Initial state Radiation and mass reconstruction at TESLA

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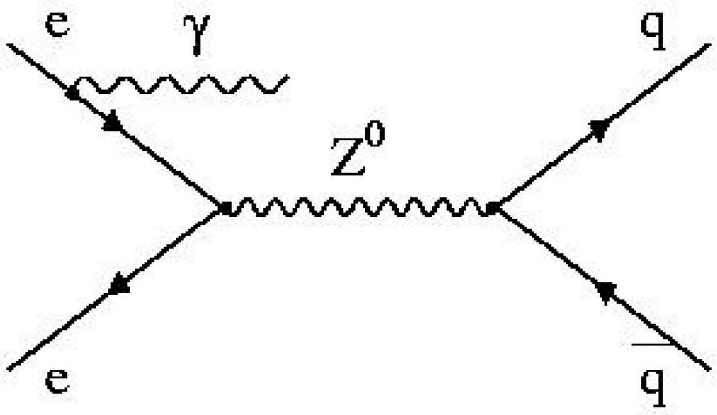
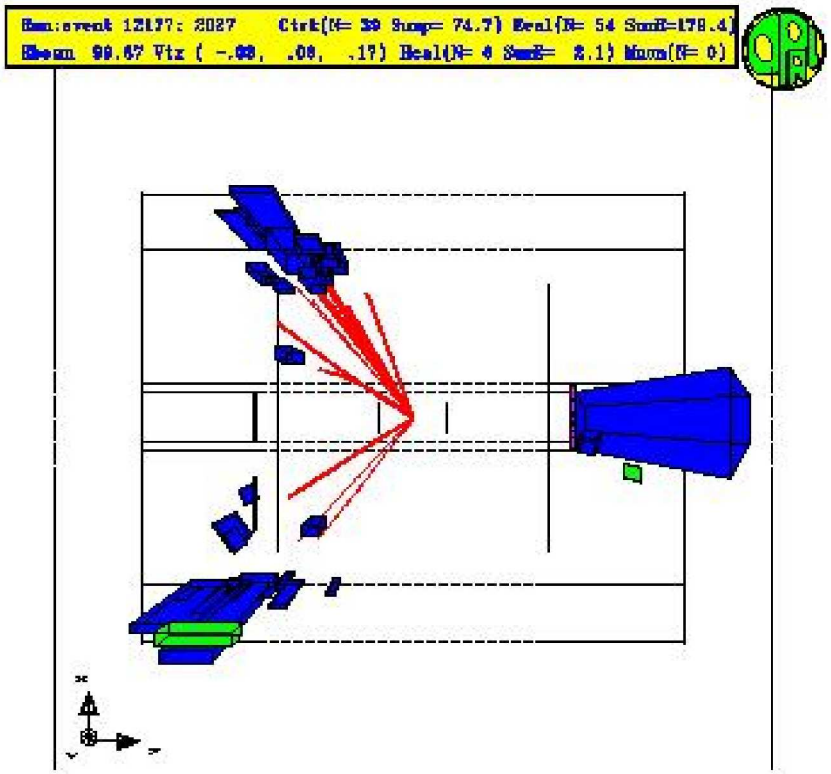
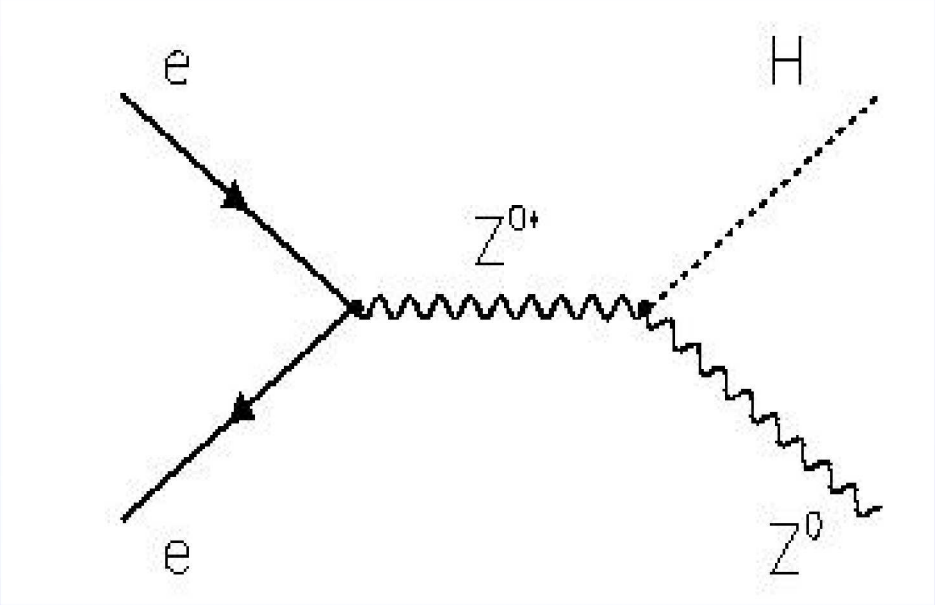




- Motivation
- Influence on Recoil Mass Spectrum
- Importance of forward detectors

Analysis Procedure

- HZ ---> mumuee
- Energy: 500 GeV
- Lumi: ~2500 fb^{-1}
- Generator: PYTHIA
- Initial State Radiation+ Beamstrahlung: CIRCE
- Ask for 2 reconstructed Electrons and Muons (only to reject photon fakes)
- Reconstruct recoil mass from the reconstructed electrons (Z decay products)->Model independent Higgs search and benchmark process
- Photon: P_{in} changes
- Efficiency: 80%



