The ATLAS Liquid Argon Electromagnetic Calorimeter

P. Pralavorio

The ATLAS Liquid Argon Electromagnetic Calorimeter [1]

Pascal Pralavorio (for the ATLAS Liquid Argon group)

CPPM,CNRS/IN2P3 - Univ. Méditerrannée, Marseille, France

Abstract. The ATLAS detector will start operation on the LHC in 2005. The collaboration has chosen a Liquid Argon electromagnetic calorimeter with accordion shape. Modules 0 of the barrel and the endcap were tested under electron beam at CERN during summer 99. The results of these tests are presented as well as the status of the modules' production.

INTRODUCTION

ATLAS is a general purpose detector under construction that will operate on a proton-proton collider, the Large Hadron Collider (LHC) [1]. This new machine will be installed in the LEP tunnel at CERN and provide 14 TeV center of mass energy collisions at a luminosity of 10^{34} cm^{-2}s^{-1}. The bunch crossing frequency will be 40 MHz and first collisions are foreseen for July 2005.

The ATLAS detector [2] is a typical high energy physics detector with a very large discovery potential for new physics such as Higgs bosons and supersymmetric particles [3]. In most of these physics channels, the electromagnetic (EM) calorimeter will play a key role in energy reconstruction and position measurement of electrons and photons. This is the case for example in the decay channels of Higgs boson: H$\rightarrow \gamma\gamma$ and H$\rightarrow eeee$.

The EM calorimeter [4] is divided in two parts, see Fig.1: i) the *barrel*, located in the pseudorapidity range $|\eta| < 1.4$, with an internal radius of $\sim$1.5 m and a total length of $\sim$6 m; ii) the *endcap*, located in the region $1.4 < |\eta| < 3.2$, made of two wheels with an external radius of $\sim$2 m.

A presampler detector in front of the calorimeter for $|\eta| < 1.8$, and is used to correct for the energy lost in the material upstream.

1) Presented at the 7th Conference on the Intersections of Particle and Nuclear Physics (CIPANP 2000), Quebec City, Canada, May 22-28, 2000

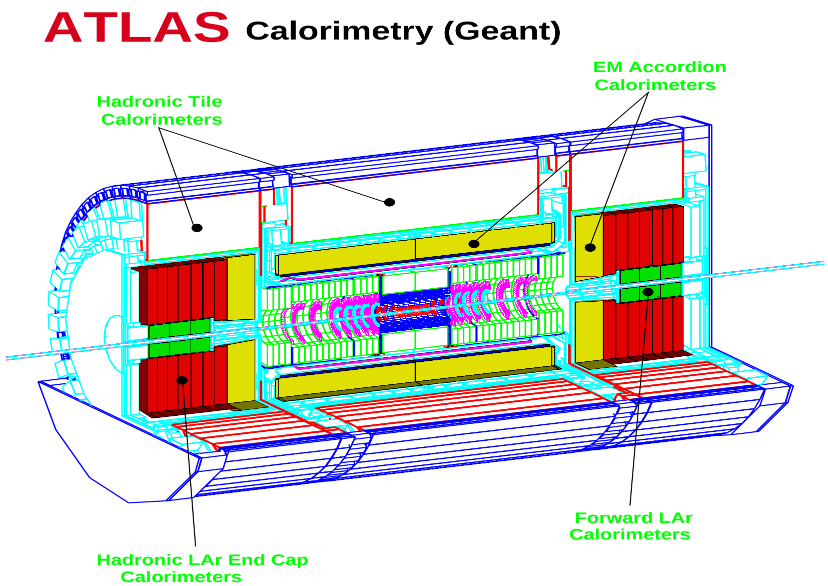

FIGURE 1. Schematic view of the ATLAS calorimeter system.

TEST BEAM RESULTS

This EM calorimeter is a sampling calorimeter where absorbers are made of lead and liquid argon is the ionising medium – thus the detector will be placed in a cryostat. Electrodes, separated from the absorbers by honeycomb spacers, collect the signal and set the high voltages. Both electrodes and absorbers have an 'accordion' geometry [3]. The calorimeter is segmented in 3 longitudinal samplings: i) *S1* made of narrow strips to perform γ-π^0 separation and position measurement. It has a depth of 6 radiation lengths (X_0); ii) *S2* made of square towers (4×4 cm^2 at $\eta = 0$) with a depth of 18 X_0 where most of the energy of e/γ shower is collected; iii) *S3* with 2 to 12 X_0 is used for high energies.

