The small angle environment at a Linear Collider

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Parallel session D4

The small angle region at a LC

- ✔ Many Physics topics based on missing E.
- ✔ Very small angle region crucial for detailed study of new phenomena. Prediction of supersymmetric particles production very detailed …. polarized beams add further details.
- ✔ Separation of $\gamma\gamma$ from genuine missing energy events.

Beam beam interactions

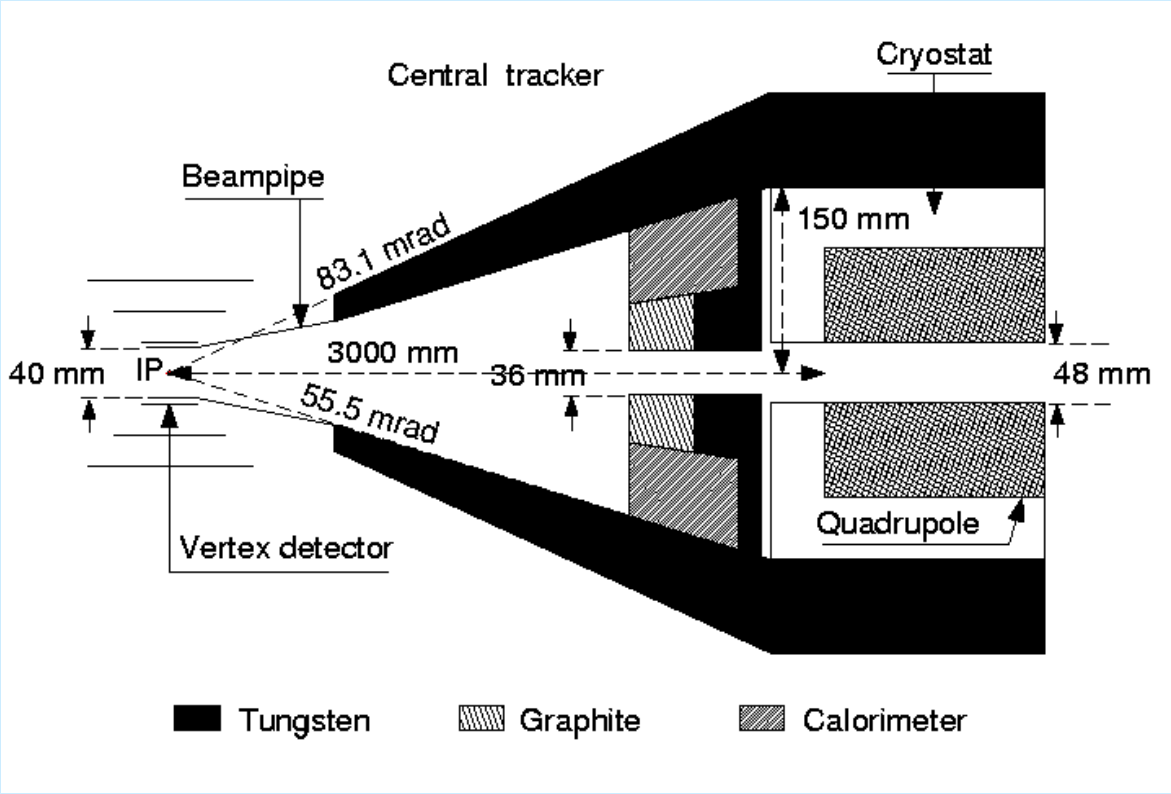
- ✔ The environment of the strong beam beam interaction at a LC does lead to limitations for what the experimental situation is concerned ?
- ✔ If so , which kind of limitations and how can we get around them ?
- ✔ How the capability of a luminometer would be impacted ?

The simulation

- ✔ Use Guinea_pig: typical parameters deck of Tesla.
  - write a file with pair produced by beam-beam interaction in HEPEVT format.
  - Beamstrahlung γ do not interact with very much with detector comp's: emission angles are too small.
  - Propagate produced pairs through the detector and beam line elements with GEANT.
  - As of now the luminometer/tagger not properly simulated yet… use a mixture of W and scintillator and smear parametrically the energy afterwards.