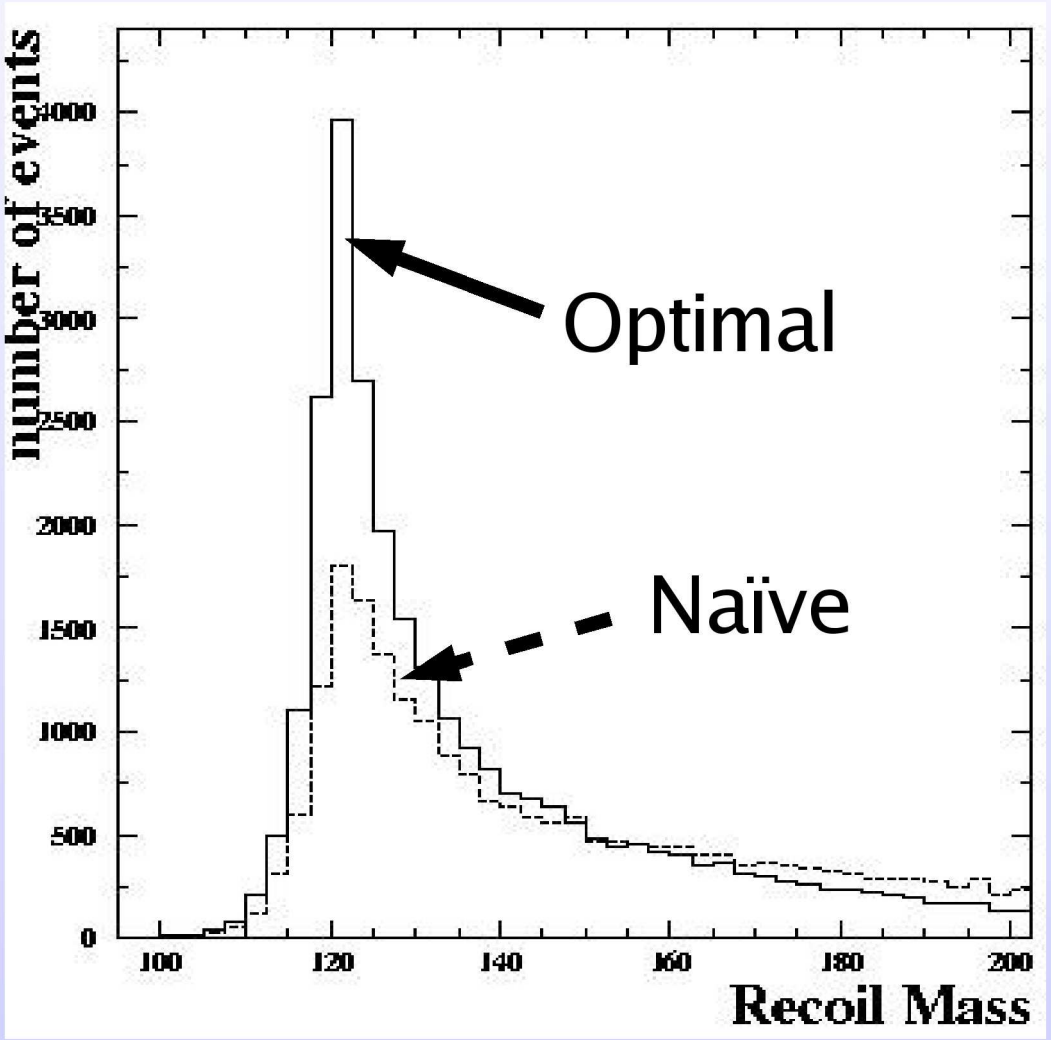
$$m_{recoil} = \sqrt{(P_{in} - P_1 - P_2)^2}$$

Optimal vs Naïve Measurement : What can we win ?

$$m_{recoil} = \sqrt{(P_{in} - P_1 - P_2)^2}$$

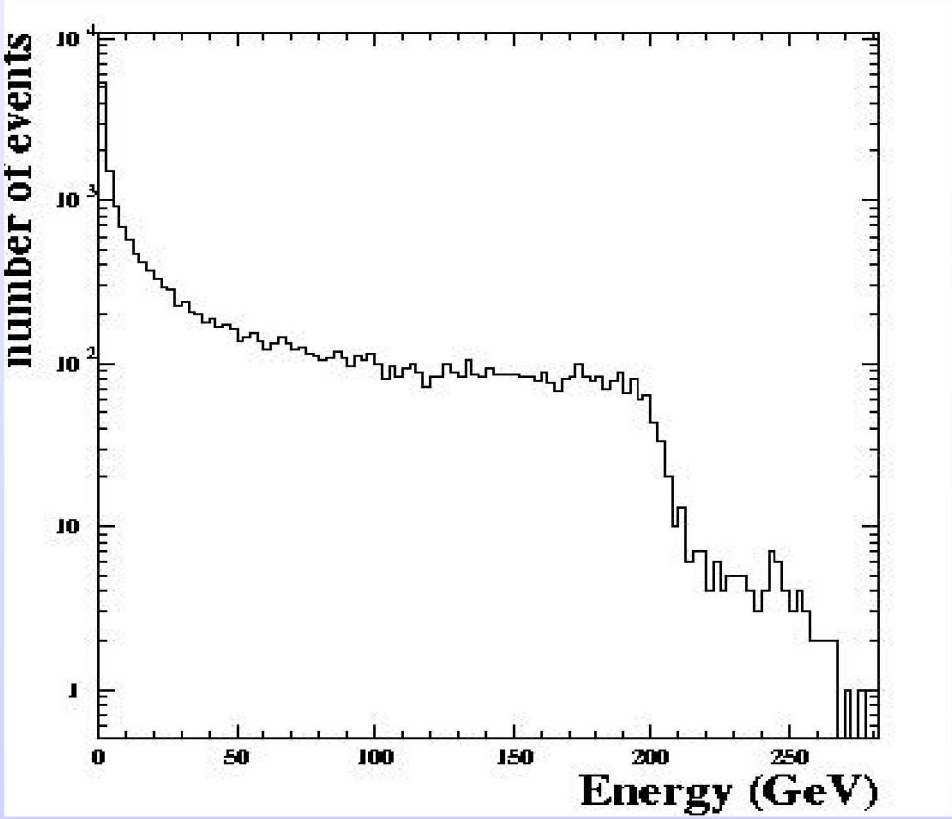
- 50% of the events have significant initial state photon
- Optimal: Use generated initial state radiation
- Naïve: Ignore initial state radiation

