Workshop on Forward Calorimetry
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Impact of 'Real Beams' interaction on LCAL performances

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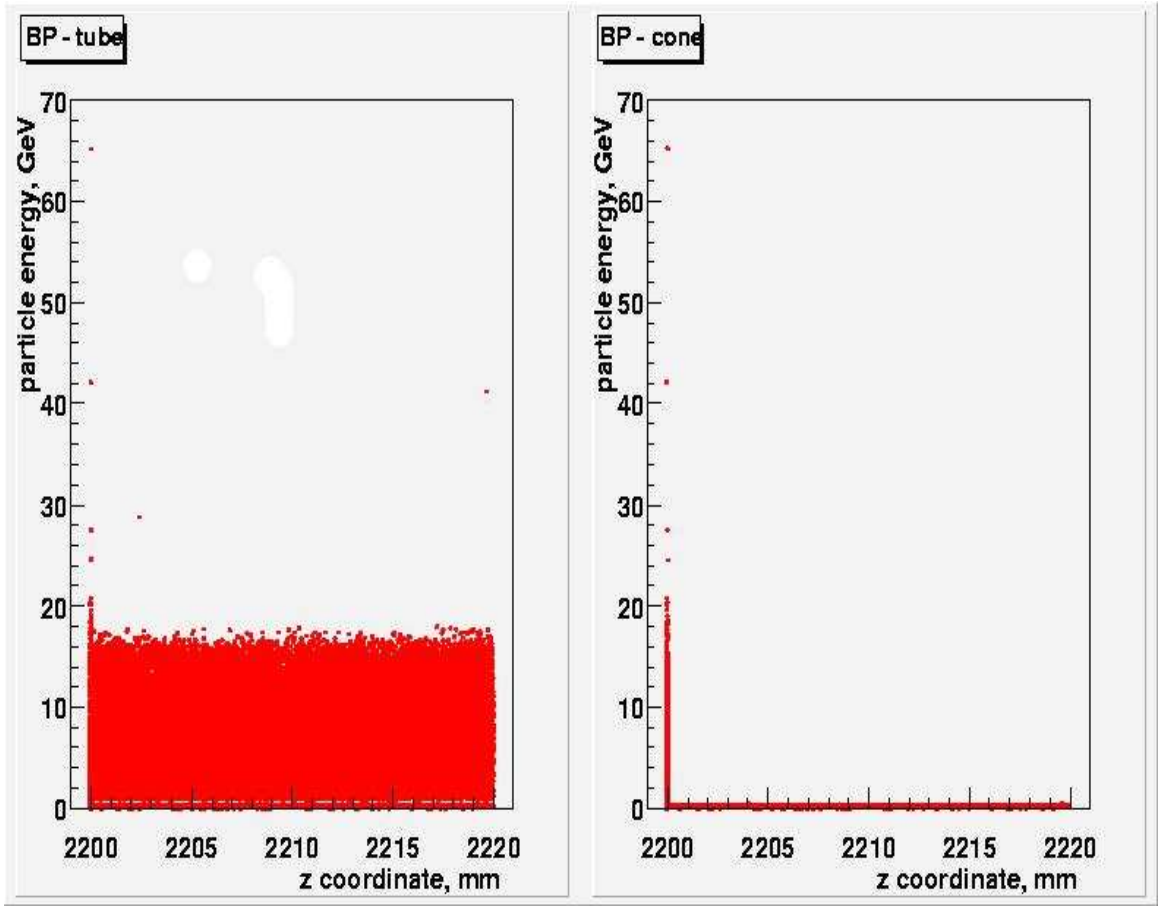
Beam Pipe: Cone vs. Tube



Each point on the plot corresponds to e^+ or e^- with energy E hitting BP from inside at z coordinate

cone BP allows to avoid high energetic component of particle flux through BP

Energy < 0.5 GeV

What means 'Real Beam' simulation

To maintain high luminosities the beams need to be kept well aligned; with $\sigma_y \sim 5$ nm it is a challenge.

One of the main limiting factors is ground motion which results from seismic activity, ocean waves etc.

That causes misalignment in magnetic component which then steer the beams away from their design orbits.

LC design incorporates automatic feedback system to steer beams and maintain luminosity.

Digital control system has already been designed and prototype tested at TTF.

Used data

2 data sets were obtained from LC simulation data repository at QMUL.
They contain the data of simulation of 500 first BX in the bunch train.

