Results from SSD validation tests

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Some numbers

Current production and validation status:

→ 95 modules built

→ 89 modules tested
  → 81 measured without silicone pad
  → 16 measured with silicone pad
  → 8 measured with and without silicon pad

→ average measurement time: 18 hours (minimum ~3h)

→ average number of MIP triggers: 5.2M

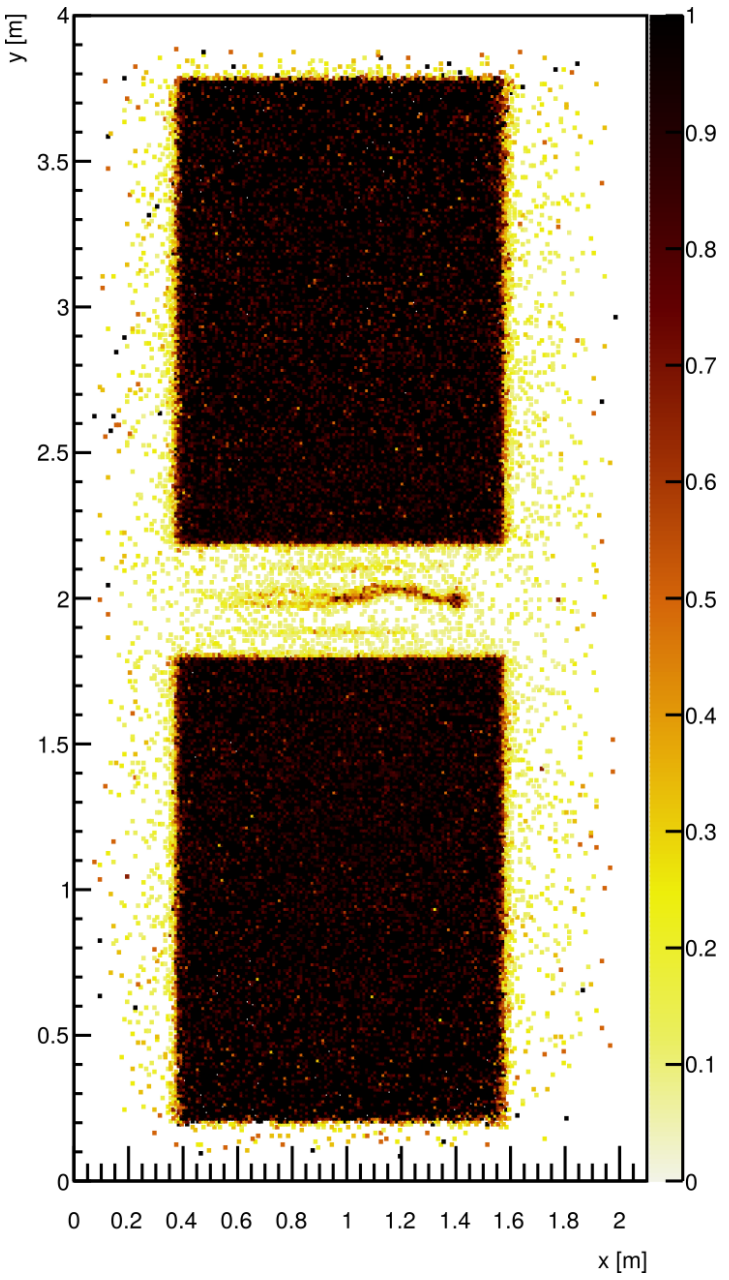
Quality checks

1) Detector efficiency
2) Average MIP response
3) Width of MIP peak
4) Light tightness (out-of-time photo electrons)
5) Detailed studies (if required)

1) Detector efficiency

Efficiency:
probability to find MIP
pulse in single muon events

→ Efficiency is above 90%
→ Uniform over the detector plane
→ can resolve fiber bundle and cookie

