# short update: 250 GeV parameters

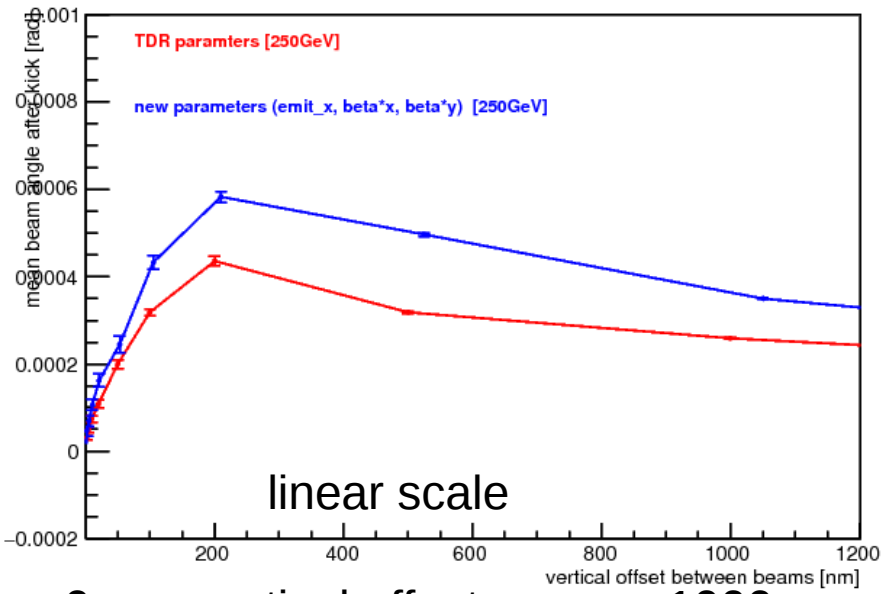
Daniel Jeans, May 9, 2017

# kick angle of beams as function of vertical offset between them

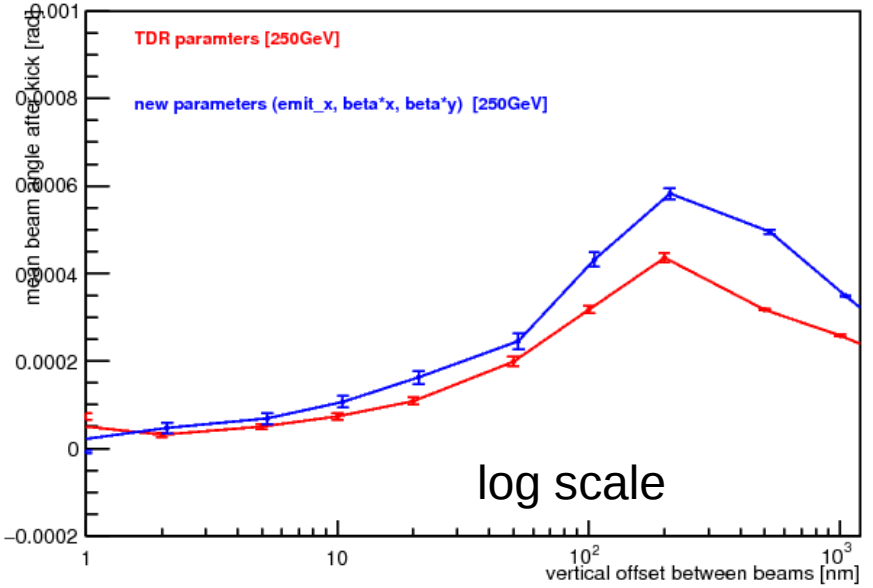
1 mrad

kick angle

0




0 vertical offset 1000 nm




1 vertical offset 100 1000 nm

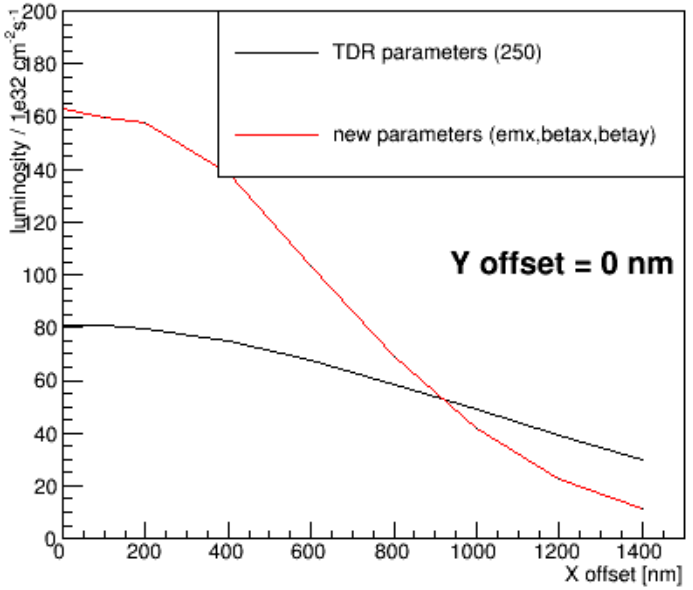
TDR

new

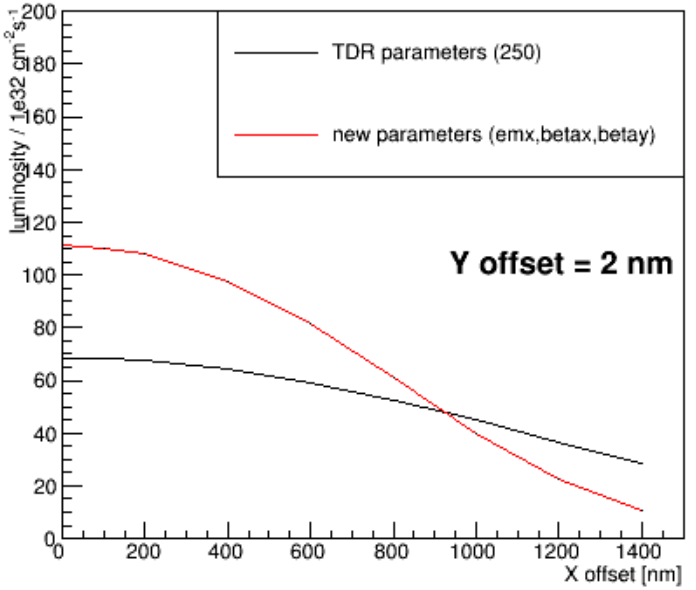
| | |
|---|---|
| emit-x | reduce by 2 |
| beta*-x | reduce by sqrt(2) |
| beta*-y | increase by sqrt(2) |

