APD Test Beam (preliminary) Results

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on behalf of $(see next page)

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APD Meeting

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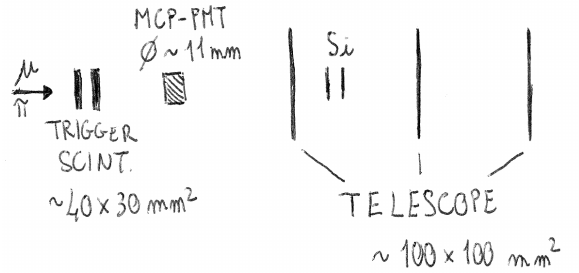
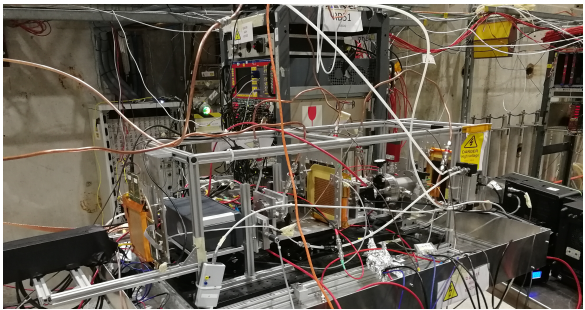
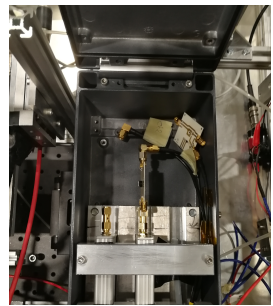
Setup



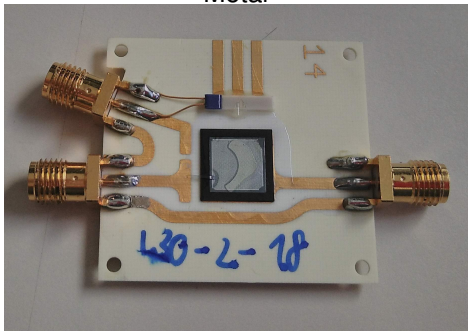
- 100 GeV μ, a few runs with π
- CIVIDEC 2 GHz 40 dB ampli
- Agilent 2.5 GHz 10 Gs/s
- Temperature, bias, and current logged
- Tracking and timing provided by RD51
- MCP-PMT signal shaped to have a few points on leading edge





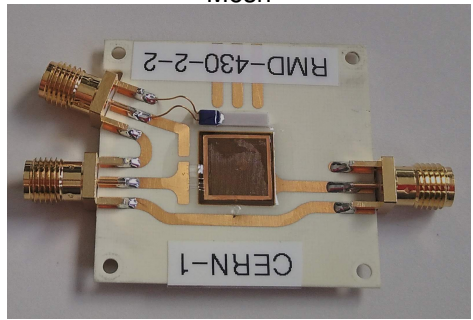
Today's Data

Metal



- (430-2-20) 1775 V
- Run number 2018-05-03_18-40-04, telescope run 1324, ≈12k events
- Noise 3.8 mV

Mesh



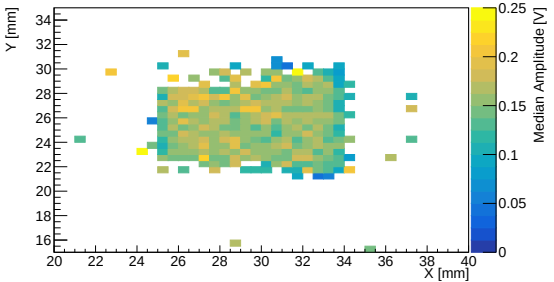
- (CERN-1) 1775 V
- Run number 2018-08-15_00-50-59, telescope run 1675, ≈66k events
- Noise 4.8 mV