Few geometric parameters

Mask and lumi cal:

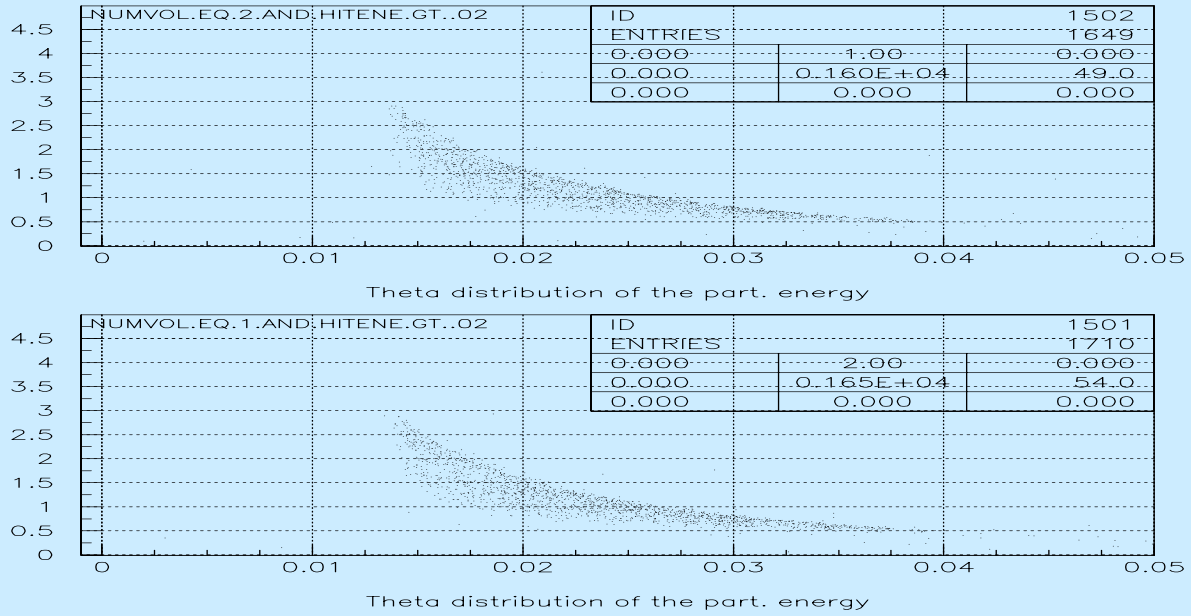


Mask and lumi-cal

- ✔ In order to cover the relevant angular range both the W-mask and the Lumi-cal have to be able to measure energy…..
  - – so one has to evaluate what the beam-beam interactions do to them
- ✔ The energy seen does to a certain extent depends on the simulation program used: I will essentially show results from Guinea_pig