# luminosity as a function of vertical and horizontal beam-beam offsets
## compare TDR and new parameter sets

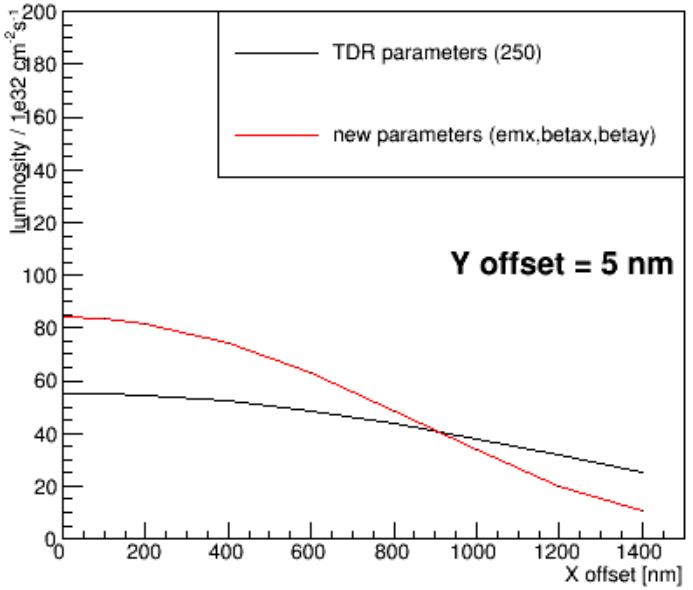
luminosity



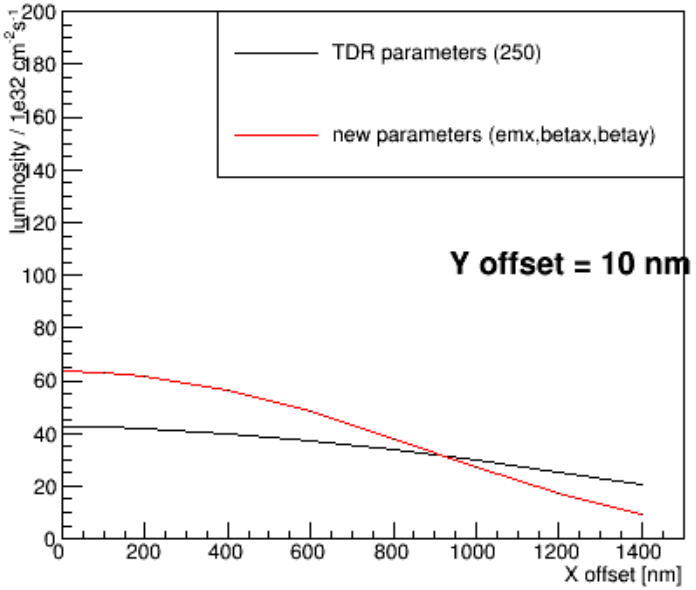

0 X offset [nm] 1400




0 X offset [nm] 1400




0 X offset [nm] 1400




0 X offset [nm] 1400

(total luminosity, integrated over all energies)

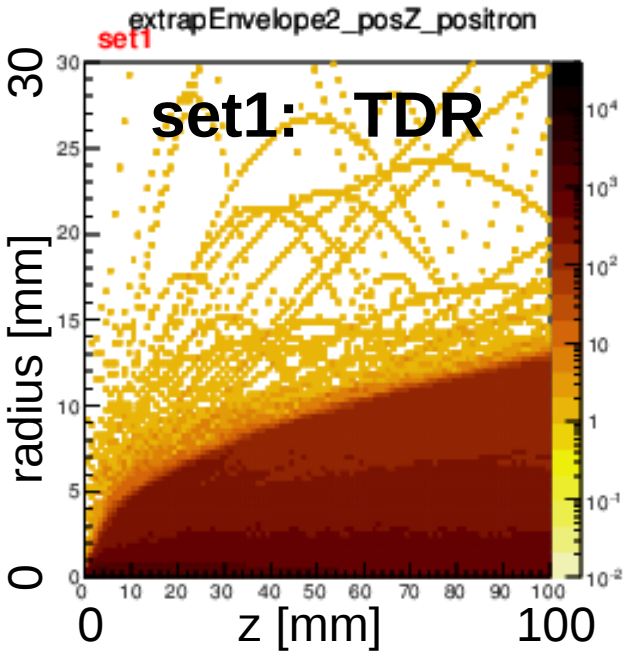
incoherent pair backgrounds in detector @ 250 GeV

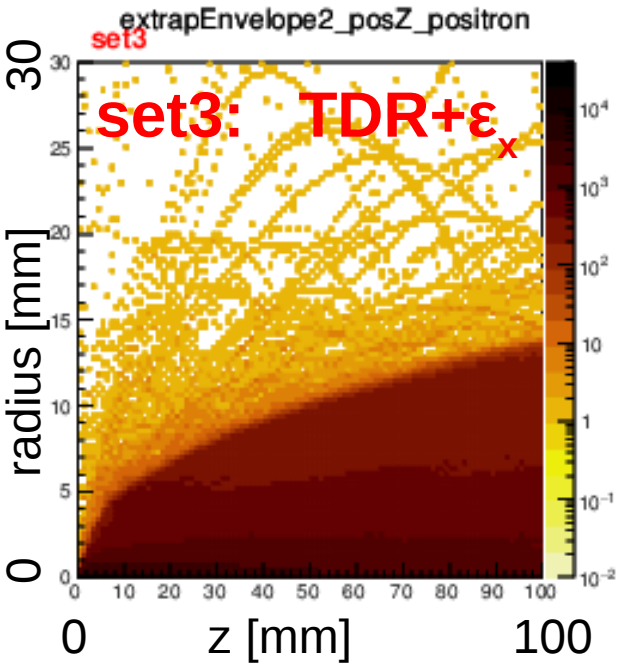
simple extrapolation in uniform field
no back-scatter from forward calorimeters

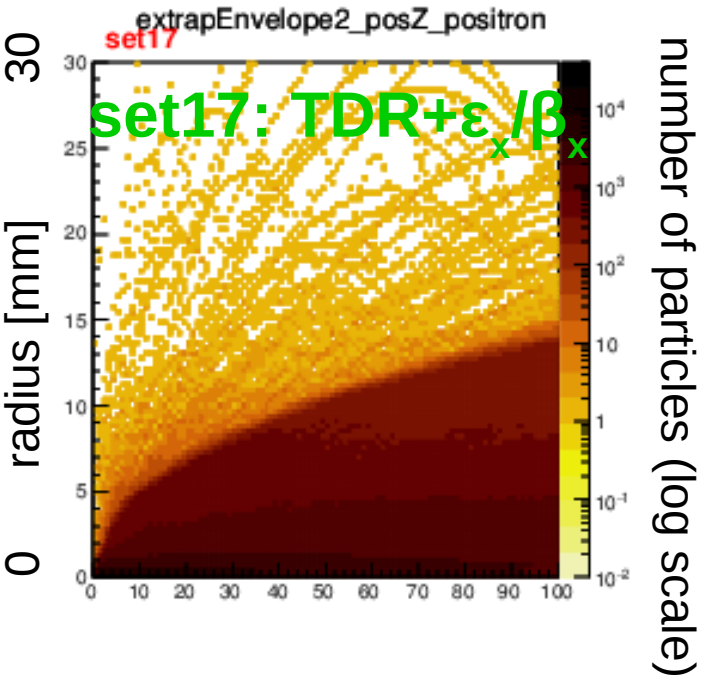
UPDATE: compare to TDR-500 beam parameters

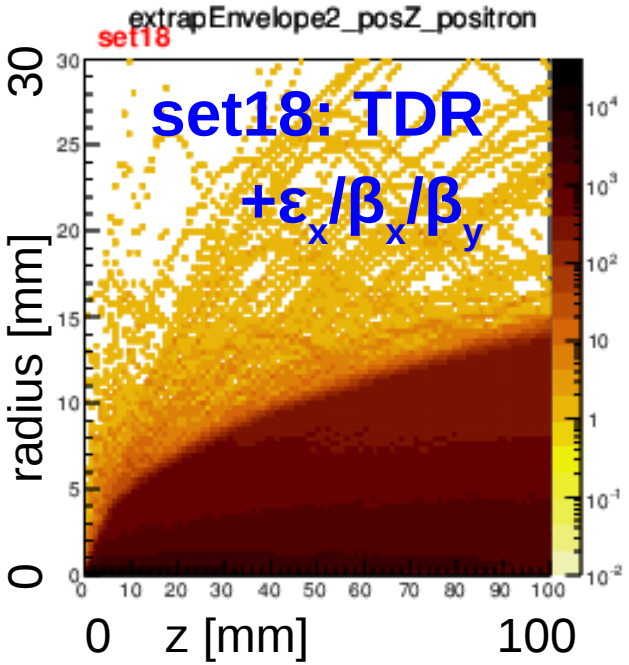
# Distribution of incoherent pairs around beampipe