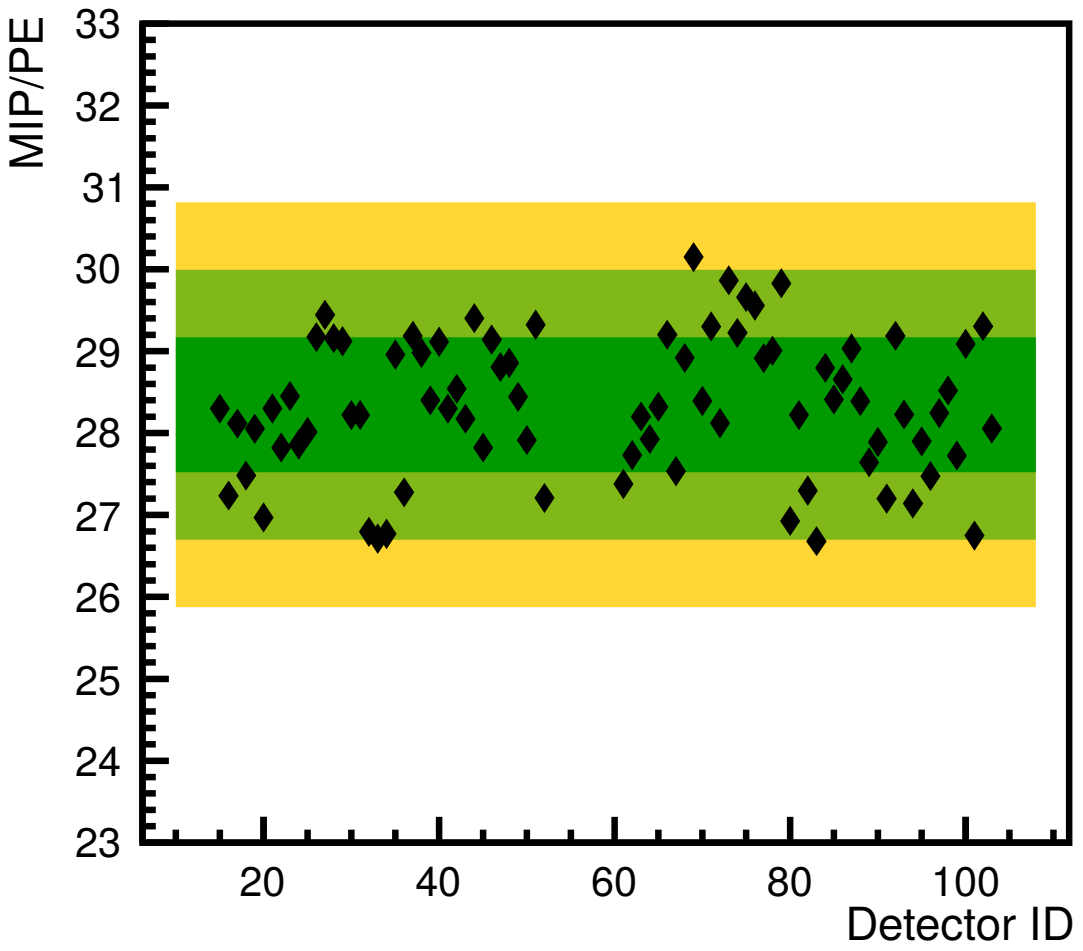


2) MIP response

Black markers: w/o siPad

→ stable detector performance

→ define 2σ as observe/alert
and 3σ as stop level



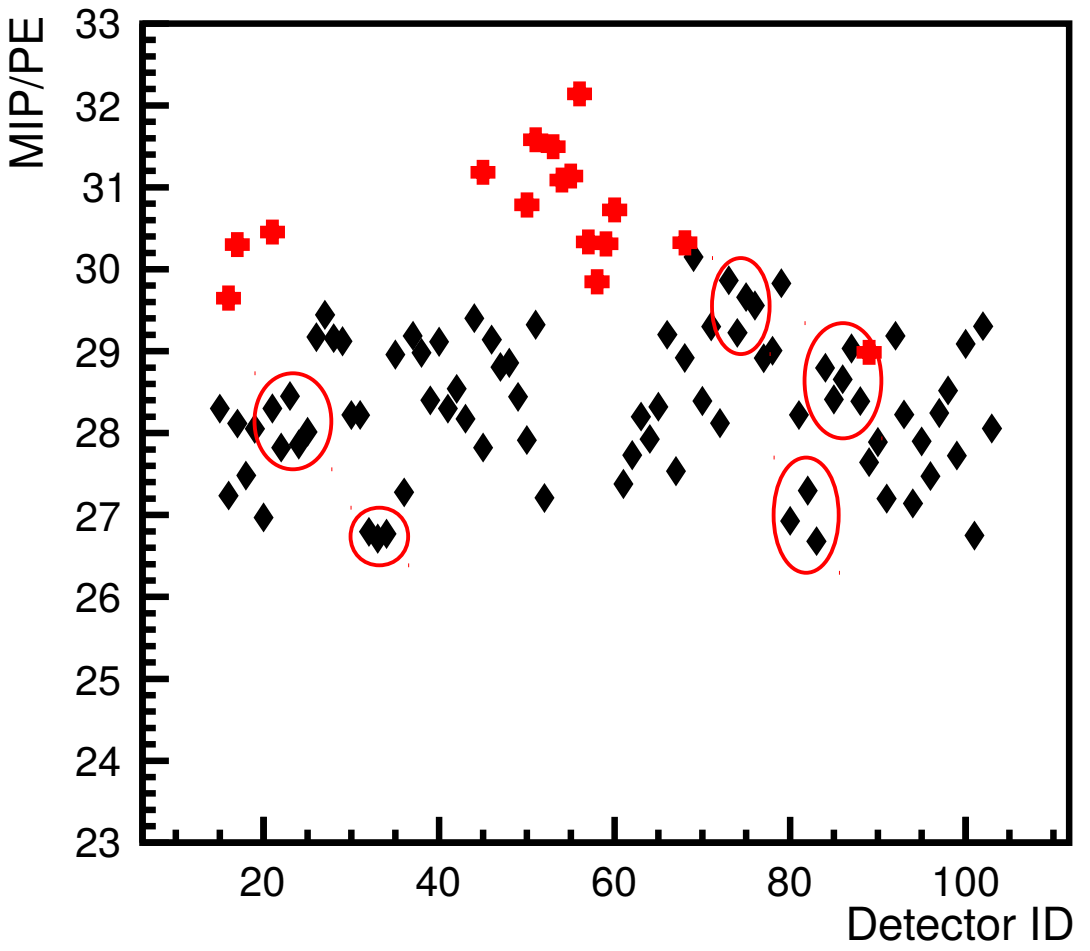
2) MIP response

Black markers: w/o siPad
Red markers: w/ siPad

→ stable detector performance

→ fibers have significant effect on the spread
→ modules with same fiber roll tend to cluster

