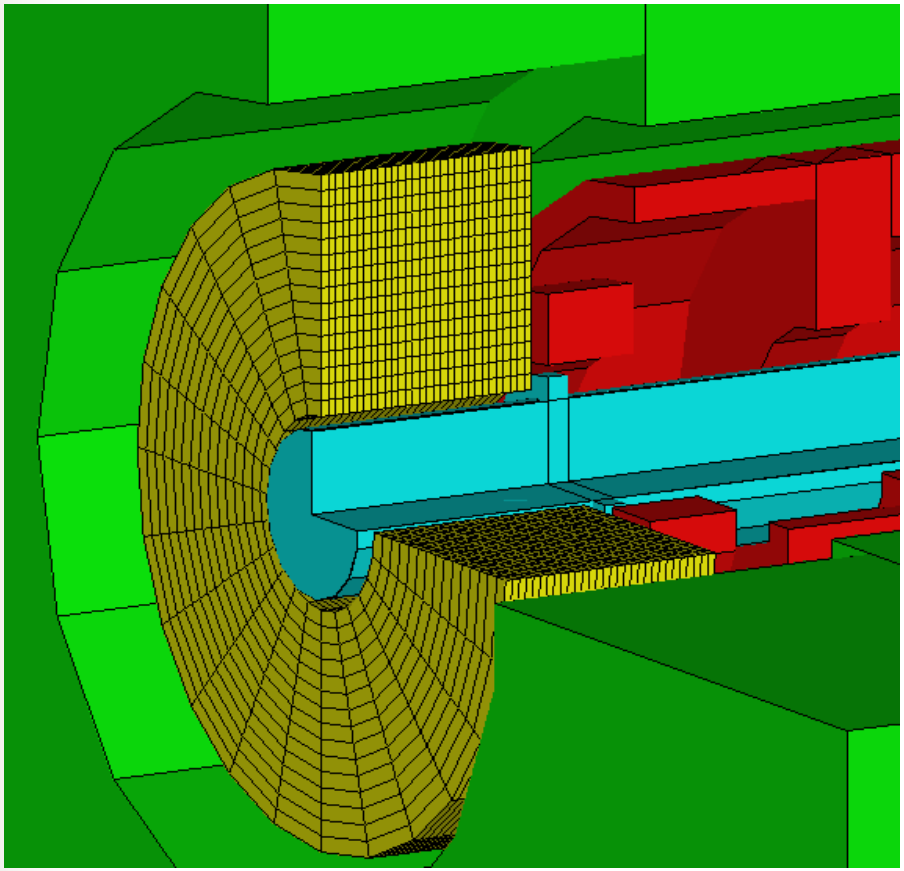
LumiCal background studies

Contents:

- Guinea Pig results
- Vermasseren results
- Remarks on energy reconstruction
- Conclusions

LumiCal in Geant3



Standard setup:

- **15cylinders x 24 sectors x 30 rings**
- **R from 8 to 28 cm**
- **Z from 305 to 324.5 cm**
- **0.65cm longitudinal period**
- **0.3 mm Si sensors (first layer not screened with W)**
- **1X_0 W absorbers**
- **Z-aligned position**

Guinea Pig program

The program includes processes (D.Schulte thesis):

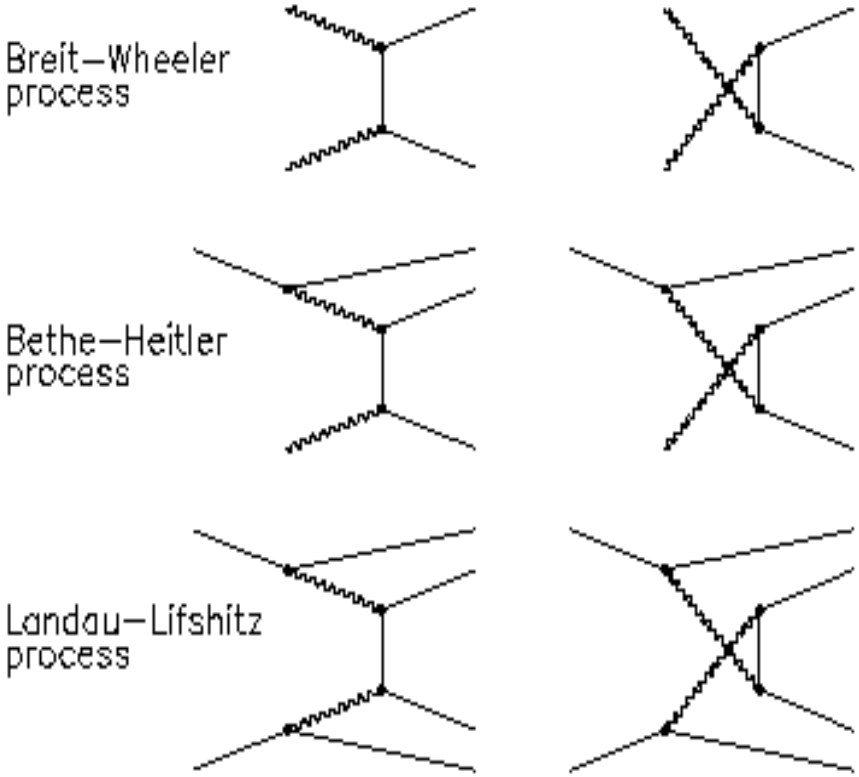
- **Coherent pair creation (interac'n with magn.field), rate low**
- **Incoherent pair creation:**

1. **Breit-Wheeler process – both γ real**
2. **Bethe-Heitler process – one γ real**
3. **Landau-Lifshitz process – both γ virtual -**
   this is called also *gamma-gamma* process