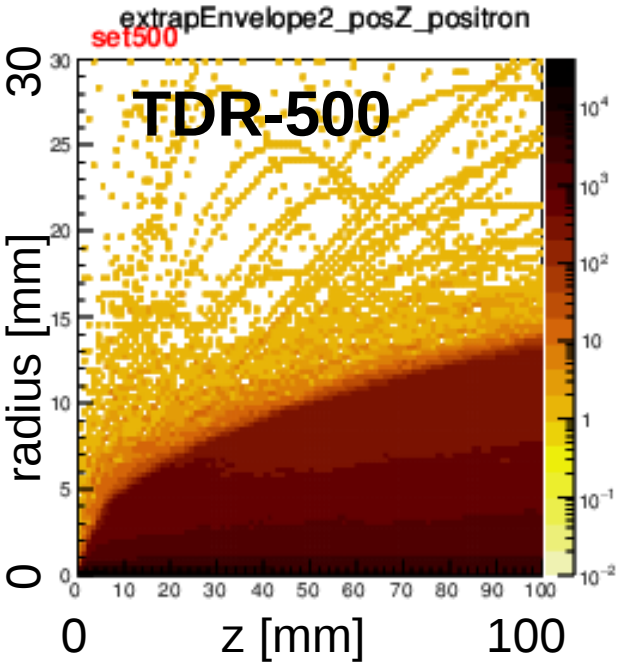
simple extrapolation in uniform 3.5T field, no beam crossing,
no material interactions, no backscatter from e.g. FCAL



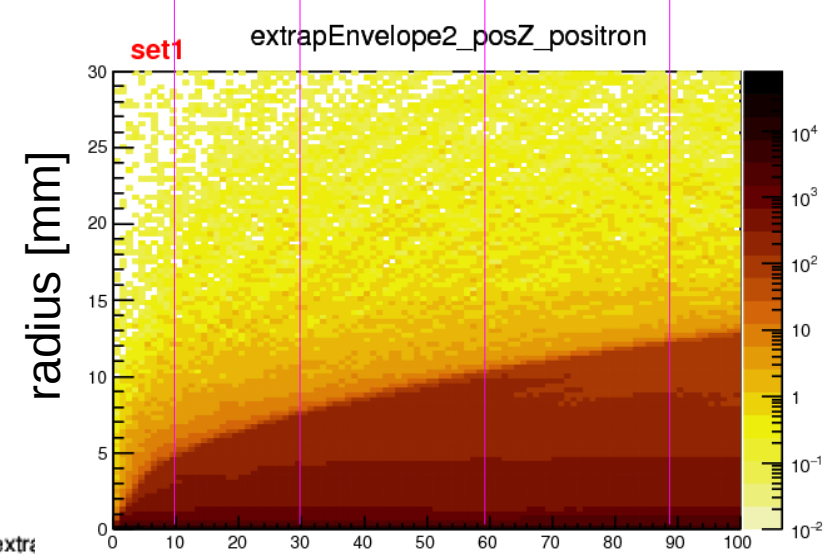



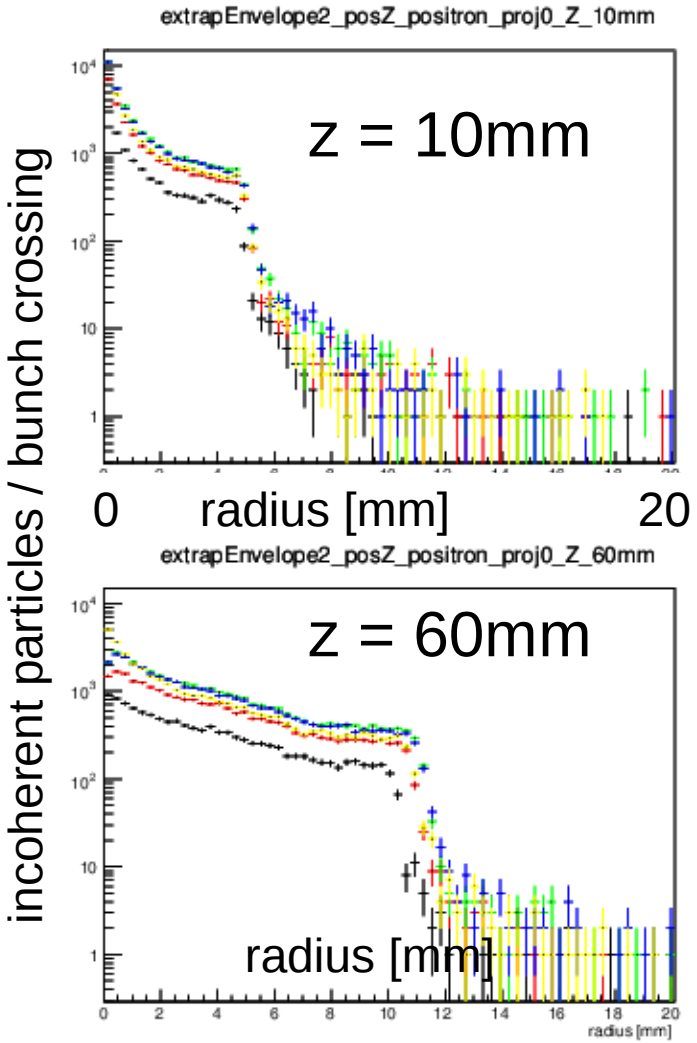



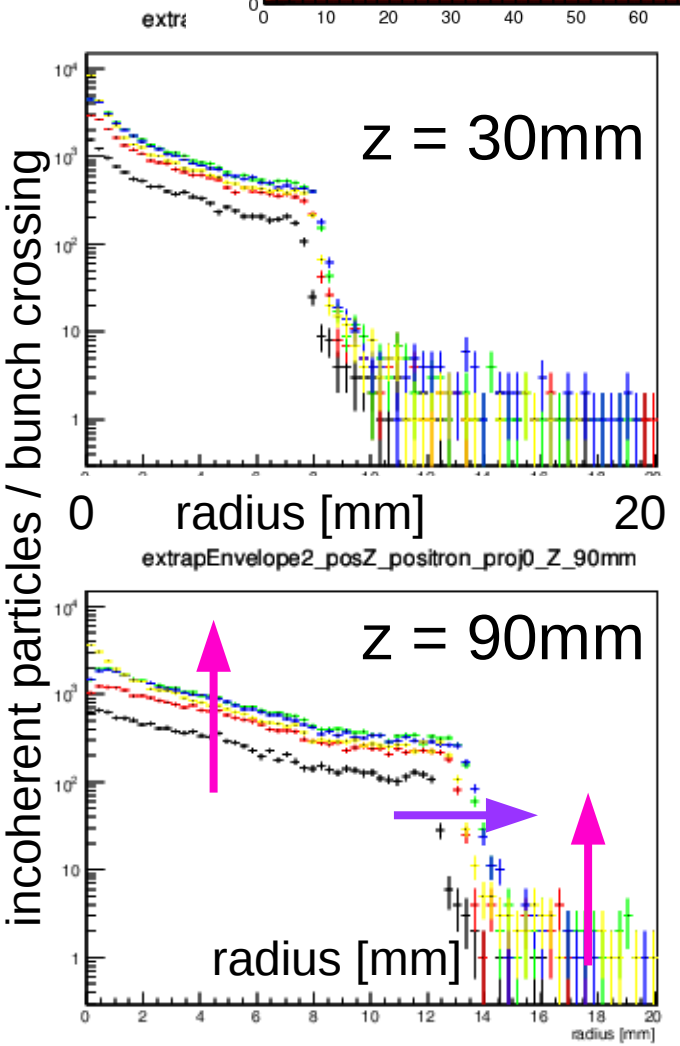
# Incoherent pairs

slice distributions in z

compare beam parameters




**set1: TDR**
**set3: TDR+$\varepsilon_x$**
**set17: TDR+$\varepsilon_x/\beta_x$**
**set18: TDR+$\varepsilon_x/\beta_x/\beta_y$**
**TDR-500**