→ no obvious outliers due to production procedure



2) MIP response

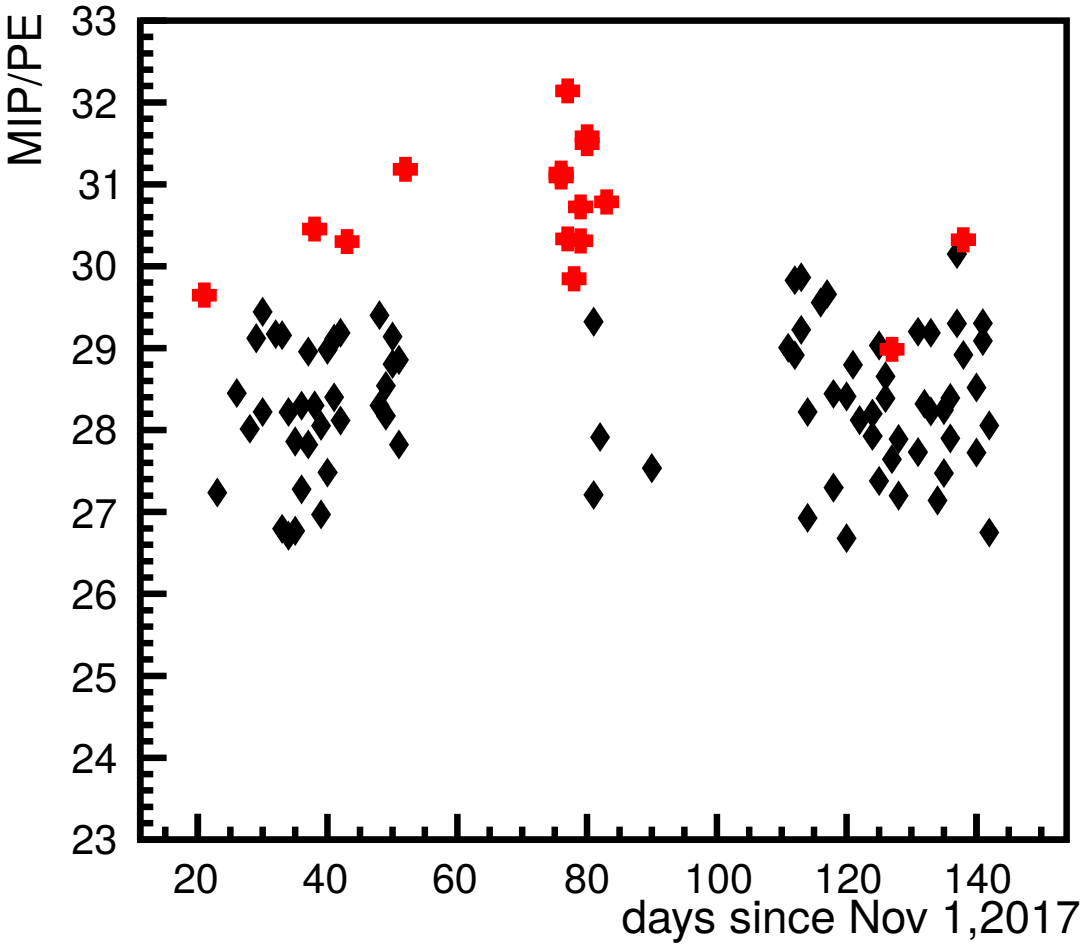
Black markers: w/o siPad
Red markers: w/ siPad

→ stable detector performance

→ fibers have significant effect on the spread
→ modules with same fiber roll tend to cluster

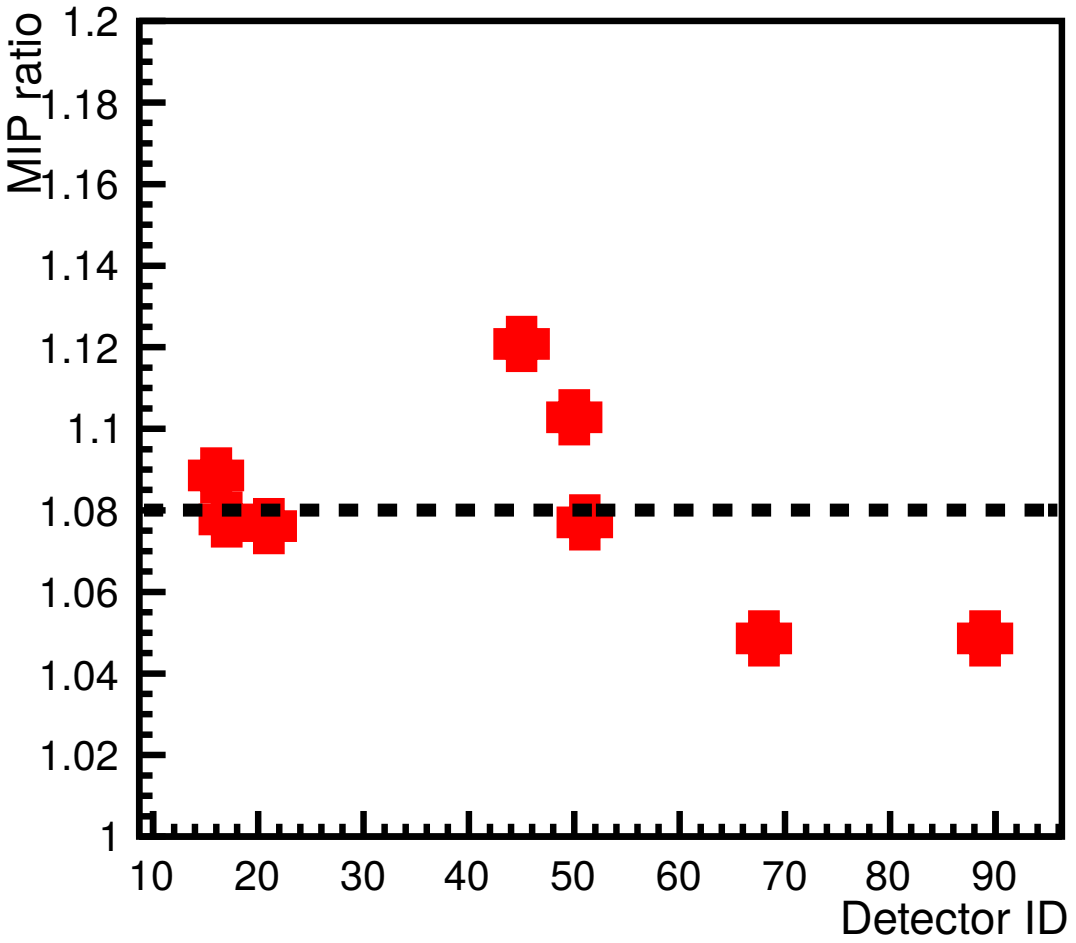
→ no obvious outliers due to production procedure

