electromagnetic shower in the HCAL

- data / MC comparison -

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outline

calibration on the em scale
-> understanding our detector

- influence of saturation correction
- influence of calibration constants
- longitudinal shower profiles
- energy resolution

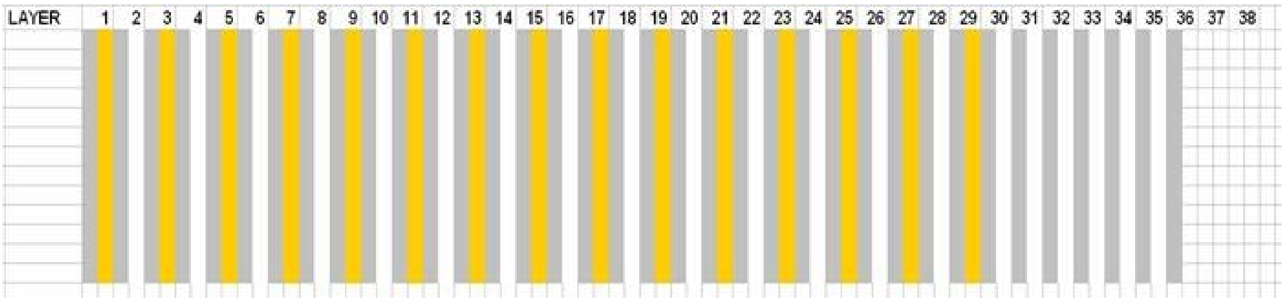
runs

<u>data selection</u>

HCAL standalone runs
in august
(320605, 320678, 320671, 320666,
320665, 320664, 320660)
6 – 45 GeV electron beam

<u>event selection</u>

(-> see talk from B. Lutz)
cherenkov counter : on
1x1 m^2 trigger : veto
veto counter :
veto max. amplitude



<u>MC</u> (-> see talk from O. Wendt)

- 6 – 45 GeV electron beam
- TBCern0806

first look into energy sums

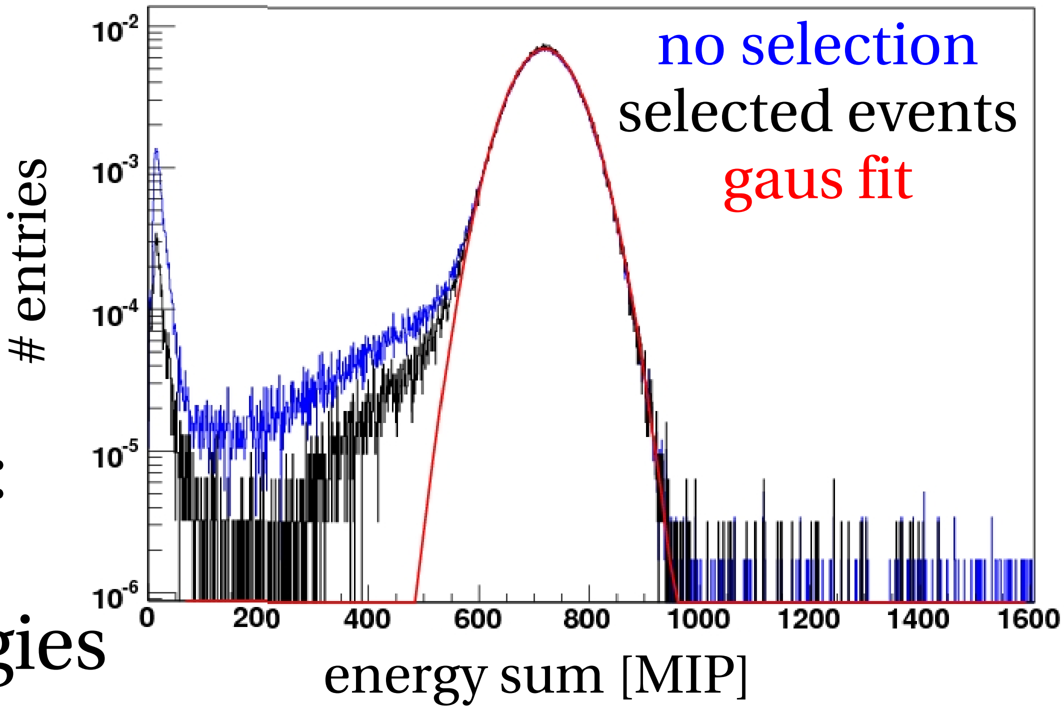
- sum up energy in whole HCAL (15 layers)
- gaussian fit

