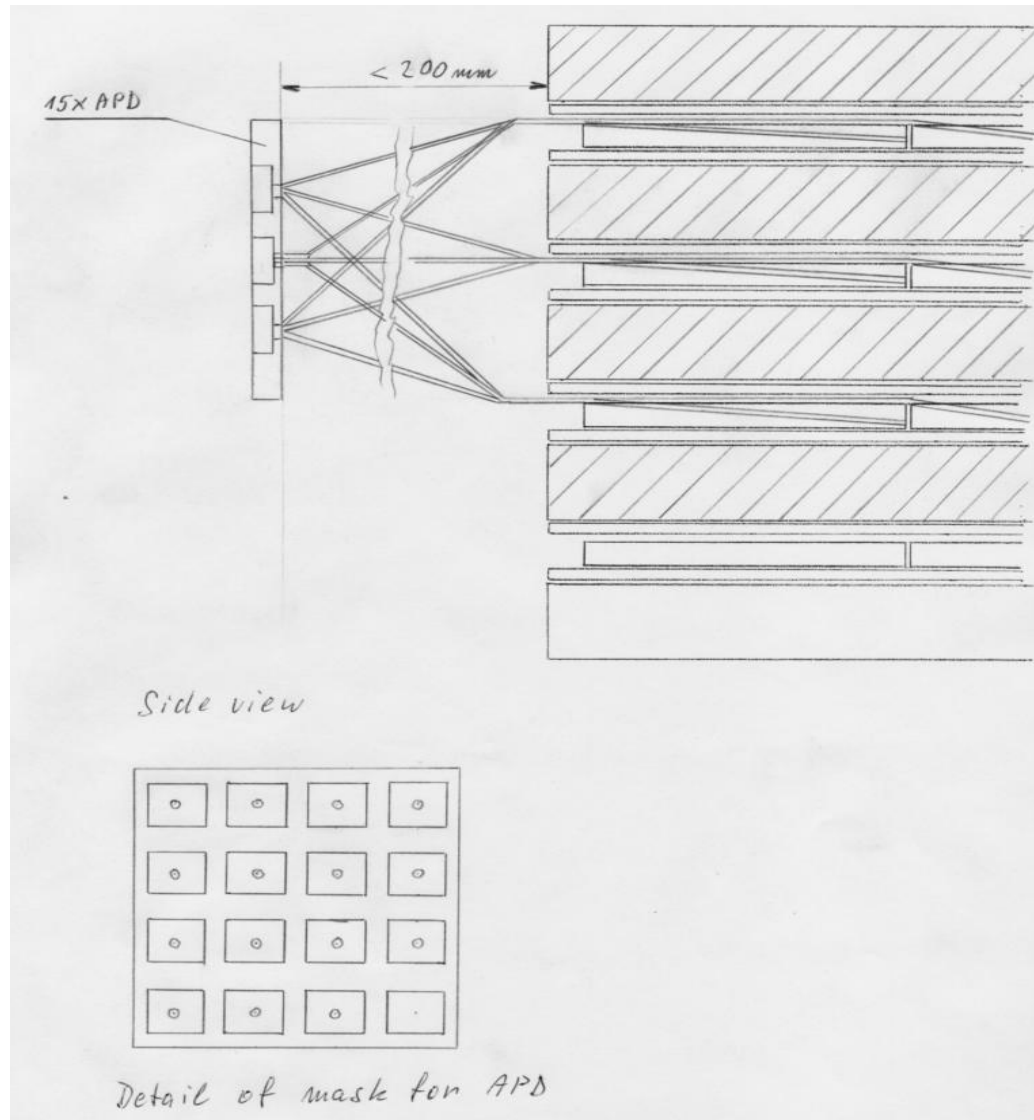
Front view of absorbers and cassettes



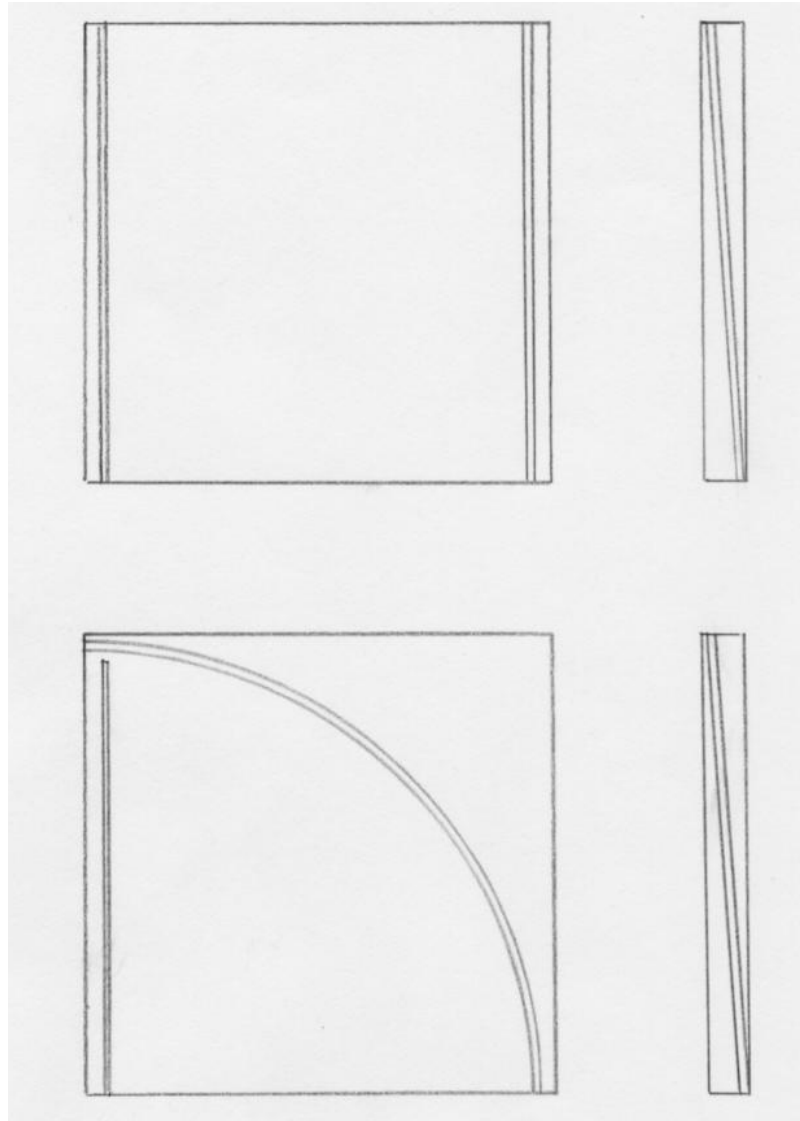
Side view of 3 planes with light tight box