→ no dependence on measurement date



2) MIP response

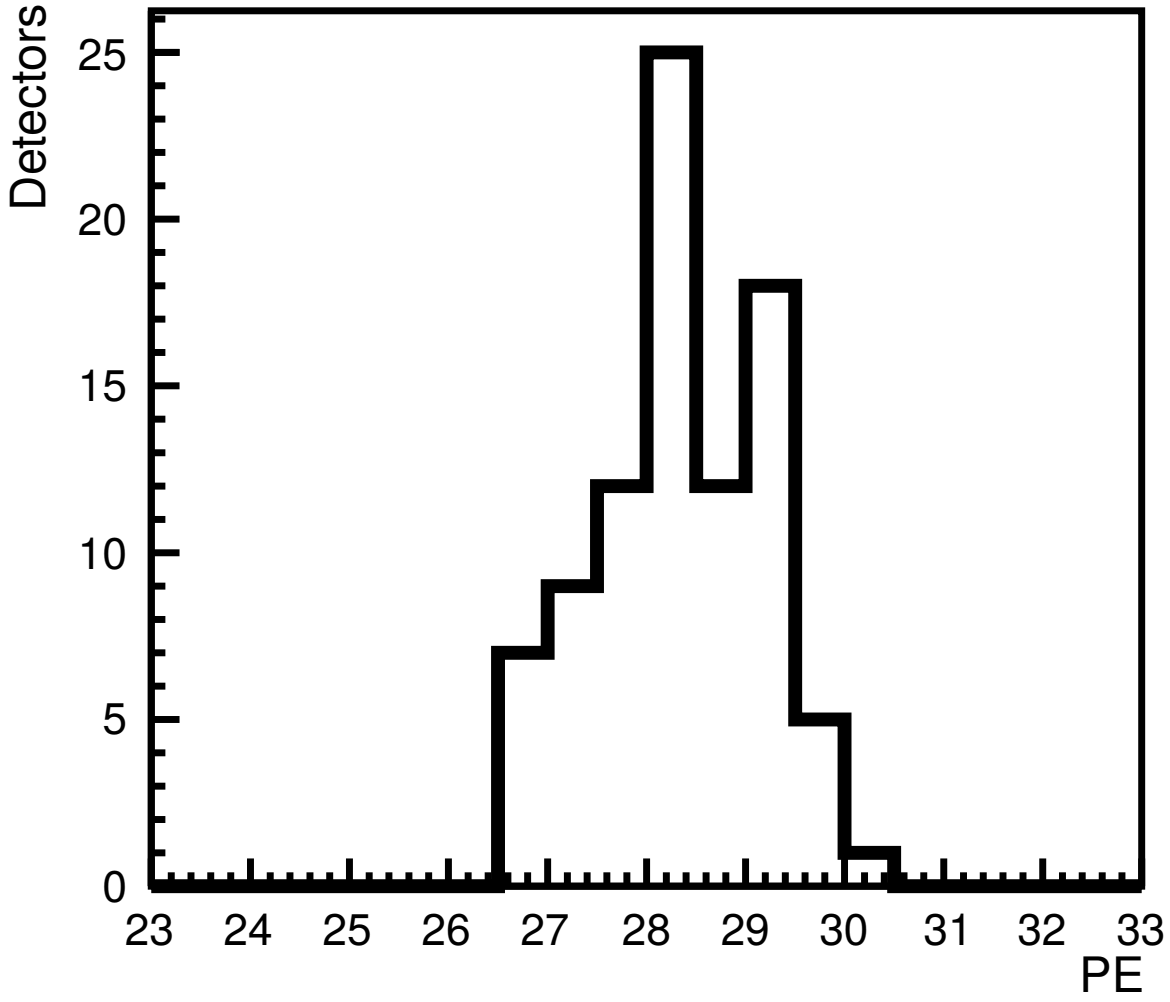
8% signal increase with siPad



2) MIP response: Summary

Distribution of all detectors:
siPad only corrected by 8 %

<MIP/PE> = 28.35
σ(MIP/PE) = 0.82

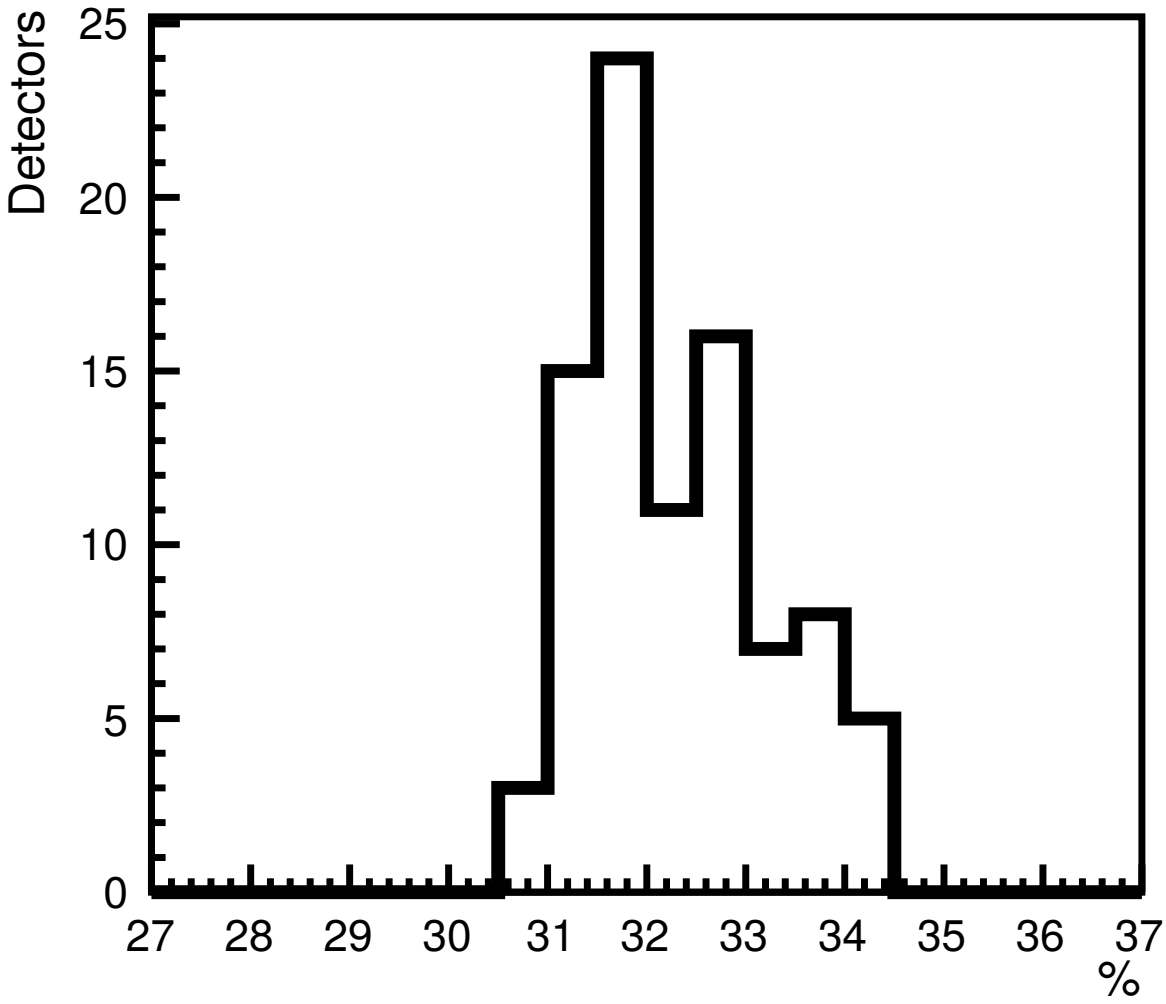