**with new 250GeV parameters:**
**number of pairs generally 2~3x higher**
**"cut-off" moves out by ~1mm**
**similar/worse than 500 GeV**

question from ILD meeting:

if detector backgrounds turn out to be
too severe with new parameters,
will it be possible to go back to TDR-like parameters,
with lower backgrounds (and lower luminosity)

end

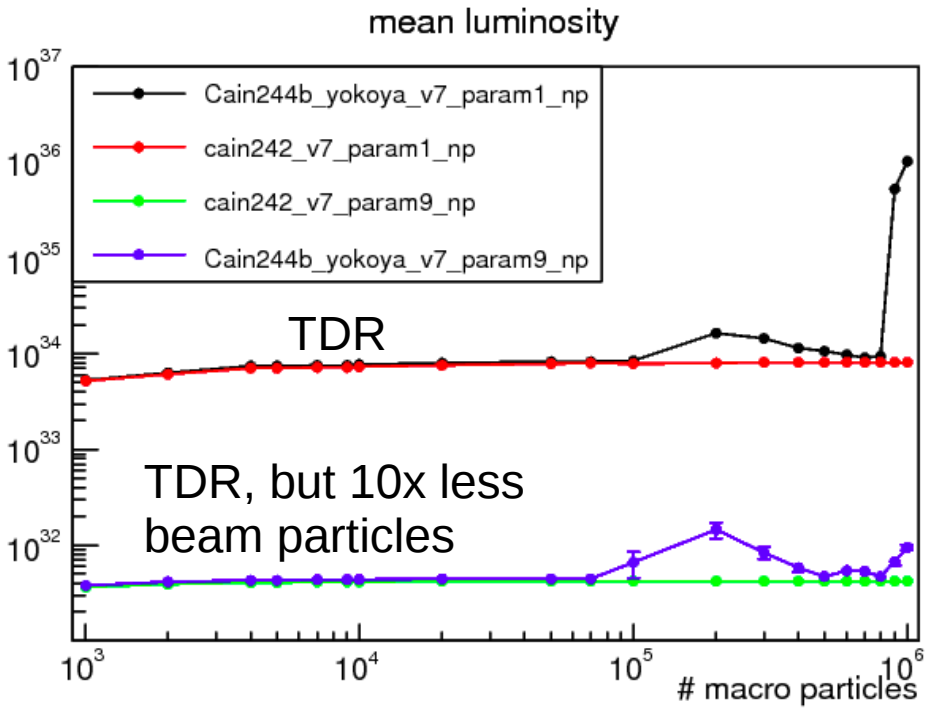
Update

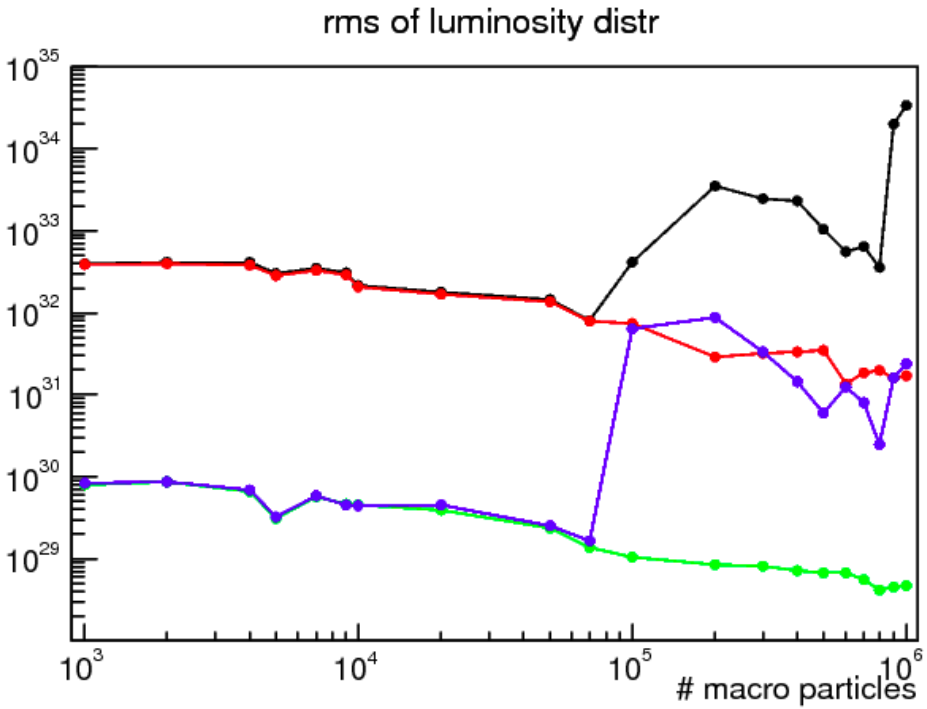
- CAIN #particles dependency
- effect on physics of different luminosity spectra @ 250 GeV
- beam kick for large y offsets

Daniel Jeans, 11 April 2017

last meeting: observed weird dependence on CAIN results
as function of # macro particles

mean and rms of luminosities calculated in 10 CAIN runs/point:




only present in most recent beta version of the code (244b)

previous version (I checked 242, 243) look as expected
→ stay with older versions for the time being

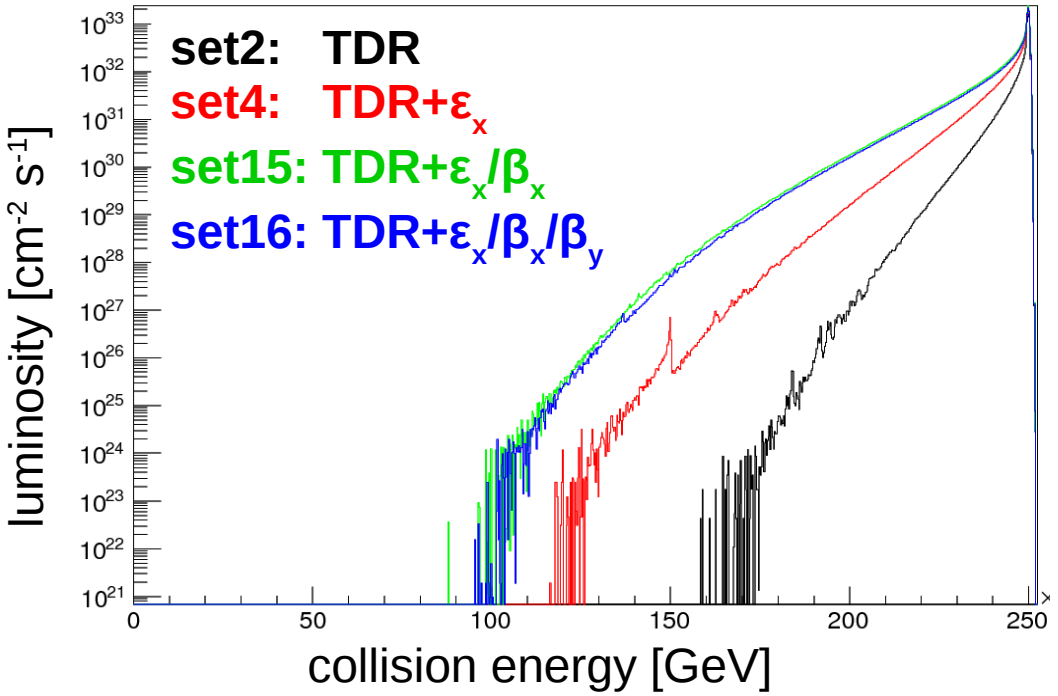
effect of 250 GeV luminosity spectra on physics

Higgs mass extraction in
Higgs-strahlung process e+ e- → HZ , Z → mu mu
is, I think, most sensitive to knowledge of collision energy

do simple full-sim pseudo-analysis to
estimate effect of different luminosity spectra

recoil mass distribution affected by:
beamstrahlung ←larger for new parameter sets
detector resolution ←smallest for Z → mu mu