Different oscilloscope scales were used

Similar conditions ⇒ a comparison is possible

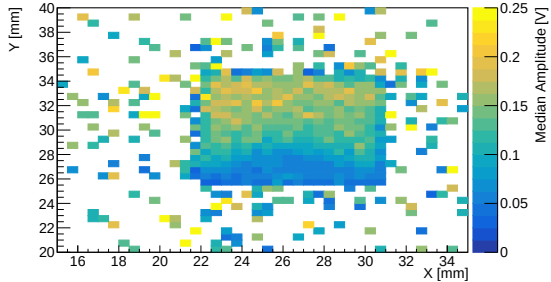
Median Amplitude

Metal



- Fairly uniform

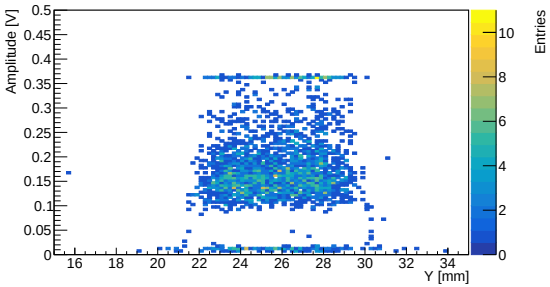
Mesh



- Decrease close to contact to p-side

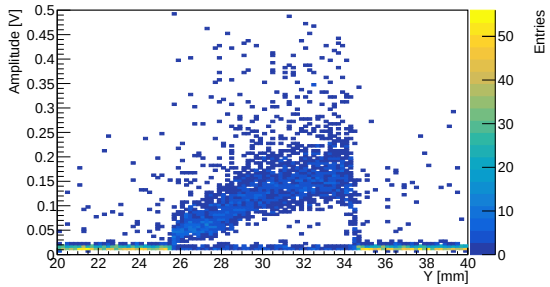
Amplitude Slices Y

Metal



- Fairly uniform

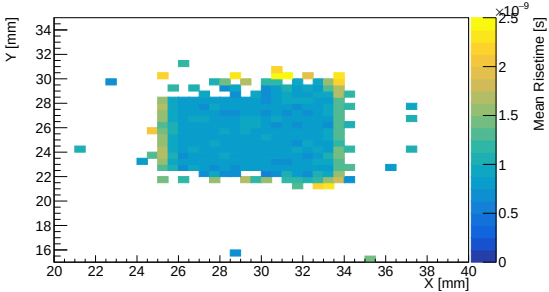
Mesh



- The amplitude decrease close to p-side contact

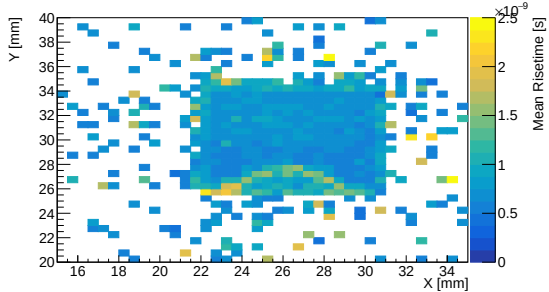
20-80% Rise Time

Metal



- Higher values at edges

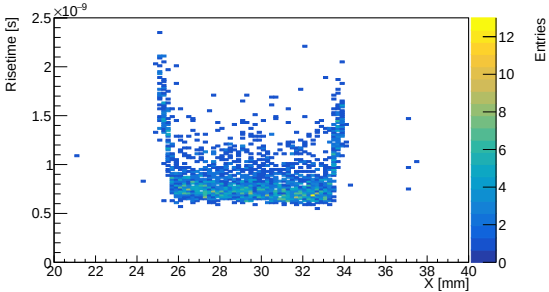
Mesh



- Same feature as amplitude

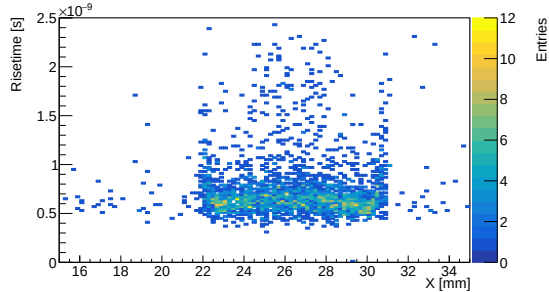
20-80% Rise Time Slices X

