

# Minimum bias simulation of parasitic collisions

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Non-collision backgrounds

Parasitic collisions

ATLAS detector

Monte Carlo simulation of Parasitic collisions

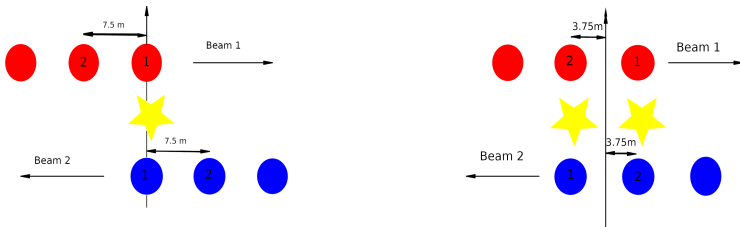
Results

Conclusion

- The term **non-collision backgrounds (NCB)** refers to signals seen in the ATLAS detector which have not been produced by normal collisions of the LHC beams.
- The main components are:
  - ☞ Beam Induced Background (BIB)
  - ☞ Cosmic rays
  - ☞ *Parasitic collisions*

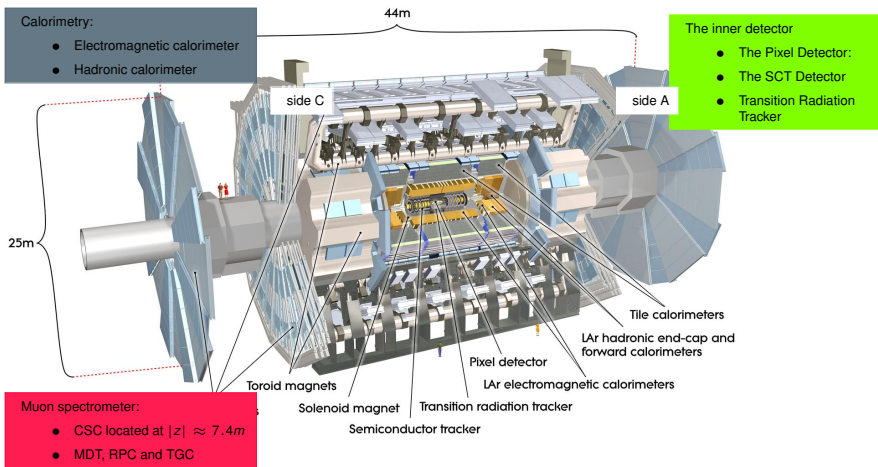
# Parasitic collisions:

**Parasitic collisions:** are proton collisions with other bunches that happen outside of the nominal interaction point.



parasitic collisions at  $z = \pm n \times 3.75$  m,  $n=1,2,3\dots$

# ATLAS Detector:

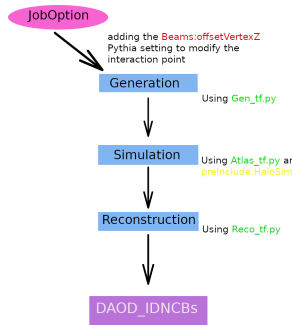


# Monte Carlo simulation of Parasitic collisions:



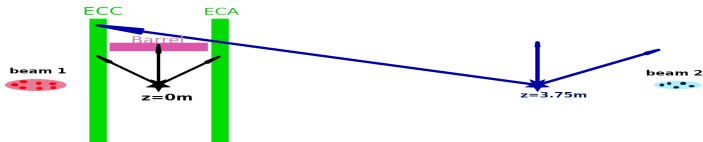
To produce Monte Carlo parasitic events I used the **Full Chain** of steps from generation to reconstruction

- **Event Generation:** We use what are called “**jobOptions**” to run MC generation:
  - These are python steering files that interact tell Athena what you want to generate: generator(Pythia) ,process(minimum bias) and settings...
  - To modify the interaction point, we tested the **Beams:offsetVertexZ** setting of Pythia.
  - we generate events for  $z=0, 3.75, -3.75, 7.5, 11.25, 15, 18.75, 22.5\text{m}$ .
- **Detector Simulation:**
  - generated events are passed through a GEANT4 Simulation
- **Digitization and Reconstruction:**
  - the tracks and energy deposits.
  - in this analysis we focus on the tracking systems.

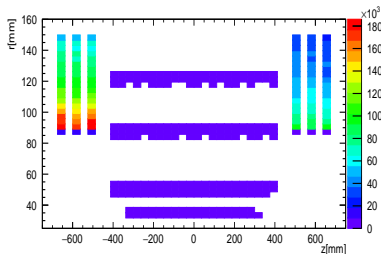


# Results: Pixel Clusters

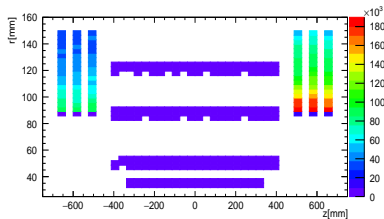
- we focus on the total number of pixel clusters per event and the  $z$  position as indicators of parasitic events.
- The most interesting parasitic encounters are  $z = +3.75\text{m}$  and  $-3.75\text{m}$ .
- The pixel detector extends over a length of 650 mm.
- A cluster is a group of neighbouring pixels in which charge was deposited, ideally originating from the same particle.
- Parasitic particles cross the pixel detector with a trajectory almost parallel to the beam pipe, because they are in the very forward region.