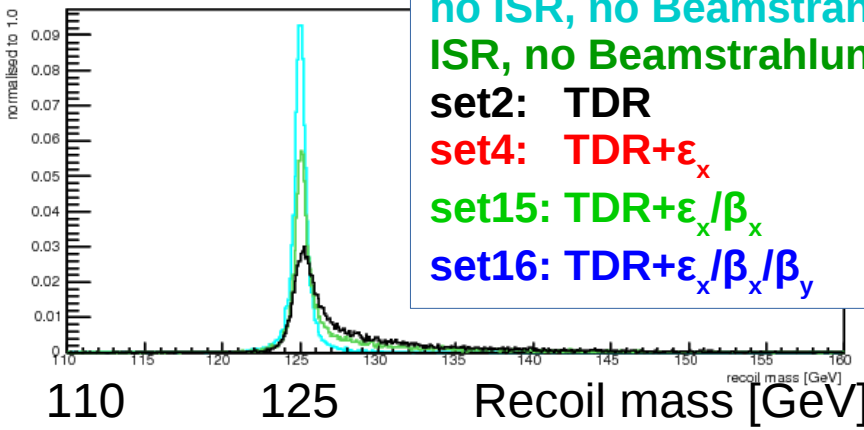
is increased beamstrahlung compensated by increase luminosity?



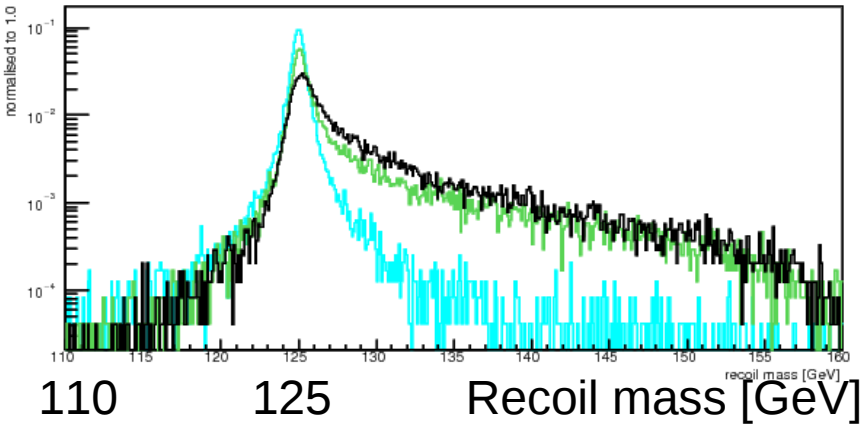
# recoil mass distributions: after full simulation and reconstruction

**no ISR, no Beamstrahlung**
**ISR, no Beamstrahlung**
**set2: TDR**
**set4: TDR+$\varepsilon_x$**
**set15: TDR+$\varepsilon_x/\beta_x$**
**set16: TDR+$\varepsilon_x/\beta_x/\beta_y$**

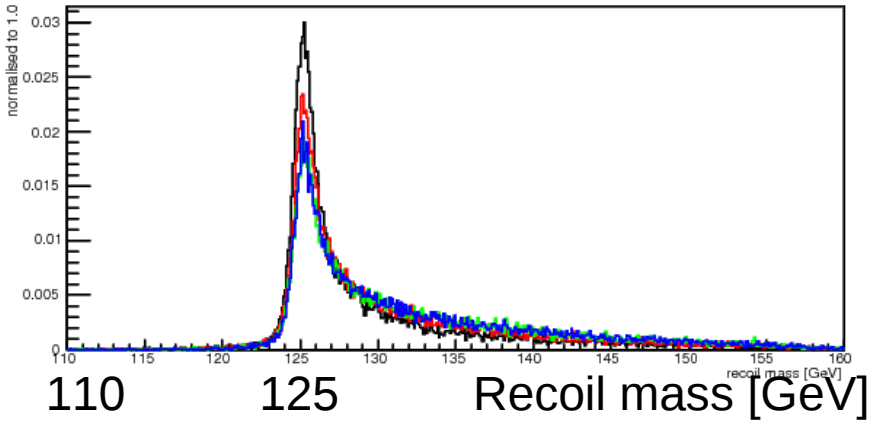
**equal normalisation**



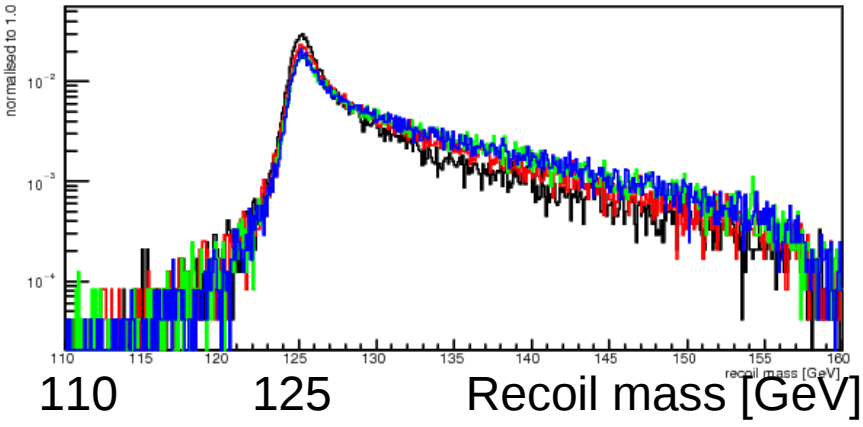

110 125 Recoil mass [GeV]




110 125 Recoil mass [GeV]

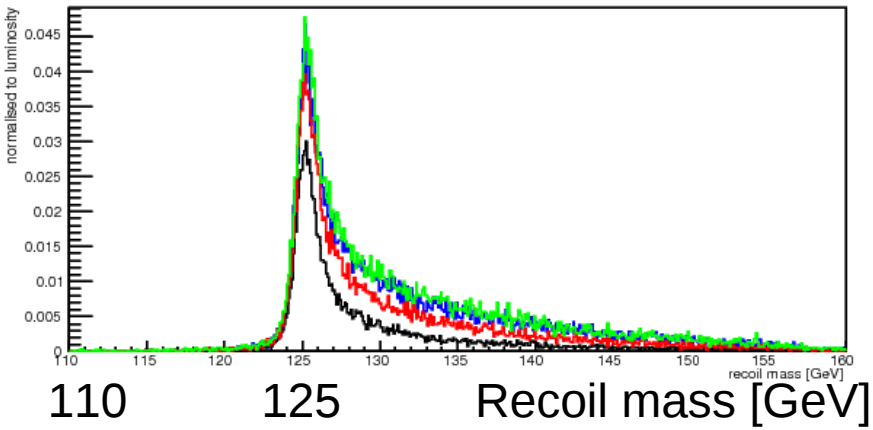



110 125 Recoil mass [GeV]

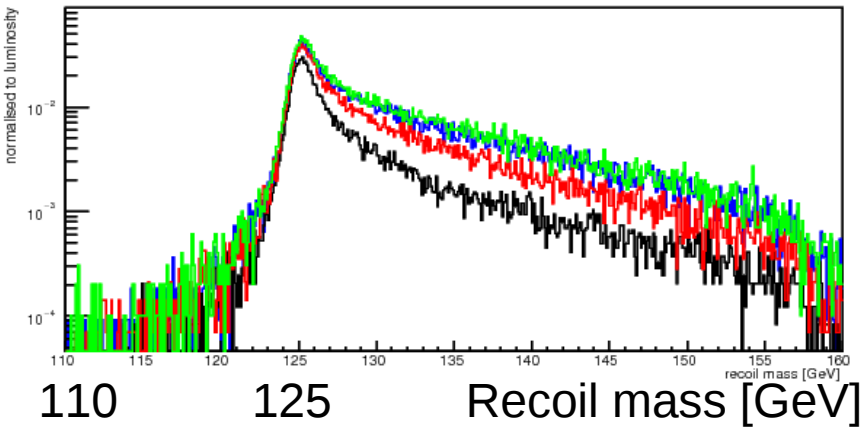



110 125 Recoil mass [GeV]