Metal



- Long tails at detector edges

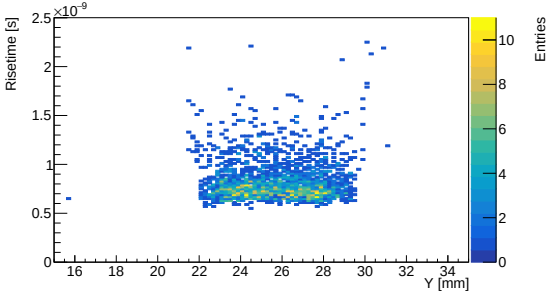
Mesh



- Better performance
- Tails less pronunced

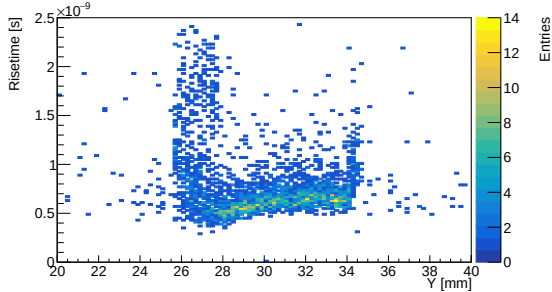
20-80% Rise Time Slices Y

Metal



- Tails cannot be seen due to trigger envelope

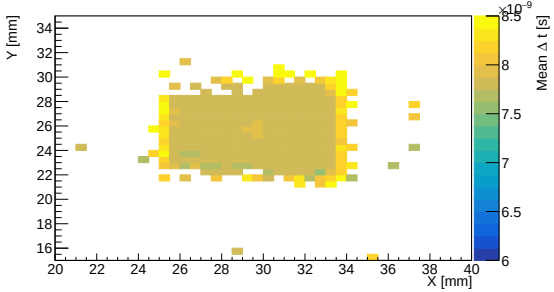
Mesh



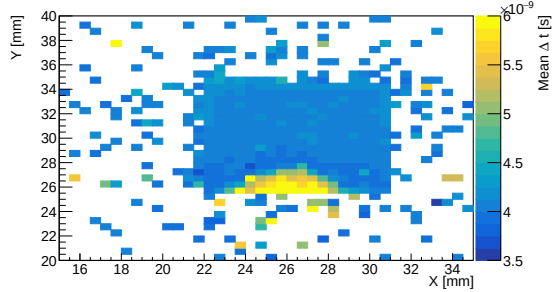
- Tail at lower Y values due to contact

Time of Arrival

Metal



Mesh



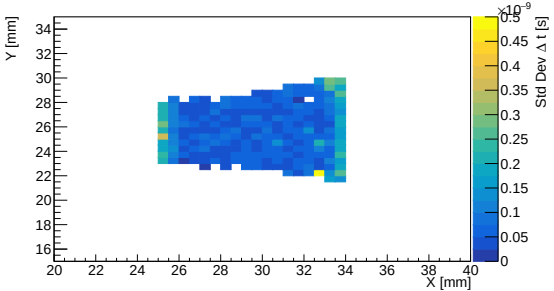
- Delayed arrival time at edges
- Non-homogeneity at center (p-side metallization hole)

- Non-homogeneity at p-side contact

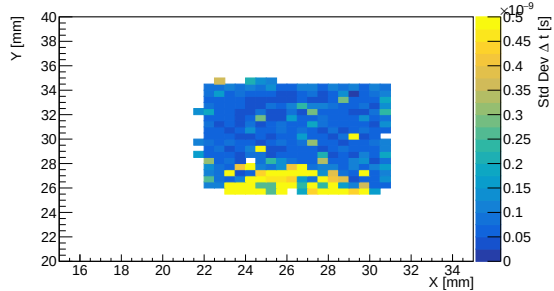
Slices in X and Y reflect the behavior of rise time