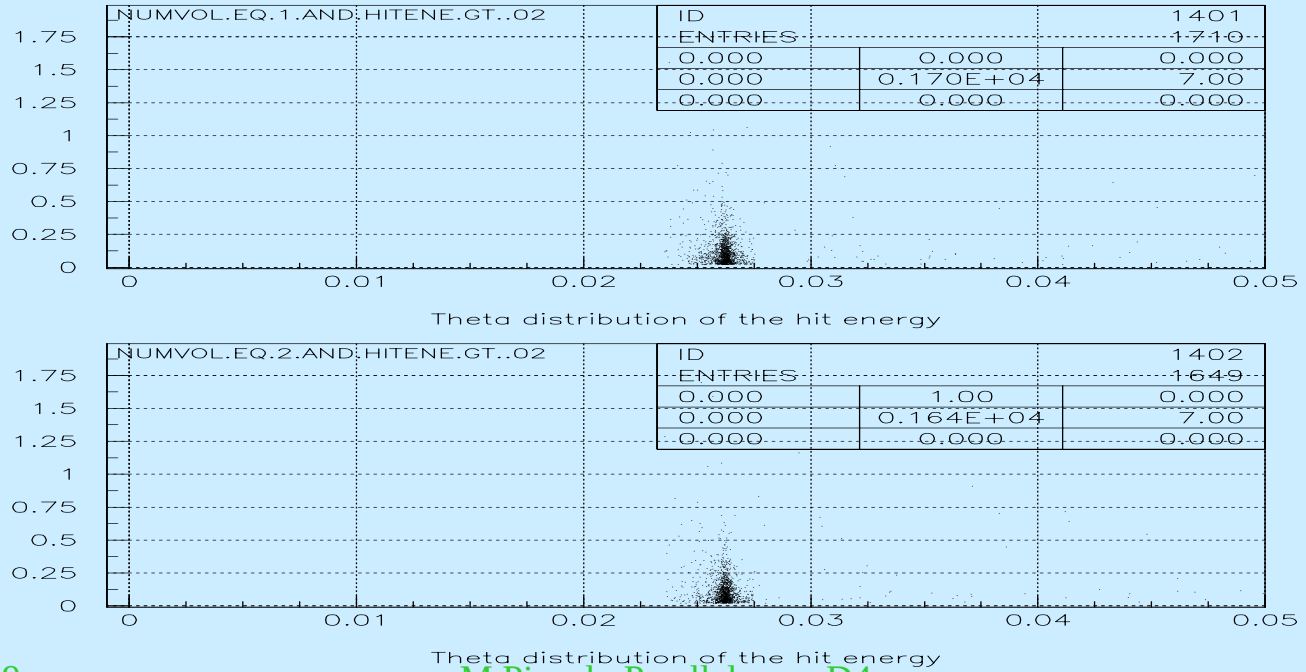
Originating particle energy deposition vs θ