3) MIP width

→ stable width of the MIP

→ less Gaussian shape

<σ(MIP)/MIP> = 32.34 %



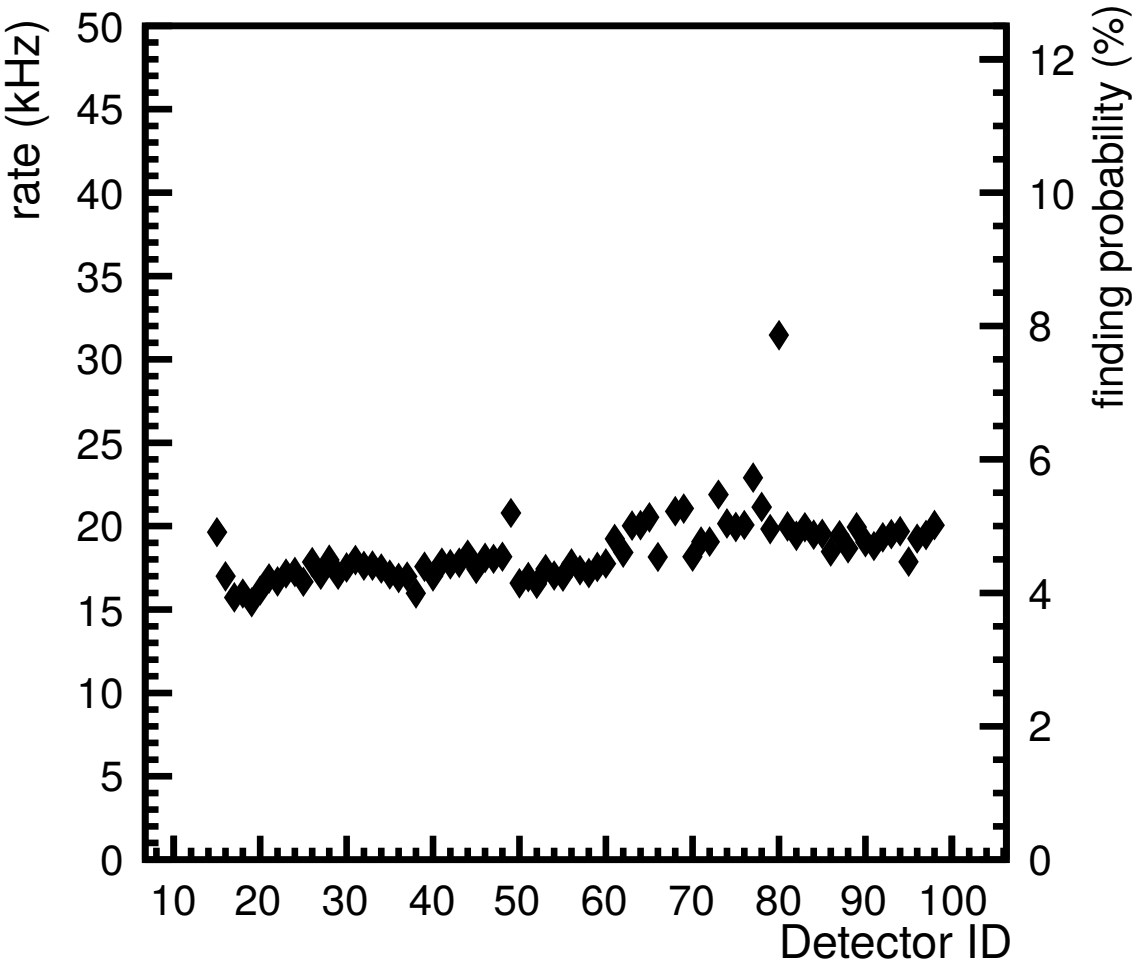
4) Light tightness

Calculate number of pulses away from the MIP trigger
→ window of 2.5 μs

Two numbers:
→ relative: pulse finding probability
→ absolute: rate of noise peaks