Time Resolution

Metal



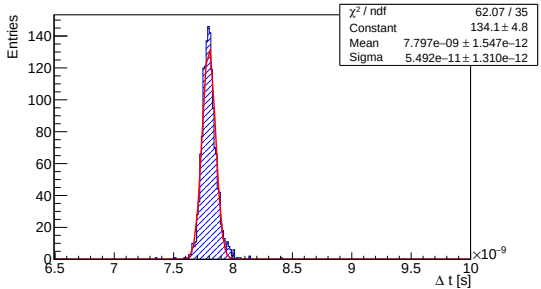
Mesh



Similar features as for time of arrival and rise time

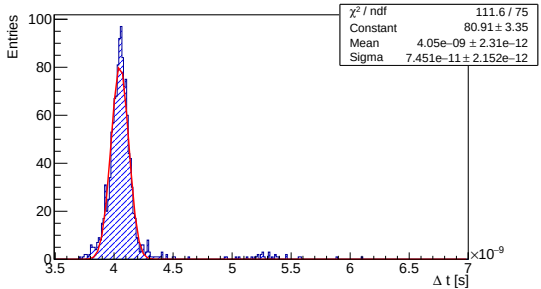
Time Resolution

Metal



- Full area minus edges: $\sigma_{\Delta t} = 55 \pm 1$ ps
- Excluding non-uniformity: $\sigma_{\Delta t} = 50 \pm 2$ ps (reducing area)

Mesh



- Full area minus edges: $\sigma_{\Delta t} = 75 \pm 2$ ps
- Excluding non-uniformity: $\sigma_{\Delta t} = 56 \pm 2$ ps (reducing area)

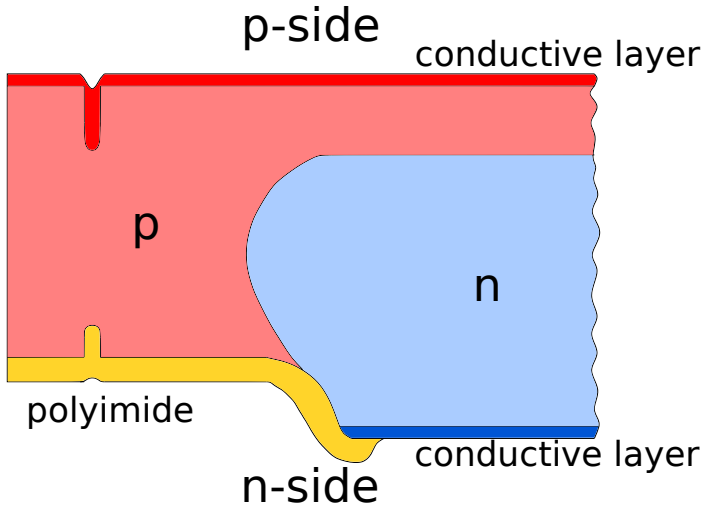
Time resolution of MCP-PMT to be determined

