Updates on the Megatile Prototypes

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Including the PRISMA detector lab team:
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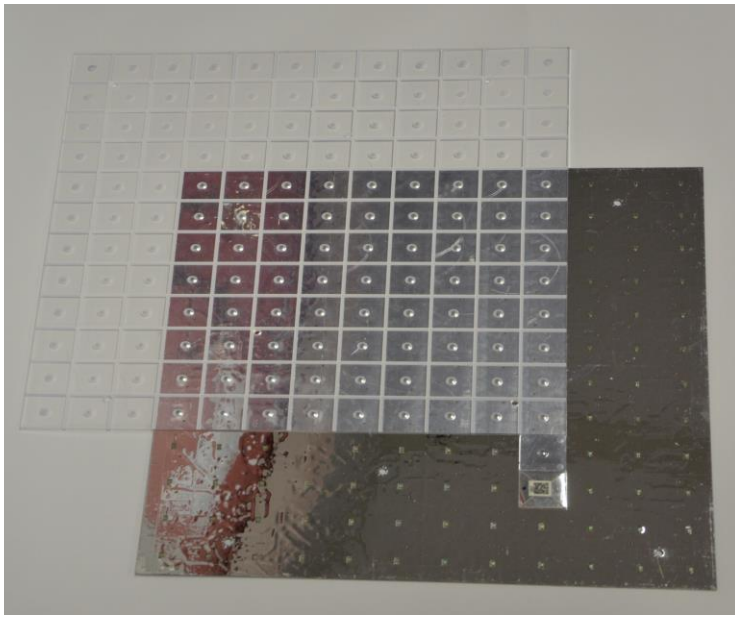
AHCAL main meeting

08.12.2021

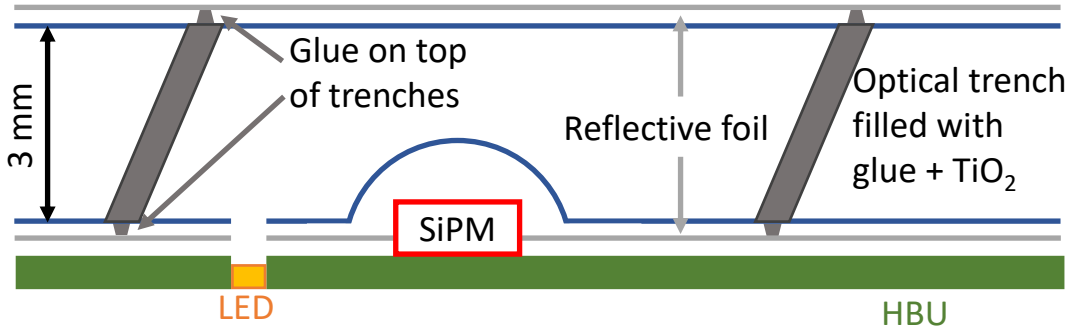
Megatile Concept

- Large 36x36 cm^2 scintillator tile
- Cut trenches at 30°
- Fill trenches with glue + TiO_2 mixture
- Dimple: Same as for single tiles



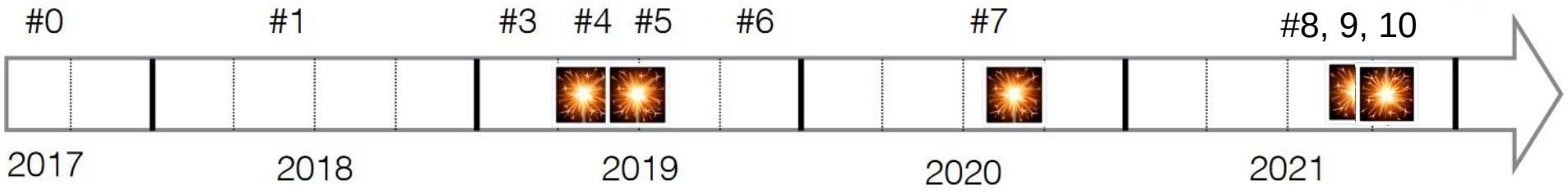
Megatile Concept

- Covered with reflective foil
- Air gap needs to be well controlled for total reflection
  - Too large gap produces cross talk
  - Glue foil to scintillator along trenches
- Edges sprayed with varnish to improve light tightness and reflectivity of edge cells