-->Factor 3 at lower edge

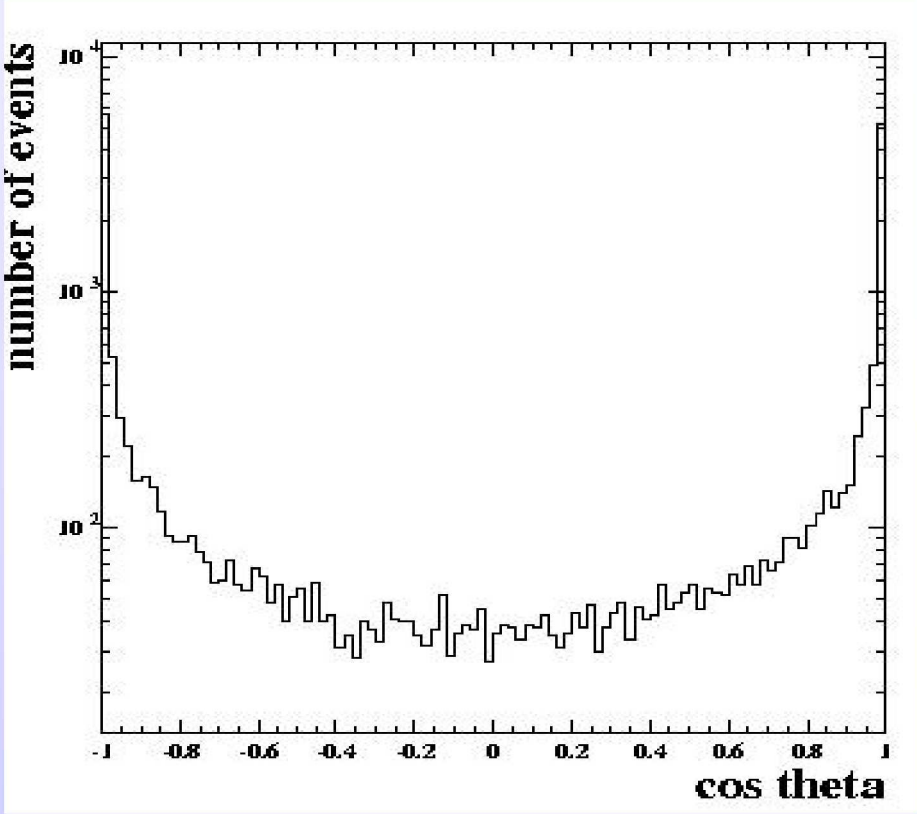


Closer look at generater level

- Energy distribution of radiation (ISR and BS)