Summary

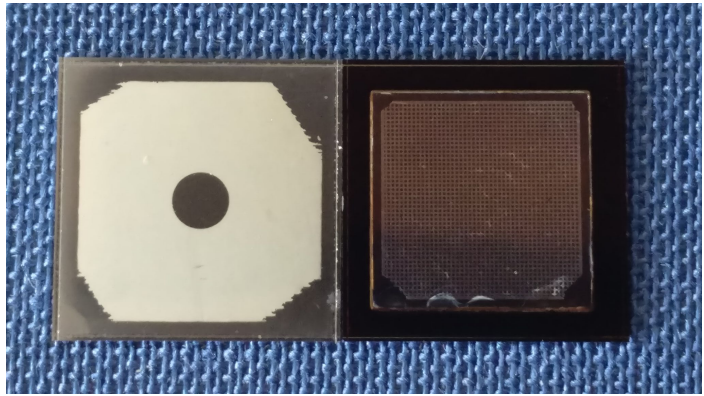
- Finally a comparison between mesh and non meshed devices
- Non-uniformity in metallized sample: hole in p-side metallization $\Rightarrow$ can be fixed easily
- Non-uniformity in mesh sample: effect of p-side contact
  Hypothesis:
  - Kapton locally more distant from sensor surface (non-uniform capacitance)
  - Non-uniform resistance on p-side to ground
- More pronounced tails in rise time (and ToA) of metallized APD: could it be effect of n-side readout?
- Note: tried to apply low pass filters to the signals $\Rightarrow$ no significant effects

Backup Material

APD Section (Not to Scale)

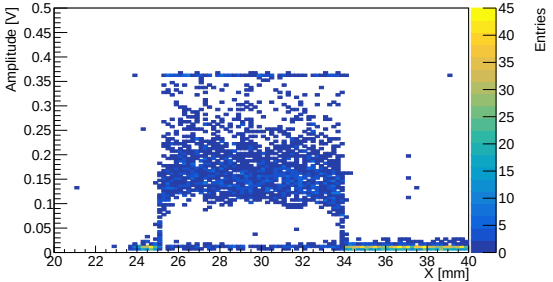


Metallization

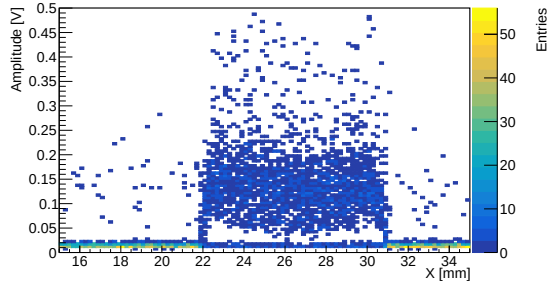


Amplitude Slices X

Metal

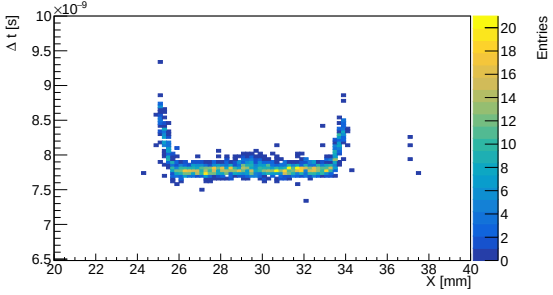


Mesh

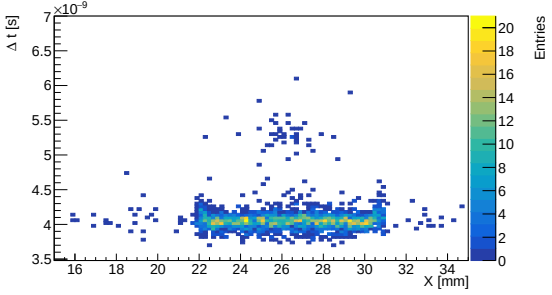


Time of Arrival Slices X

Metal

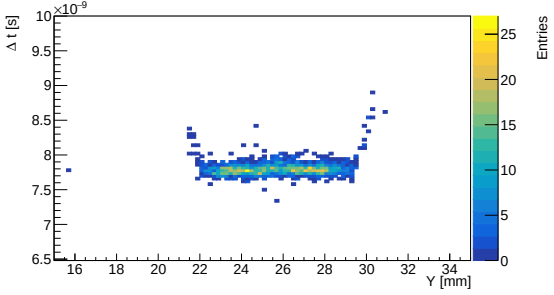


Mesh



Time of Arrival Slices Y

Metal



Mesh