- ✔ Nominal situation TESLA_HIGH



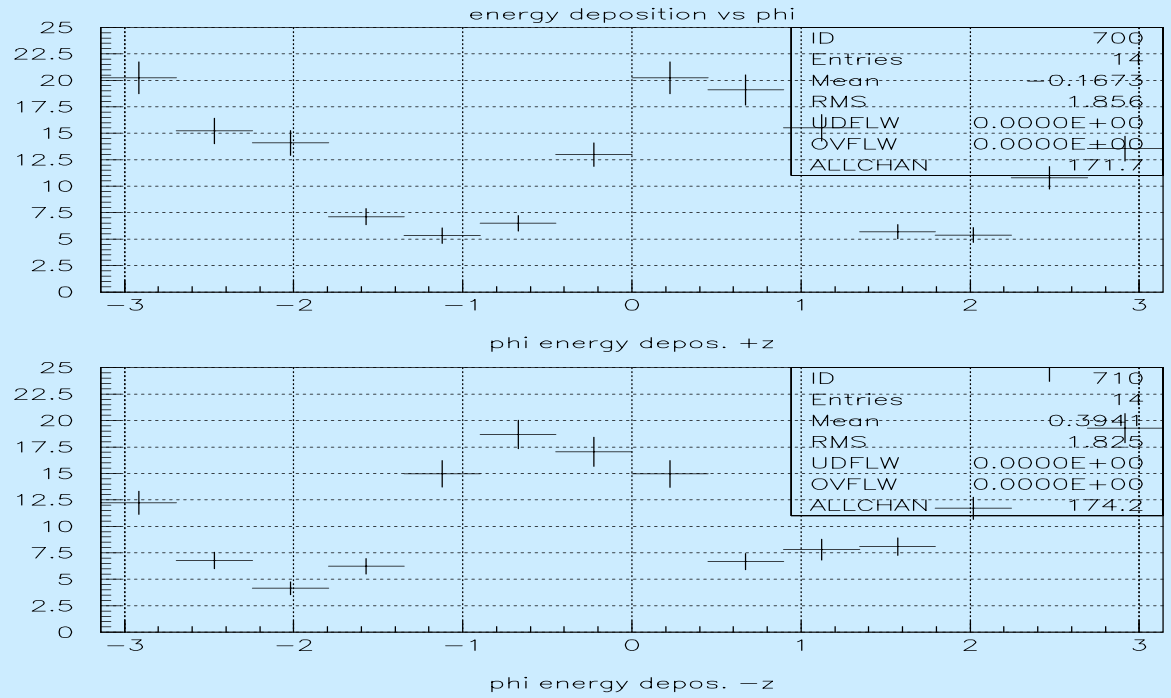
Hit energy deposition vs θ

- ✔ Nominal situation TESLA_HIGH



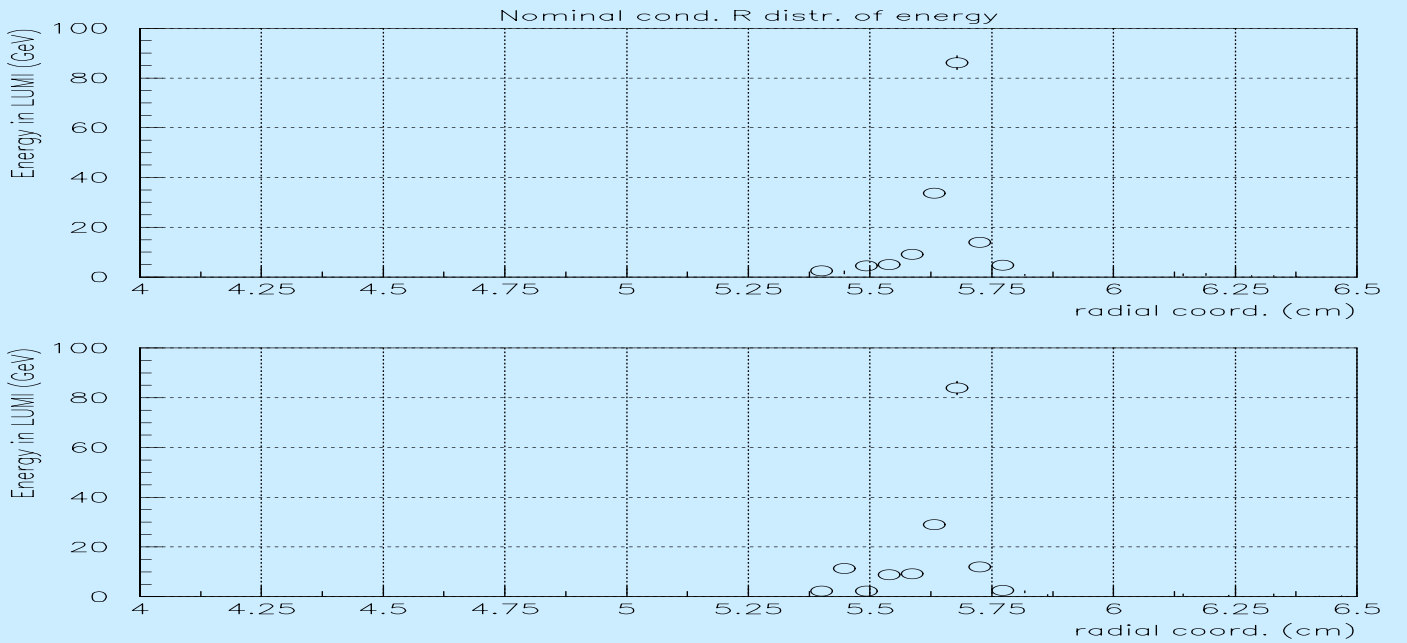
Φ distribution of deposited energy

- ✔ Nominal situation TESLA_HIGH