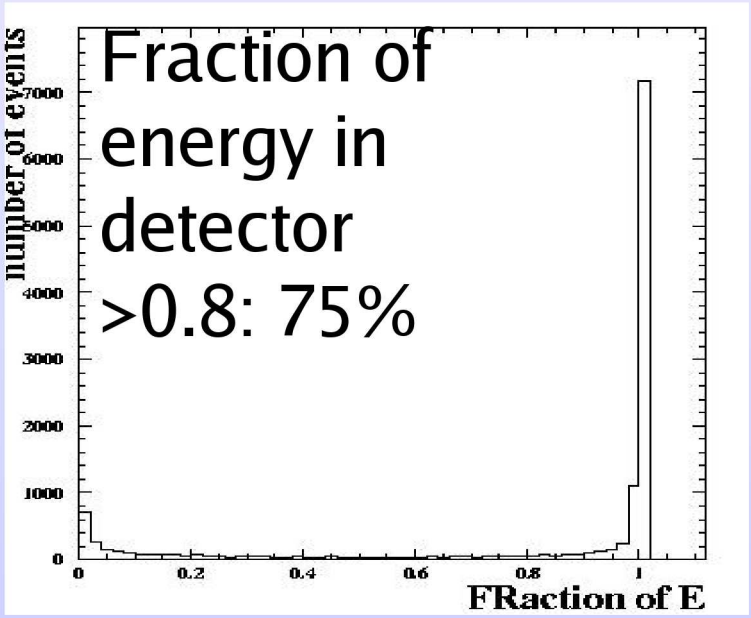


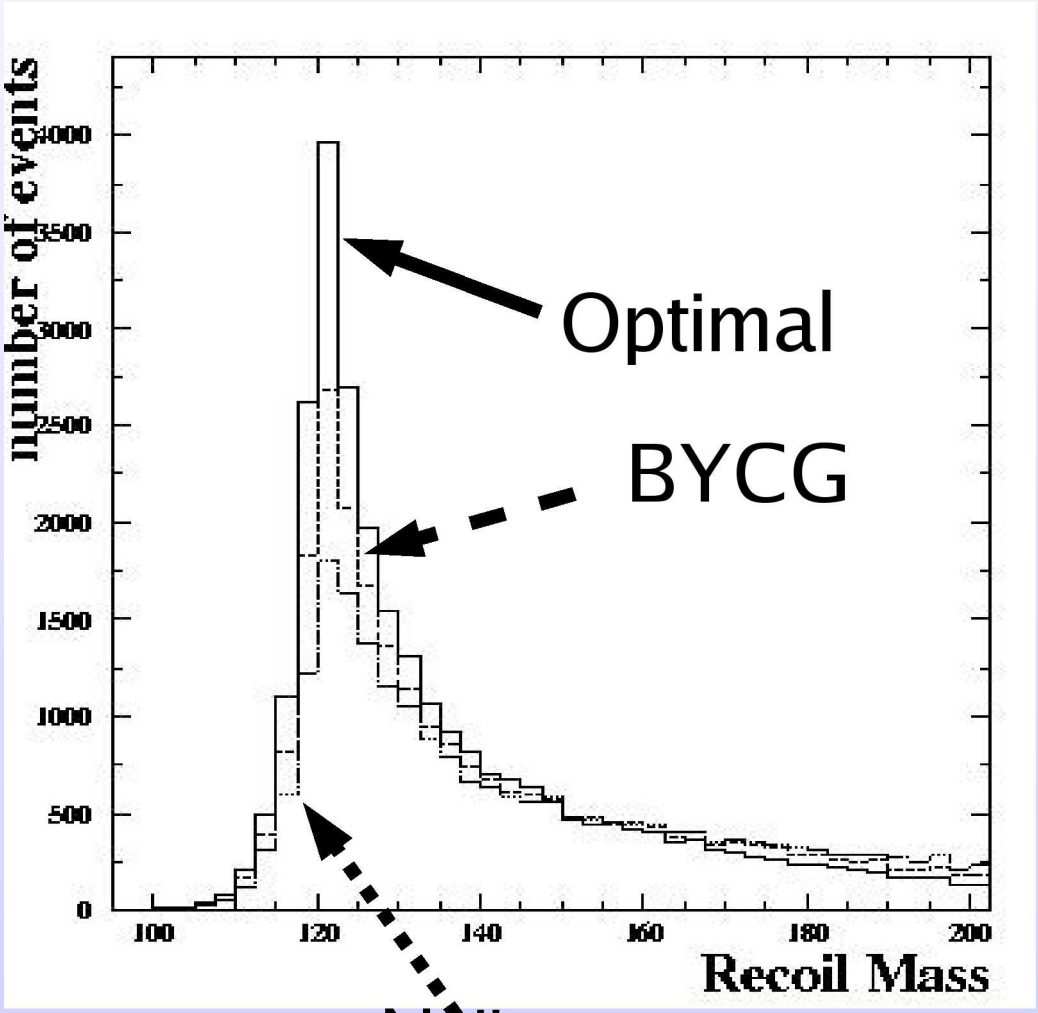
- Cos(Theta) distribution of radiation



But detector has holes ...

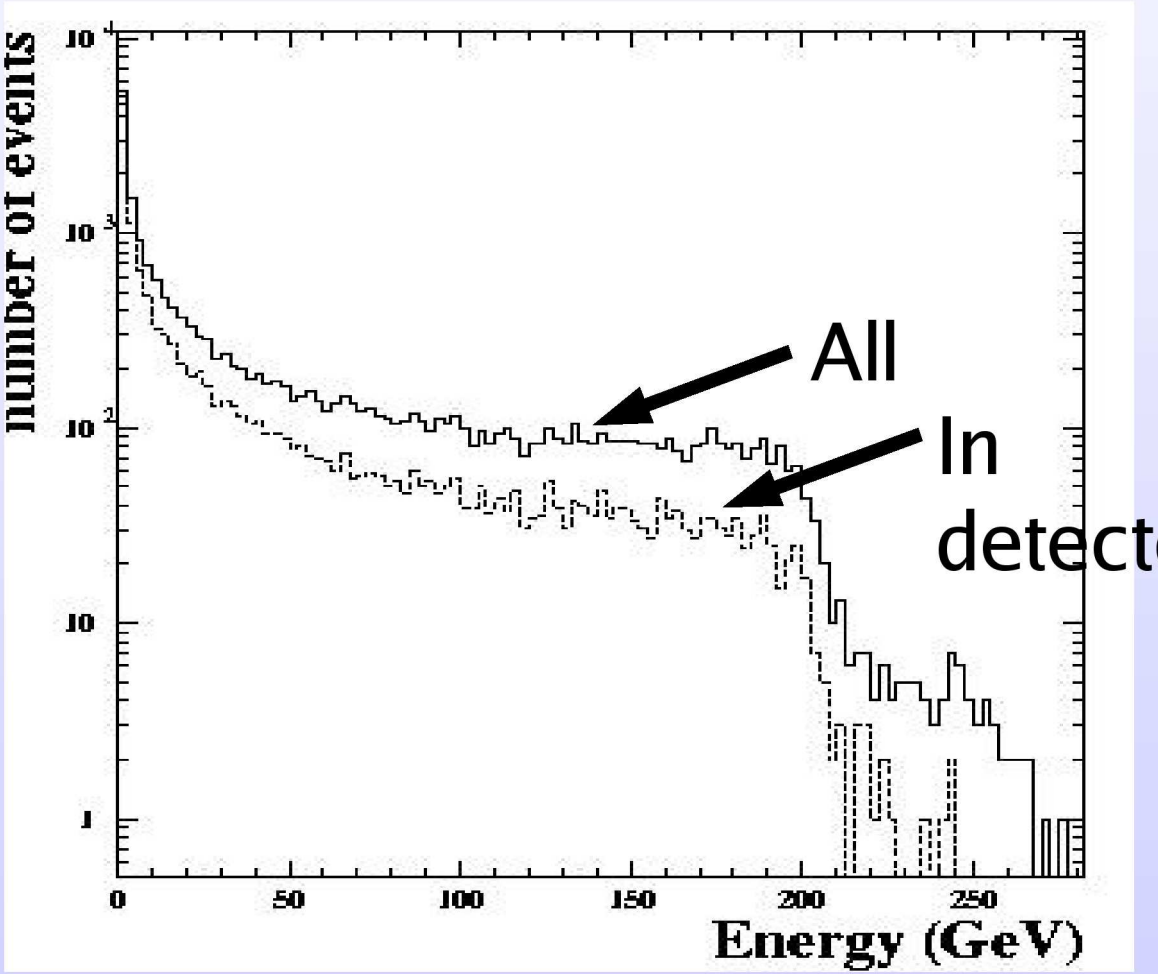
- Optimal: Use tree initial state radiation
- Best you can get: Take holes into account
- Even Bigger holes w/o LAT/LCAL (end of talk)