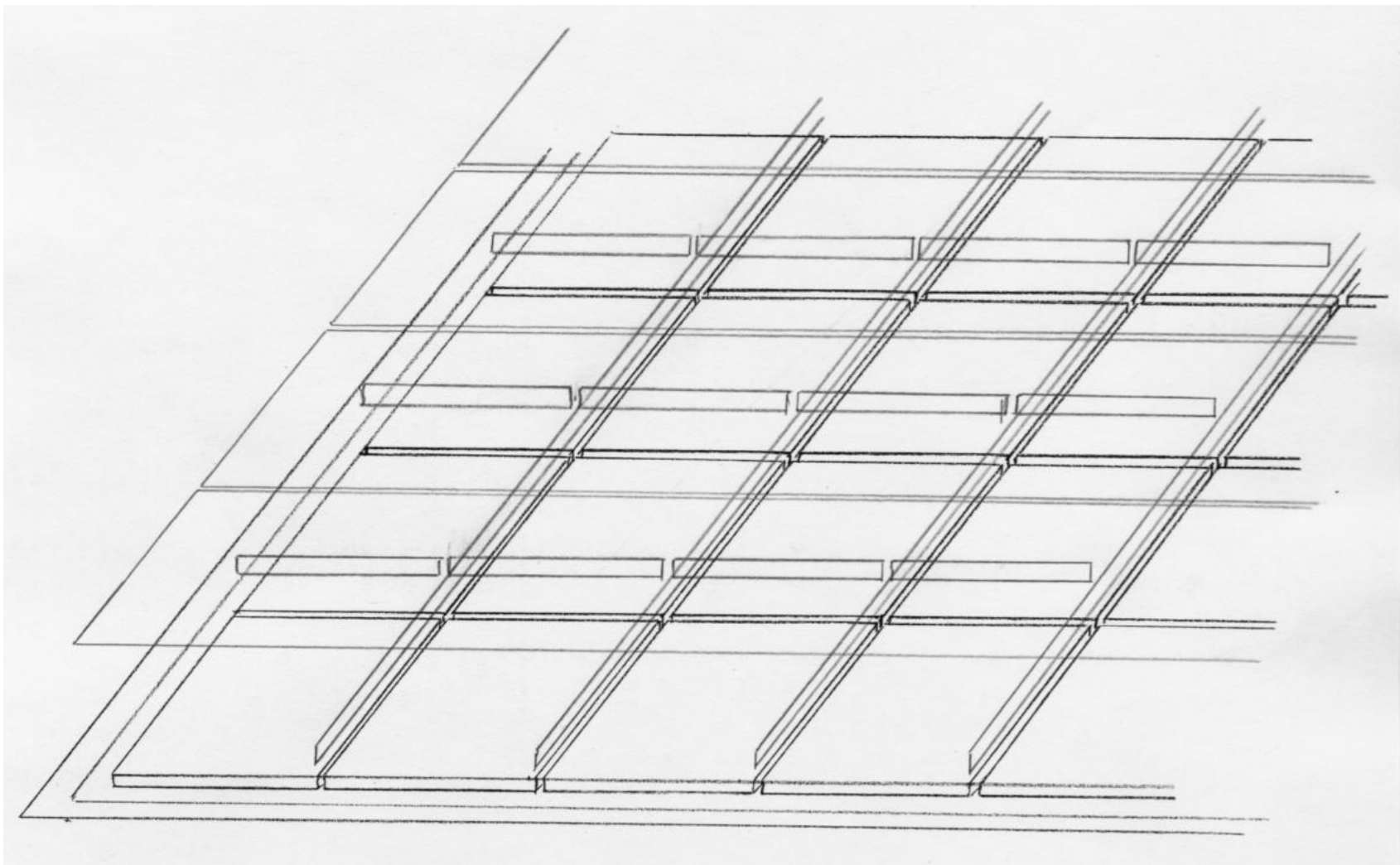
Side view + detail of mask for APD



