Alignment requirements

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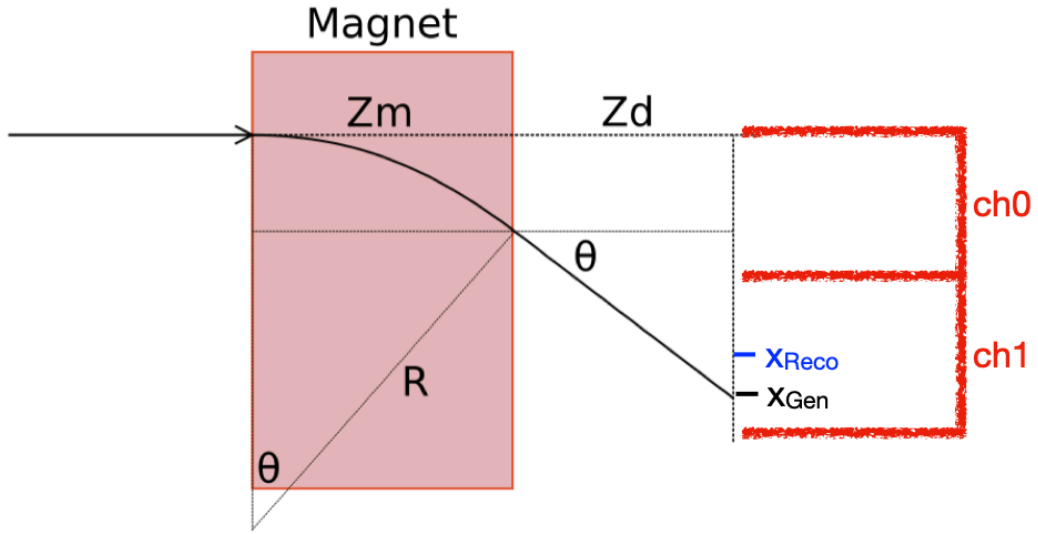
(thanks to R. Jacobs, O. Borysov, L. Helary)