influence of event selection

- lost statistics:
  36 / 80% (6 / 45GeV)
- change in mean:
  4 / 0% (6 / 45GeV)
- change in sigma:
  17 / 2% (6 / 45GeV)
- improvement in resolution:
  20 / 2% (6 / 45GeV)

->improves a lot at low energies

30GeV electron beam from august run



SiPM calibration

SimpleHcalCalibrationProcessor
flat file with MIP, gain, ic
linearity correction with

$$N_{pe} = N_{pix} / (1 - N_{pix}/N_{tot})$$

N_{tot} = max. number of pixels

$$N_{pix} = A[ADC_{phys}] * ic[ADC_{calib}/ADC_{phys}] / gain[ADC_{calib}/pix]$$

no light xtalk correction between scintillator tiles
(-> see talk from N. Meyer)

testing saturation correction

measure N_{pix}

-> need N_{pe}

$N_{pe} = N_{pix} / (1 - N_{pix}/N_{tot})$

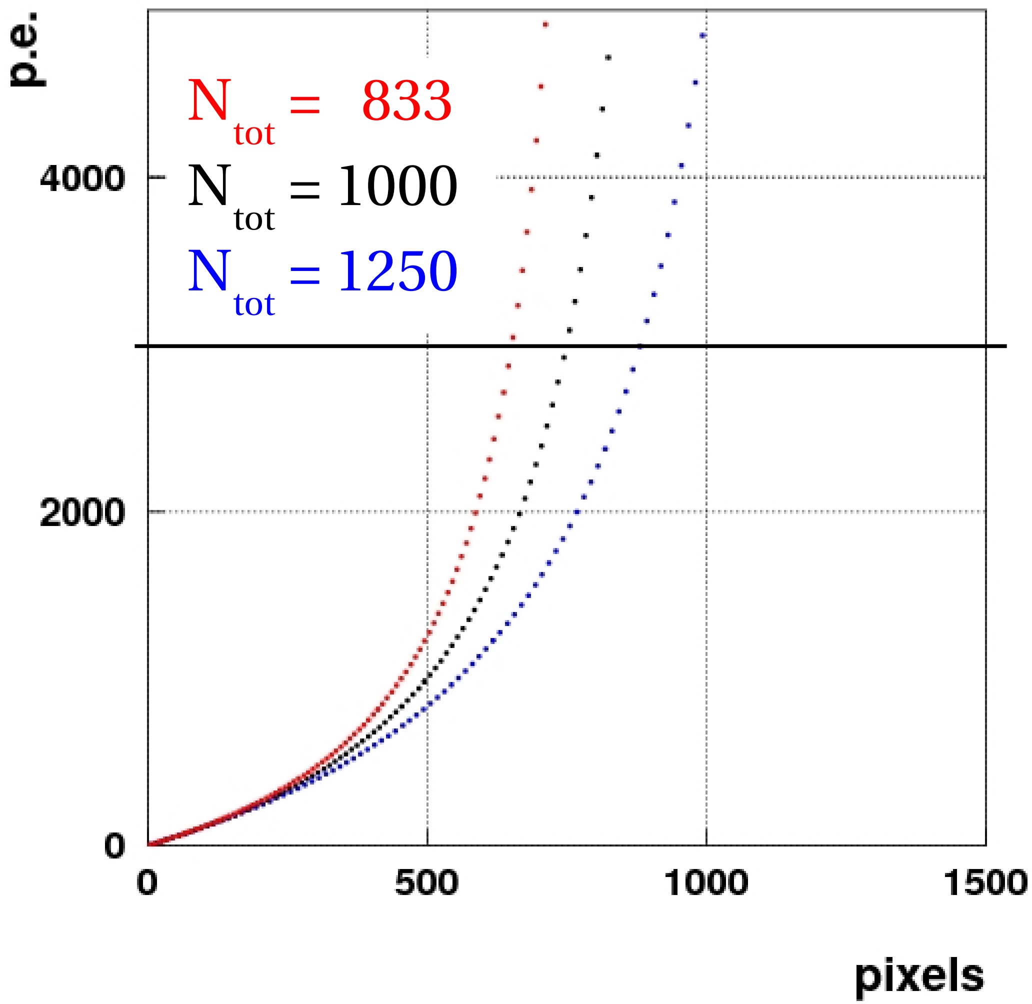
Use one N_{tot} for all SiPM

exponential rise

-> cut @ $N_{pe} = 3000$

everything above

is set to $N_{pe} = 3000$

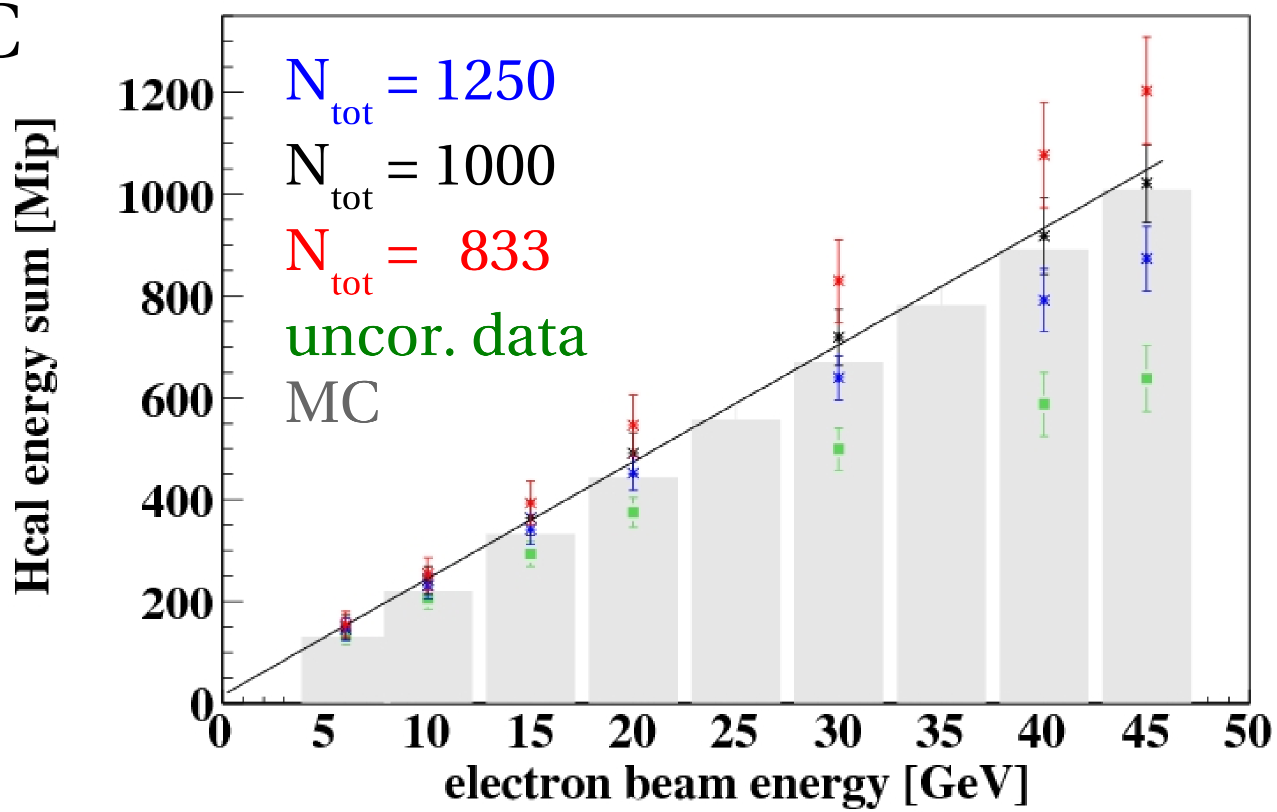


Influence of N_{tot}

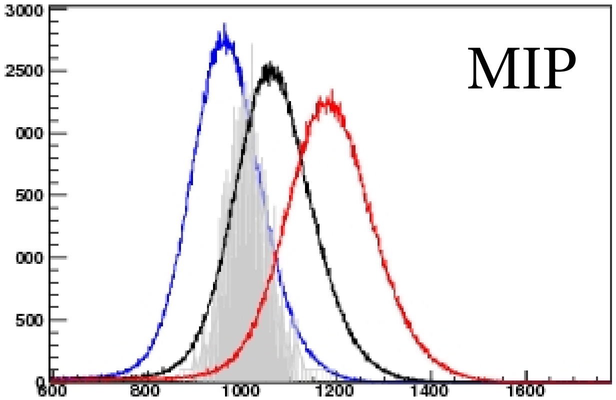
Saturation correction is important

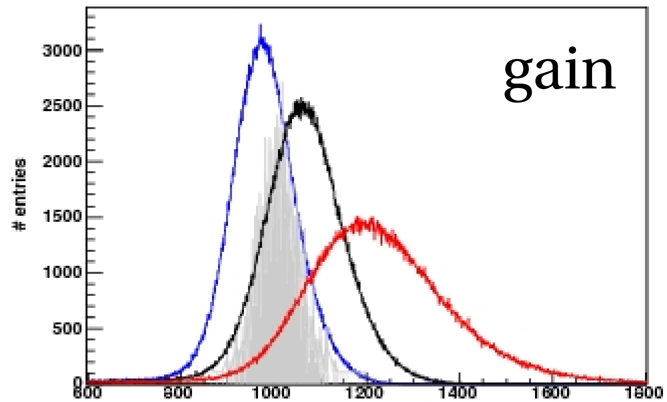
N_{tot} = 1000
in agreement with MC
and with ITEP values