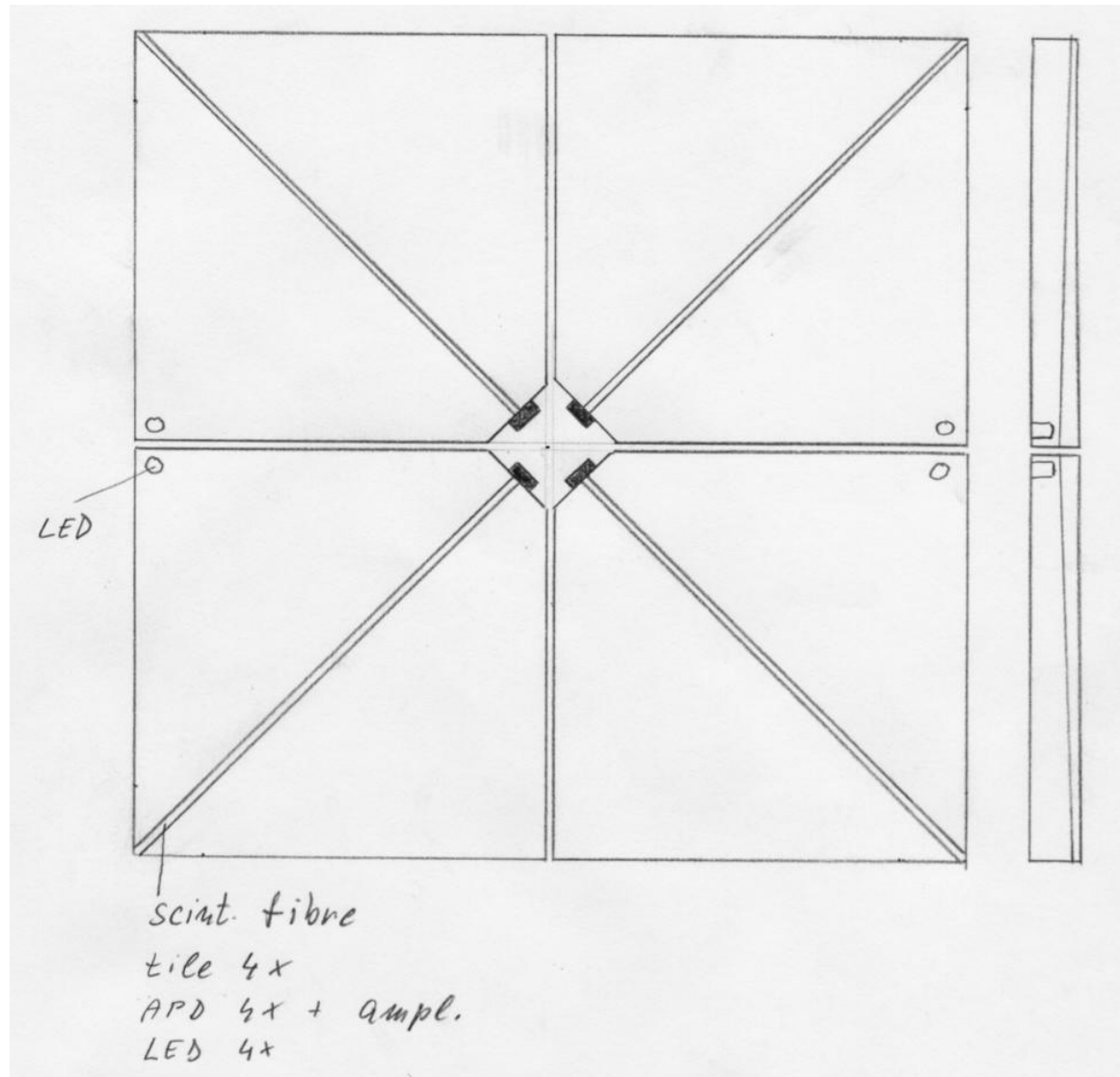
Top view and side view of grooves for WLS



