

# Translation between dE/dx resolution and separation power

Separation power

$$S = \frac{|\mu_1 - \mu_2|}{\sqrt{\frac{\sigma_1^2 + \sigma_2^2}{2}}}$$

dE/dx resolution

$$\sigma_{dE/dx}$$



# Translation between dE/dx resolution and separation power

Separation power

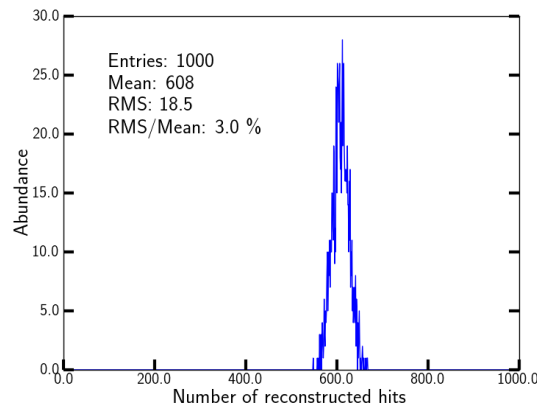
$$S = \frac{|\mu_1 - \mu_2|}{\sqrt{\frac{\sigma_1^2 + \sigma_2^2}{2}}}$$

dE/dx resolution

~~$\sigma_{dE/dx}$~~

$$R := \frac{\sigma}{\mu}$$

$$R \leq 5\%$$



$\mu$ : mean  
 $\sigma$ : width



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$$S = \frac{|\mu_1 - \mu_2|}{R \sqrt{\frac{\mu_1^2 + \mu_2^2}{2}}}$$

dE/dx resolution

$$\cancel{\sigma_{dE/dx}}$$

$$R := \frac{\sigma}{\mu}$$

$$\sigma = R \mu$$



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$$S = \frac{|\mu_1 - \mu_2|}{R \sqrt{\frac{\mu_1^2 + \mu_2^2}{2}}}$$

$$S = \frac{\mu_2 \left| \frac{\mu_1}{\mu_2} - 1 \right|}{R \mu_2 \sqrt{\frac{\left(\frac{\mu_1}{\mu_2}\right)^2 + 1^2}{2}}}$$

dE/dx resolution

~~$\sigma_{dE/dx}$~~

$$R := \frac{\sigma}{\mu}$$

$$\sigma = R \mu$$

$$\frac{\mu_\pi}{\mu_K} = \frac{1.19}{1.03} = 1.16 \quad \text{my simulation}$$

$$\frac{\mu_e}{\mu_\mu} = \frac{1}{0.7} \approx 1.43 \quad \text{GridPix}$$



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$$S = \frac{|\eta - 1|}{R \sqrt{\frac{\eta^2 + 1}{2}}}$$

dE/dx resolution

~~$\sigma_{dE/dx}$~~

$$R := \frac{\sigma}{\mu}$$

$$\sigma = R \mu$$

$$\frac{\mu_\pi}{\mu_K} = \frac{1.19}{1.03} = 1.16 \quad \text{my simulation}$$

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$$\frac{\mu_1}{\mu_2} =: \eta$$



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dE/dx resolution

$$R = \frac{|\eta - 1|}{S \sqrt{\frac{\eta^2 + 1}{2}}}$$



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dE/dx resolution

$$R = \frac{|\eta - 1|}{S \sqrt{\frac{\eta^2 + 1}{2}}}$$

3 reasons for new separation power numbers:

- had neglected the extra factor in the denominator
  - had used ~inverted relative ionisation
  - revised numbers from GridPix
- (- also: new number from GridGEM)

$$\frac{\mu_e}{\mu_\mu} = \frac{1}{0.7} \approx 1.43$$



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dE/dx resolution

$$R = \frac{|\eta - 1|}{S \sqrt{\frac{\eta^2 + 1}{2}}}$$

for comparison use  $R_N$  with  $N$  = number of hits

published

30 cm tracks

ILD, publ.