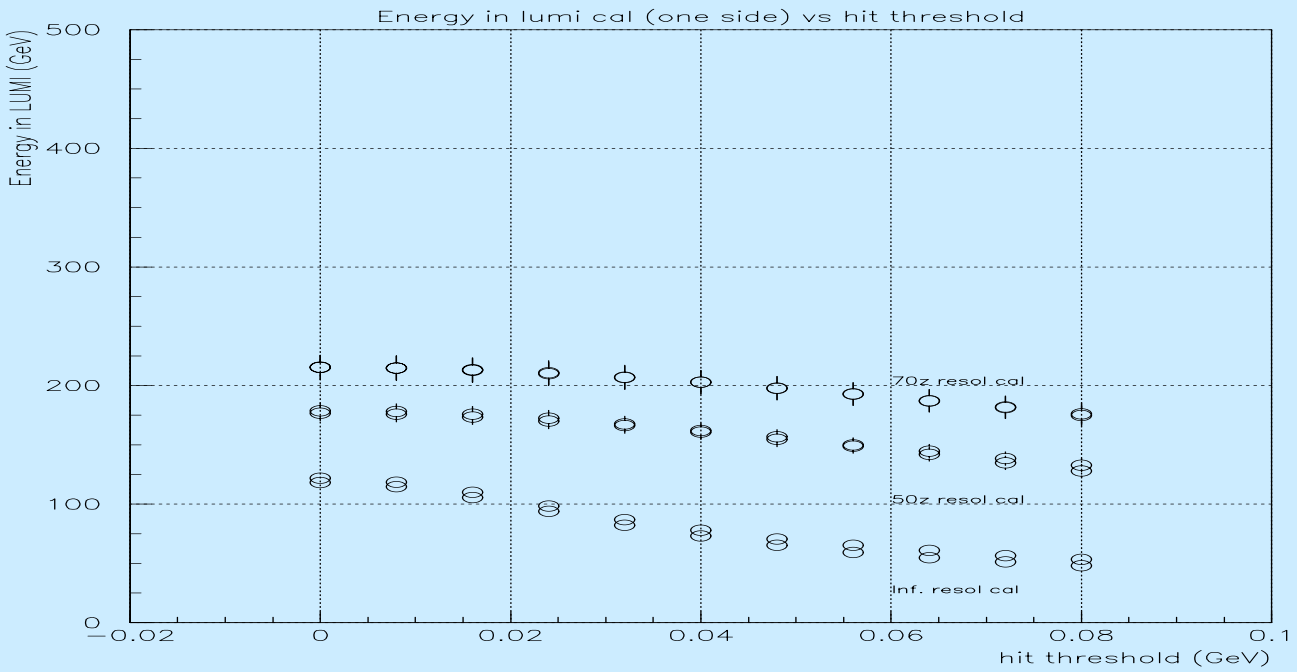
R distribution of deposited energy

- ✔ Nominal situation TESLA_HIGH



Total energy collected vs hit threshold

- ✔ Nominal situation TESLA_HIGH



Do we need to worry about tagging ?

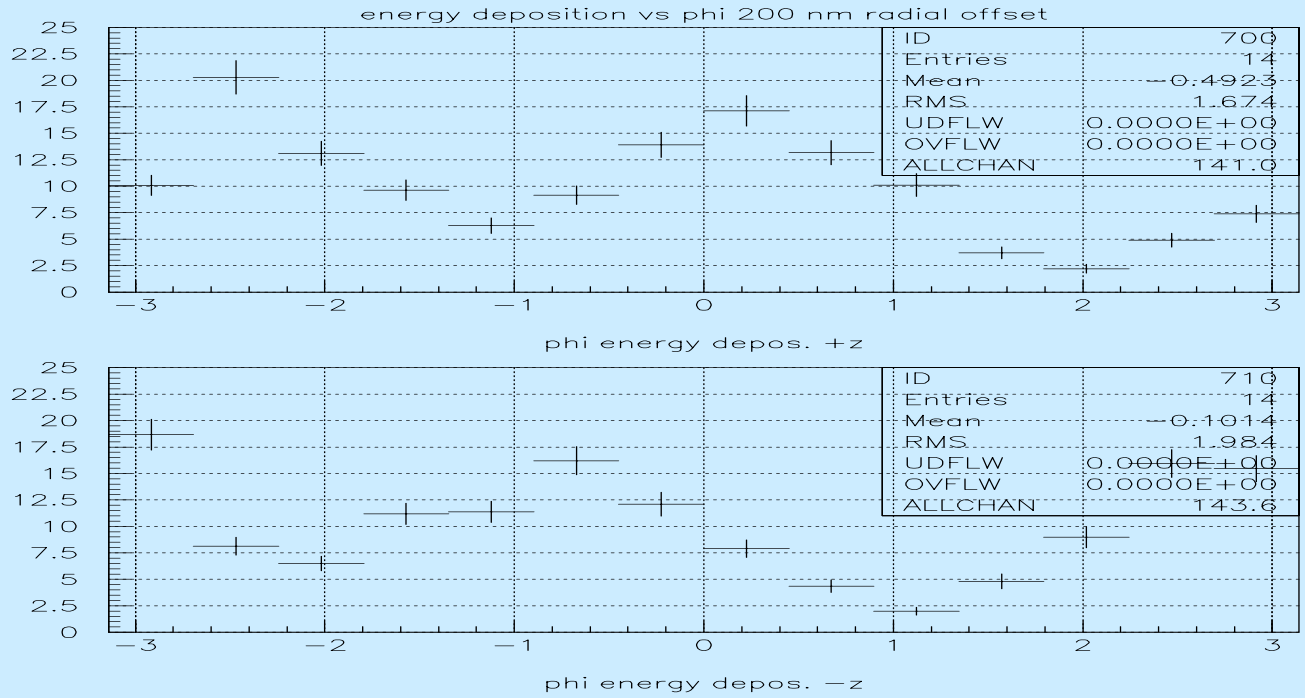
- ✔ With the nominal geometry it is quite evident that:
  - a) total collected energy relevant >100GeV
  - b) energy per ϕ bin not very big (~ 20 GeV)
  - c) r.m.s of energy/ϕ bin small (~ 2 GeV)
- ✔ No trouble/problem foreseen to tag 25 GeV electrons.

