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The ZDC Detector in ATLAS

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Summary. — The ATLAS Zero Degree Calorimeter (ZDC) is mainly used for studies in heavy-ions physics. It provides information about the collision impact parameter and it is a trigger in ultra-peripheral collisions. ZDC may also detect neutral particles during pp collisions and it is a tool for diffractive physics. We present some preliminary results on ZDC performance for the detection of photons and π^0 obtained using pp collisions data.

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1. – The detector

The Zero Degree Calorimeter (ZDC) of the ATLAS experiment at CERN is located 140 m far from the interaction point, exactly on the proton beam axis and covering the region of pseudorapidity larger than 8.3. It is composed by 2 quartz-tungsten sampling calorimeters (side A and C), each one longitudinally segmented in 4 modules.

Each module (1 electromagnetic and 3 hadronic) contains quartz rods which transport the Cherenkov light to photomultipliers (PMT) located on top of it to measure the total energy. Some modules have also pixel segmentation for the determination of the position of the electromagnetic and hadronic showers [1].

2. – ZDC calibration in pp collisions

In order to calibrate the measurement of the energy of electromagnetic showers, $\pi^0 \to \gamma\gamma$ decays are reconstructed (see fig. 1).

We assume that the total energy of each of the 2 photons corresponds to half the energy collected by the electromagnetic module, while the segmented part is used to localize

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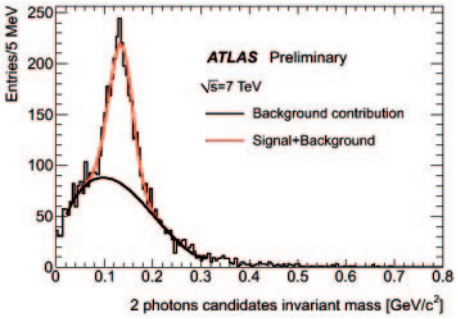

Fig. 1. – Invariant mass of $\pi^0 \to \gamma\gamma$ candidates in pp collisions at $\sqrt{s} = 7\,\text{TeV}$. The measured resolution is about 16%.

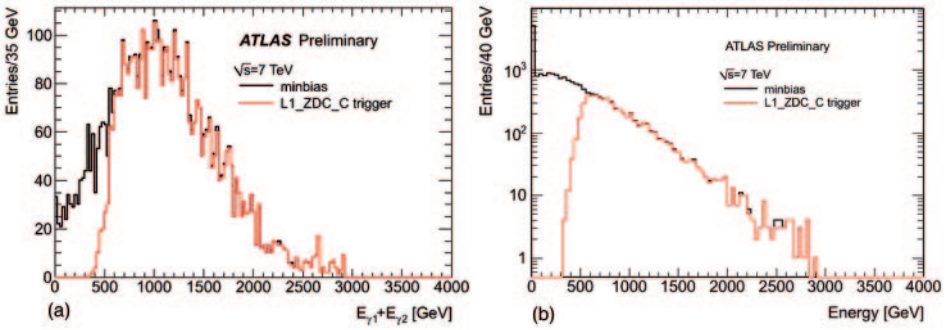

Fig. 2. – (a) The energy distribution of reconstructed π^0 candidates in ZDC-C in pp collisions at $\sqrt{s} = 7\,\text{TeV}$. (b) Energy distribution measured for photons candidates at $\sqrt{s} = 7\,\text{TeV}$. The dark lines represent all the events in the ATLAS Minimum Bias stream, the light lines the ones triggered by the ZDC on side C.

the impact point of photons. It was verified with Monte Carlo that the π^0 invariant-mass peak is not shifted under this assumption. In fig. 1 the fit for the distribution has been obtained by using the sum of a Gaussian distribution for the main π^0 peak and a third-degree polynomial for background events. The total energy scale is calibrated from the π^0 mass peak to obtain the energy distribution of π^0 and photons candidates (fig. 2a and 2b).

The latter are defined using the longitudinal development of the shower, by selecting events with energy deposition only in the first module.

3. – Conclusions

Through the ZDC Detector, it has been possible to detect different neutral particles. First we reconstructed the π^0 invariant mass in order to calibrate the detector. In this way we studied the energy of forward photons and π^0 produced in pp collisions.

REFERENCES

[1] ATLAS Collaboration, ZDC letter of intent, CERN-lhcc-2007-001 (2007).