Additional effects:

- **Beam-size effect (on)**
- **Beam energy spread (not used)**
- **Gamma-gamma → hadrons (not used)**

Guinea Pig program

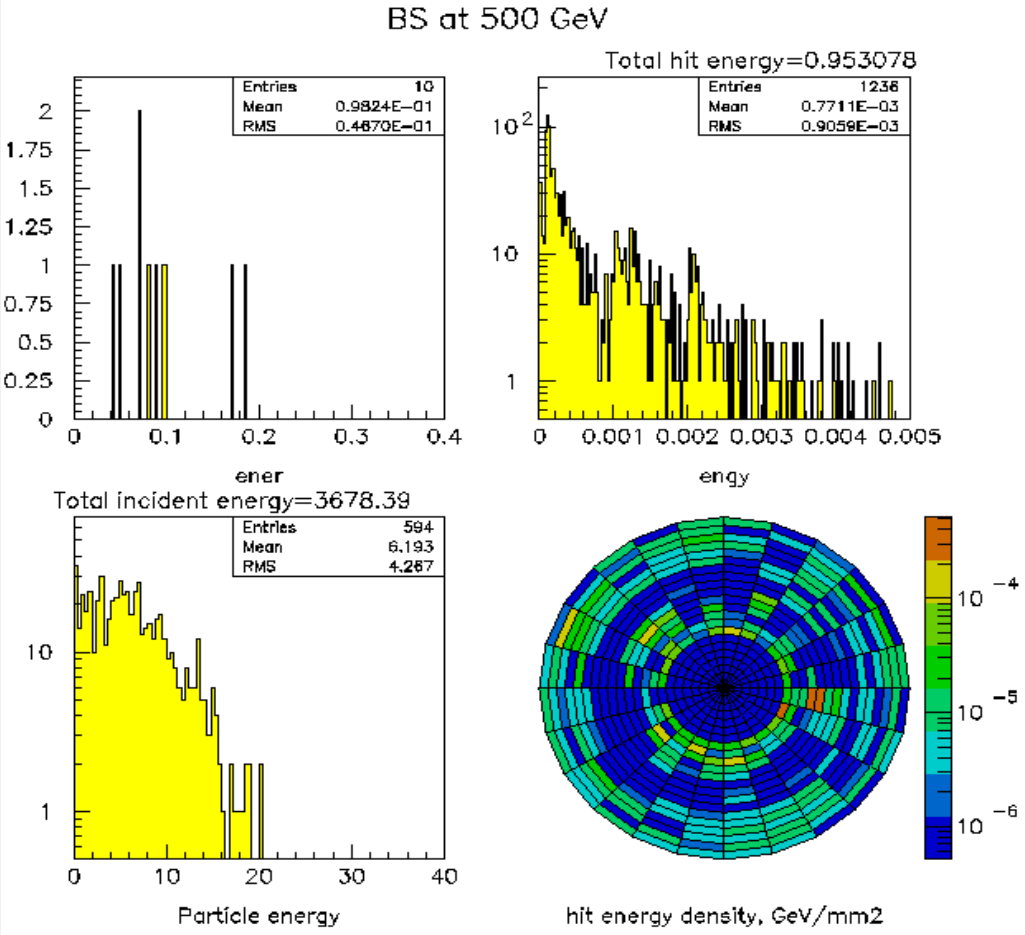


Remark:

the program also calculates bremstrahlung –2 particle process, not collective interaction –