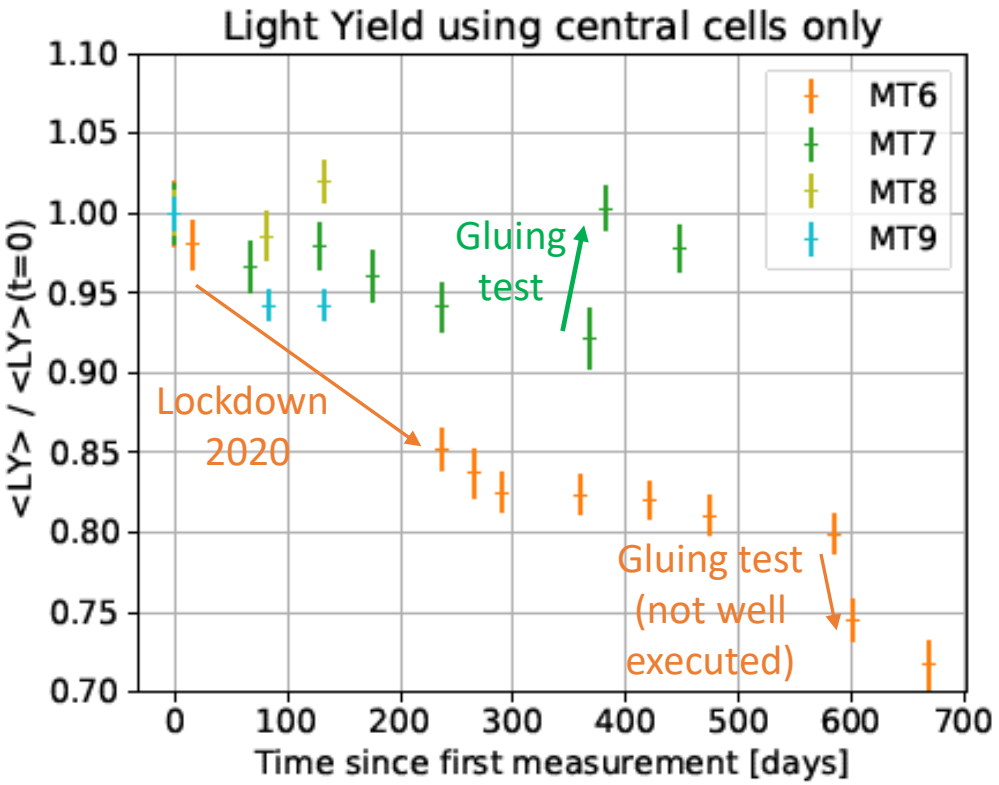
Megatile Development

- Project started in 2017
- Already 10 prototypes built with steady improvement
- Continuously tested in cosmic test stand in Mainz
- 5 test beams at DESY II
- Latest TB in comination with KLAUS HBU



Ageing Effects

- Light yield observed over a long time period
- Small decrease of <~5%/year
- Cause still under investigation
- Megatiles have to be stored in the dark



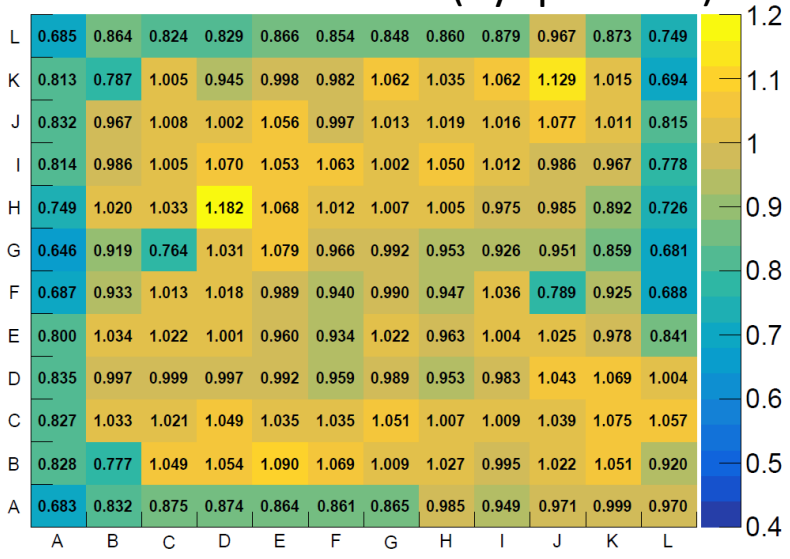
Light Yield (MT 10, Varnished)

- High light yield in center with mean of 35.2 p.e./MIP
- With varnish: LY in edge channels improved
- Uniformity map: For each quadrant, plot LY/<LY in central channels>
- Still optimising varnishing procedure