-> will be used
in further analysis



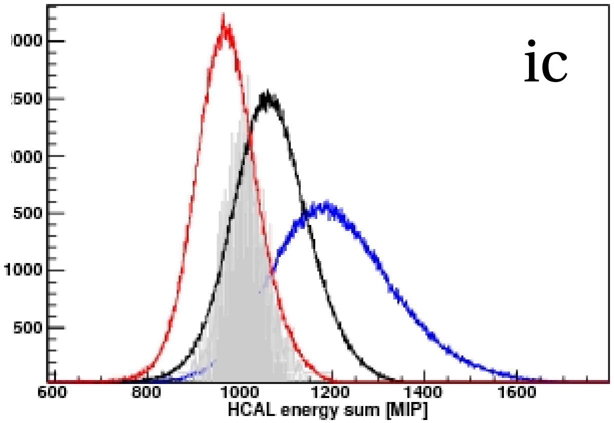
influence of calibration





HCAL energy sum [MIP] -->

entries -->



nominal +10%
nominal (august)
nominal -10%
MC

$$N_{pix} = A[ADC_{phys}] * ic[ADC_{calib}/ADC_{phys}] / gain[ADC_{calib}/pix]$$

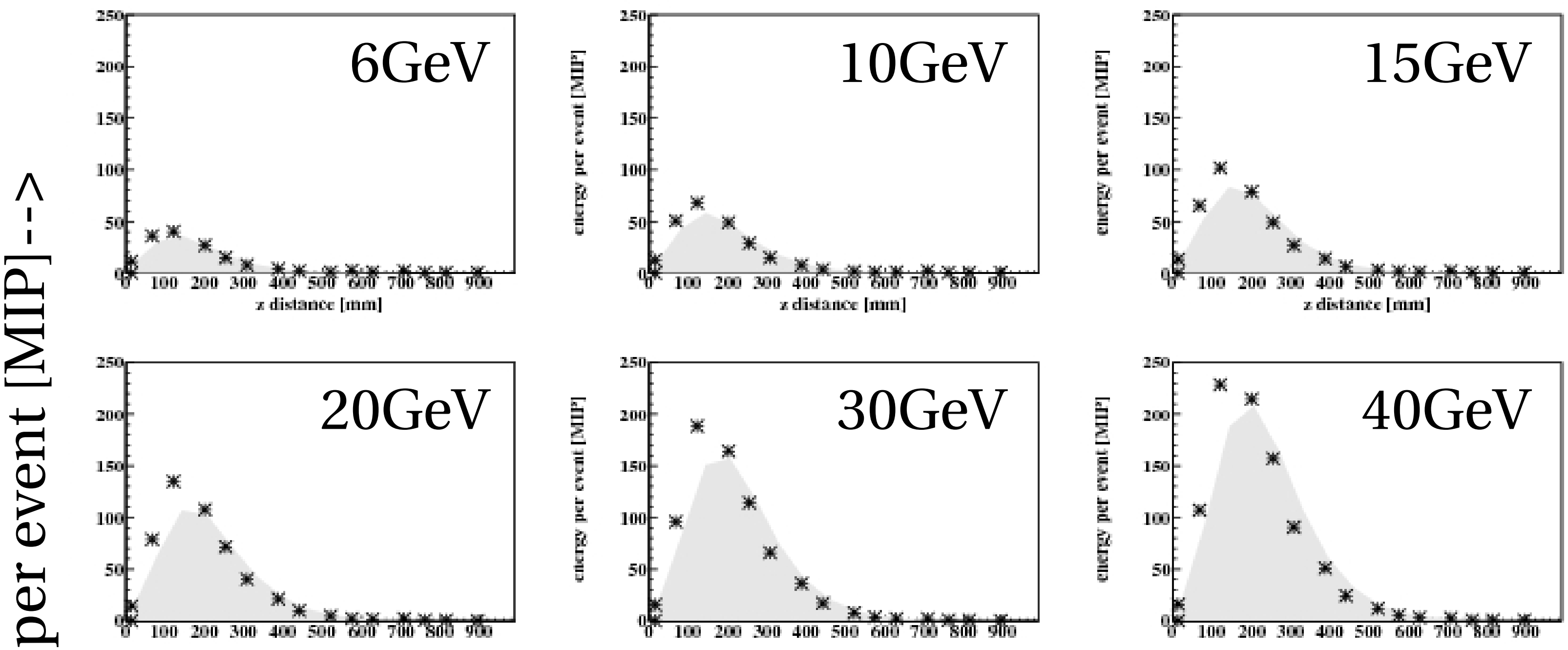
A 10% shift of calibration constants would change the energy resolution for a 45GeV electron beam in august:

σ / Mean = 0.072 (gain+10%/ic-10%)

σ / Mean = 0.081 (nominal)

σ / Mean = 0.118 (gain-10%/ic+10%)

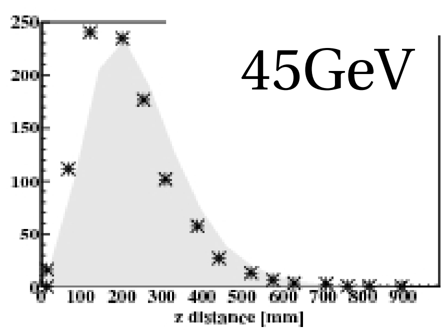
longitudinal shower profile



MC
data

? ? ?

