Overview of Calorimeters

Detector Basic

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Electromagnetic Calorimeter

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  - Global layout

Forward Calorimeter

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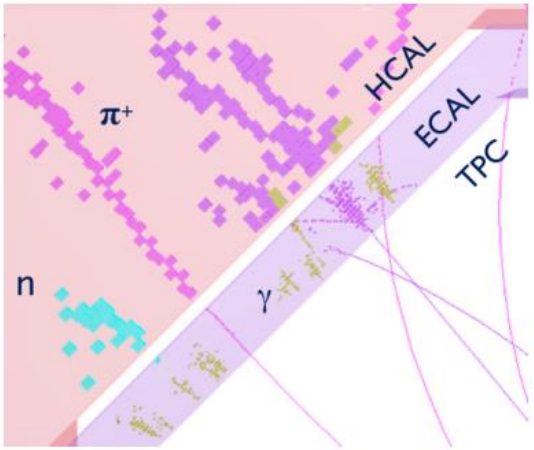
  - Pair Monitor

Introduction to Calorimeter

- Calculate the energy of the original particle by measuring the shower energy generated from the particle.

- ILC uses a technique called Particle Flow Algorithm (PFA) to achieve high shower energy resolution.
- PFA is a method to measure charged particles with a TPC and neutral particles with a calorimeter.



The Electromagnetic Calorimeter

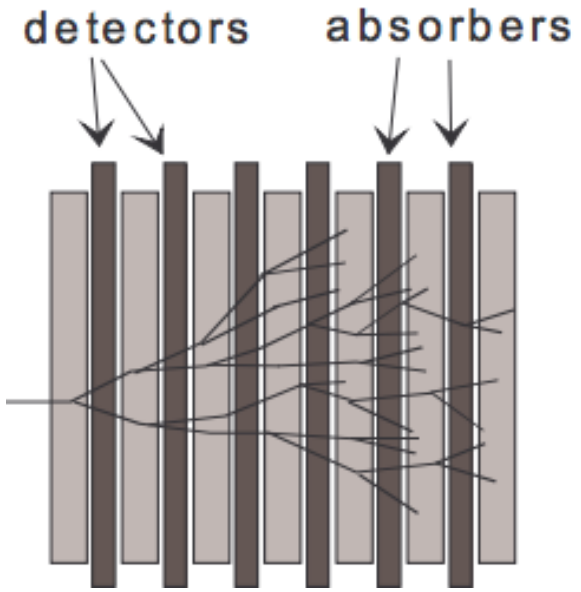
- The electromagnetic calorimeter (ECal) uses electromagnetic shower to measure electrons and photons.

- To increase compactness and particle separation ability, choice of a sampling calorimeter.

Sampling calorimeter

- The sampling calorimeter is composed of a combination of an absorption layer and a detection layer.

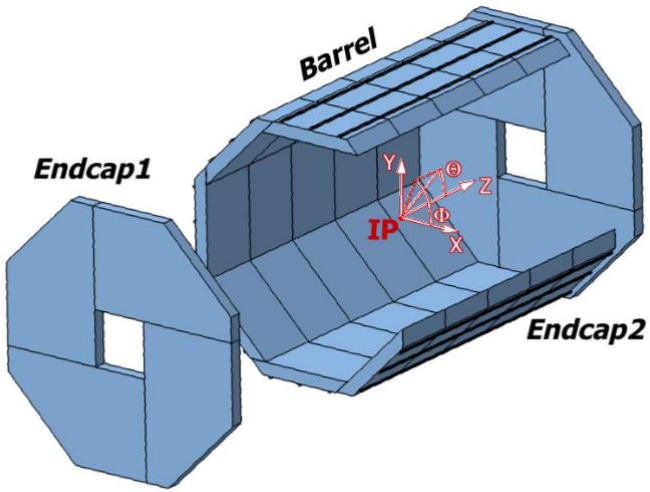
  - absorbers
    - tungsten
  - detectors
    - scintillator
    - silicon sensor



Global layout of the ECAL

- To achieve an adequate energy resolution, the ECAL is longitudinally segmented into around 30 layers.