See talk by Antoine at last CALICE Collaboration Meeting

LY map (Data from Cosmic Ray Test Stand)

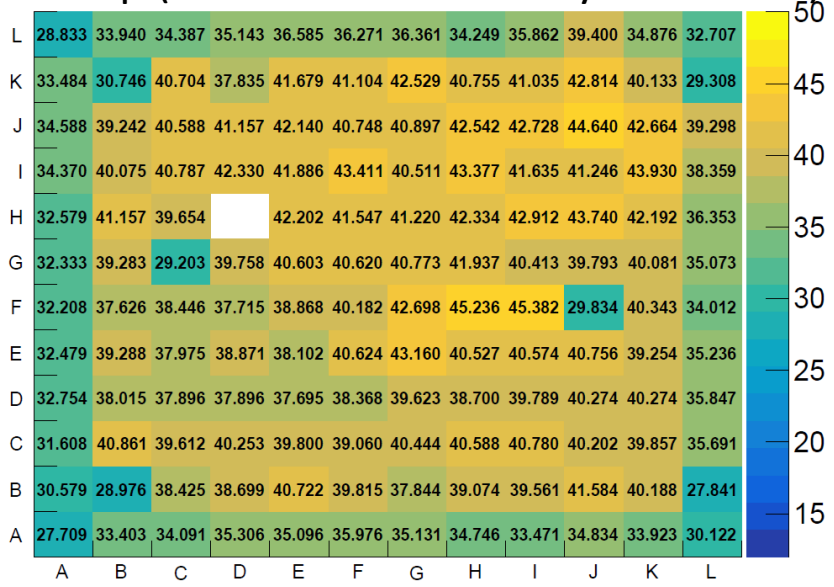
Ratio to center cells (by quadrant)



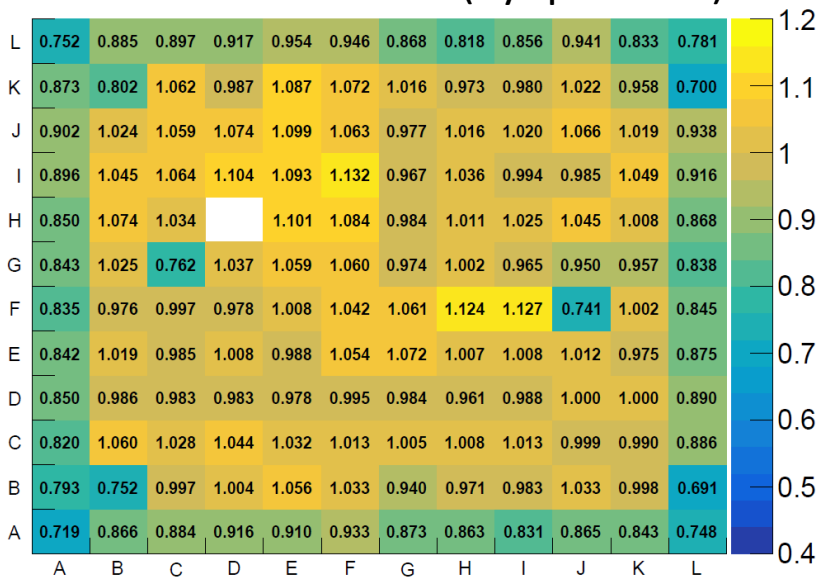
Light Yield (MT 10, 2 Foils, Varnished)

- With foils glued: LY even higher
- Mean LY in center: 39.8 p.e./MIP
- Results still very preliminary

LY map (Data from Cosmic Ray Test Stand)



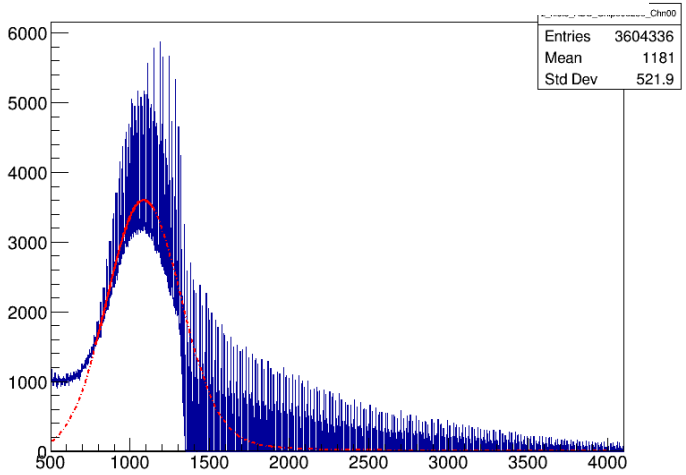
Ratio to center cells (by quadrant)