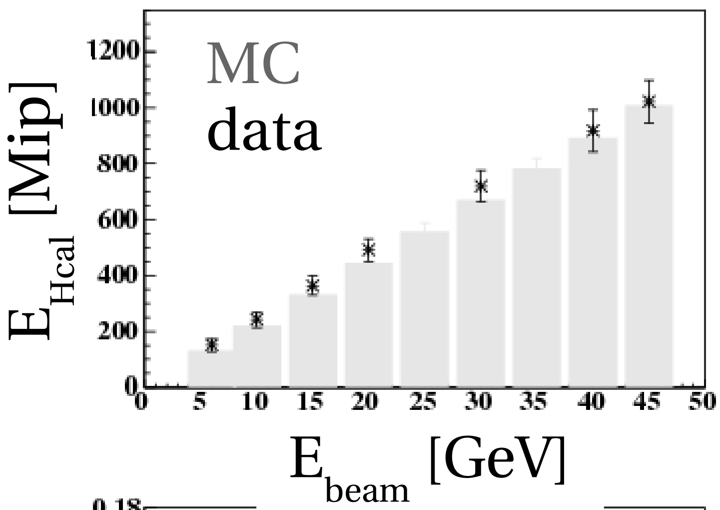
z-distance [mm] -->



difference in shape -> more work to do

(no noise in MC, no noise cut (LD) in data)