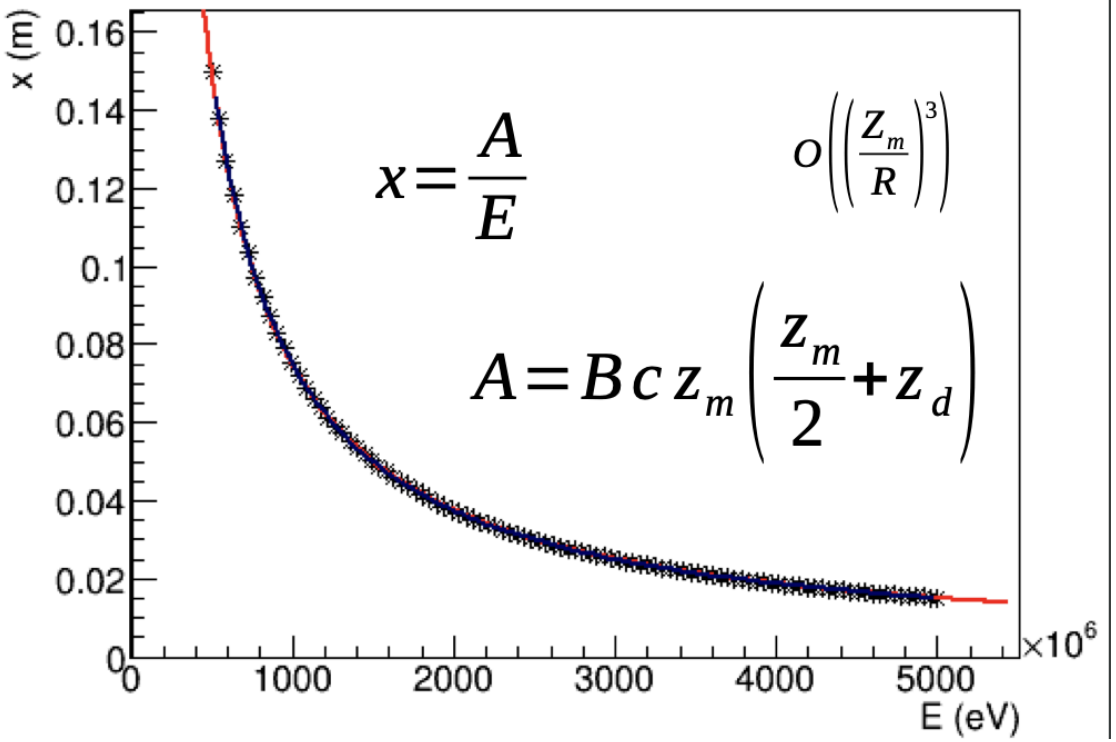
Alignment requirement

- Would be good to come up with generic number for alignment precision required
- Position shift translates to energy shift
  - Analytically calculable: $E_{shift} = 0.00163 \times E^2 \times \frac{shift}{1\,mm} \times \frac{B-field}{2T}$ (see next slide)
- Need to convolute with the relevant energy spectra
  - Already done by R. Jacobs for Compton case

