L. Silvestris

on behalf of the CMS Collaboration

I.N.F.N. – Bari, Via Amendola 173, I-70126 Bari, Italy

and

CERN, CMS/CMC, EP Division, CH-1211 Geneva 23, Switzerland

lucia.silvestris@cern.ch

Received: 15 Jan 2002 / Accepted: 15 Jan 2002 / Published online: 25 Sep 2002

Abstract. The CMS detector has been designed to detect diverse signatures of new physics at Large Hadron Collider (LHC). It will do so by identifying and precisely measuring muons, electrons, photons and jets over a large energy range. In this article will be described the layout and the performances for the Inner Tracker and the Calorimeter System: electromagnetic and hadronic components. These CMS sub-systems play an essential role in jet identification and missing transverse energy studies. They are also important in studies on \( \tau \) and \( b \) trigger and tag.

PACS: CMS, Jet Identification, \( \tau \) tagging, \( \tau \) trigger, \( b \) tagging, Missing \( E_T \)

1 Introduction

The CMS detector \[1\] has been designed to detect cleanly the diverse signatures of new physics at Large Hadron Collider (LHC). It will do so by identifying and measuring precisely muons, electrons, photons and jets over a large energy range. The CMS detector has a length of 21.6 m, a radius of 7.5 m and calorimeter coverage in \(|\eta| \leq 5\). CMS consists of a powerful inner tracking system based on fine-grained microstrips and pixel detectors (Tracker), a scintillating crystal calorimeter (ECAL) followed by a sampling hadron calorimeter (HCAL) and a high magnetic field superconducting solenoid coupled with a multi-layer muon system. In this article will be, briefly, described the Inner Tracker and the Calorimeter System (ECAL+HCAL), both in term of layout and performances. These CMS sub-systems play an essential role in the measurement of missing energy and jet identification, as well as for \( \tau \) and \( b \) studies.

All the results are for the low instantaneous luminosity \( L = 2 \times 10^{33} \text{cm}^{-2}\text{s}^{-1} \) scenario and are produced using the CMS official software based on Geant3 (Fortran) up to hit simulation level and on OO/C++ \[2\] for all other steps, i.e. detector and trigger simulation, reconstruction (reconstructed hit and cluster, jet, track and vertex) and analysis (High Level trigger software).

2 Inner tracker

The conceptual design of the tracker \[3\] relies on a modest number of high precision stations embedded in a 4 T solenoid magnetic field to reconstruct the very
complex events generated at LHC. The detector occupies the pseudorapidity range $|\eta| < 2.4$ centered on the interaction region and extends up to 110 cm in radius and $\simeq \pm 270$ cm along $z$. The tracker consists of three coaxial sub-systems characterized by different technologies and performances. Each subsystem is divided into barrel and endcap configurations. The barrel detectors are arranged in cylindrical layers, while the forward regions are instrumented by disks, segmented into concentric rings. At the core of the tracker, a silicon pixel detector has a typical channel occupancy less than $10^{-4}$ at low luminosity. The channel occupancy for the silicon micro-strip detectors is between 1% and 3%.

Robust tracking and detailed vertex reconstruction are expected to play an essential role in addressing the full range of physics which can plausibly be accessed at the LHC and CMS in particular. The characterization of events involving bosons and in particular their leptonic decays will be of primary importance. The tracker will provide a good momentum measurement for energetic leptons. The tracker measurements are combined with track segments reconstructed in the outer muon system to extend the kinematic region of a precise muon momentum measurement. Several studies imply an efficient isolated reconstruction as well. The track reconstruction efficiency for single muons at different energies (1, 10 and 100 GeV) and the $P_t$ resolution versus $\eta$ for single muons at 100 GeV are shown in Fig. 1 and Fig. 2. The track reconstruction efficiency for single pions (1, 10 and 100 GeV) is shown in Fig. 3. The track efficiency for pions is lower than for muons due to interactions in the tracker material. The same effect is shown in Fig. 4 for b jets at $E_T$ 50 and 200 GeV. For b jets the efficiency is calculated for particles in a cone 0.4 around the jet axis. For electrons, both

http://link.springer.de/link/service/journals/10105/index.htm