can be neglected comparing to beamstrahlung

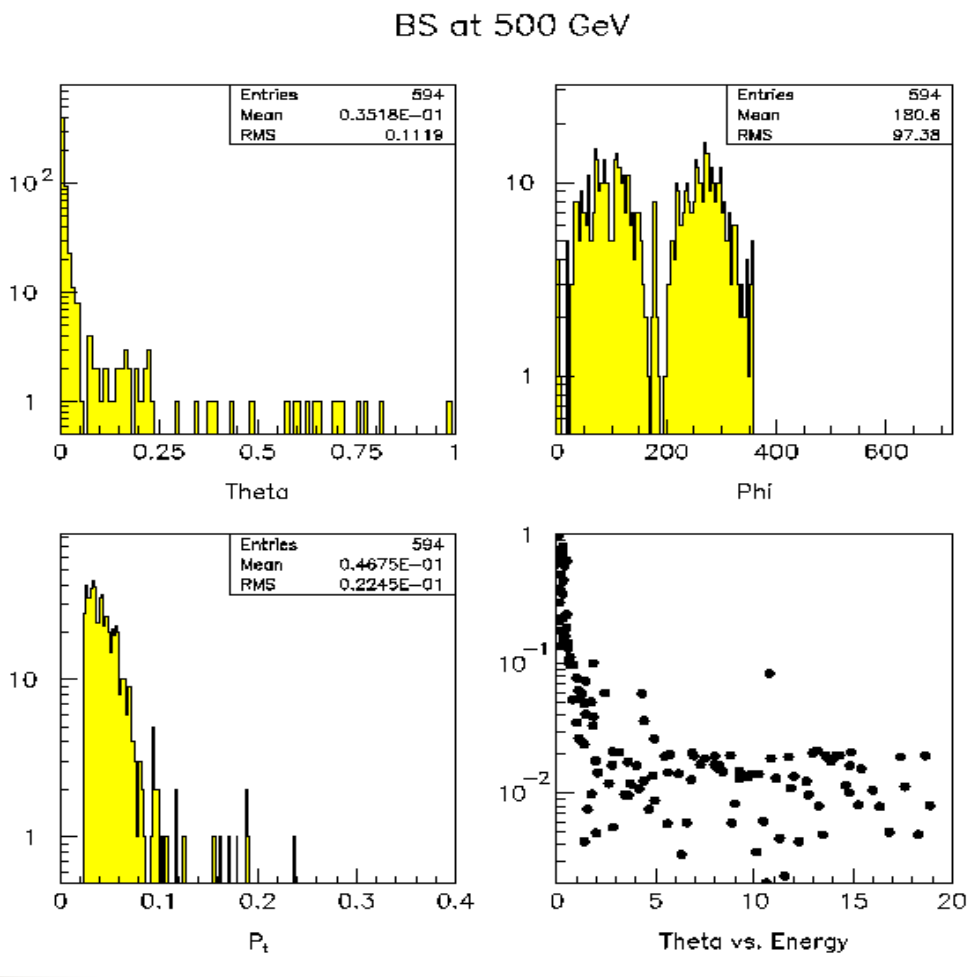
Beamstrahlung: head-on



Guinea Pig simulation:

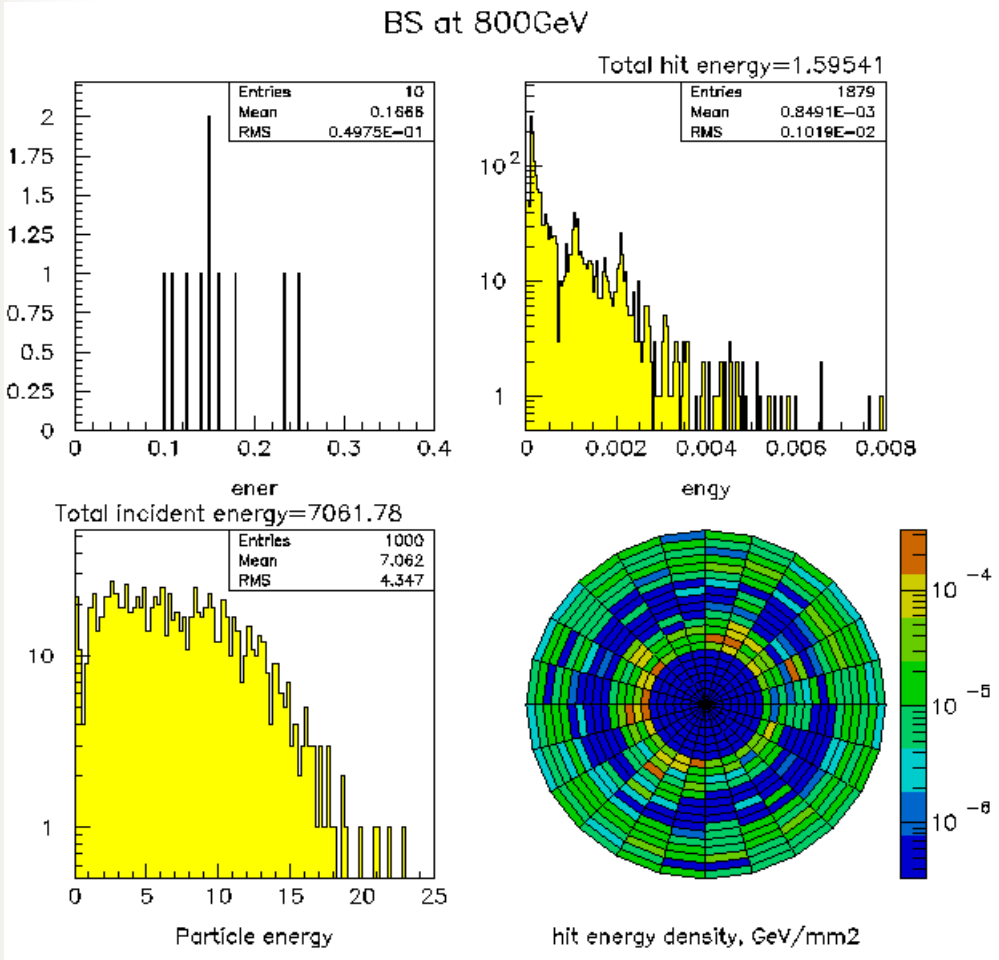
- 10 bunches
- TDR Tesla accelerator parameters
- 500 and 800 GeV