**scaled to luminosity**




110 125 Recoil mass [GeV]

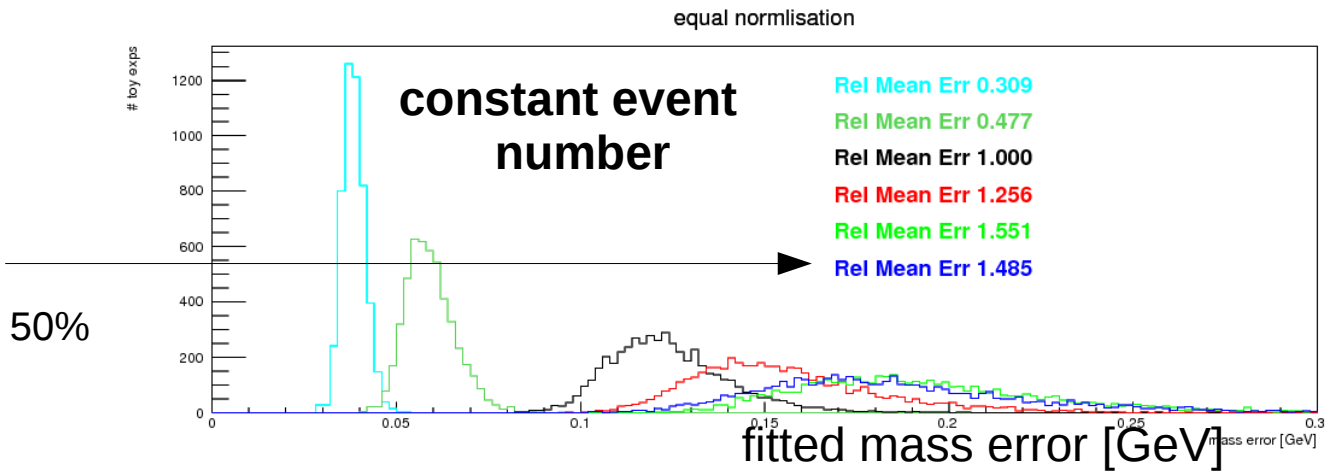



110 125 Recoil mass [GeV]

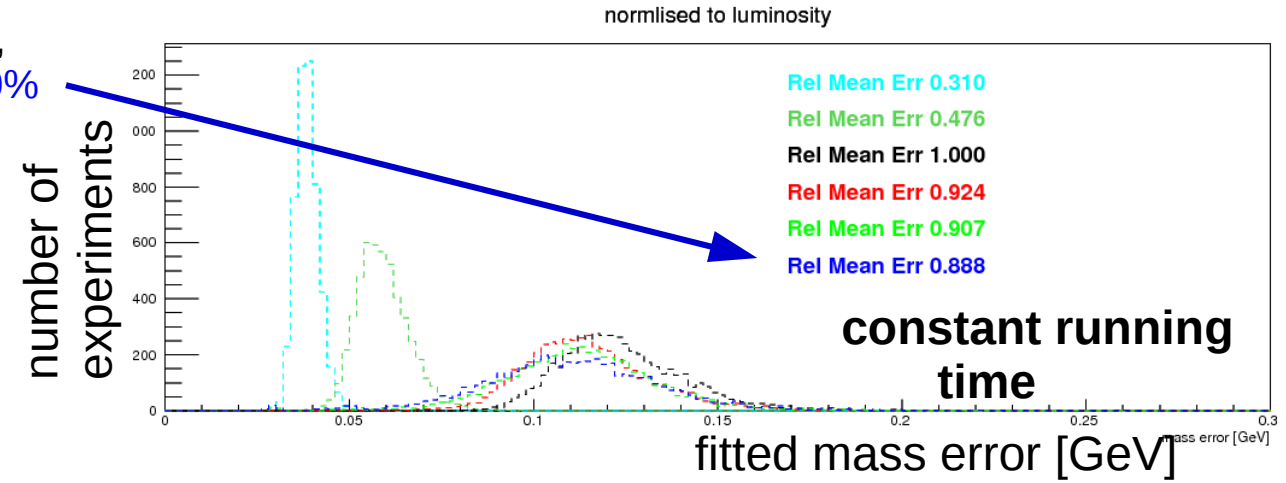
# Toy MC experiments, assuming flat background expected mass measurement errors using different beam spectra

**no ISR, no Beamstrahlung**
**ISR, no Beamstrahlung**
**set2: TDR**
**set4: TDR+$\varepsilon_x$** L0.01 ↑ 41%
**set15: TDR+$\varepsilon_x/\beta_x$** L0.01 ↑ 69%
**set16: TDR+$\varepsilon_x/\beta_x/\beta_y$** L0.01 ↑ 55%

with same **number of events**:
new spectra are less powerful,
expected mass error degrades by 50%
compared to TDR




with same **running time**:
higher lumi more than compensates,
expected mass error improves by 10%
compared to TDR

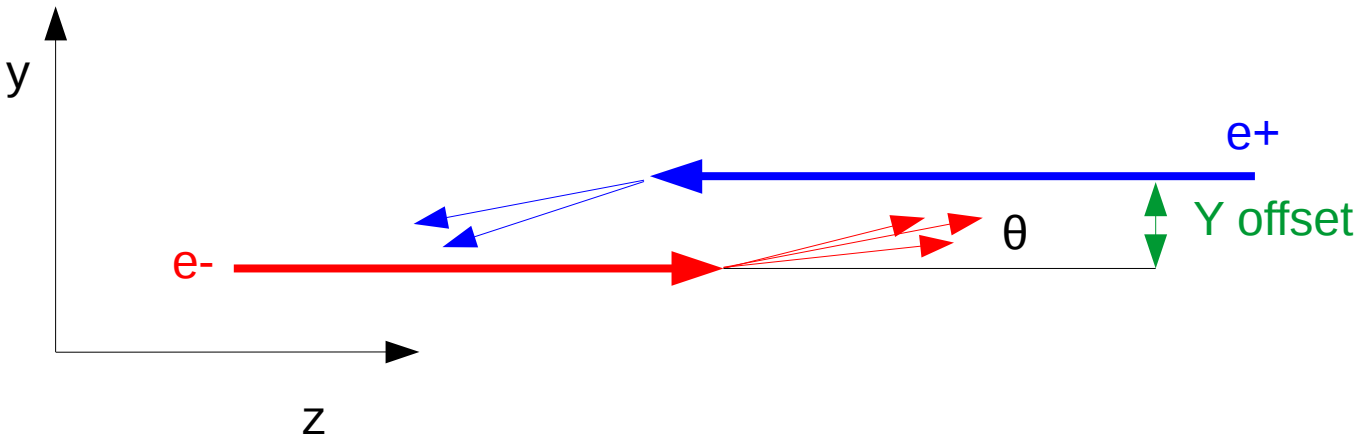



even for this analysis, which is rather sensitive to the luminosity spectrum,
new parameters are better than the TDR
→ expect larger improvement in other analyses

beam kick vs. vertical displacement
for different 250 GeV parameter sets

(request from Okugi-san :
if I understand correctly related to tolerance to vibrations)

look at distribution of beam particles' θ = atan(py/pz) after the collision
using CAIN
comparing TDR and **TDR+$\varepsilon_x/\beta_x/\beta_y$** parameters

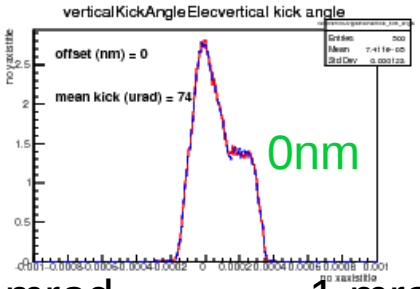


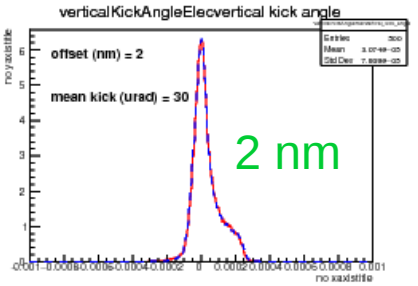
TDR parameters, vertical offsets: 0, 2, 5, 10, 20, 50, 100, …, 1000, …., 10000 nm
plot distribution of atan(Py/Pz) after CAIN simulation