MIP Intercalibration Problem

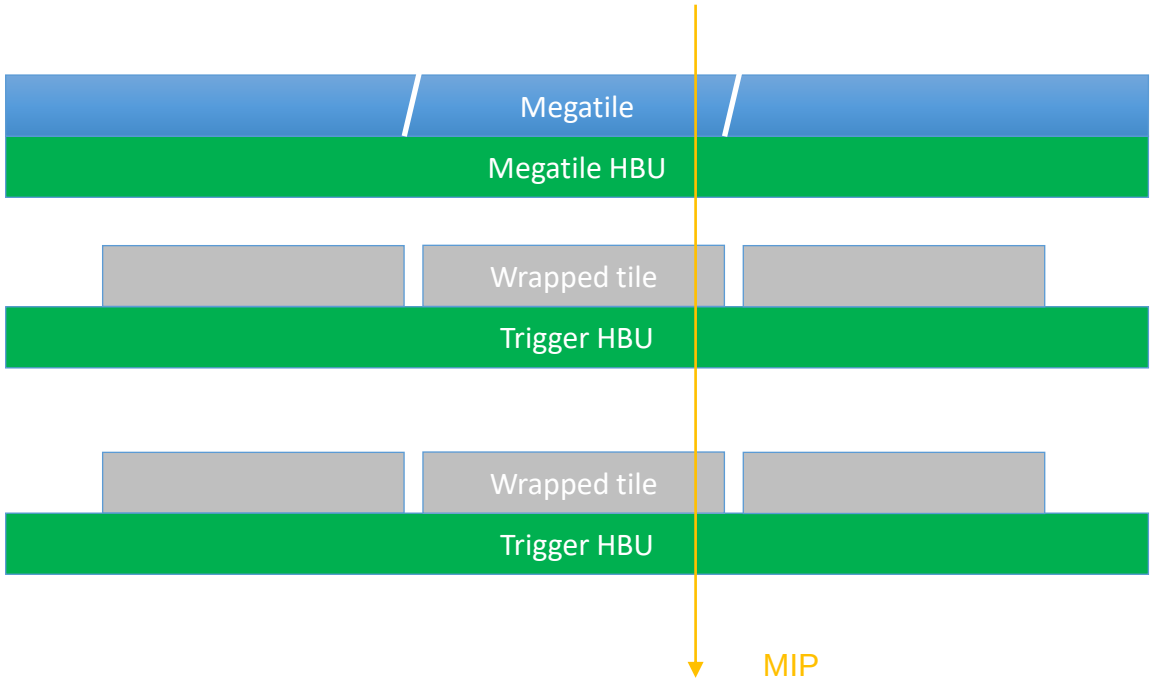
- MT 10 tested in test beam in September 2021
- LY too high for eletronics settings now
- MIP peak ends up in HG-LG intercalibration region
- Fit with higher uncertainty; improvement ongoing
- For next test beams: adjust electronics settings