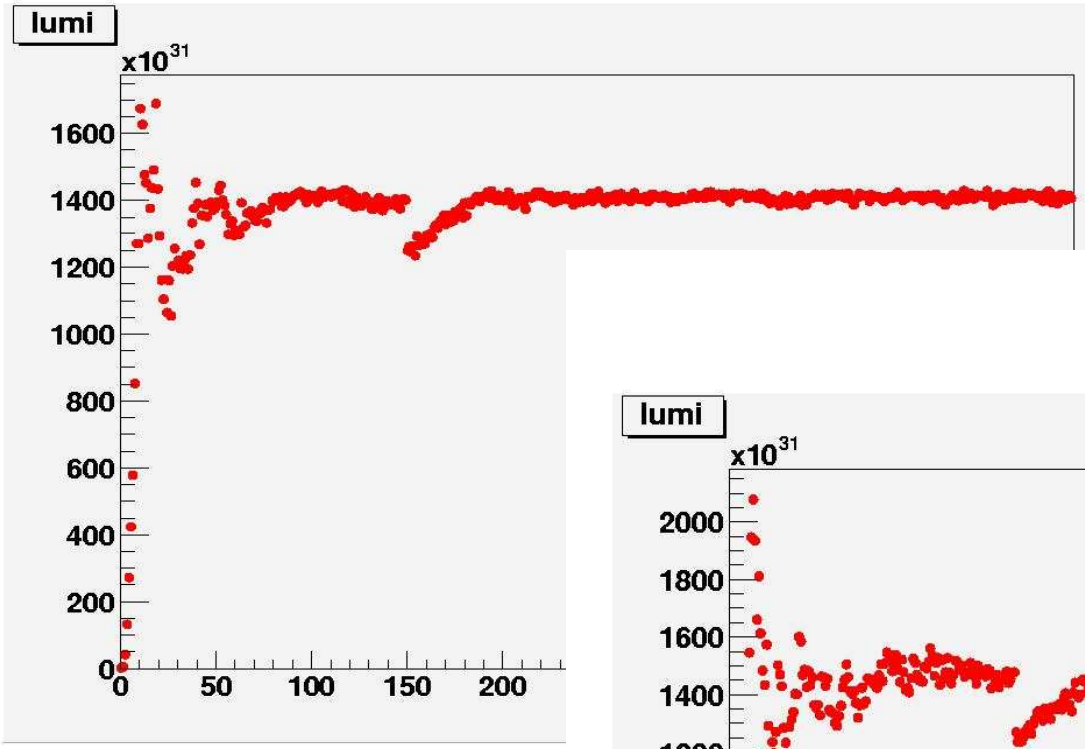
Particular data sets correspond to 'worse case' of high frequency ground motion:

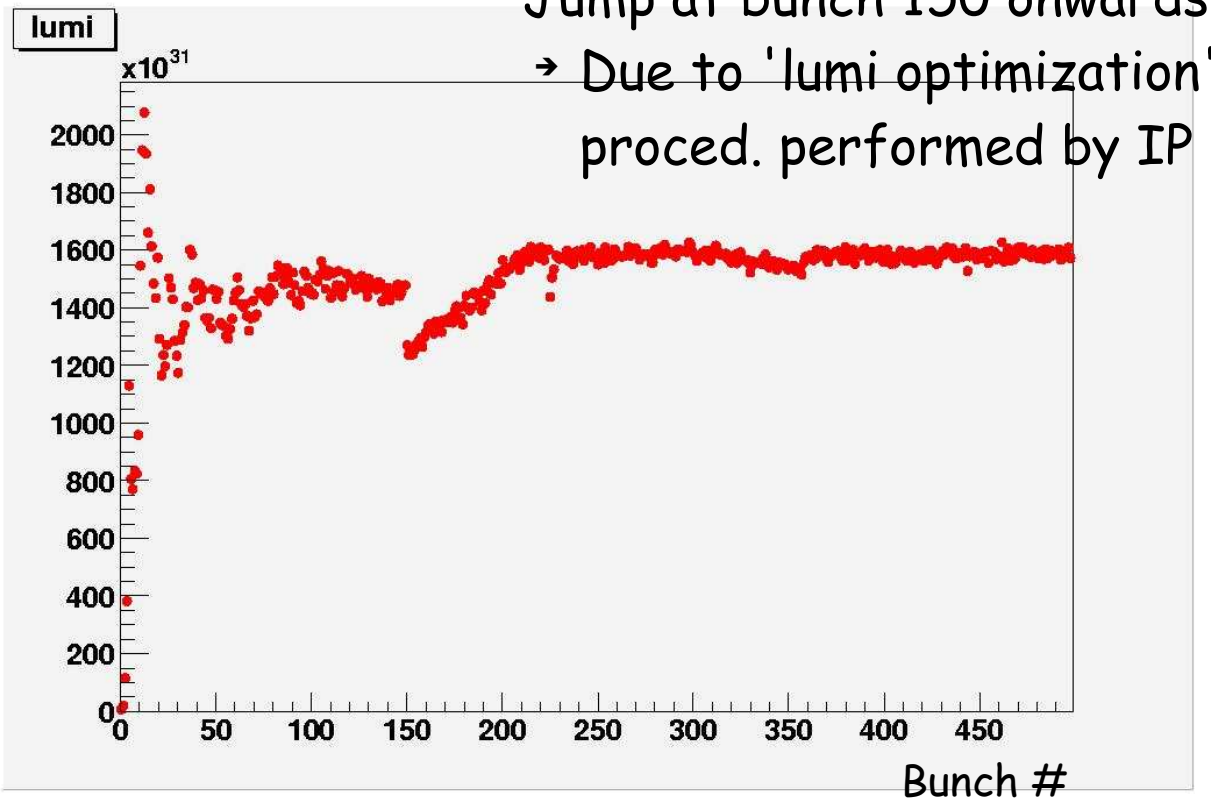
- RMS jitter of 70 nm is added to all quadrupole in the machine
- 0.2 σ injection error into linac from damping ring
- Linac with the expected emittance growth

That result in lower than expected luminosity (next slide)

Pairs data were analyzed and compared with 'Ideal Beams' case.