Beamstrahlung: head-on



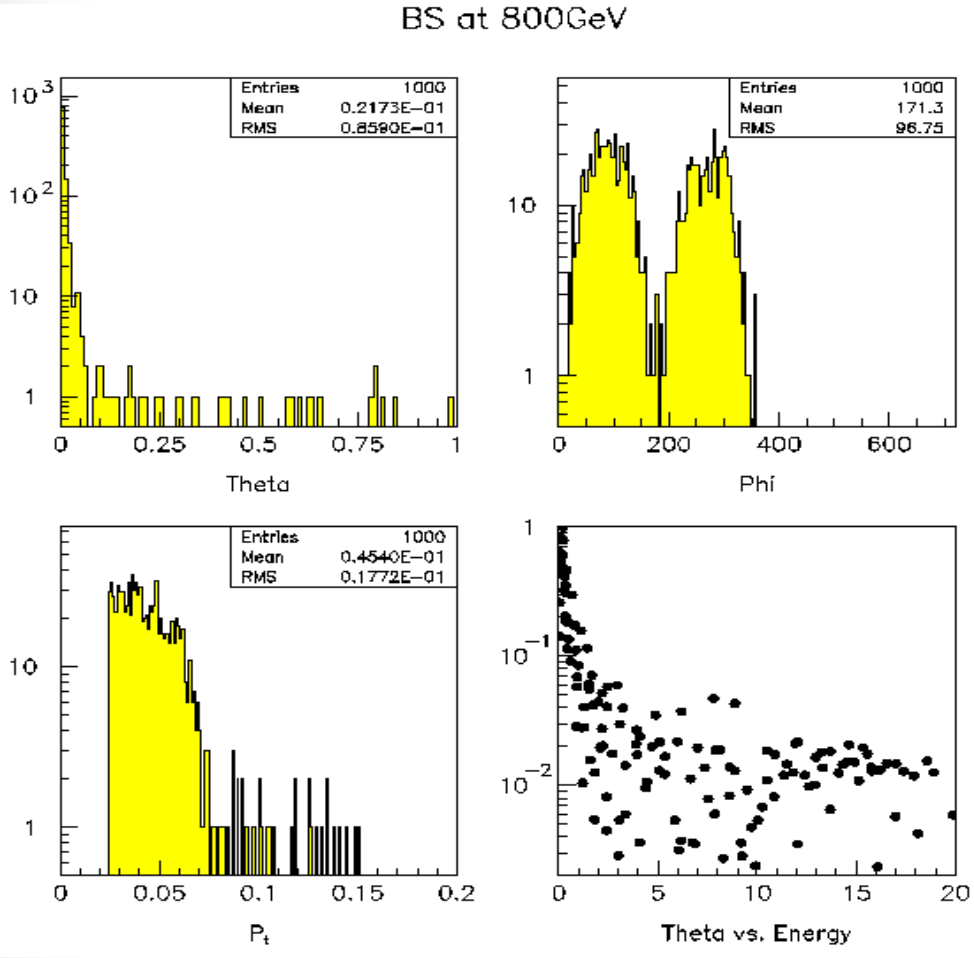
500GeV cont'd

Beamstrahlung: head-on



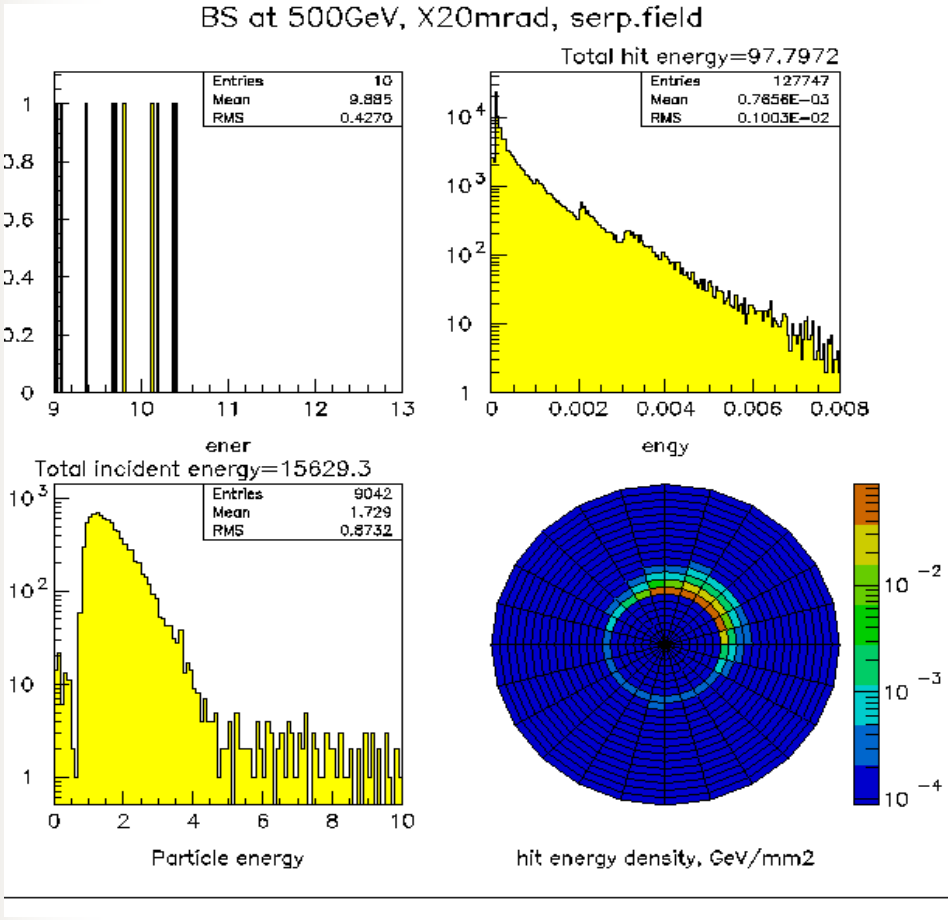
800 GeV

Beamstrahlung: head-on

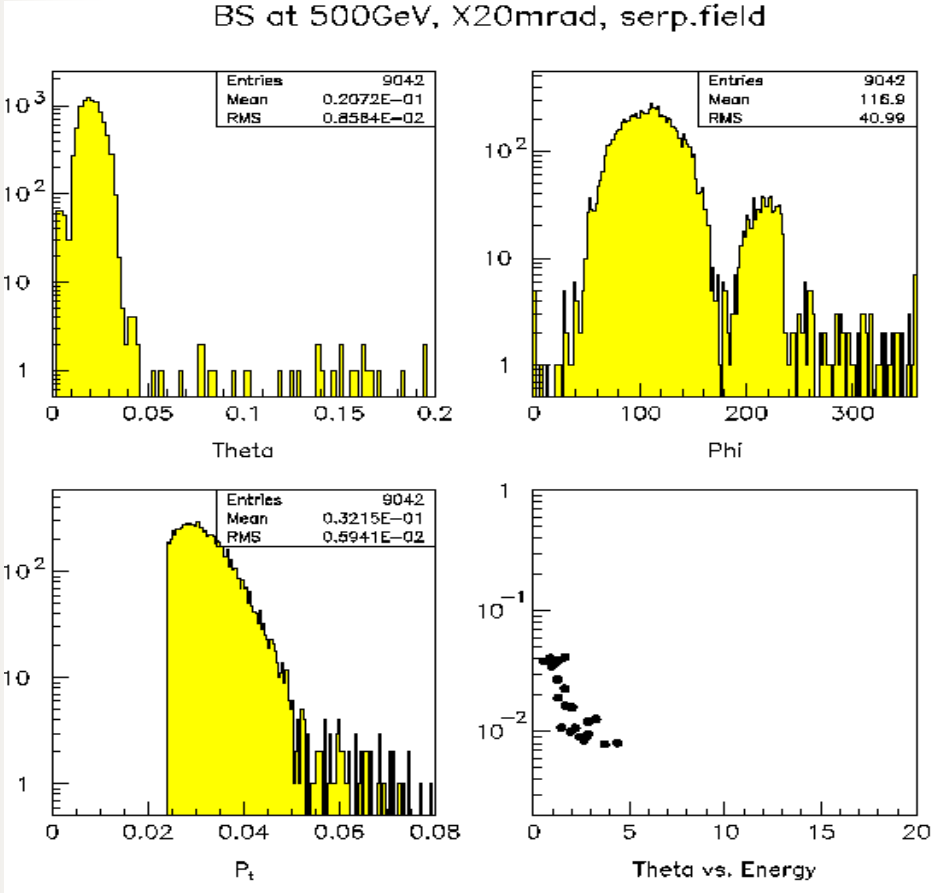


800 GeV cont'd