1.35 m

|               |   |                   |            |                    |                      |
|---------------|---|-------------------|------------|--------------------|----------------------|
| GridGEM:      | $R_N = 0.587 \cdot N^{-0.465}$                          | $R_{51} = 9.43\%$ | $S = 1.57$ | $R_{220} = 4.71\%$ | $R_{231} = 4.67\%$   |
| AsianGEM:     | $R_{26} = 13.52\% (k = -0.48)$                          | $R_{57} = 9.28\%$ | $S = 1.59$ | $R_{234} = 4.61\%$ | $R_{257} = 4.50\%$   |
| MicroMegas:   | $R_{192} = 4.8\% (k = -0.48)$                           | $R_{43} = 9.84\%$ | $S = 1.50$ | $R_{192} = 4.8\%$  | $R_{193} = 4.79\%$   |
| GridPix:      | $S = 9.2$ for $e/\mu$ 1m<br>( $\eta = 1.43, k = -0.5$ ) | $R = 6.92\%$      | $S = 2.14$ |                    | $R_{1.35m} = 3.26\%$ |
| GridPix, 60%: |   | $R = 8.93\%$      | $S = 1.65$ |                    | $R_{1.35m} = 4.21\%$ |



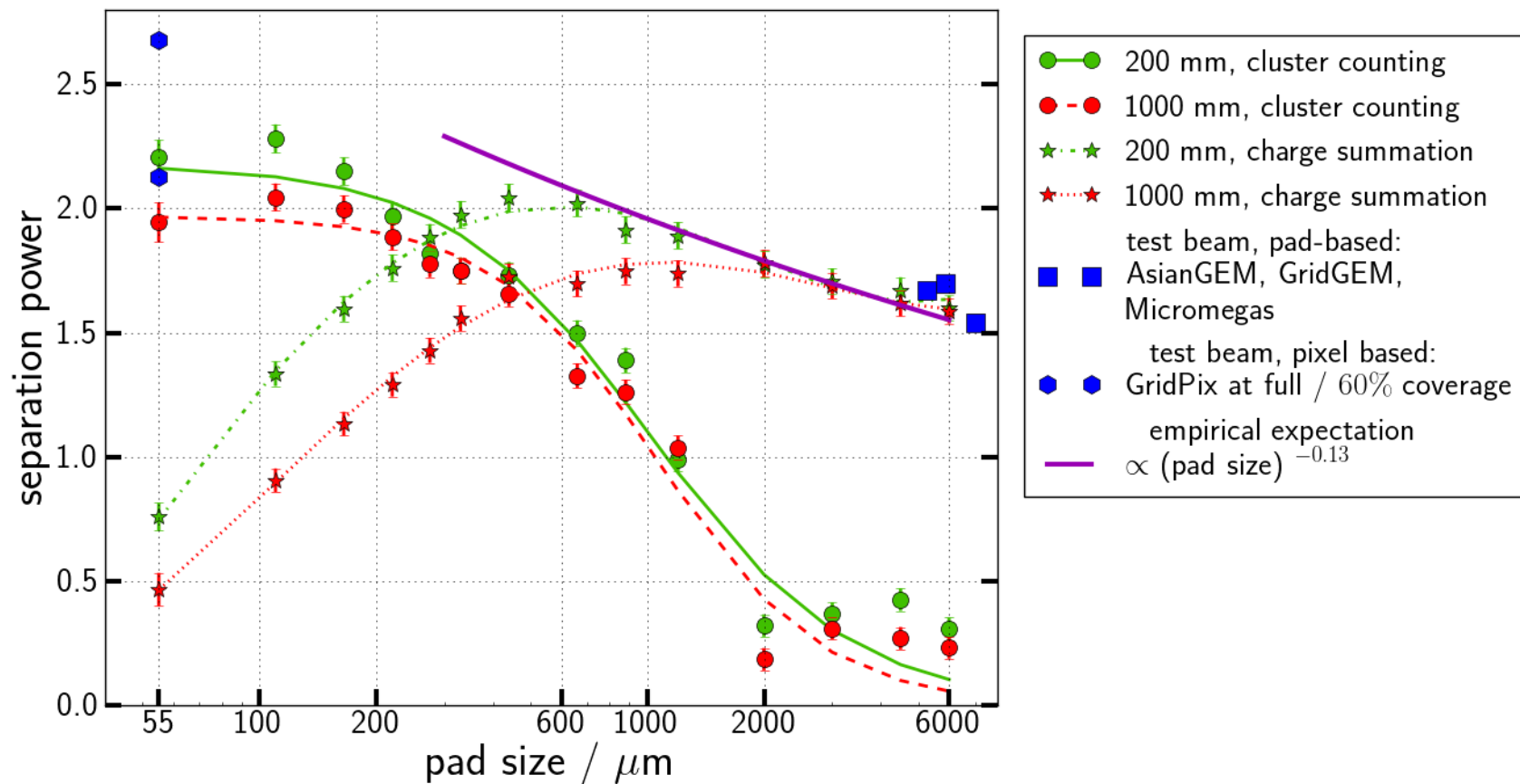


# Reference publications

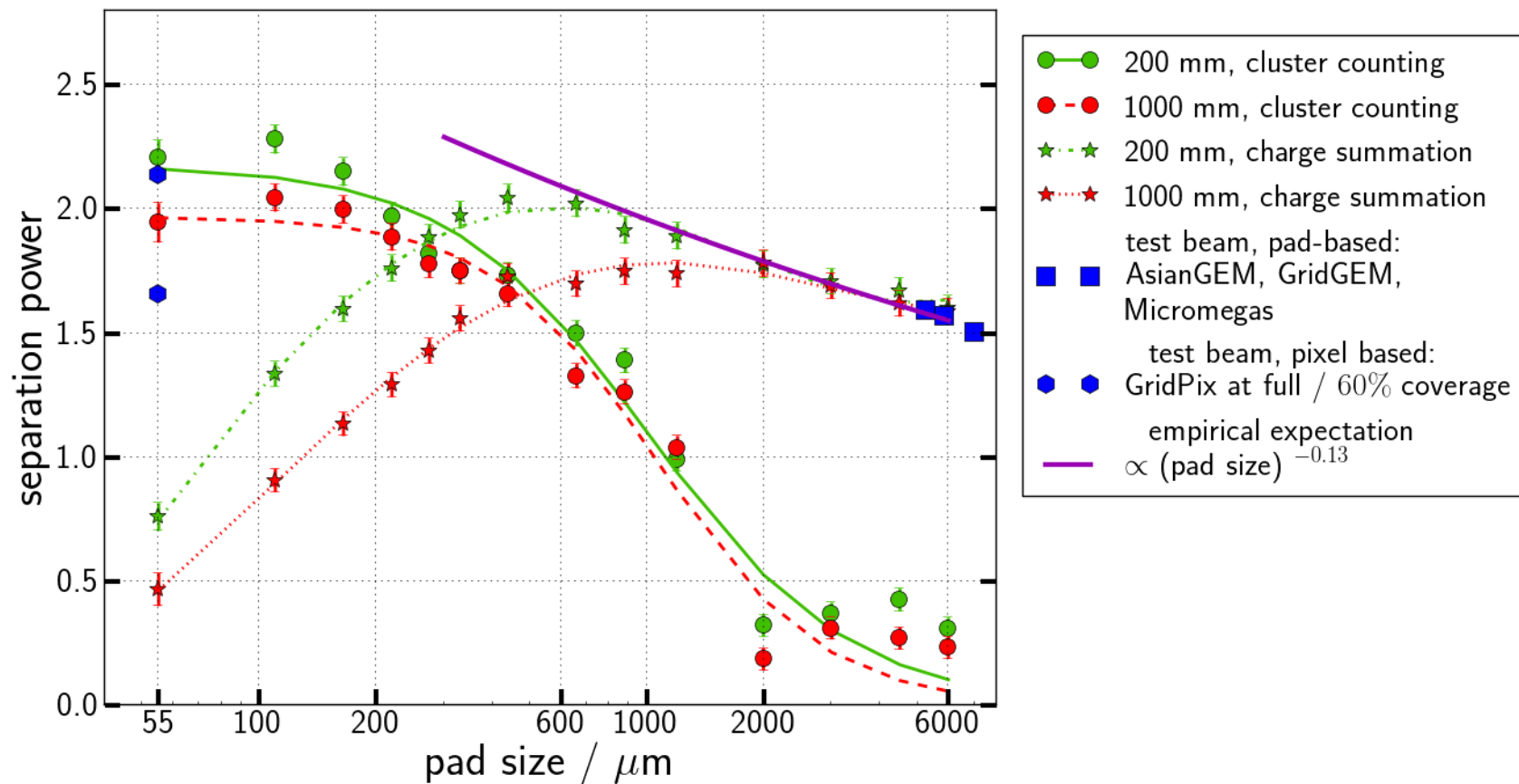
- GridGEM: joint paper, the one currently in review
- AsianGEM: A. Shoji, LCWS 2017 proc. <https://arxiv.org/pdf/1801.04499.pdf>
- Micromegas: P. Colas, MPGD 2019 talk  
<https://indico.cern.ch/event/757322/contributions/3387077/>
- GridPix: C. Ligtenberg, LCWS 2018 proc. <https://arxiv.org/pdf/1902.01987.pdf>
- GridPix, revised numbers: C. Ligtenberg, thesis (in prep.) and private email conversation



# Effect on plots



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