→ 15-25 kHz should be an acceptable rate

→ depends on pulse definition and readout noise



4) Light tightness

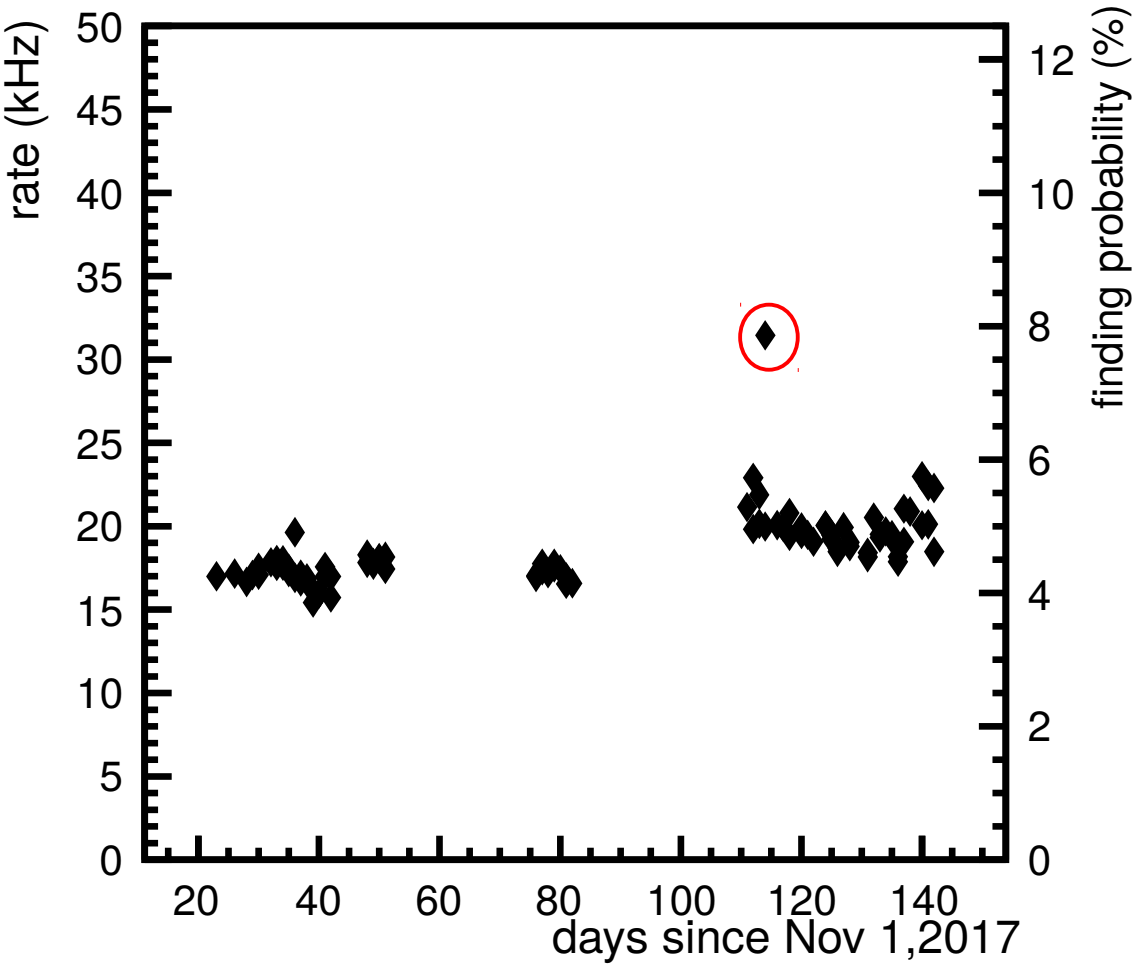
Search for deviations:

→ rate slightly depends on time
→ sometimes increase grid noise since January

→ try to avoid during measurement

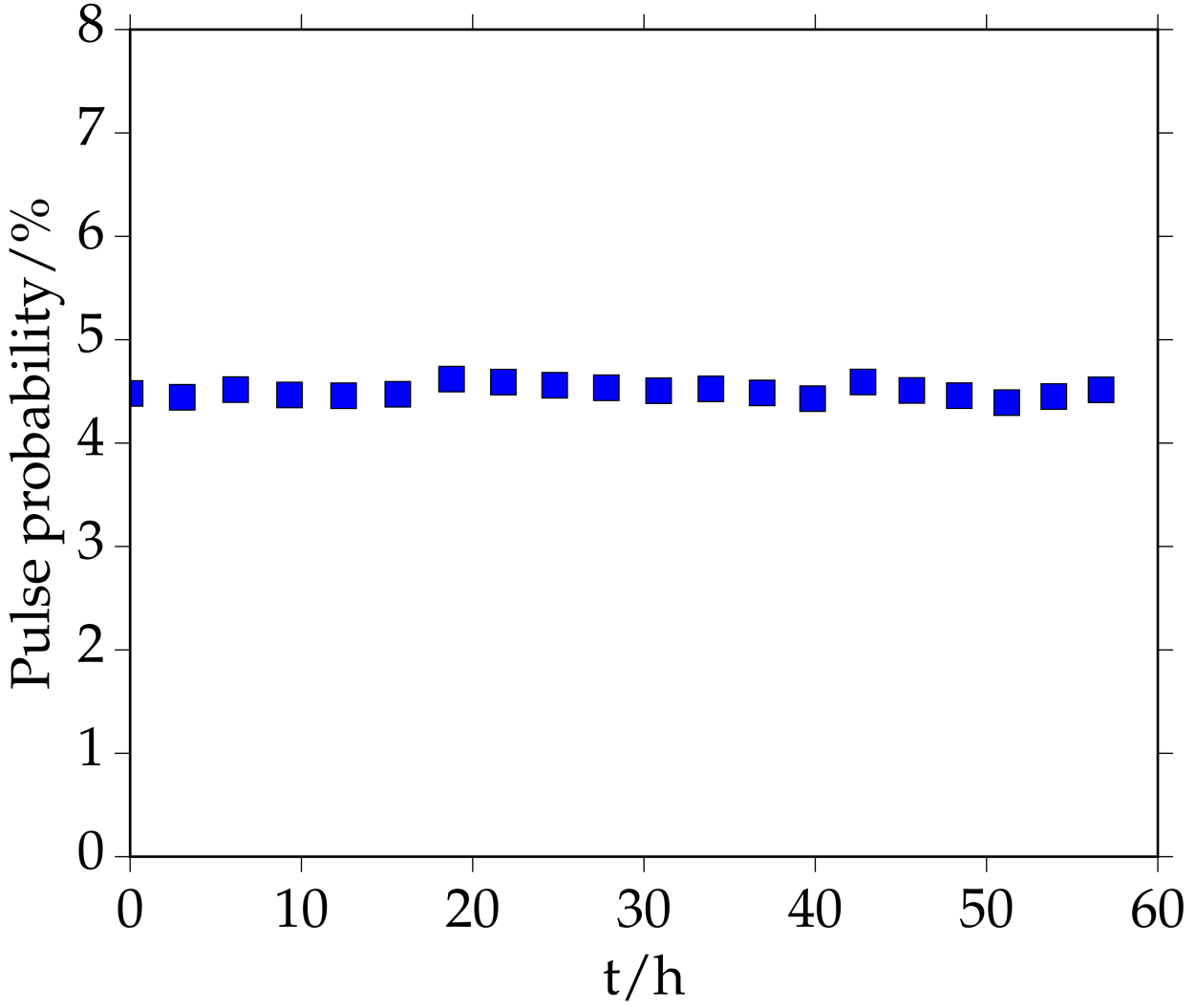
→ one outlier
→ we assume power grid noise