energy resolution

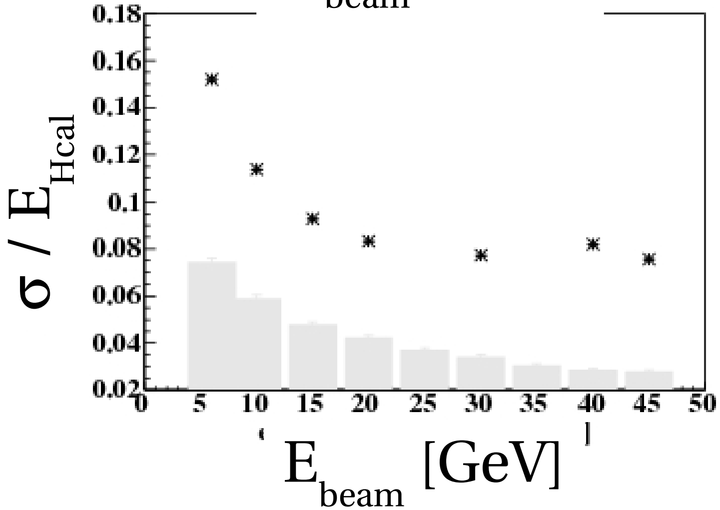


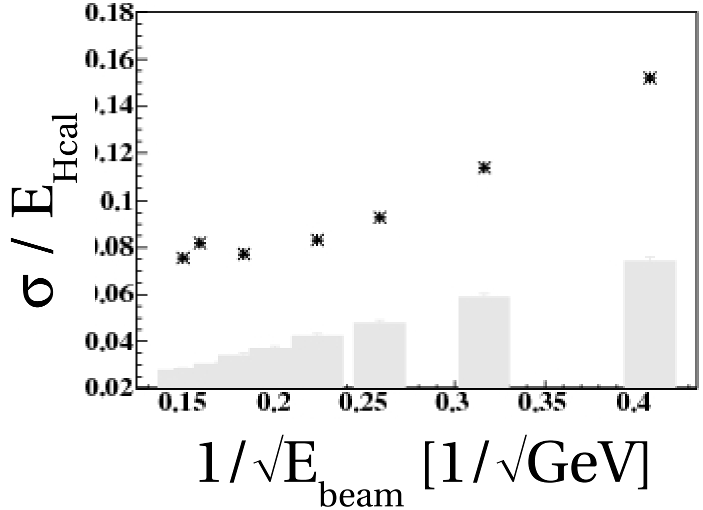
linear fit to E_{Hcal} vs E_{beam}

MC: $y = 22.5 \cdot x + 4$

data: $y = 22.9 \cdot x + 15$

remember: double sampling
no noise in MC





conclusion

• data & MC can be analysed
& used to calibrate the detector
• already in quite good agreement
• but still a lot of work to do

outlook

• testing other saturation correction approaches
•include light xtalk between scintillator tiles
• repeat everything for october