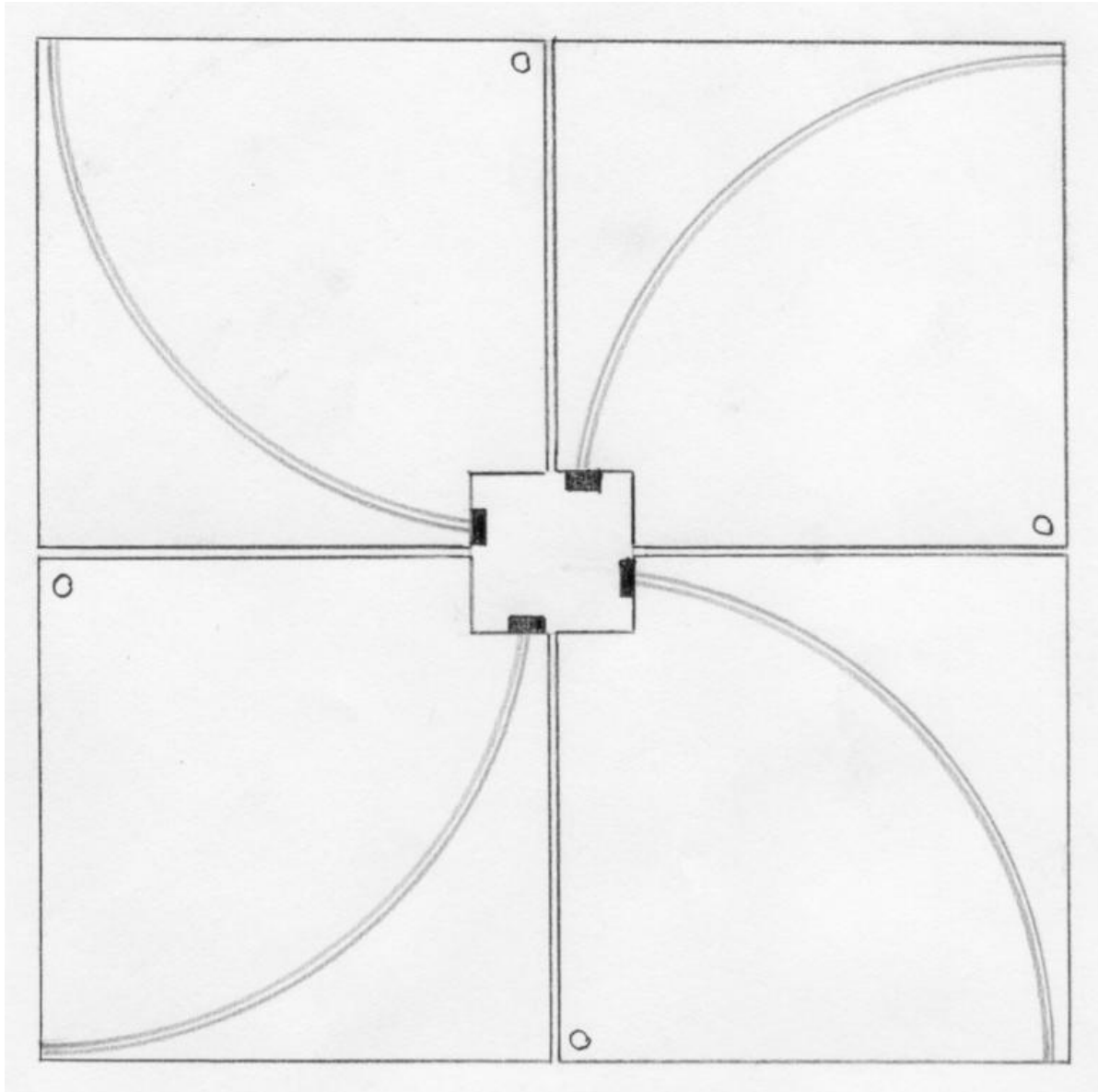
3D – view of tiles and reflection 3M foils