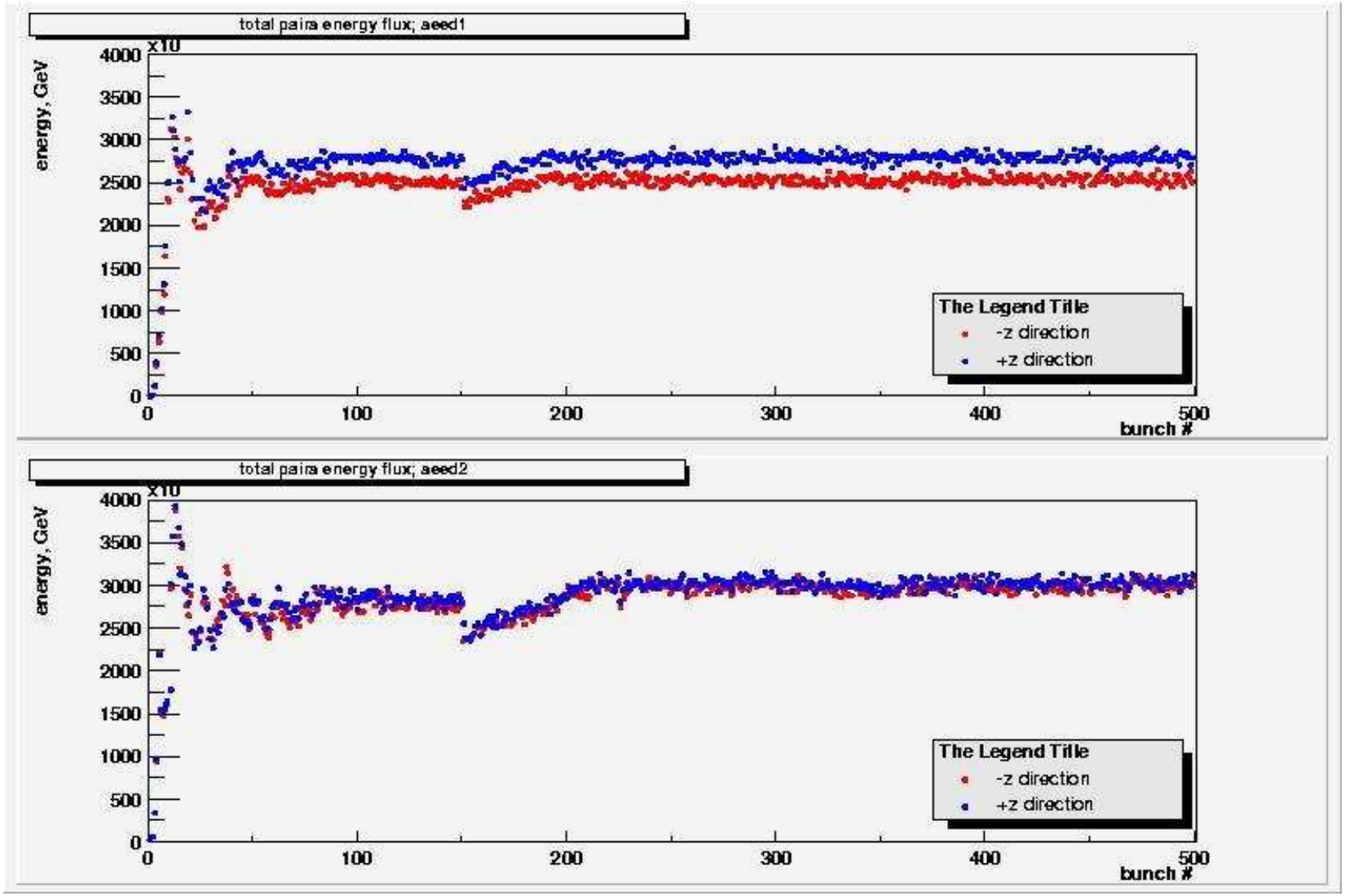
General behavior remarks





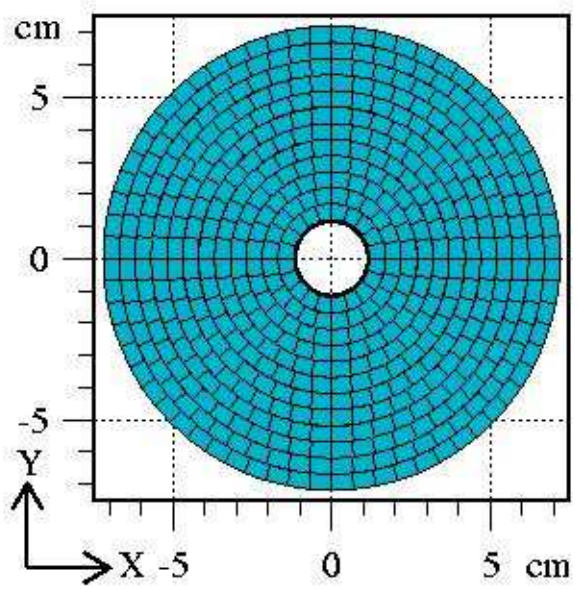
- Low numbers for the first few bunches
  - → Due to initial offset
- Transient behavior for the first approx. 100 bunches
  - → Due to HOM's in the linac
- Jump at bunch 150 onwards
  - → Due to 'lumi optimization' proced. performed by IP FB

General behavior remarks



Difference between directions due to the beam-beam interaction on different bunch shapes