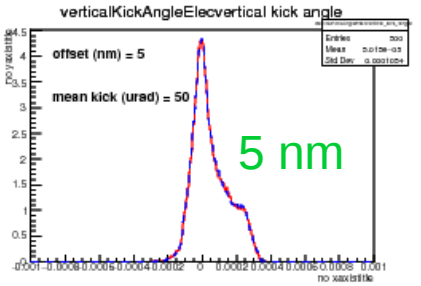
electrons / positrons

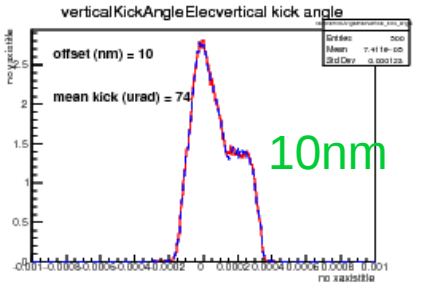
# particles

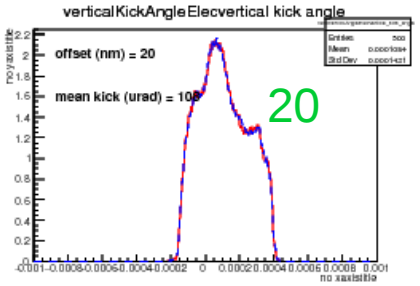
-1 mrad → 1 mrad

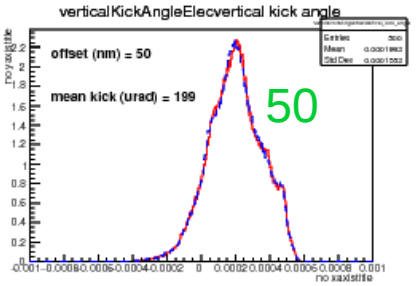


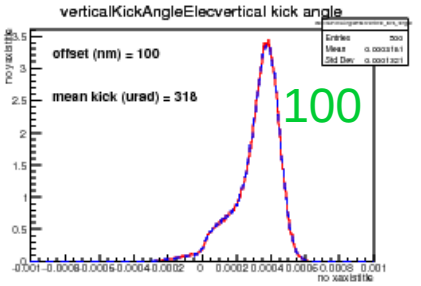



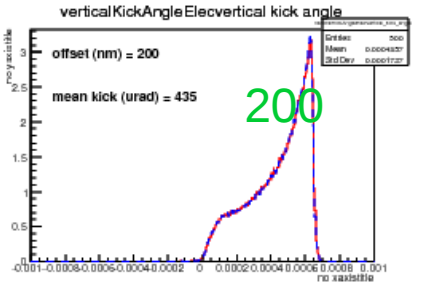



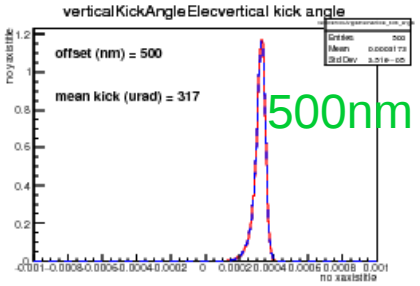



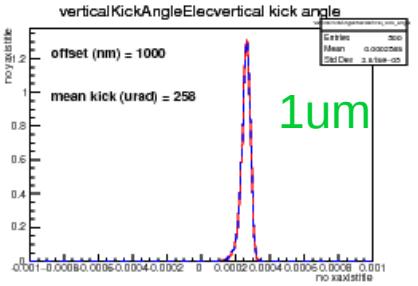



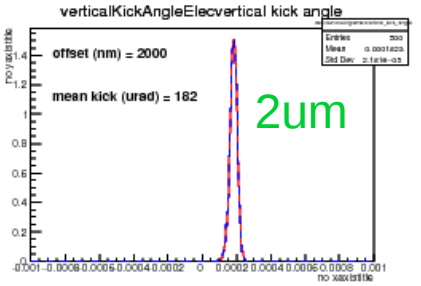



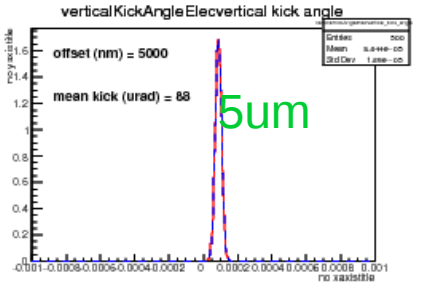



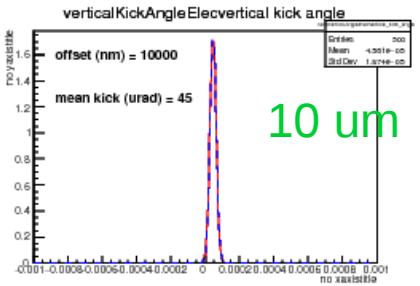



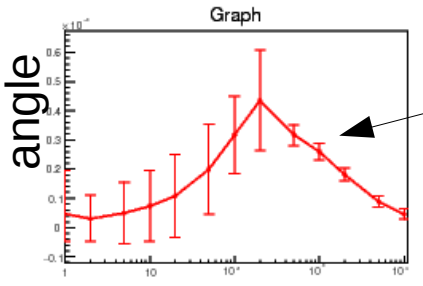




mean and RMS

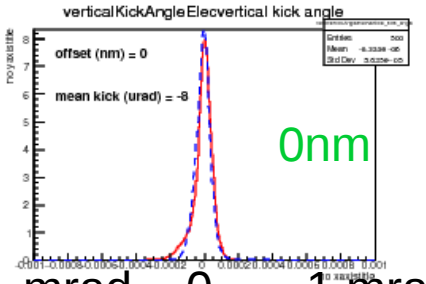
why are some of these so lumpy?

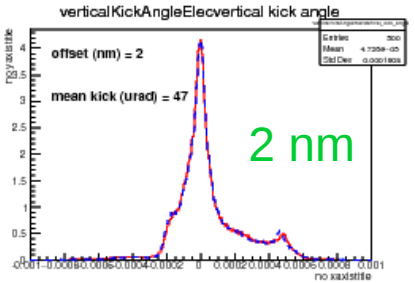
same for new parameters **TDR+$\varepsilon_x/\beta_x/\beta_y$**