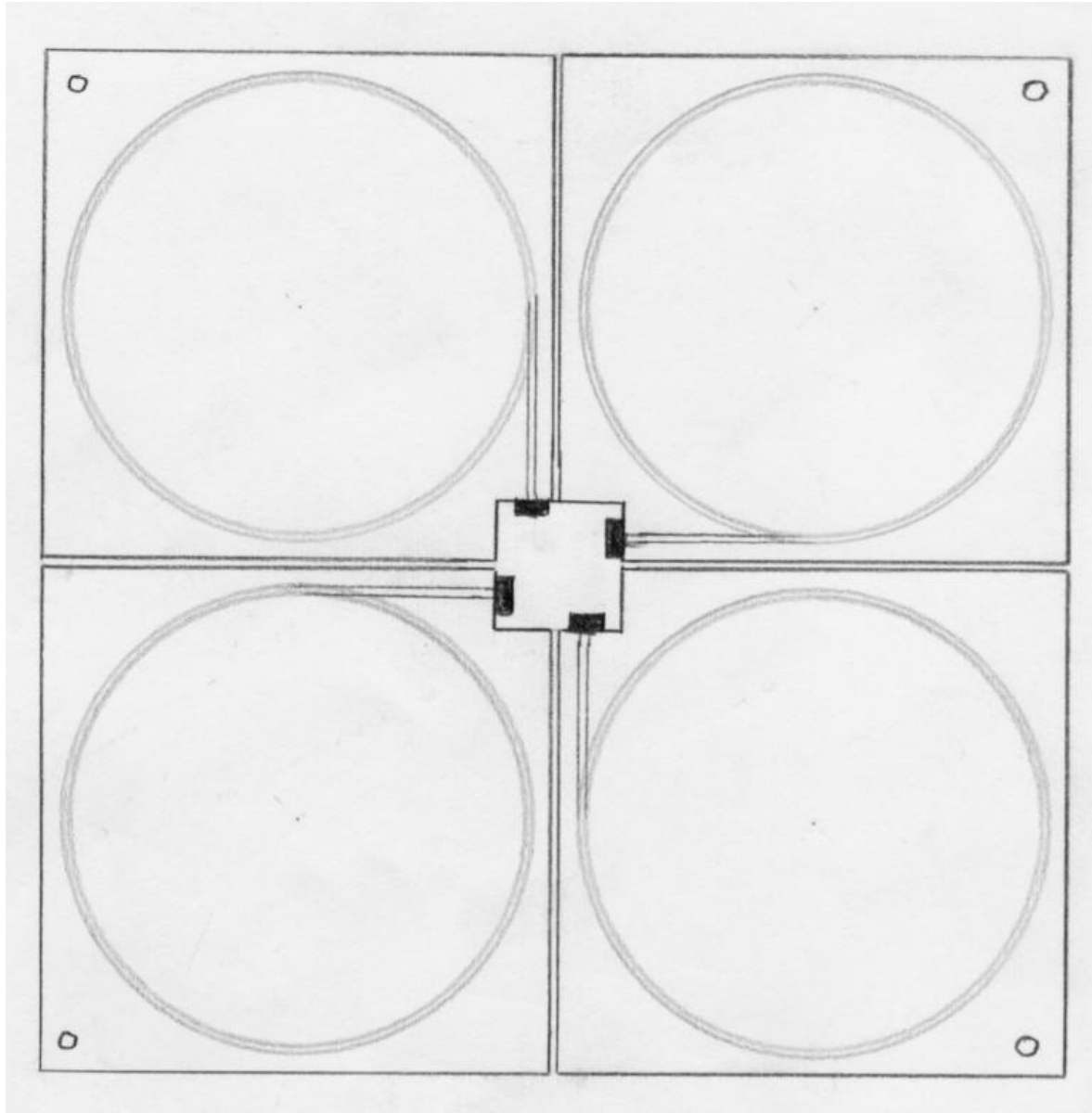
Four tiles equipped with four APDs readout by one preamp - board



Different geometries for WLS fibers



Different geometries for WLS fibers



Conclusions

- Tested APD (Hamamatsu S 8864-55) show good performance – similar to PMT and SiPM.
- We are looking for the cheap APD or APDg (1mm^2) Suitable for the light detection from single tile. (See Preprint 11-03, ITEP, 2003.)
- For the tested (3mm^2) APD's we prepared design for 'Tile + WLS + APD' instrumentation for 3 consecutive planes.