Comparison RB vs. IB: pairs energy flux, asymmetry



$A = \sum A_i;$

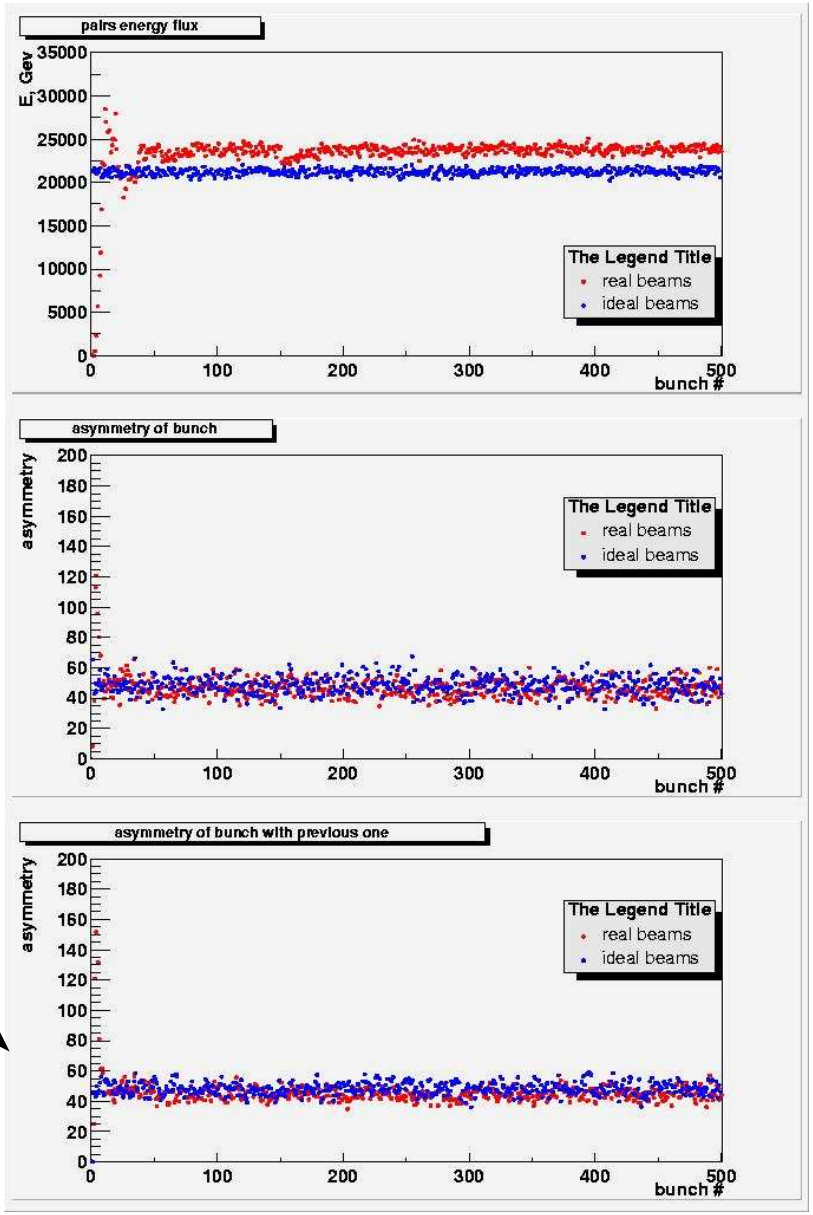
$A_i = (E_i - E_i^{op})/ (E_i + E_i^{op})$