(more layers and recovered LY, but less energy points)
• compare to improved MC
(more statistics, include: noise, xtalk, saturation)

Backup

saturation correction

testing other saturation correction approaches:

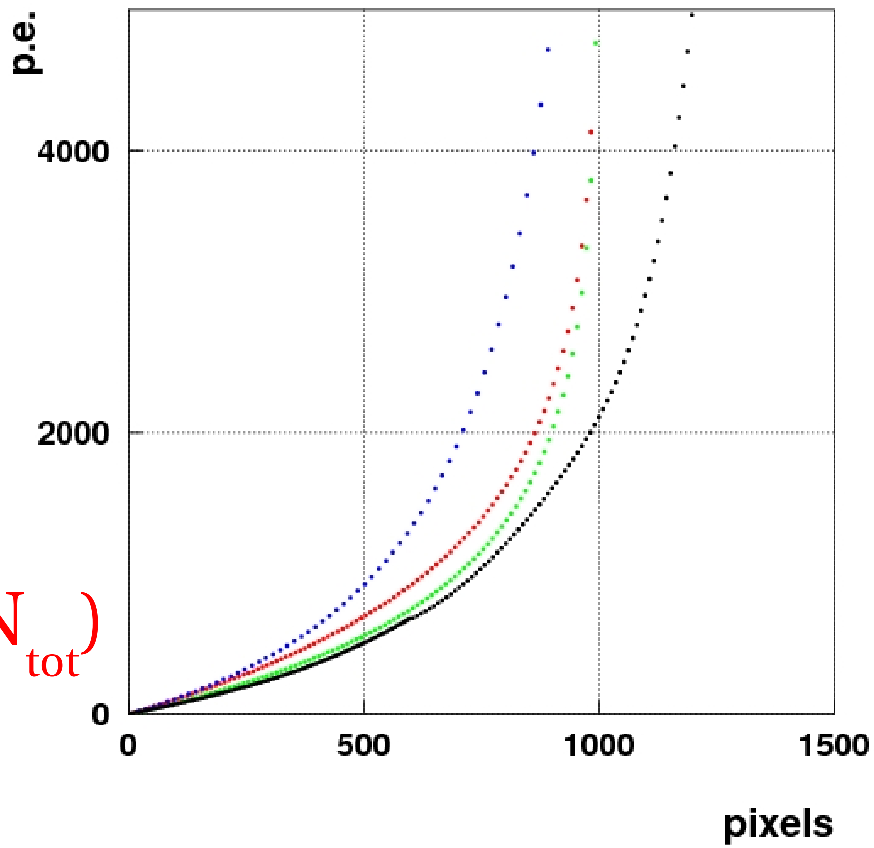
currently used:

$N_{pe} = N_{pix} / (1 - N_{pix} / N_{tot})$

binomarial approach:

$N_{pe} = \log(1 - N_{pix} / N_{tot}) / \log((N_{tot} - 1) / N_{tot})$

fit to data from lab measurement



include inter pixel xtalk xp:

$N_{pe} = N_{tot} * \log(2xp / (xp - 1 + \mathrm{sqrt}(xp^2 + 2xp(1 - 2N_{pe} / N_{tot}))))$