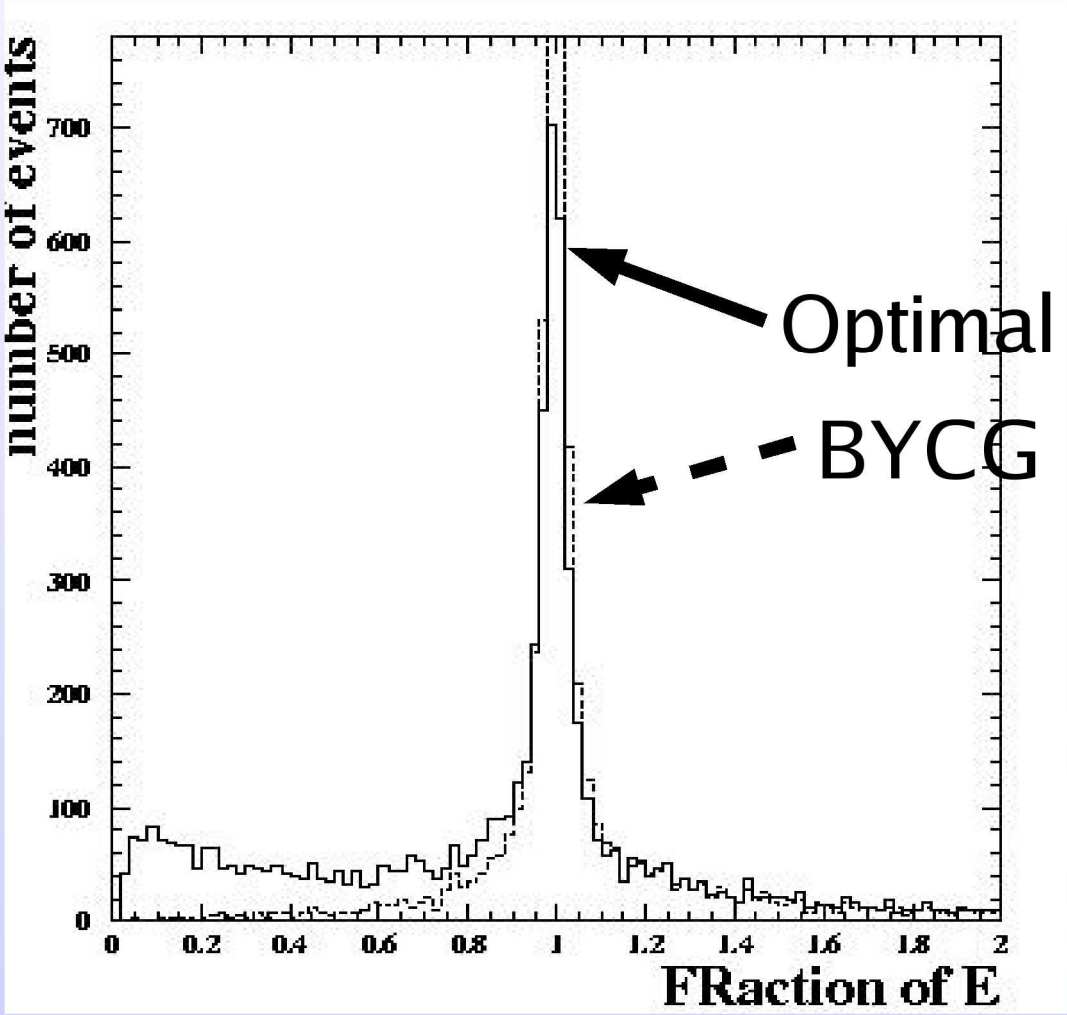
Why do we loose so much at the edge ??