$A_i = (E_i^n - E_i^{n-1})/ (E_i^n + E_i^{n-1})$

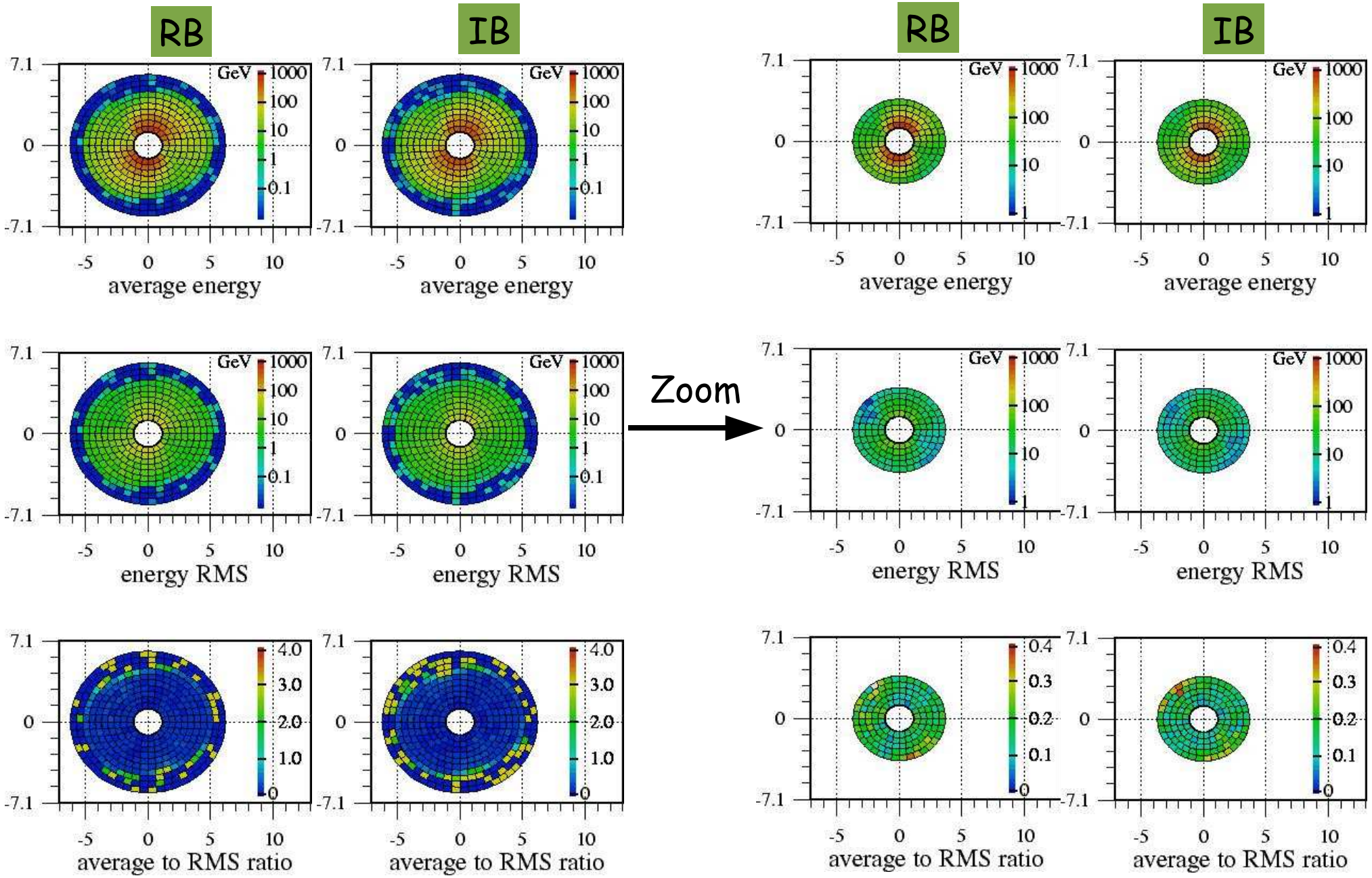
where i – cell index

n – bunch index

op – opposite cell

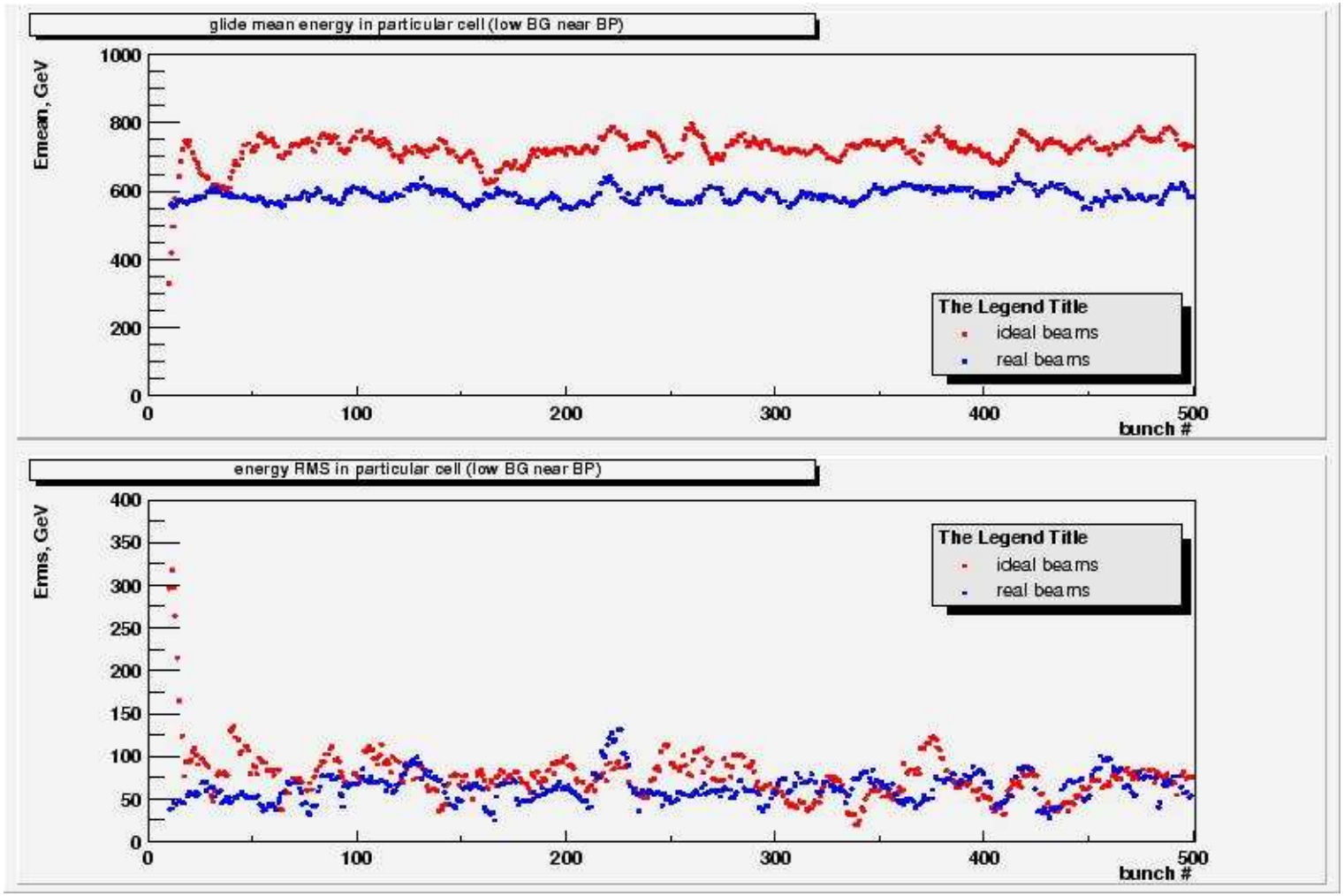


Comparison RB vs. IB: average energy



Comparison RB vs. IB: gliding average energy spread

cell near BP weaker suffered from pairs



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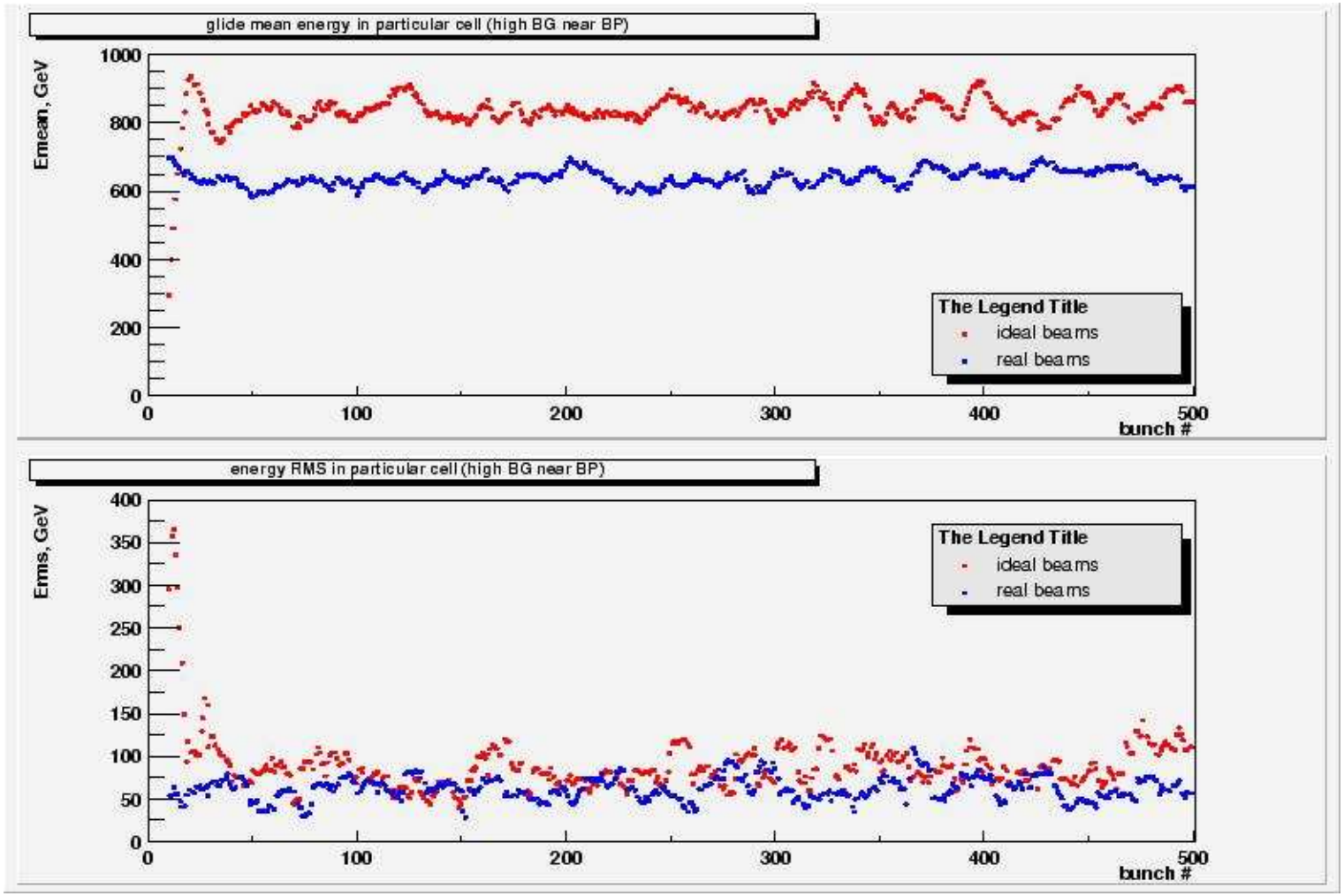
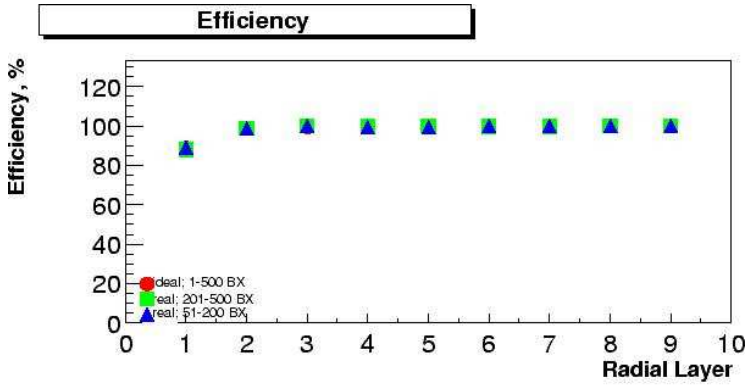