## **z vs r for z=3.75m:**



## **z vs r for z=-3.75m:**

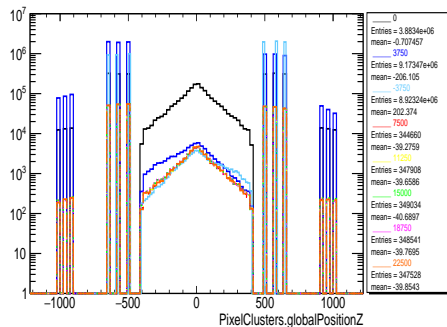


- ▶ for  $z=3.75\text{m}$ : most of clusters are in the EndCap C
- ▶ for  $z=-3.75\text{m}$ : most of clusters are in the EndCap A

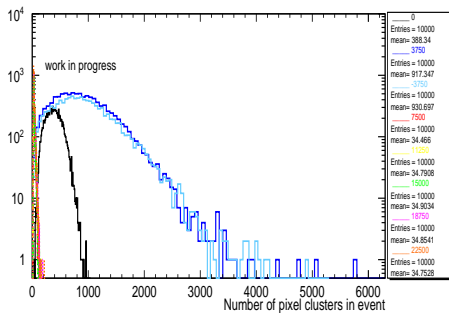


# Pixel Clusters:

## globalZ position:

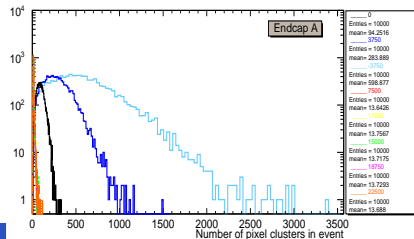
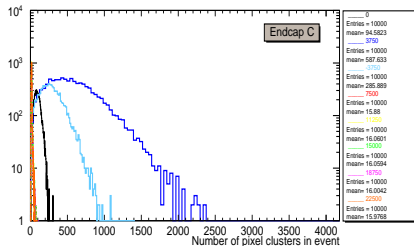
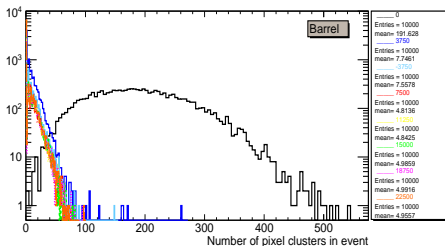


## total number of clusters per event



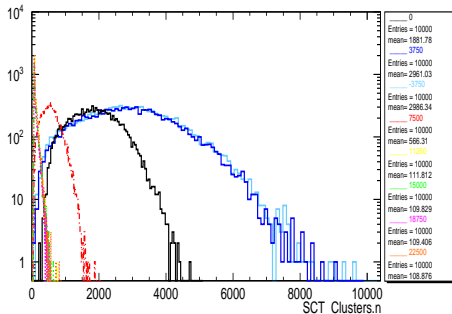
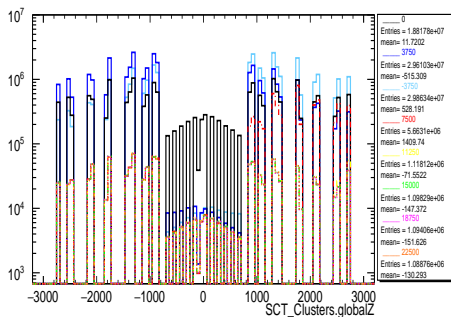
# Pixel Clusters:

## Number of clusters per event in the barrel and the EndCaps:



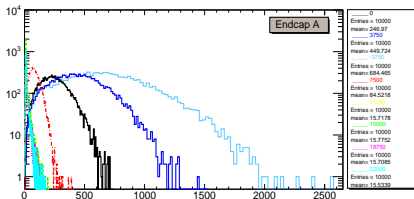
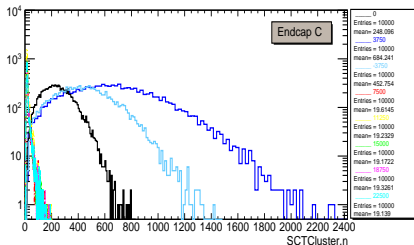
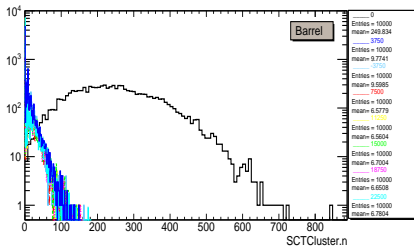
**globalZ position:**

**number of clusters per event :**



# SCT Clusters:

number of clusters per event in the barrel and the EndCaps:



# Conclusion:



- SCT and Pixel detectors can help indicating the presence of parasitic collisions for  $z = \pm 3.75m$ .
- Nominal interaction point interact almost with the barrel regions.
- Parasitic collisions at  $z=3.75m$  generate mostly fragments almost parallel to the beam pipe, that then interact mainly with the end-caps C
- Parasitic collisions at  $z=-3.75m$  generate hits mostly in the end-caps A.

Thank you! Questions?