MIP fit, MT 10, 2 foils, varnish

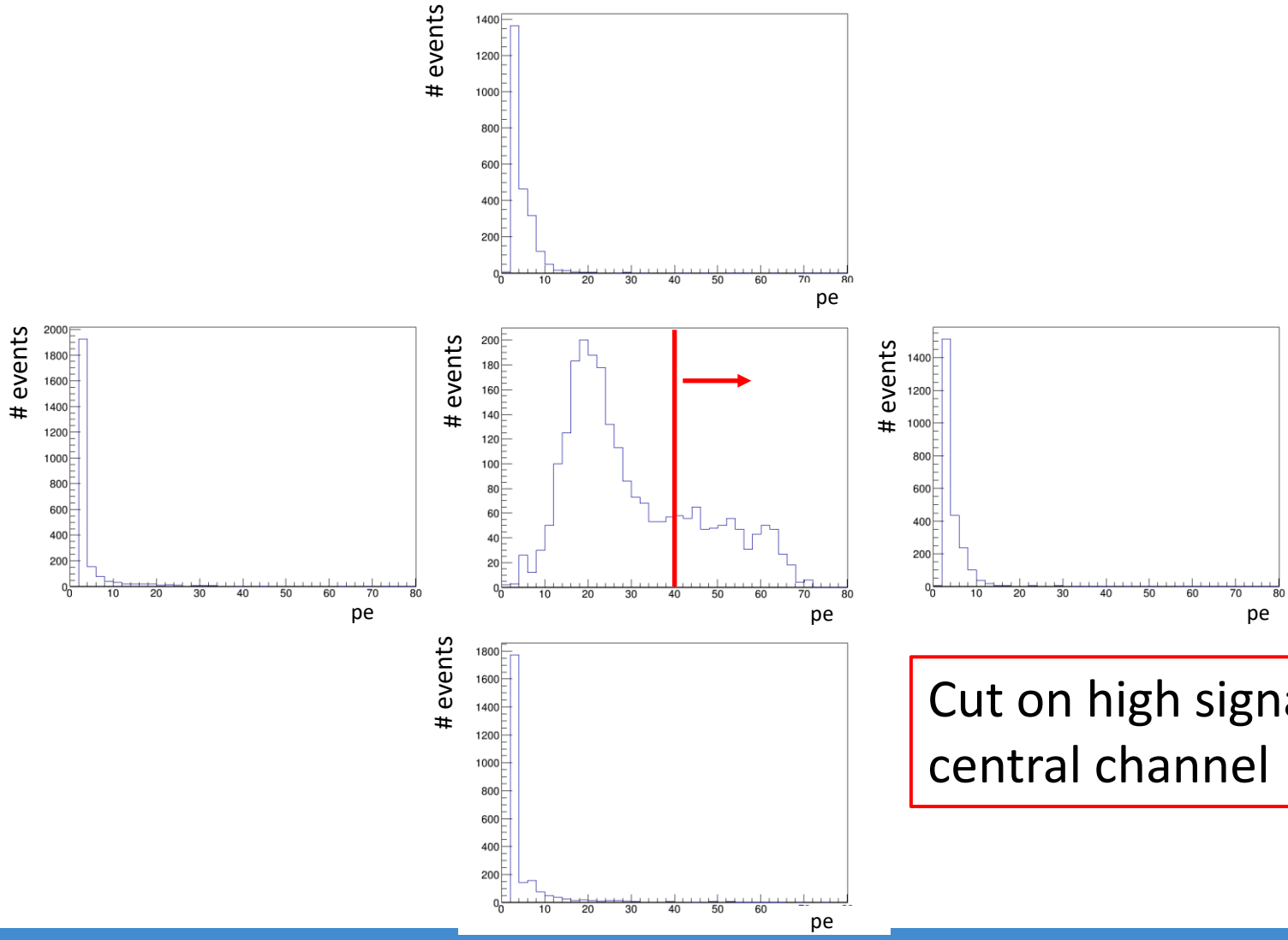


Cross Talk Measurement

1. Central channel of MT defined by coincidence in single tile layers



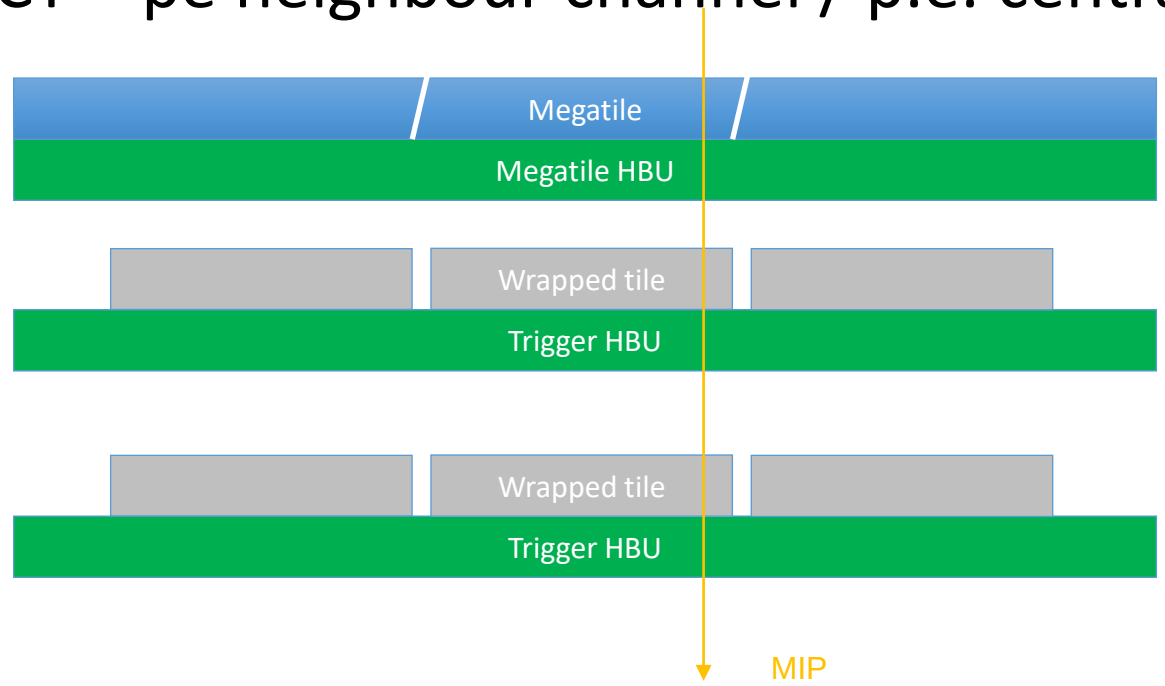
Cross Talk Measurement



Cut on high signal in central channel

Cross Talk Measurement

1. Central channel of MT defined by coincidence in single tile layers
2. P.e. cut on central tile
