Resolution Studies of the High Granularity Calorimeter of the CMS experiment at the LHC at CERN

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Introduction

The LHC is currently being upgraded in order to achieve higher luminosities. As part of this upgrade, the spatial resolution of the calorimeter of the CMS experiment is receiving a significant upgrade. This new versions is called the High Granularity Calorimeter (HGCAL).
In this new upgrade the rate of data production (100TB/s) far exceeds the capacity of the the output channel, therefore a decision must be taken to trigger the calorimeter. This has to be done on detector within a very small latency. In order to achieve this, we are studying the response of the new detector to two photons, specifically how its resolution varies in different parts of the detector and for different cone sizes.

Background

There is pileup. Basically there are always some particles flying around as a background. These also get caught in the detector, but have nothing to do with the event being observed. This is called pileup.
The HGCAL is mainly made out of xx layers of small hexagonal silican wafers, in which particles deposit their energy. This energy is then read out via an HGC read out chip (HGROC) and passed to a motherboard. 3 HGCROCs run into one motherboard. There are also some layers of scinitllator material in the hadronic calorimeter.
The detector geometry is usually destribed in reduced coordinates and in eta and phi. Eta is some complicated shit.

Methods

We are working on data compiled from CMSSW, the advanced software produced by the CMS team to simulate the physics of incoming collisions. These are very computationally heavy, so we work on the output files of these simulations. These files are root ntuples, containing segmented data of all the results. We then simulate a detector environment and different trigger mechanisms, and analyse the resulting output.
There are several clustering mechanisms:

1. Triggering on the generated particle (only in theory).
2. Triggering on all trigger cells above a threshold.
3. Triggering on trigger cells whose energy content is significantly higher than the surroundings.
4. Triggering on groups of trigger cells whose energy content is significantly higher than the surroundings.

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Methods

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Mathematical Section

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$$X \to r(X) = \arg\max \left\{ \max \left\{ \sum \delta(x_i, Y_{n,c}) \right\} \right\}$$

Results: Table

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Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table 1: Table caption

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Table 2: Table caption

Results: Figure

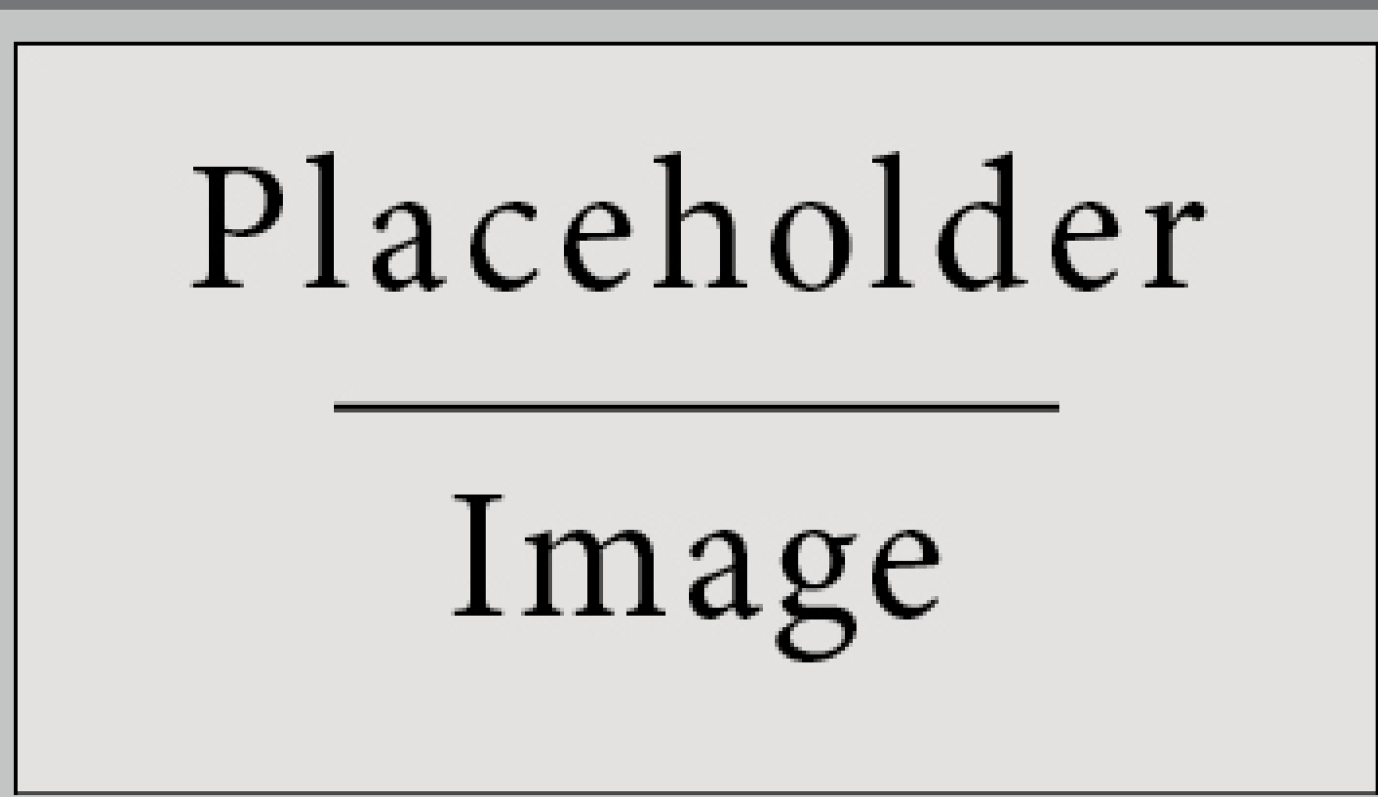

Figure 1: Figure caption

Conclusion

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Article Title.
Journal title, 13(52):123–456, March 2013.

Acknowledgments

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