Parametrisation x vs energy

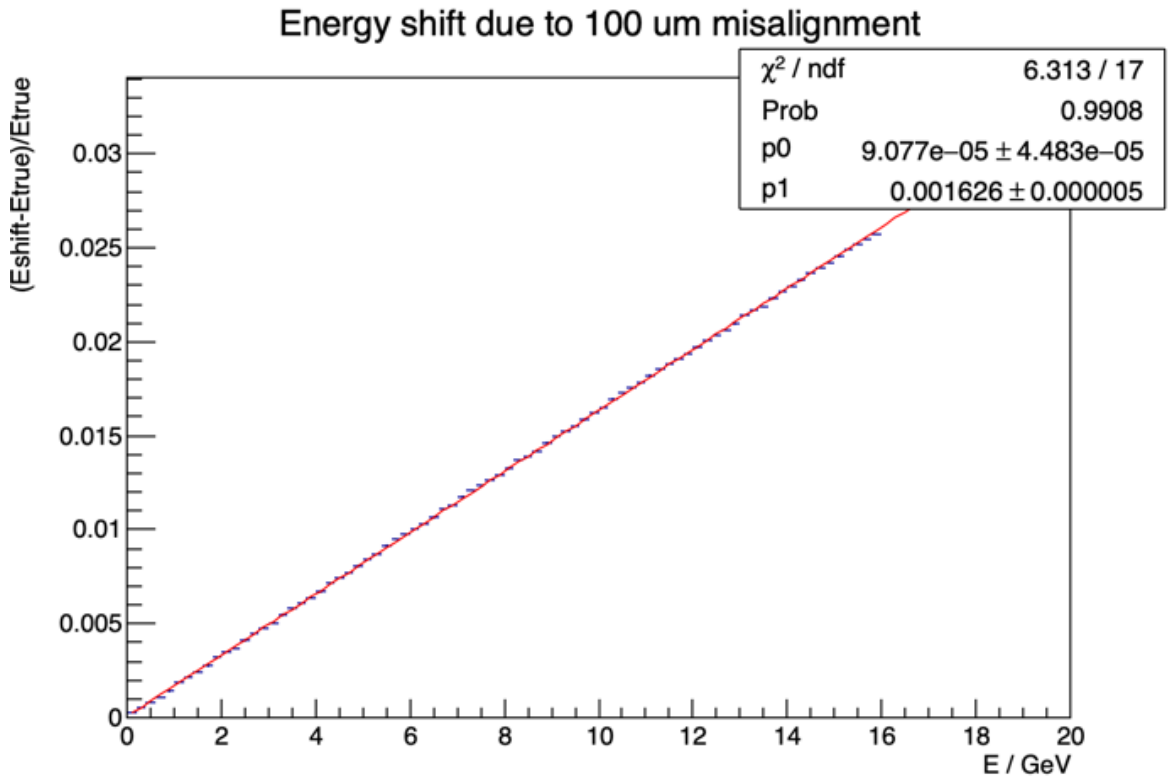


from Sasha's slides



For toy study: use z_m=1m and z_d=0.5m

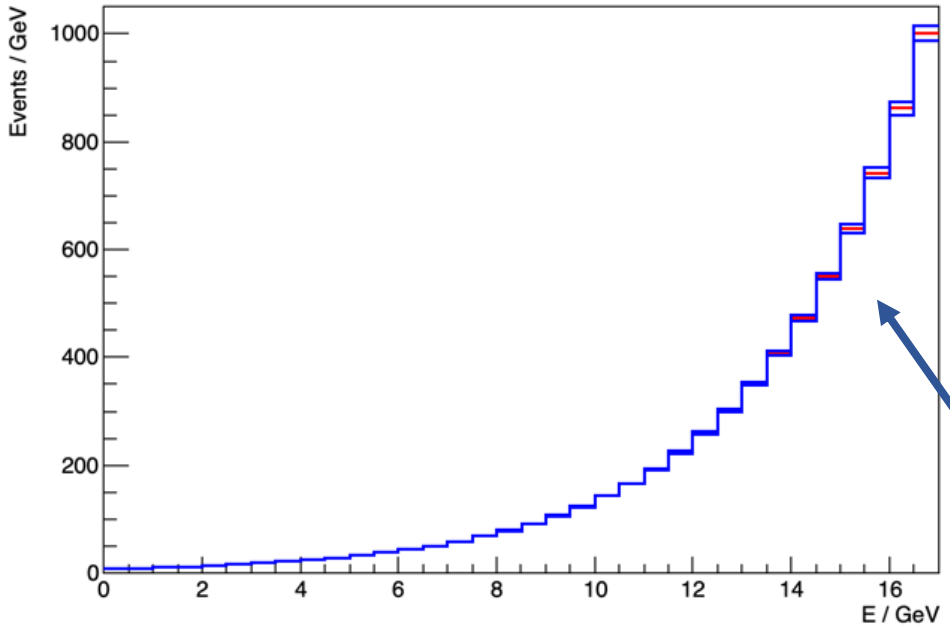
Shift in energy due to misalignment



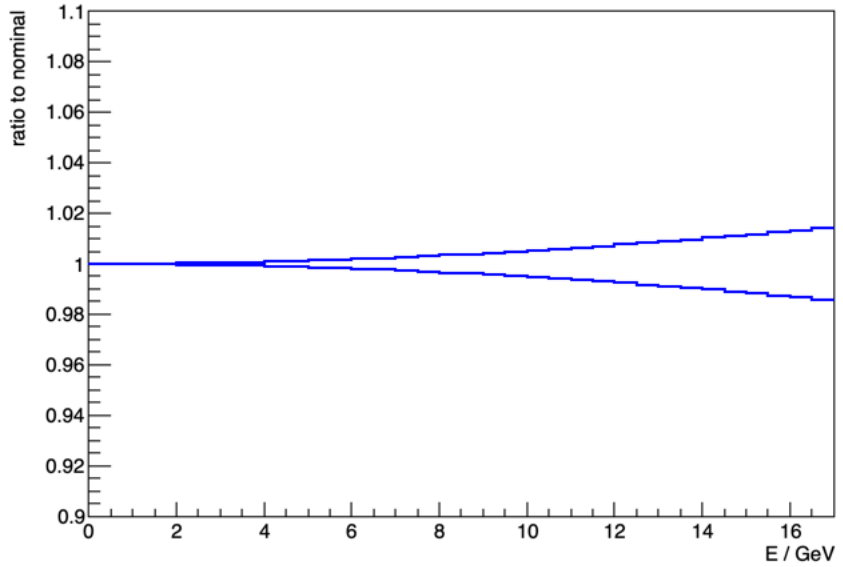
$$E_{shift} = 0.00163 \times E^2 \times \frac{shift}{1\,mm} \times \frac{B - field}{2\,T}$$

- Energy shift up to 2.5% for 1 mm misalignment

Energy spectrum: example of steep spectrum (Compton-like)