3. CT = pe neighbour channel / p.e. central channel

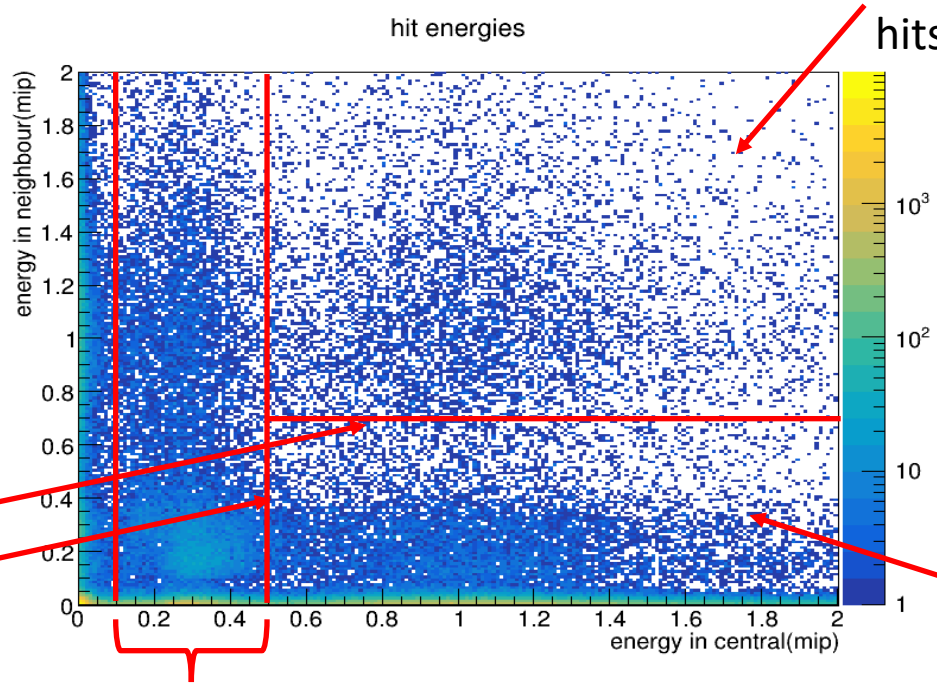


Details Cross Talk Measurement

- With August 2020 TB data
- Trigger treshold lowered as far as possile
  - CT can be calculated more exactly (not only as upper limit)

Cuts:

- Exactly 1 hit in each single tile layer
- Hit energy in single tile layer >0.7 mip
- Energy in neighbour < 0.7 mip
- Energy in central > 0.5 mip