- A lot of the hard radiation is in very forward direction
- Lost for recoil spectrum but easy to recover for final states w/o missing energy , e.g. HZ--> qqbb,qqll



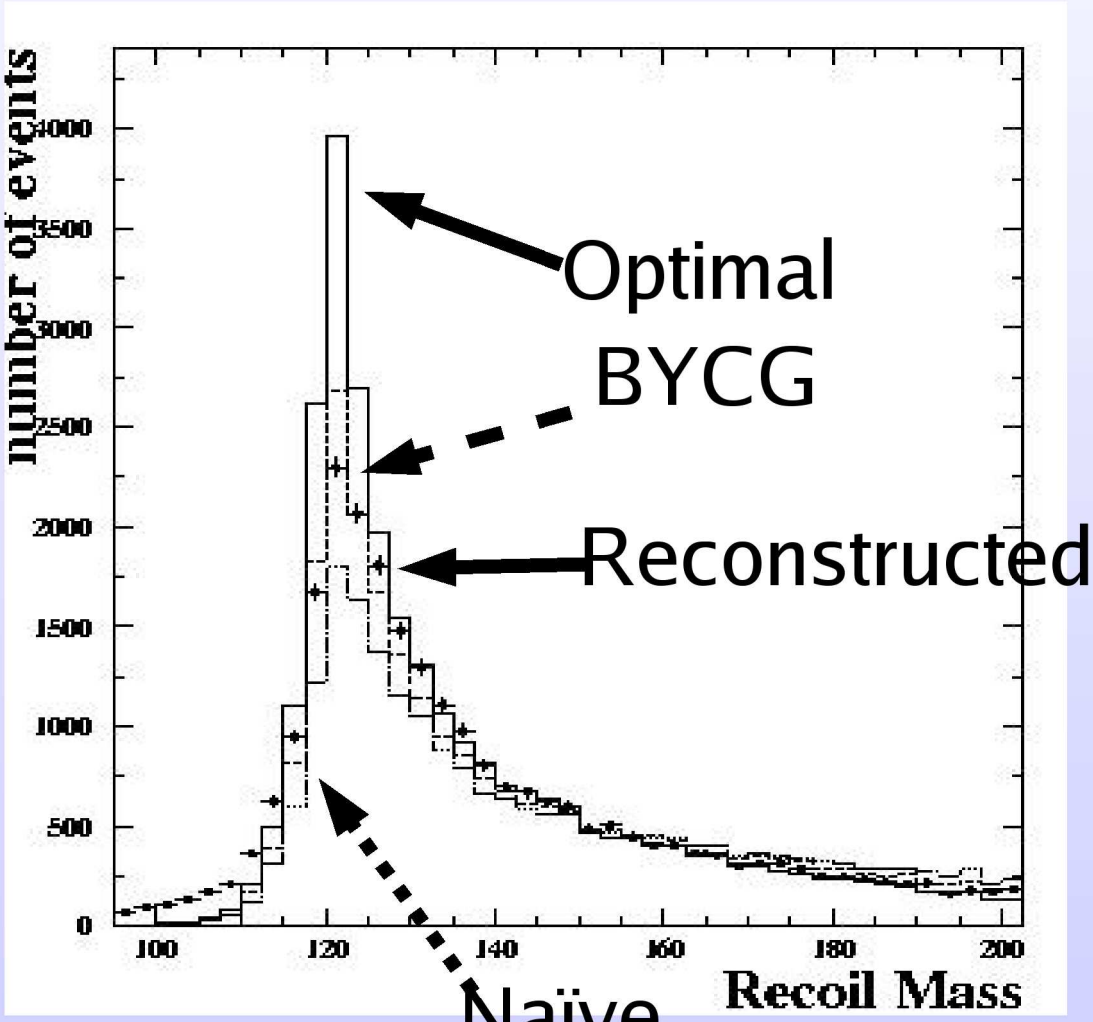
And our photon reconstruction is not perfect

- Conservative: reconstruct only photons with E>4 GeV
- Plot: E_rec/E_tree
- Simdet: 5% photon resolution