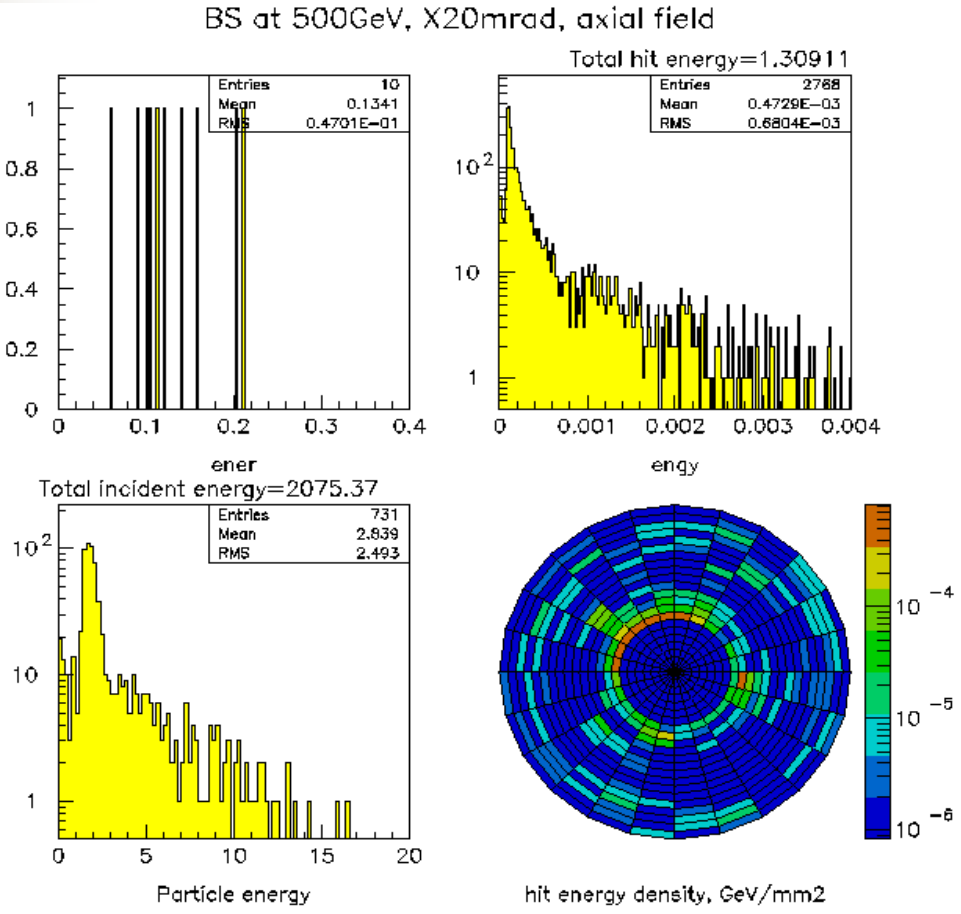
Beamstrahlung: X20mrad serpentine field



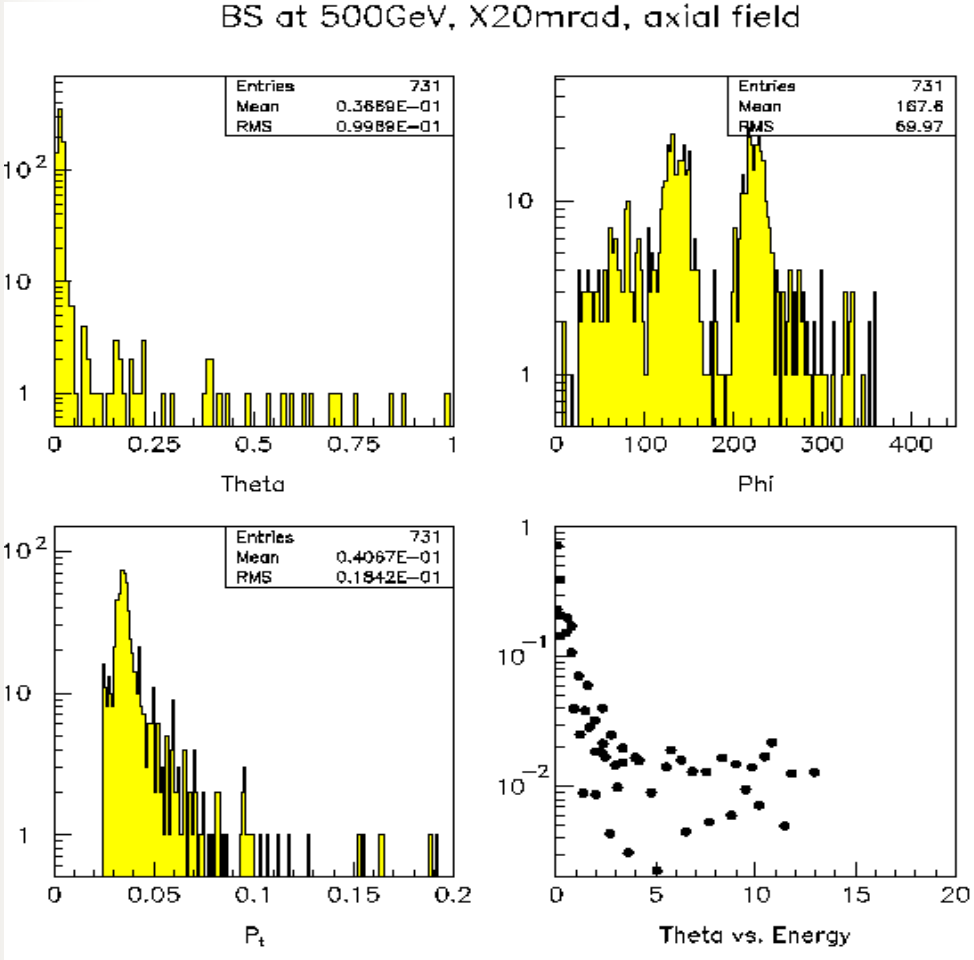
Beamstrahlung: X20mrad serpentine field



Beamstrahlung: X20mrad axial field



Beamstrahlung: X20mrad axial field



Beamstrahlung summary