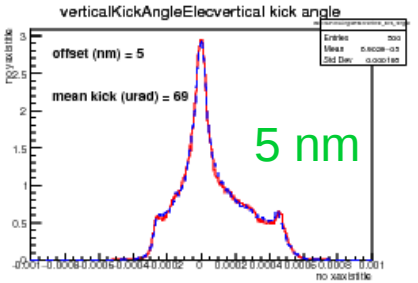
electrons / positrons

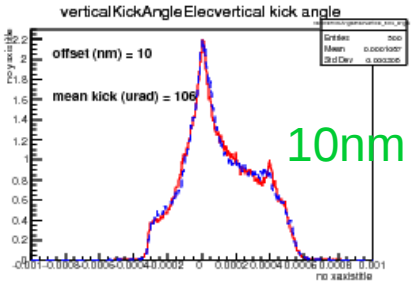
# particles

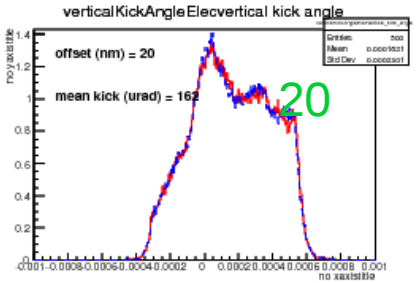
-1 mrad 0 1 mrad

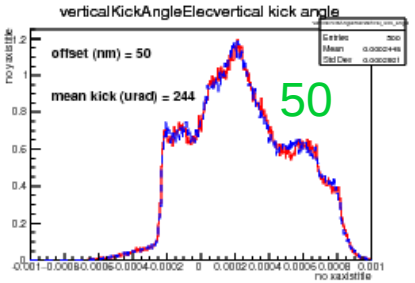


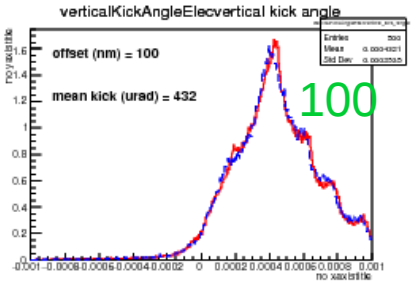



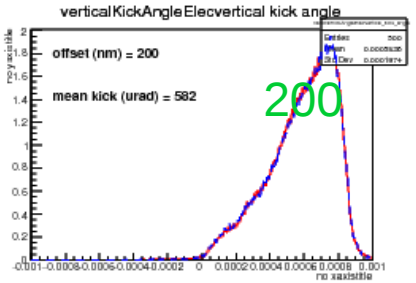



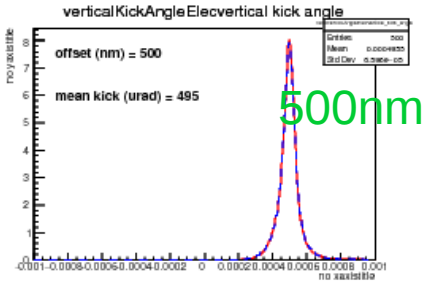



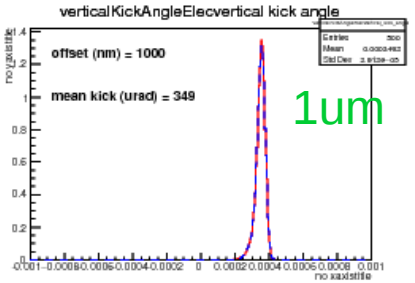



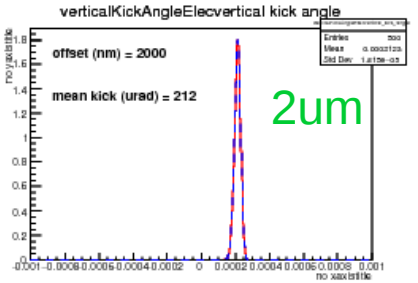



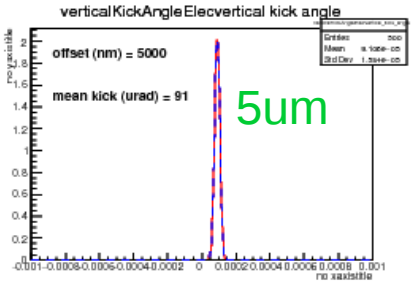



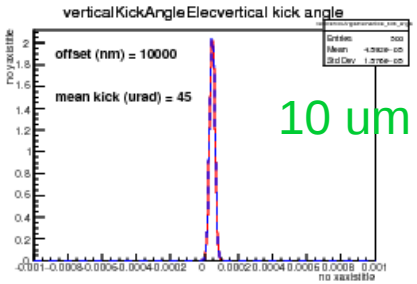



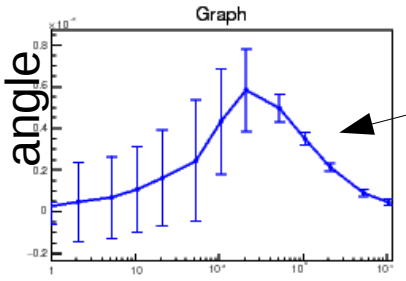



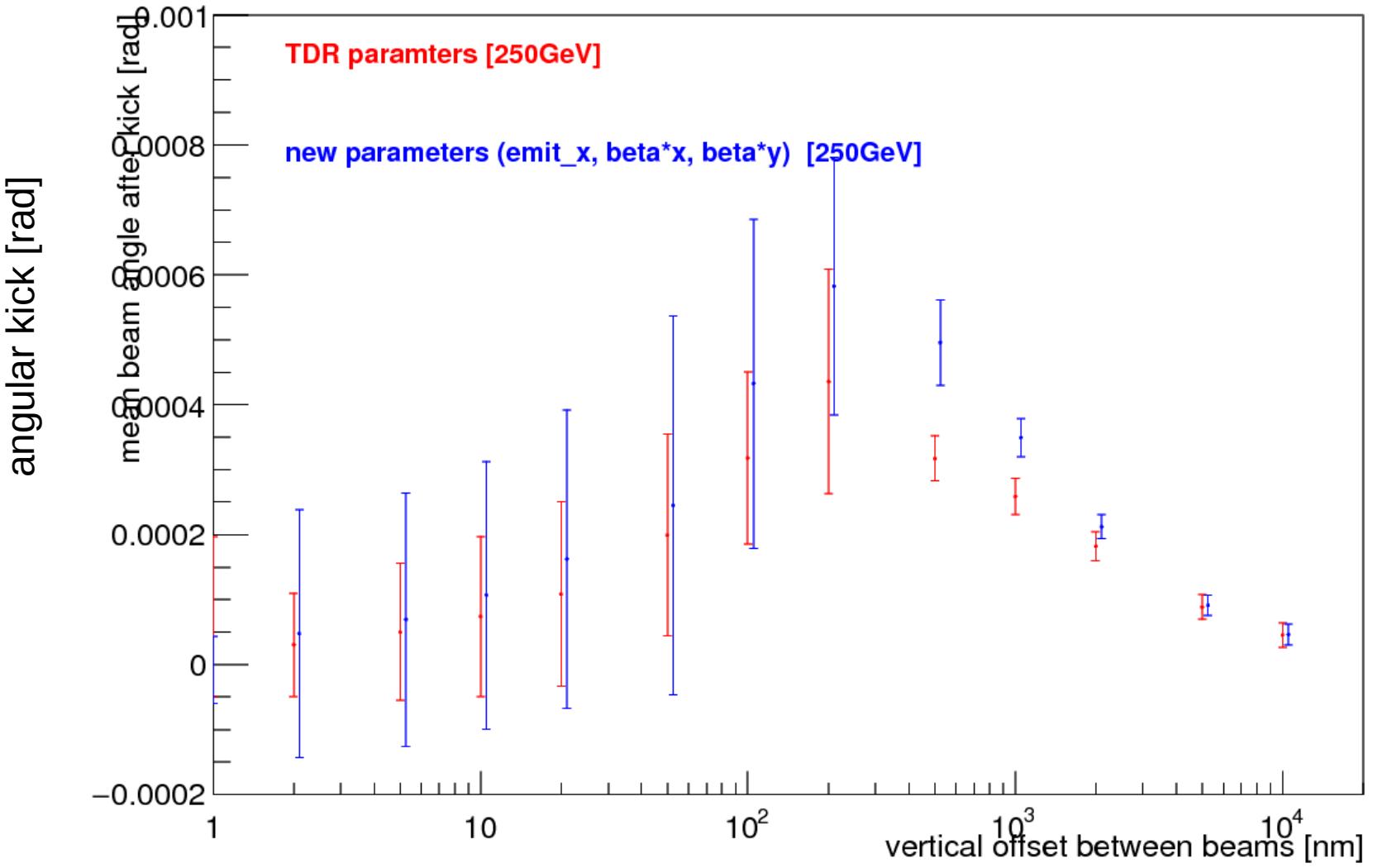




mean and RMS

why are some of these so lumpy?

compare the two parameter sets



movie of simulated bunch crossings (CAIN)
comparing different parameters