

RESULTS OF THE 2006 TEST BEAM CAMPAIGN FOR THE CMS ELECTROMAGNETIC CALORIMETER*

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The CMS electromagnetic calorimeter (ECAL) comprises 75 848 Lead Tungstate scintillating crystals. The barrel part of ECAL consists of 36 supermodules of 1 700 crystals each. During summer 2006, nine of them were exposed to an electron beam, allowing us to determine intercalibration coefficients for all crystals and to study the response and the energy resolution. These measurements will be presented, showing that the calorimeter performance is in agreement with the design resolution.

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1. Introduction

The electromagnetic calorimeter of CMS is made of 75 848 lead tungstate crystals covering up to $|\eta| < 3.0$. The size of a crystal is 0.0175×0.0175 in $\Delta\eta \times \Delta\phi$ plane for barrel [1]. 9 supermodules from barrel have been put in a beam of electrons with energy between 15 GeV and 250 GeV.

2. Amplitude reconstruction

The electronics signal is sampled at 40 MHz. In order to reconstruct the amplitude, a weight method is used. As the quadratic sum of the weights is less than 1, one can optimize the signal over noise ratio. CMS uses the combination of 3 samples to compute the pedestal and 5 to measure the amplitude. This allows a dynamical pedestal subtraction.

3. Corrections and intercalibration

The geometry of the electromagnetic calorimeter of CMS requires corrections to compensate for energy loss. One is due to the containment variation from $|\eta| = 0$ to $|\eta| = 1.5$. This effect is of the order of 1% for the energy

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deposited in one crystal with respect to the one using 5×5 crystal matrix. Another correction depends on the impact point of the electron in the 5×5 matrix. Corrections of maximum 2% are applied. During the test beam period different methods of intercalibration have been tested. One of them consists in reading energy in each single crystal for events perfectly centered on the crystal and equalizing the response of all of them. Another method comparable to the one to be used during data taking, considers reconstruction of energy of electrons in a 5×5 matrix. Solving the system $\sum_{i=0}^{i=25} c_i E_i = E_{\text{beam}}$ allows access to intercalibration coefficients c_i for each crystals i . The two methods are in agreement at the per mille level.

4. Results

The energy resolution using reconstruction in 5×5 matrix for the 1700 crystals of one supermodule is shown in Fig. 1. Intercalibration using 5×5 matrix, geometrical and local containment correction has been applied. The measured resolution is in agreement with design value.

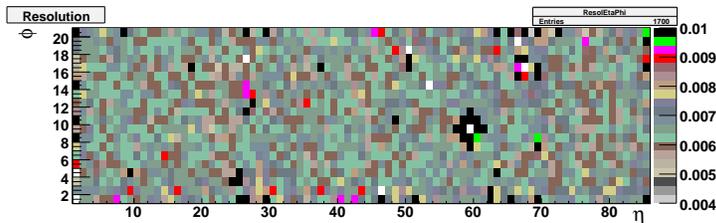


Fig. 1. $\eta \times \phi$ map of resolution obtained using 5×5 clustering algorithm on a supermodule. Geometrical and containment corrections have been included. Intercalibration using 5×5 matrix has been used.

5. Conclusion

The test beam campaign of 2006 has been successful. 9 Supermodules have been put in beam of electrons with energy between 15 GeV and 250 GeV. Geometrical and containment corrections have been studied. 15300 crystals have been intercalibrated with different methods and the full chain of intercalibration for CMS in situ has been studied. The calorimeter energy resolution is in agreement with the expected value.

REFERENCES

- [1] CMS Collaboration, Physics Technical Design Report, Vol.1, Detector Performance and Software, CERN/LHCC 2006-001 (2006).