- The active layers are segmented into cells with a lateral size of 5 – 10 mm to reach the required pattern reco



Layout of the ECal

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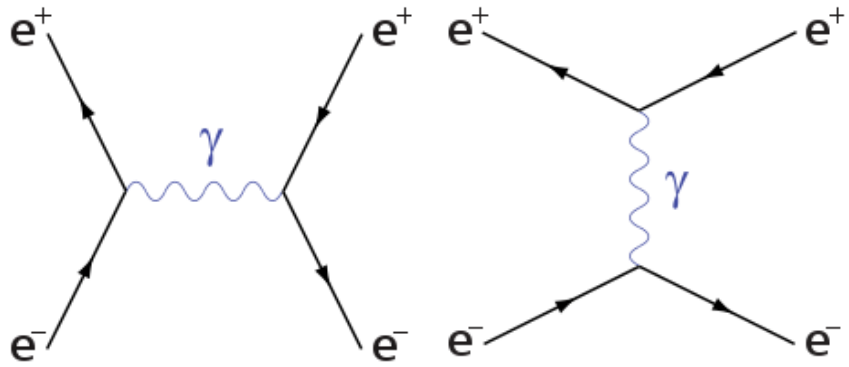
LumiCal & BeamCal

- An R&D program is ongoing to develop the technologies for detectors for precision measurements in a new energy domain.
- In ILD and SiD detectors two specialized calorimeters are foreseen in the very forward region, LumiCal for the precise measurement of the luminosity.
- BeamCal for a fast estimate of the luminosity and for the control of beam parameters.
- Both will also improve the hermeticity of the detector

LumiCal

- With LumiCal the luminosity will be measured using Bhabha scattering,$e^+e^- \rightarrow e^+e^-(\gamma)$, as a gauge process.



Bhabha scattering

- To match the physics benchmarks, an accuracy of better than 10^{-3} is needed at a centre-of-mass energy of 500 GeV.

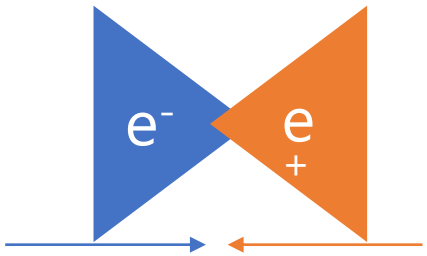
- For the GigaZ option, where the ILC will be operated for precision measurements at CM energies around the Z boson, an accuracy of 10^{-4} would be required.

BeamCal

- BeamCal is positioned just outside the beam-pipe.
- At ILC energies we have to tackle here a new phenomenon – the beamstrahlung.

- When electron and positron bunches collide, the particles are accelerated in the magnetic field of the bunches towards the bunch centre.

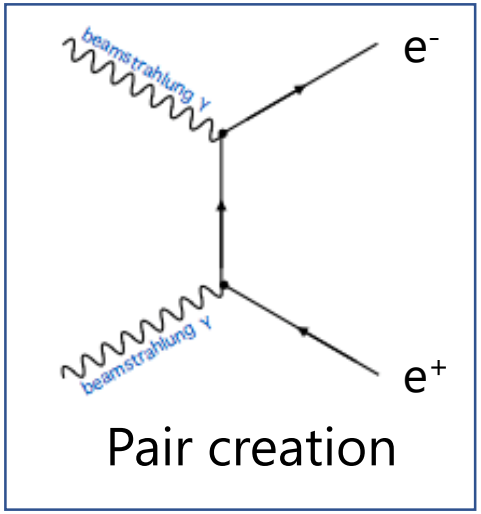
- This so called pinch effect enhances the luminosity.



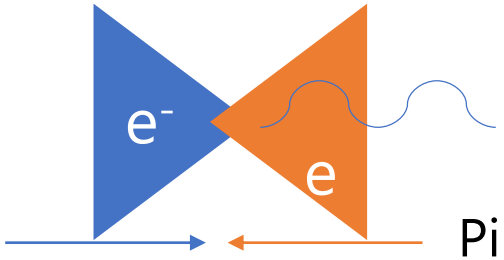
Pinch effect

beamstrahlung

- However, electrons and positrons may radiate photons.
- A fraction of these photons converts in the Coulomb field of the bunch particles creating low energy e^+e^- pairs.



Pair creation



Beamstrahlung
γ

Pinch effect

Pair Monitor

- These depositions, useful for a bunch-by-bunch luminosity estimate and the determination of beam parameters, will lead, however, to a radiation dose of about one MGy per year in the sensors at lower polar angles.

- Hence radiation hard sensors are needed to instrument BeamCal.BeamCal is supplemented by a pair monitor.

- Pair monitor give additional information for the beam parameter determination.