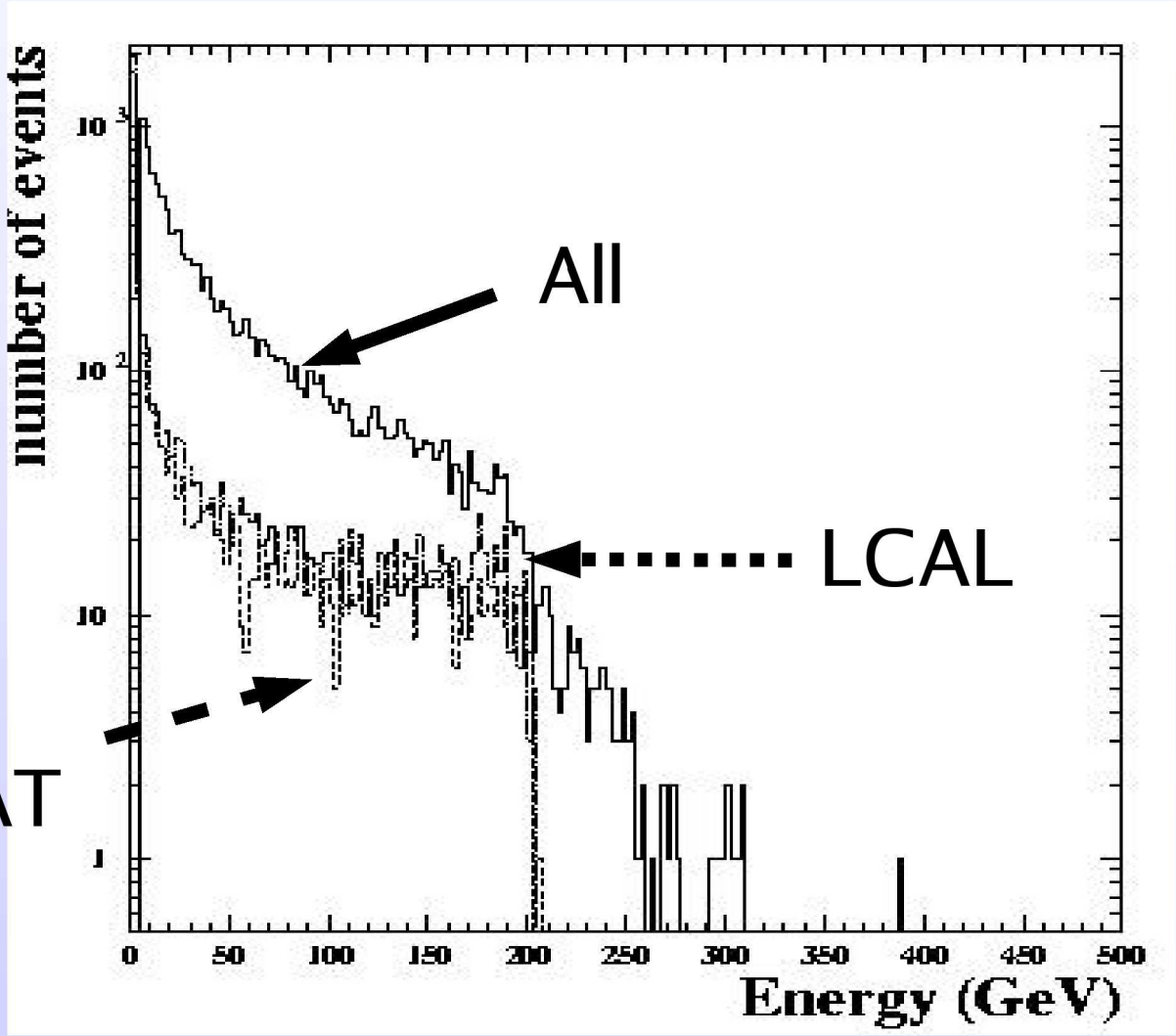
But at the end we win a lot

- With simple photon reconstruction and 1 hour work ...
- More than half way to BYCG



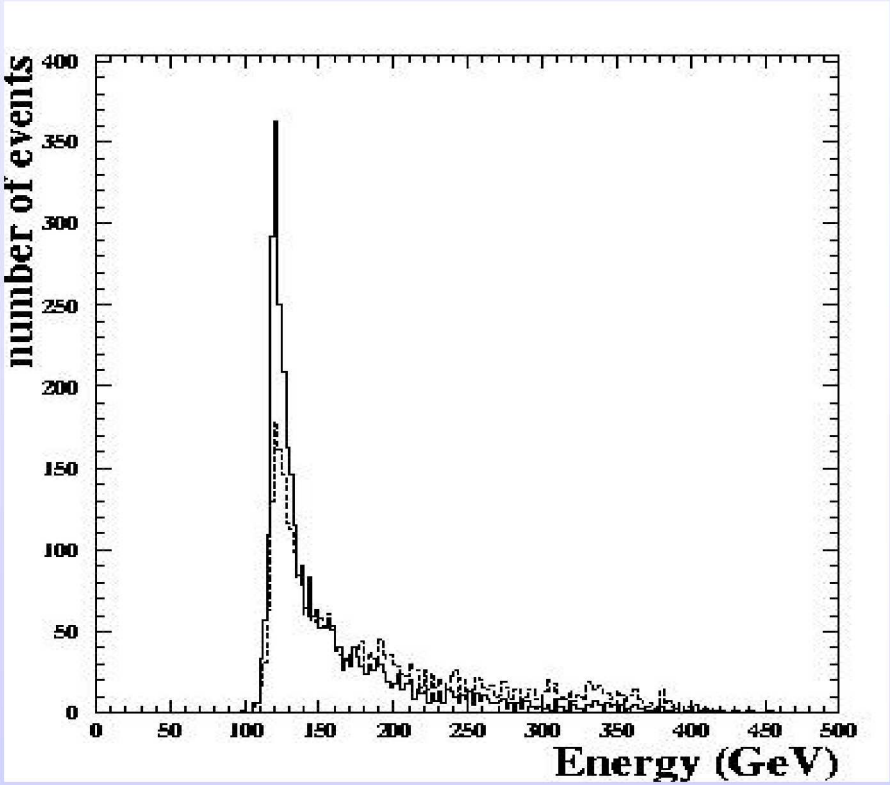
Now include LAT and LCAL

- Tree photon Energy > 5 GeV: 40% of all events
  - ➔80% in detector
  - ➔13% in LAT
  - ➔17% in LCAL
- 15% of all events affected