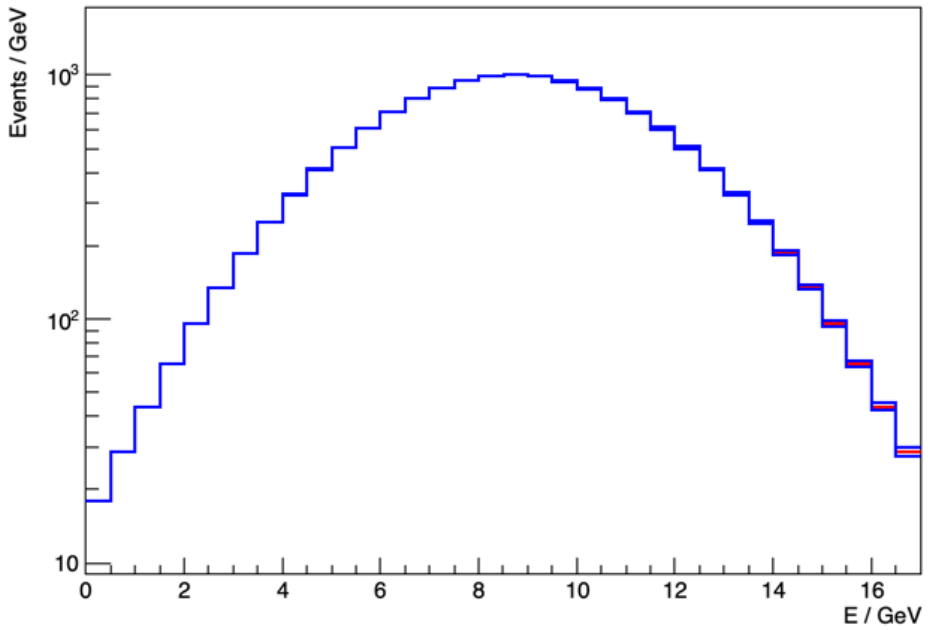
Ratio to nominal

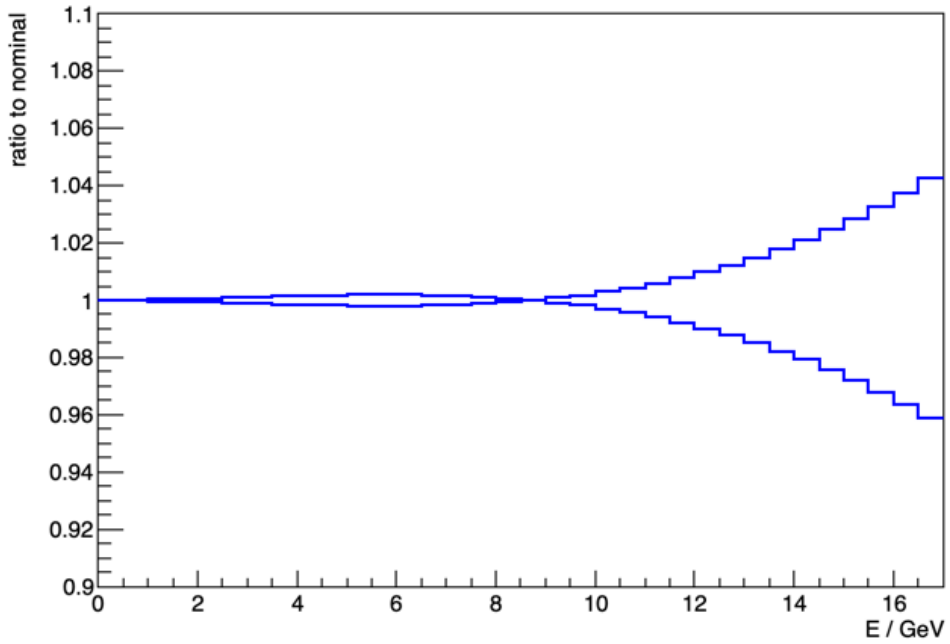


Assuming energy mismeasured due to +-100 um misalignment

100 um shift impacts normalization by up to 1.5% for this spectrum

Differential energy spectrum: example of BPPP-like spectrum

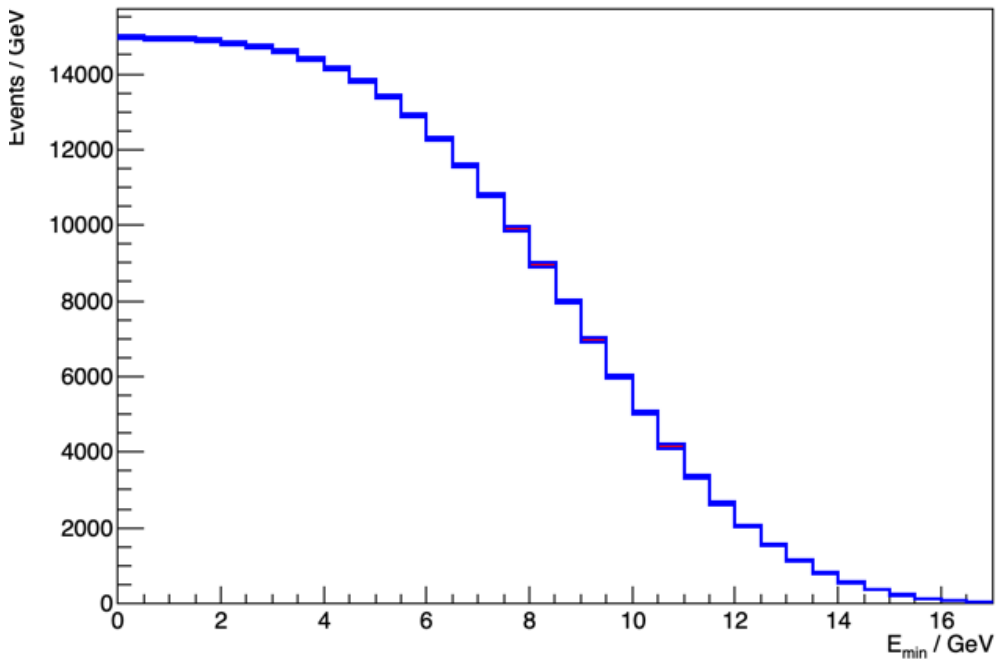


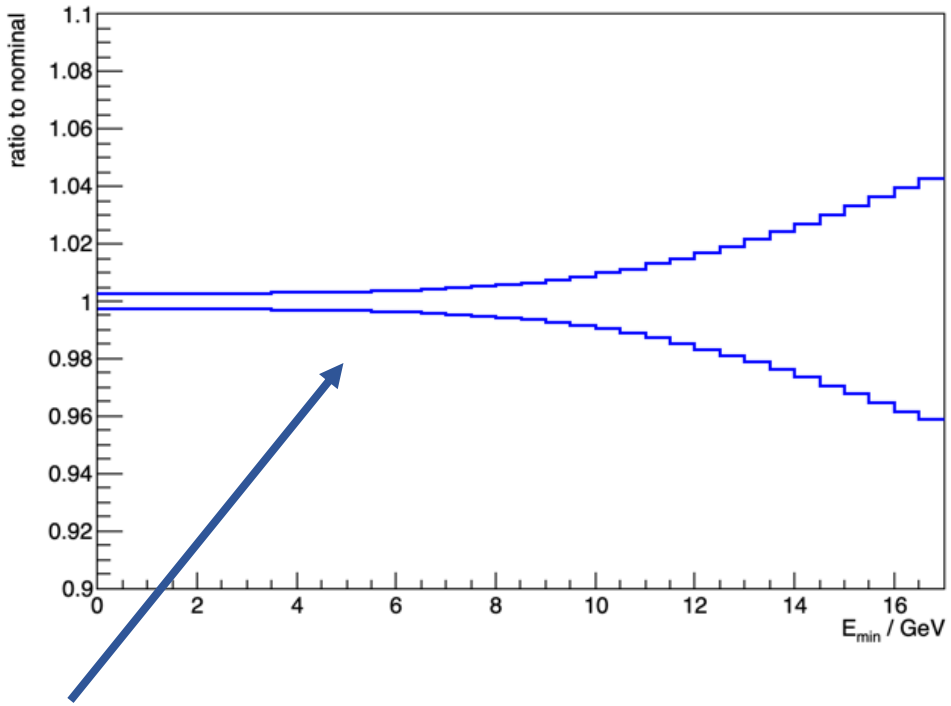