Option:	0mrad 500GeV	0mrad 800GeV	20mrad 500GeV,serpent.f.	20mrad 500GeV,axial f.
Energy/b.cr.:				
E_inc	370GeV	700GeV	1600GeV	210GeV
E_sens	0.095GeV	0.16GeV	9.8GeV	0.13GeV
E_seen	9GeV	15GeV	**900GeV**	12GeV

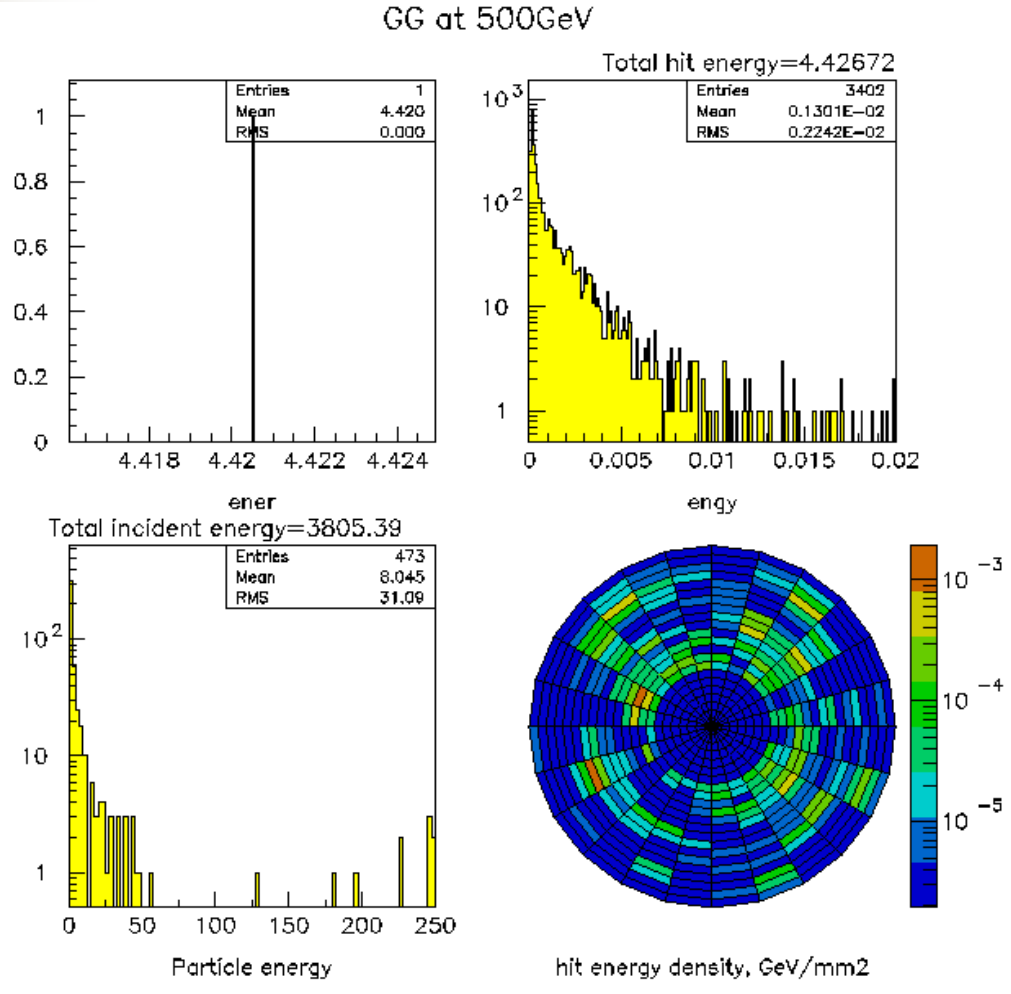
Remark:

E_seen = E_sens*(calorimeter calibration constant=91.37, calculated from 250GeV electron MC)

Vermasseren

- Vermasseren generator used by DELPHI at LEP (thanks to B. Muryn for the code)
- It can simulate gamma-gamma to f-fbar (e+e- done)
- It does NOT take beam size effect into account
- Only head-on option simulated

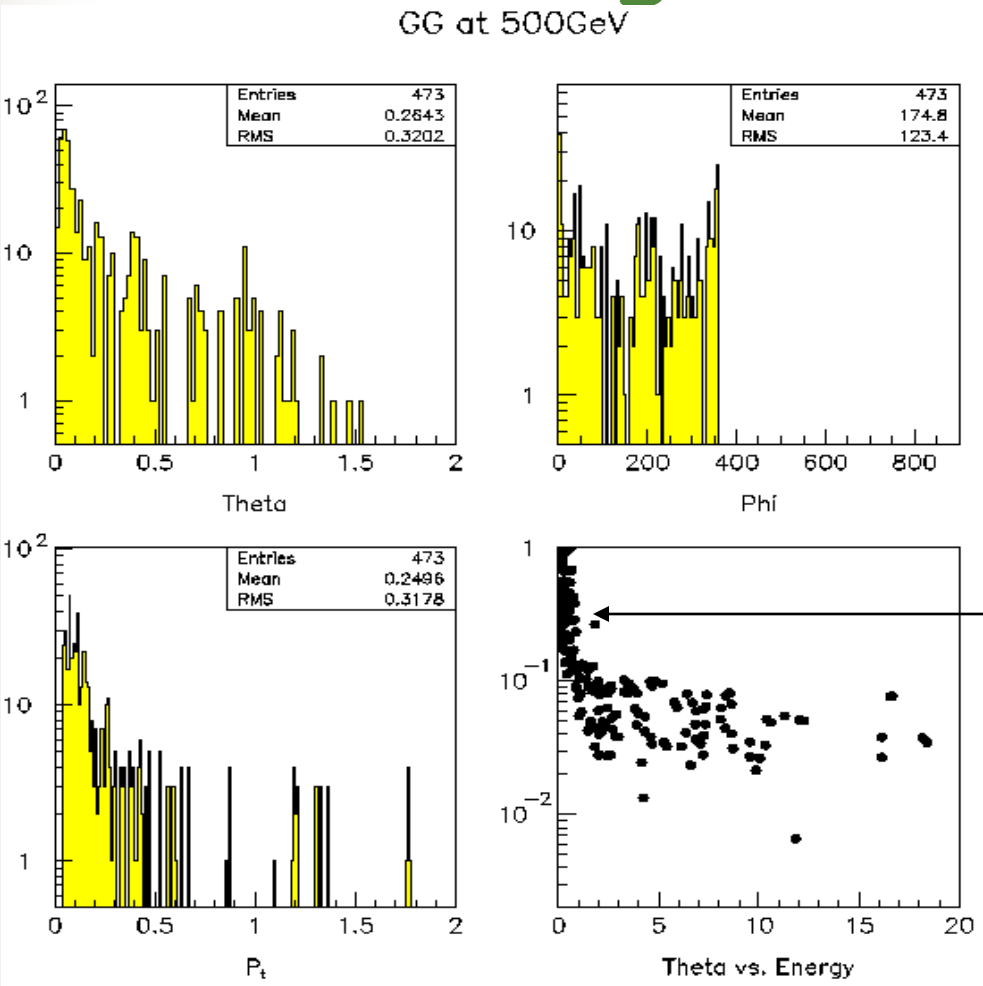
Gamma-gamma head-on



Total cross section (with some reasonable cuts) = 71 nb

Results for 1000 events generated

Gamma-gamma head-on



Low energy particles emitted at large angles hit LumiCal

Vermasseren summary

gamma-gamma -> e+e-

Total rate = $2.8*10^{-3}$/b.cr.

Mean energy E_{inc} = 0.9GeV

Rate(E_{inc}>150GeV) =~$6*10^{-5}$/b.cr.