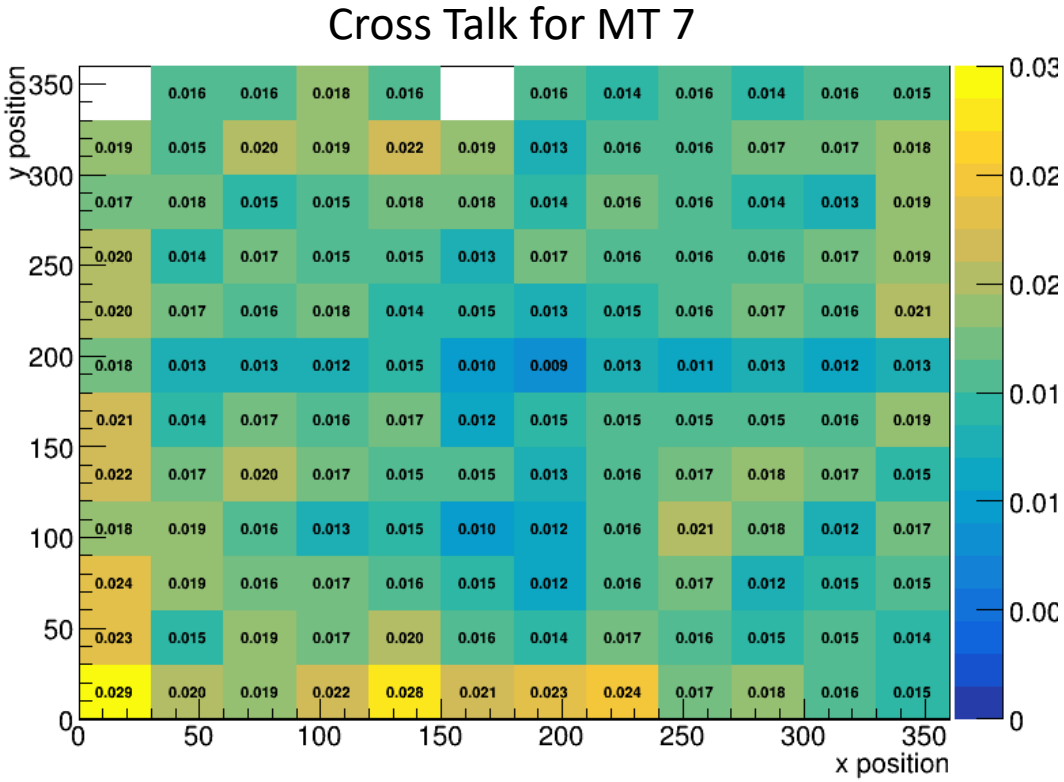
Double hits

Real CT

Trench region

Cross Talk Results

- Uniform cross talk < 3%
- Mean cross talk of 0.016



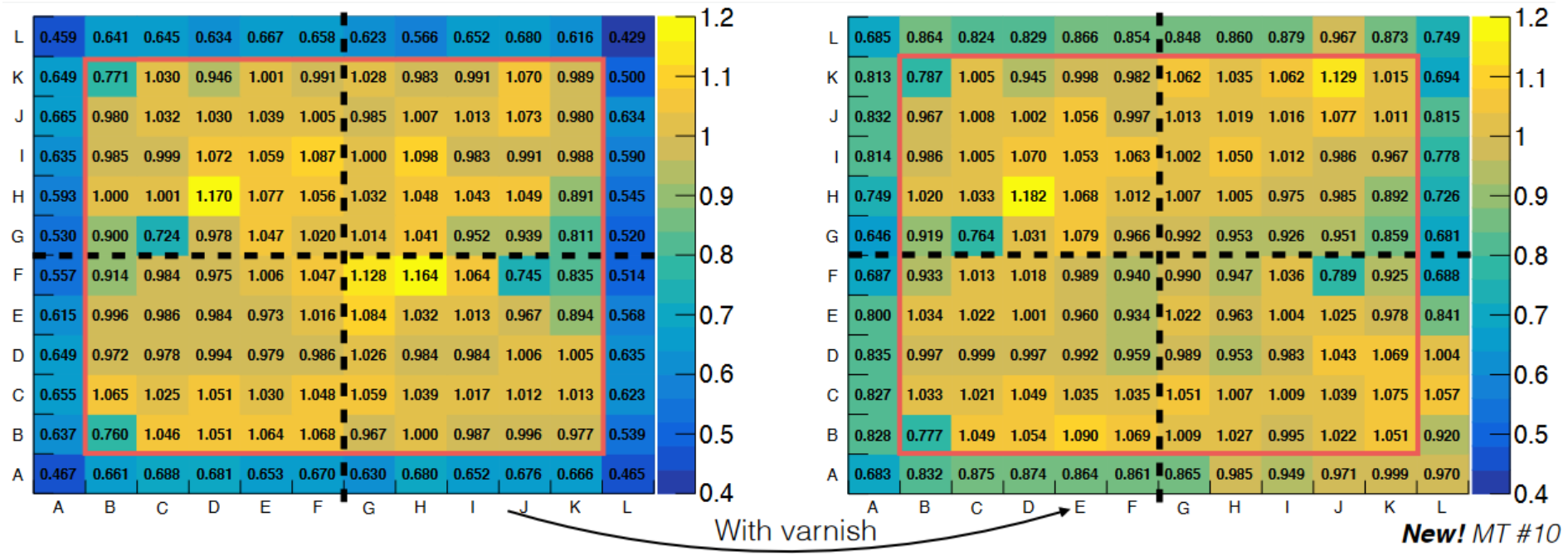
Conclusion and Outlook

- Optical stability, no unexpected ageing with proper storage
  - Long term monitoring ongoing
- Foil gluing process and varnishing successful
  - Optimisation ongoing
- Now: need to adapt electronics settings to high LY
  - Improvements for fits ongoing
- Cross talk <3%
  - Under control due to foil gluing onto the Megatile
  - Use time and telesope data
- Investigation of trench region with telesope data