→ optimizations ongoing



4) Light tightness

Day-night variations negligible

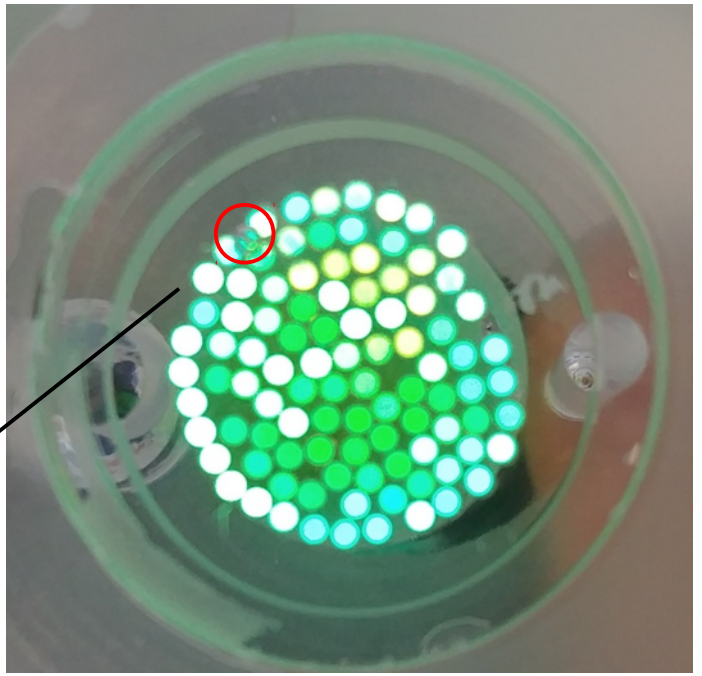


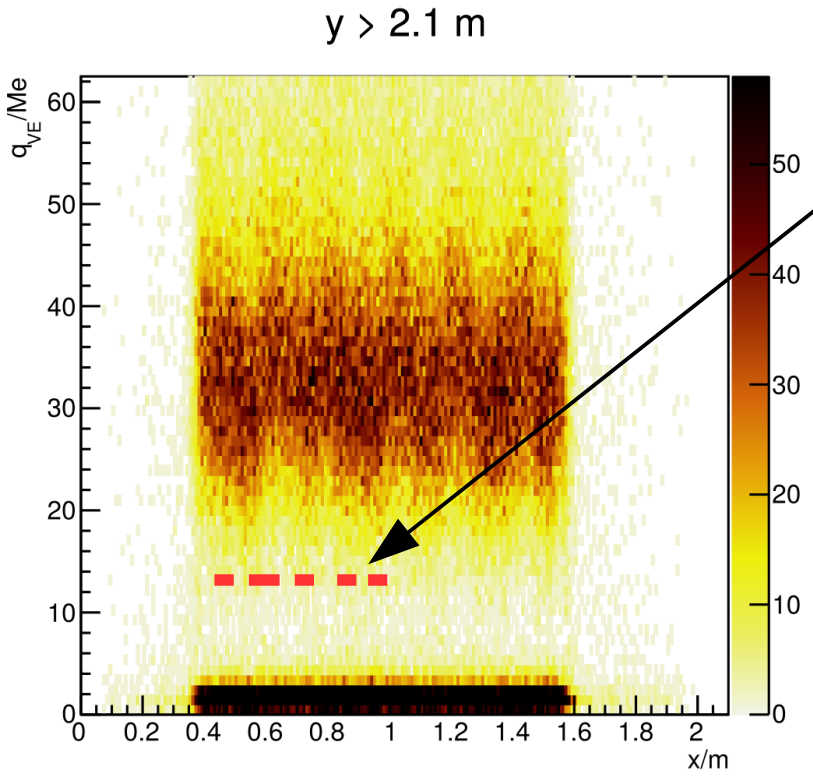
5) Details example: air bubbles

Study details whenever needed:
Example SSD KA.0090

One bubble in front of 3 fibers
→ 6 scintillator bars partially affected

No reduction of the MIP signal observed



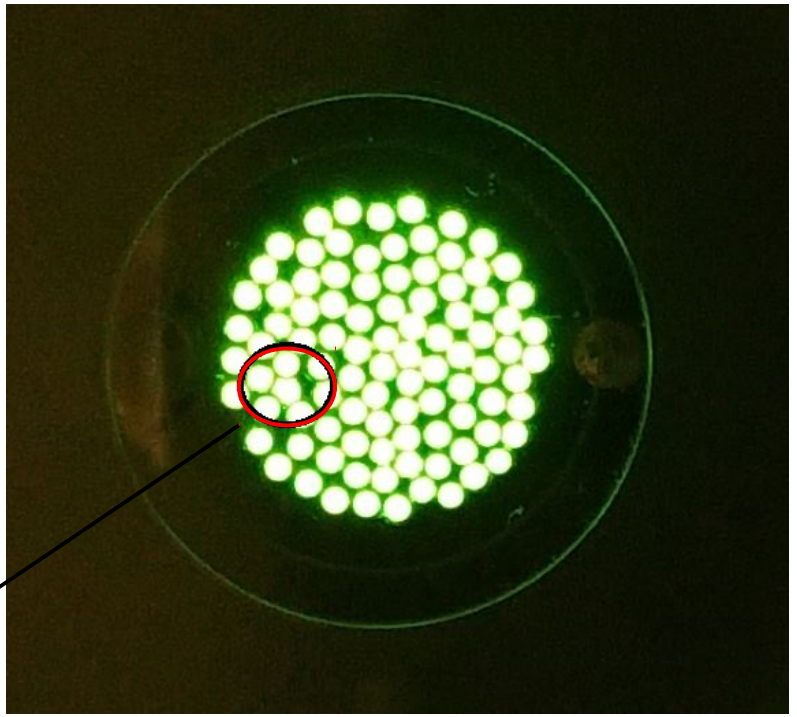


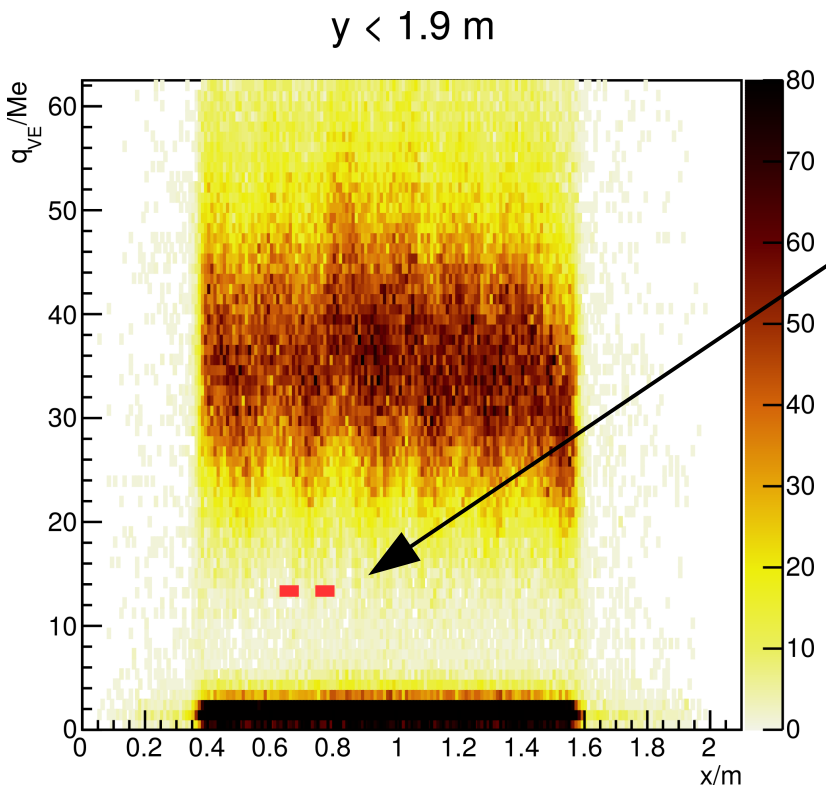
5) Details example: misalignment

Study details whenever needed:
Example SSD KA.0092

Two fiber ends shifted back by ~2mm
→ 2 scintillator bars partially affected

No reduction of the MIP signal observed





Summary

1) Detector efficiency

→ all detectors well above 90%

→ can we define efficiency between institutions?

2) Average MIP response

→ MIP/PE within 28.35 ± 2.47 (3σ) (or > 25)

3) Width of MIP peak

→ σ(MIP)/MIP smaller 35 %

4) Light tightness

→ out-of-time sPE rate 25 kHz

5) Detailed studies

→ until now all positive