Assuming energy mismeasured due to +-100 um misalignment

100 um shift impacts normalization by up to 4% for this spectrum

Integrated energy spectrum: example of BPPP-like spectrum



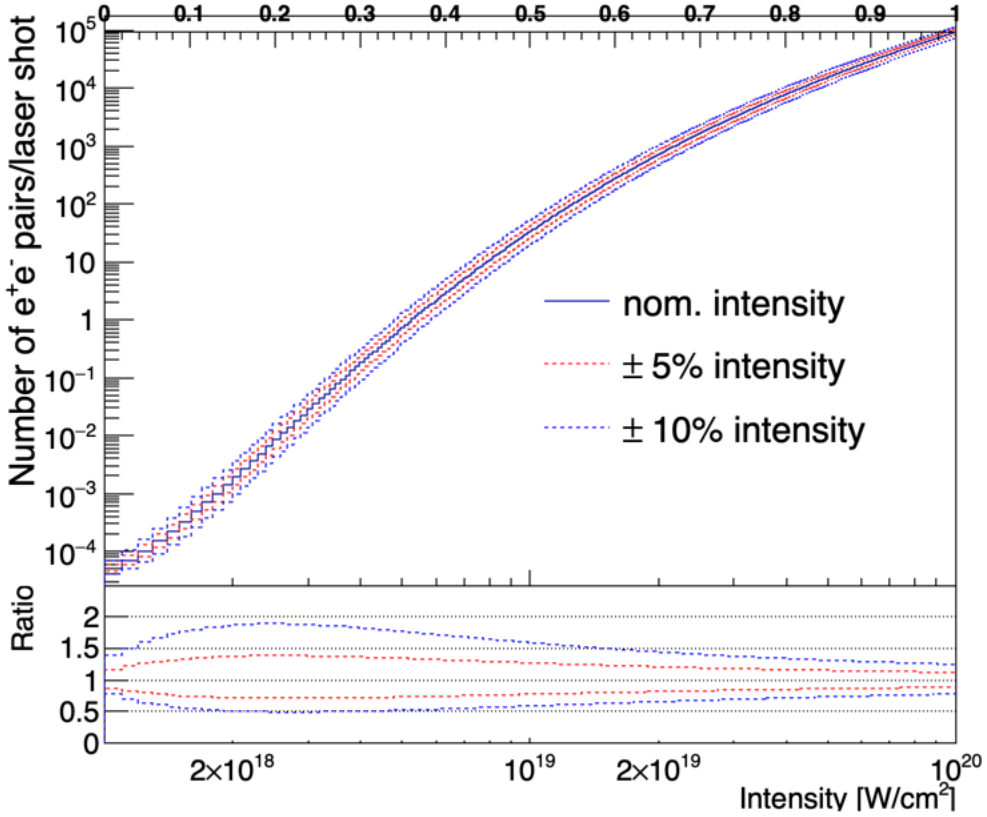


Assuming energy mismeasured due to +-100 um misalignment

100 um shift impacts normalization by ~1% for energy cutoffs <8 GeV

Conclusion

- Simple parametrization can be used to assess alignment requirements
  - For reasonable spectra it seems that 100 um is sufficient to ensure syst. uncertainty on differential rate below 5%
    - Impact on integral lower
  - Will check with actual spectra in MC
- Remember: 5% uncertainty laser intensity corresponds to 40% uncertainty on integrated event rate
- Need to in general estimate syst. uncertainties on all analyses and document them



Energy Spectrum BPPP