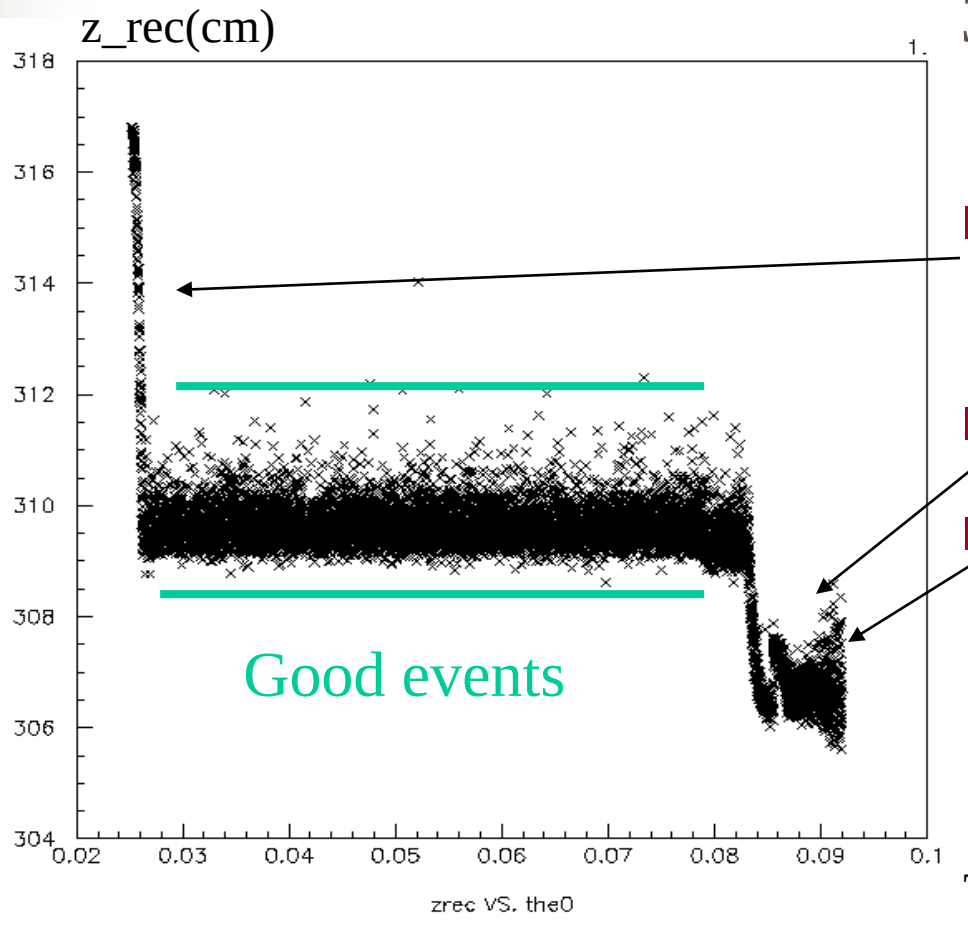
(MC statistics is small – only
~10 particles >150GeV)

Comparable (?) to Bhabha rate = ~6* 10^{-5}/b.cr.

Needs further study

Beam size effect can lower rate by 50-100%

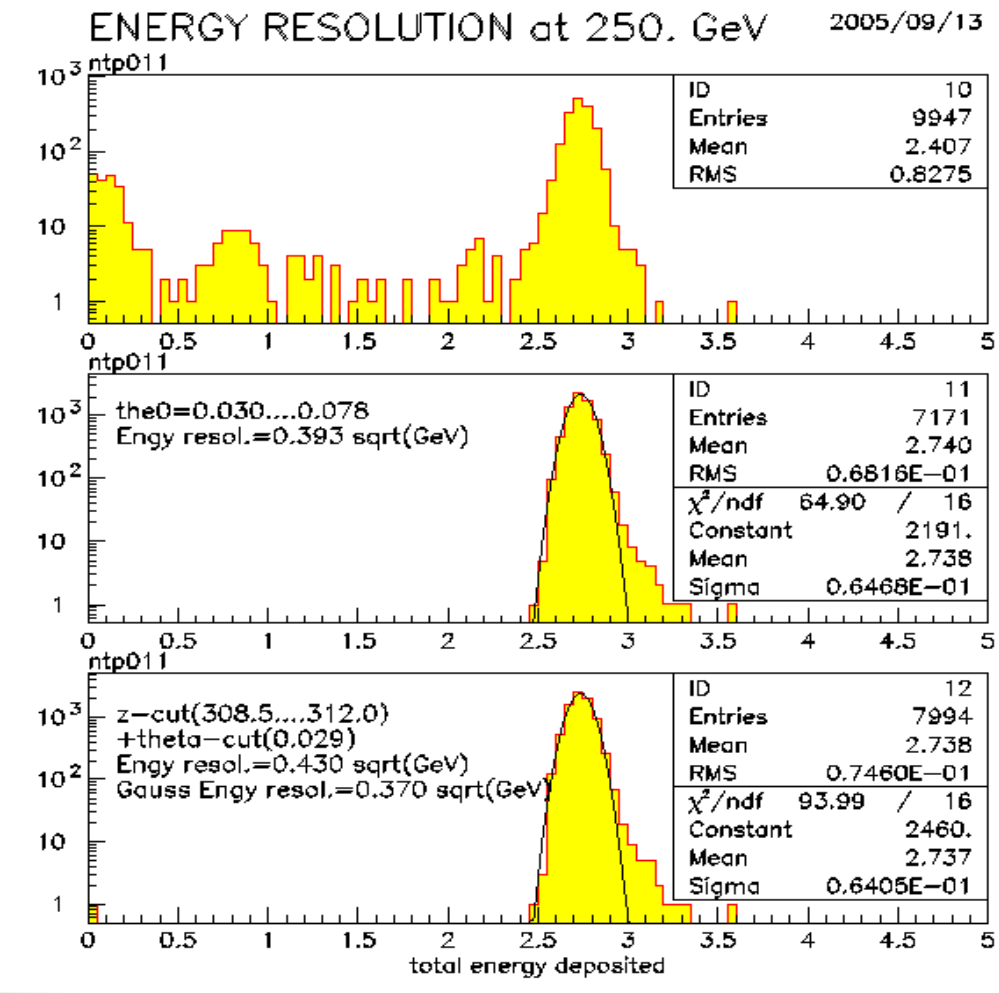
Background from scattered particles



3 sources of high energy background:

- BeamCal, backscattering
- ECAL edge
- Beampipe near IP z~14cm (change of shape)

Background from scattered particles



Cleaning up the energy distribution:

1. All events
2. Particles emitted in the LumiCal theta range
3. Events selected with z_rec = 308.5 - 312

Conclusions

- Serpentine field for X 20mrad is bad for LumiCal
- MC of gamma-gamma background yet not conclusive
- Selection of events with z-cut should help to supress some background