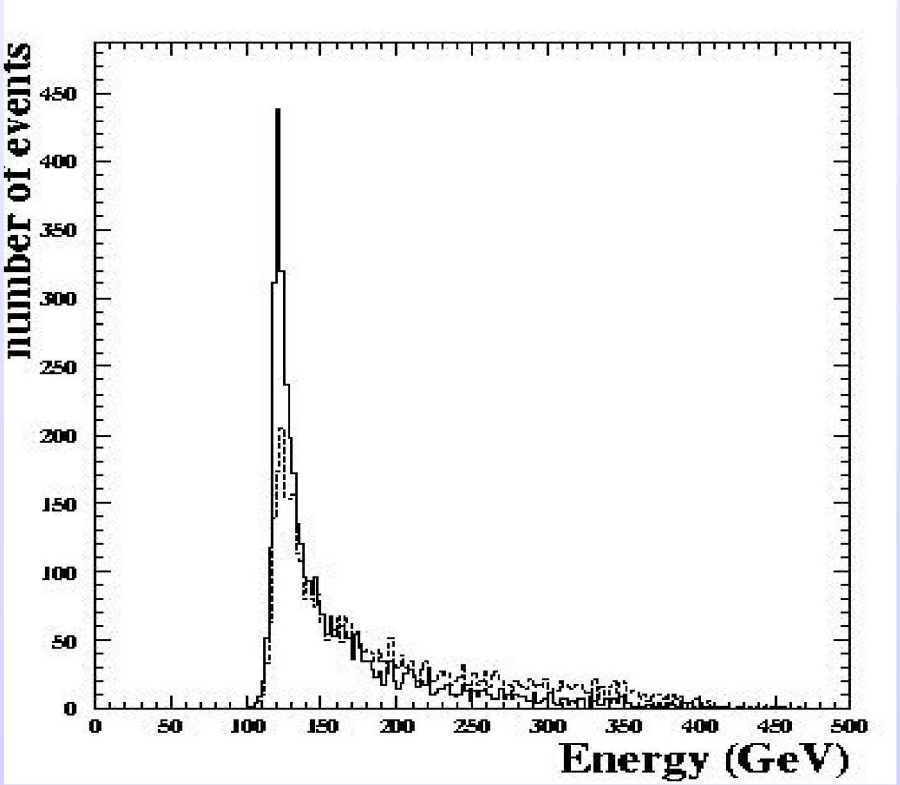


Forward detectors recoil mass

- LAT events with/wo correction

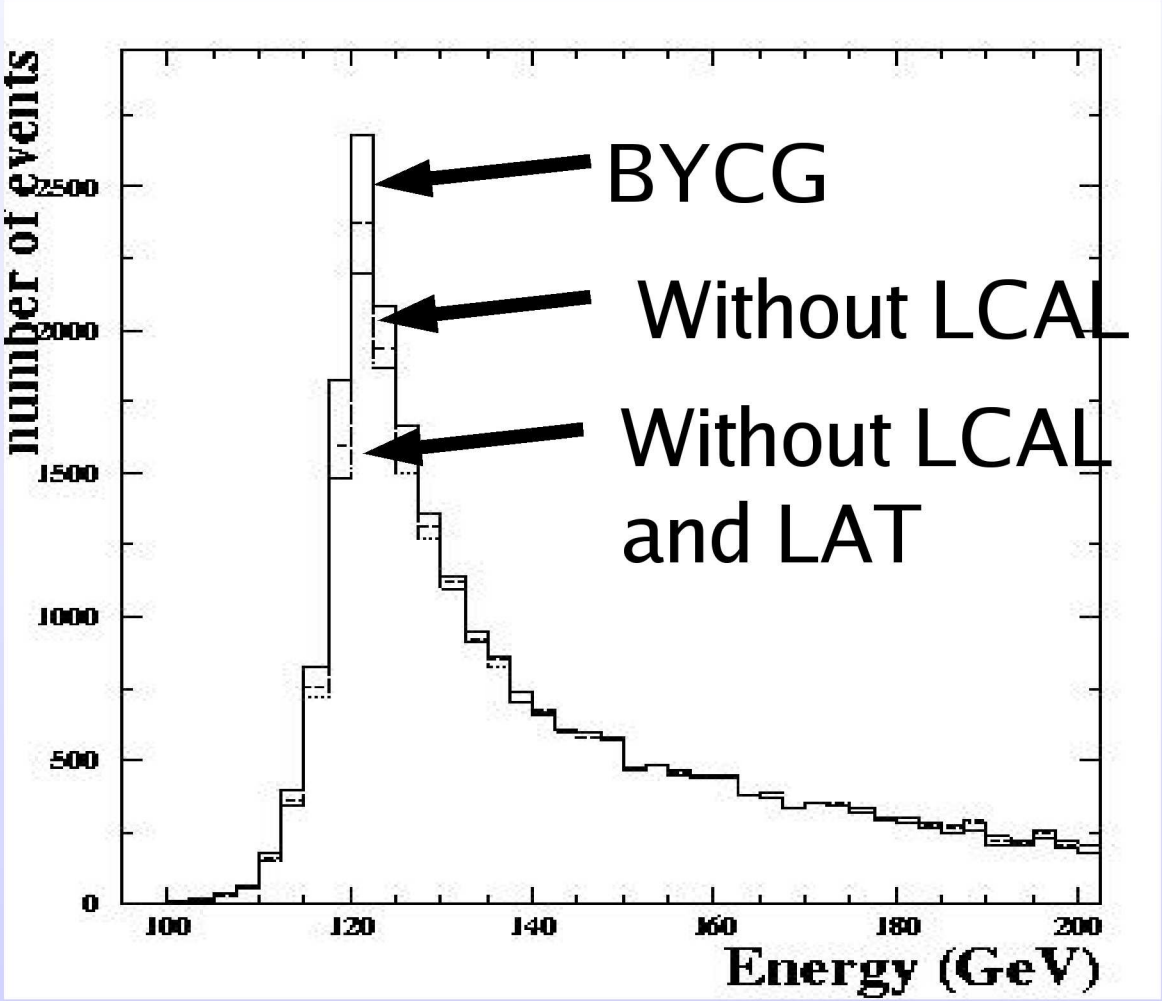


- LCAL events with/wo correction



Combined

- Loose signigficant number of edge events
- More than the differents of BYCG and real reconstruction with 4 GeV photon cut
- 4 GeV threshold is sufficient but we need best angular coverage!



Summary

- Initial state photons influene recoil spectrum strongly
- Reconstruction of photons rises sensitivity
- More than 30% of the photons are in LCAL and LAT--> important for this purpose
- Better initial state reconstruction: Summer Student at DESY