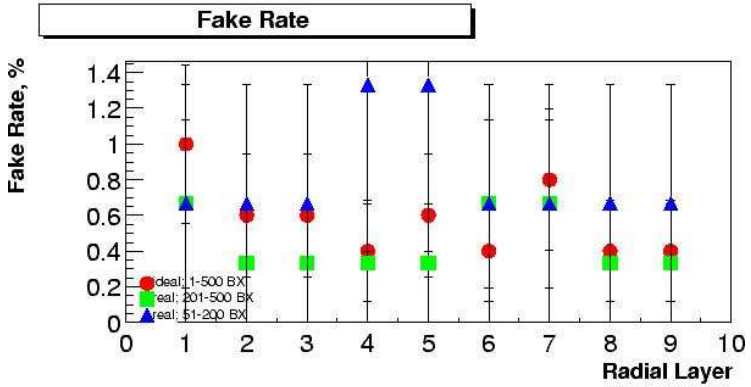
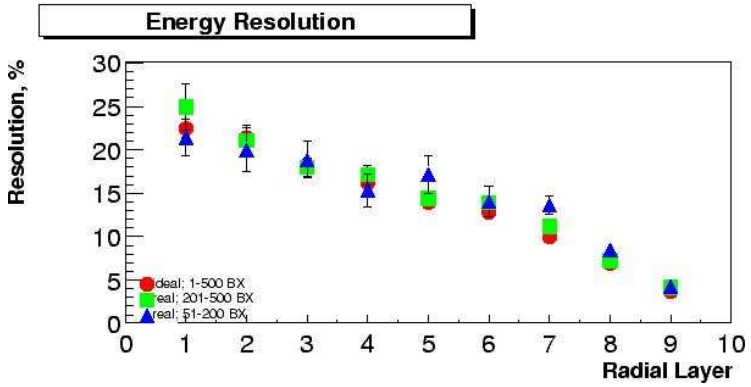


Comparison RB vs. IB: particle recognition performance







Energy of probe particles is 100 GeV

azimuthal angle corresponds to area with relatively low background

very first results look very promising:

- Particle recognition efficiency is nearly the same.
- Fake rate resulting from BG fluctuation is at the same level
- Energy resolution is also at the same level; though correction of reconstructed energy according to average energy is needed in order to calculate precise and more reliable values

Conclusions

Energy flux of pairs is higher

- → Result in higher radiation dose

Maximal energy deposition per cell from pairs is larger:
10.4 GeV instead of 7.2 GeV

- → May require larger dynamic range.

First results say us that calorimeter performances won't changed significantly.