Can this energy measure L

- ✔ The # of pairs detected by the Lumi-cal are related to the strength of the beam-beam interaction…. so to the luminosity in the end.
- ✔ To test this correlation I ran different simulation with (radial) offsets of the beams to change the interaction luminosity and then looked at the lumi energy.

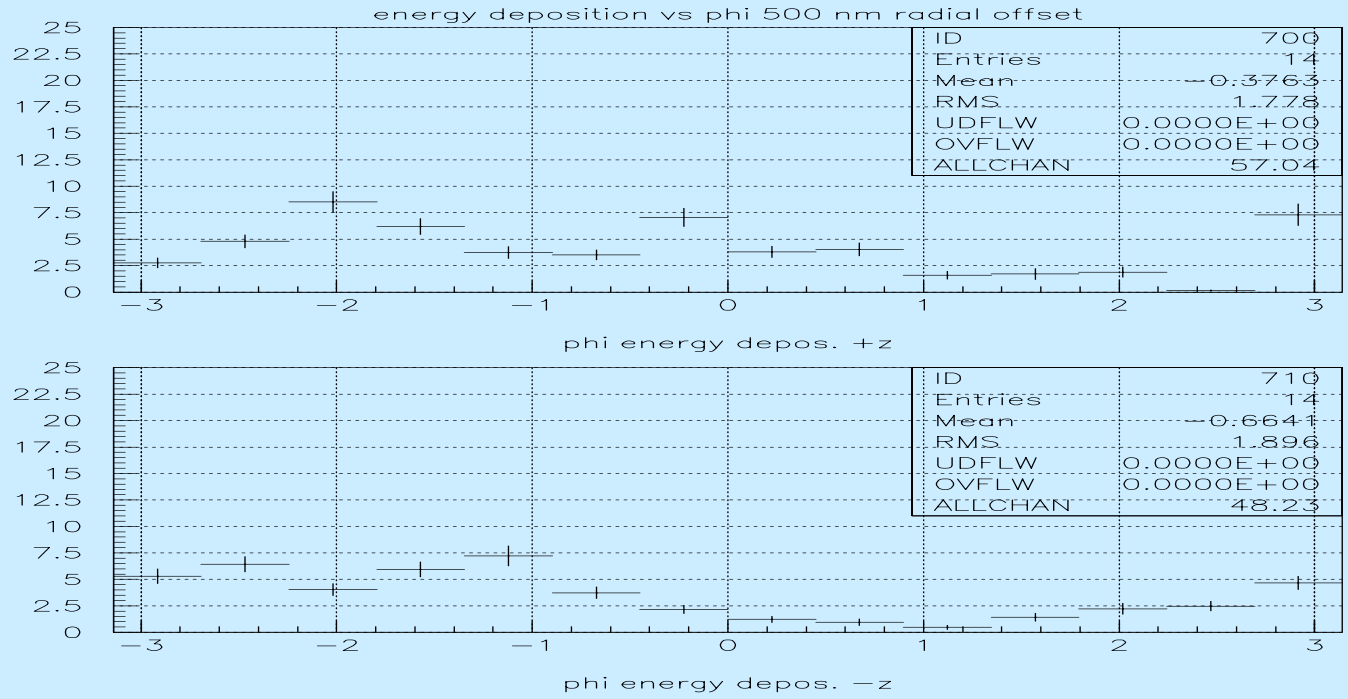
Φ distribution of deposited energy

- ✔200 nm rad. offset TESLA_HIGH



Φ distribution of deposited energy

- ✔500 nm. rad. offset TESLA_HIGH



Scaling from Tesla

- ✔ Tesla machine very benign for small angle calorimetry:
  - time structure of the collision very favorable

    $\Delta t = 330$ nsec.
- ✔ A normal conducting machine would lead to integration of few pulses in the detector time response…..

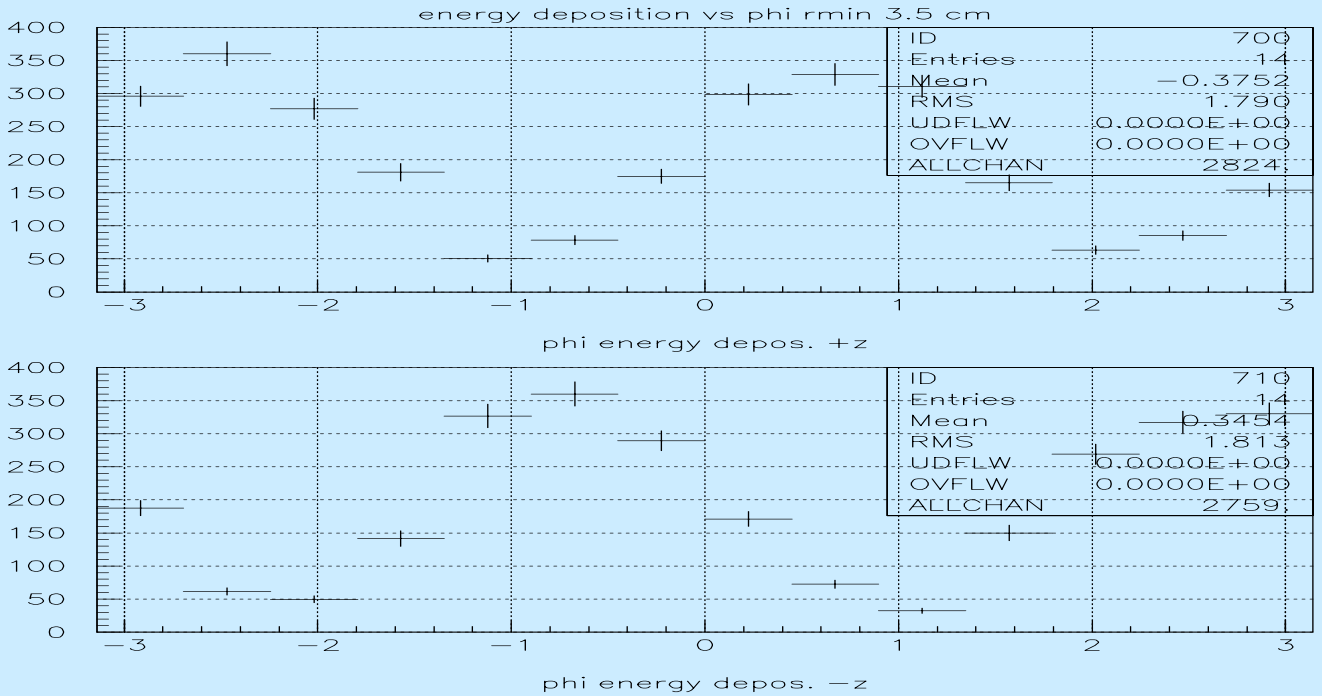
Could we really exploit the pairs signal ?

- ✔ It would be nice to have a bunch by bunch (fast ~ few nsec) measurement of L.
- ✔ Can we devise a detector capable to do so ?