The readout electronics is made of current preamplifiers and shapers, placed outside the cryostat. The signal is sampled, digitised every 25 ns and sent to the control room if accepted by the trigger. The electronics chain has been calibrated continually for each readout channels during the test beam period.

Barrel and endcap modules 0, equipped with ATLAS-like electronics, were intensively tested during summer 1999 at CERN with 5 to 300 GeV electron and muon beams. The Fig. 2 shows these modules before insertion in the cryostat.

For data analysis, a cluster (typically 3×3) is formed in S2 around the most energetic cell and then add up with an adequate number of strips and S3 cells to compute the total energy, E. Corrections are applied to take into account the finite size of the cluster and the accordion shape of the absorbers. After these corrections, typical resolutions for both modules are shown in Fig.3, where a represents the

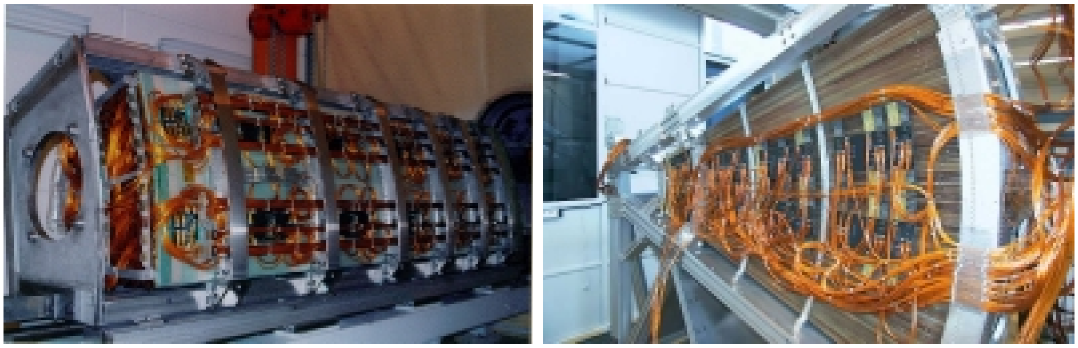

FIGURE 2. View of the barrel (left) and endcap (right) modules 0.

stochastic term and c the local constant term. The electronics noise is estimated to be ~300 MeV per cluster and has been subtracted from the energy resolution. For muons a signal-to-noise ratio of 4 was obtained.

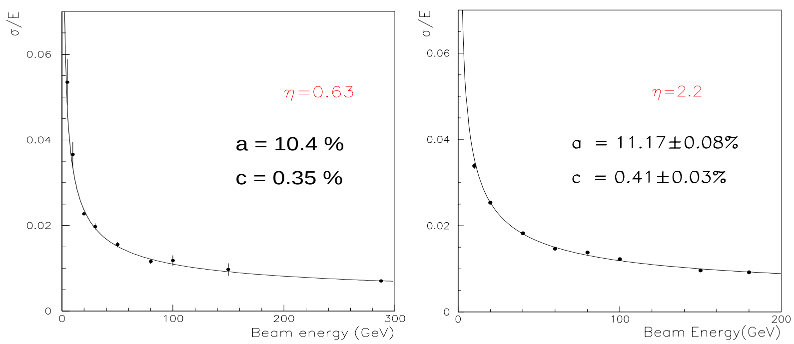

FIGURE 3. Energy resolution of barrel (left) and endcap (right) modules 0.

CONCLUSIONS

Barrel and endcap modules 0 have undergone 3 weeks of intensive beam test at CERN, last year. An energy resolution of $\frac{\sigma_E}{E} \sim \frac{10\%}{\sqrt{E}} \oplus 0.4\% \oplus \frac{300MeV}{E}$ consistent with simulation has been found for both modules. Overall constant term is still to be obtained.

The module production (32 modules for the barrel and 16 for the endcap) has just started and will last 3 years.

REFERENCES

1. The Largon Hadron Collider, CERN/AC/95-05 (1995)

2. The ATLAS Technical Proposal, CERN/LHCC/94-43 (1994)
3. The ATLAS Detector and Physics Performance, Technical Design Report, CERN/LHCC/99-14 and 99-15 (1999)
4. The ATLAS Liquid Argon Calorimeter, Technical Design Report, CERN/LHCC/96-41 (1996)