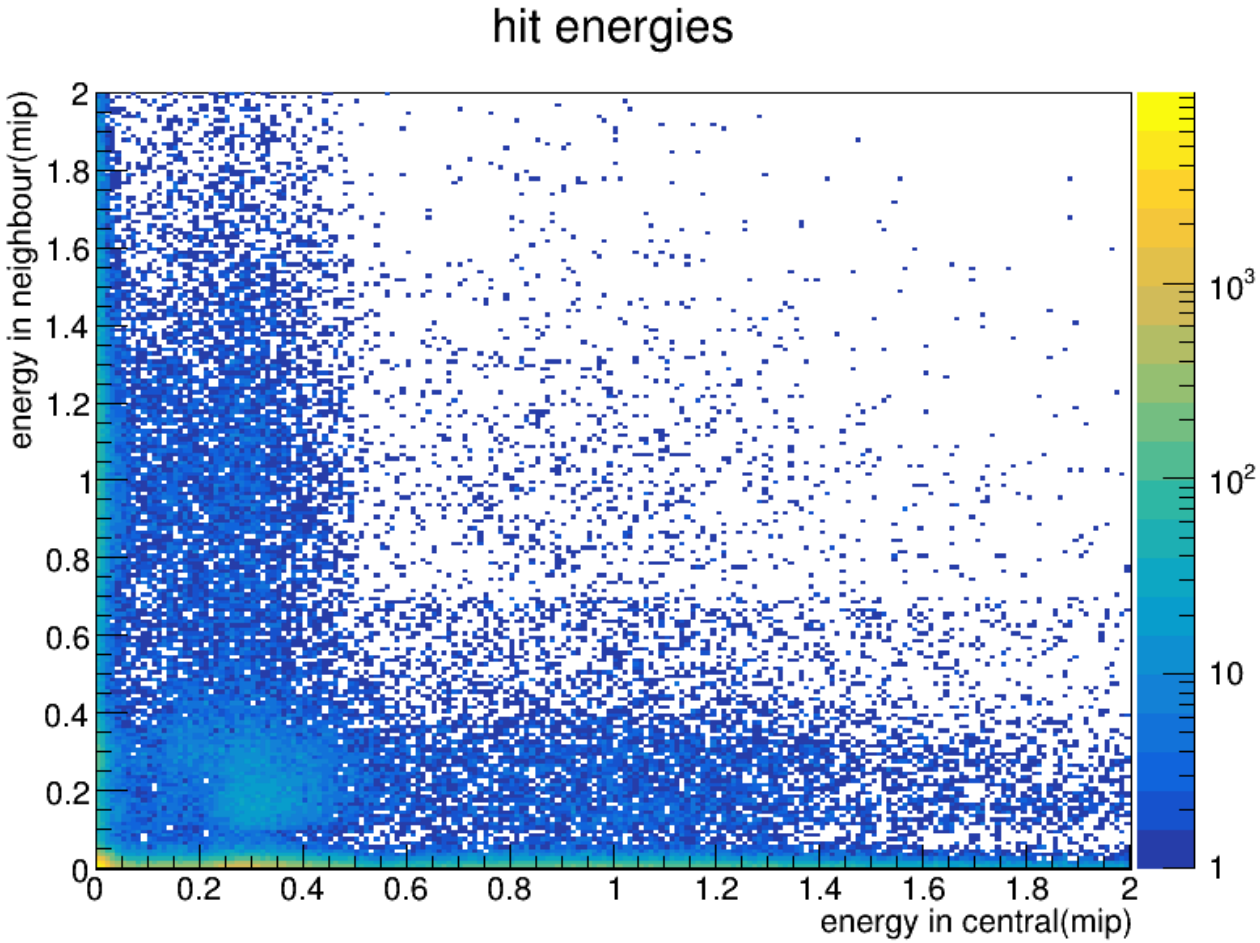
Thank you for your attention!

Backup

Improvement with Varnish



Time Difference Cut for Double Hits



Remove events in upper right region if -200 < TDC < 200