- ✔ As a first try I ran a simulation lowering the min. R of the cal. down to the edge of the graphite plug (3.5 cm.)

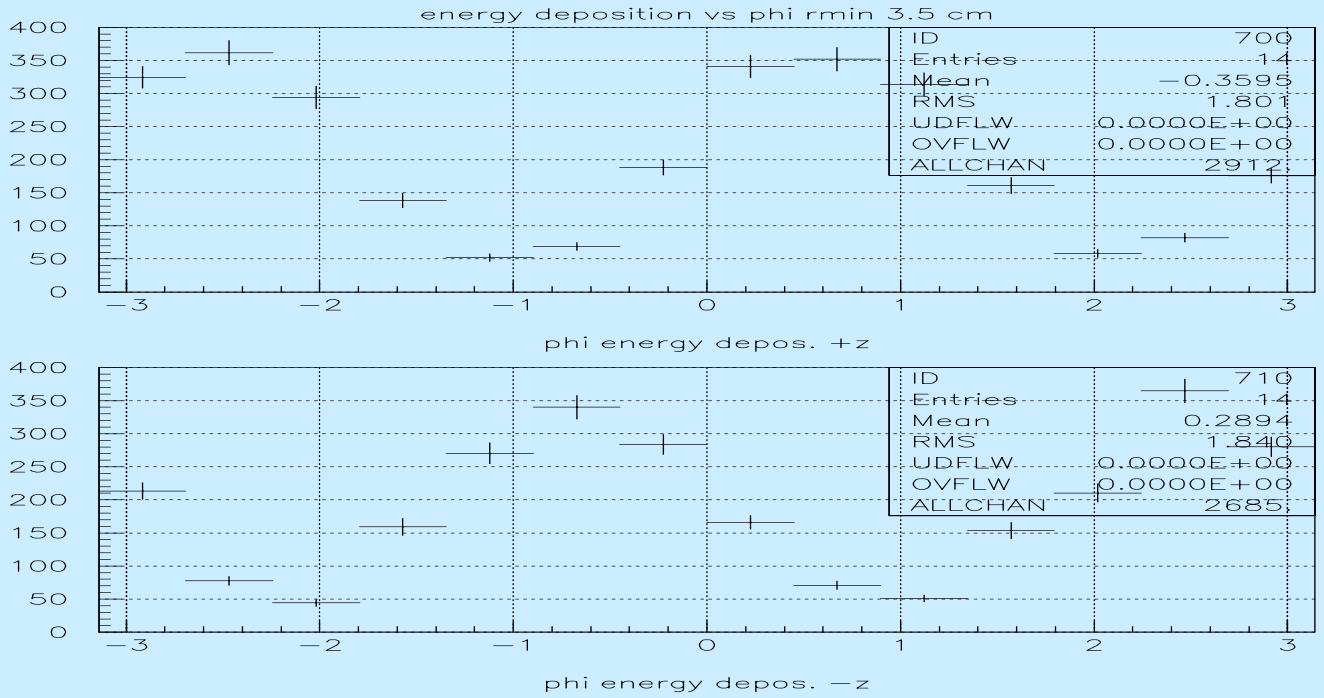
Φ distribution of deposited energy

- ✔ R_{min} 3.5 cm Tesla_high nominal



Φ distribution of deposited energy

- ✔ R_{min} 3.5 cm Tesla_high nominal (other ev.)



Few figures

- ✔ In the two examples before the calculated luminosities were 2.219 and 2.253 (10^{34}).
- ✔ Total energies in the lumi. cal 5.58 and 5.6 TeV respectively.
- ✔ What was really different in the two cases was the energy asymmetry: 65 GeV in one case 227 GeV in the other.
- ✔ It will be worth to investigate if this can be exploited to measure β_{cm}.

Conclusions

- ✔ Tagging and/or measuring luminosity in the usual way should not present problems down to 25-30 mrad in the Tesla configuration tested up to now.
- ✔ Pairs signal could in principle be exploited to monitor machine luminosity on a pulse by pulse basis eventually extending the coverage to smaller angles.
- ✔ Results shown are very preliminary and should be extensively re-checked.