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## ATLAS RPC Cosmic Ray Teststand at INFN Lecce

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### ABSTRACT

We describe the design and functionality of the cosmic ray teststand built at INFN Lecce for ATLAS RPC quality control assurance.

### 1 Introduction

Resistive Plate Chamber ( RPC [1] ) will be used as the muon trigger detector, in the barrel region of the ATLAS experiment at LHC [2]. Good high  $p_t$  muon trigger performance is crucial in order to address the broad physics program of LHC.

In order to cover the barrel region a total number of 1116 RPC units will be installed, for a total surface area of about  $3800 m^2$ . The extreme difficulty in accessing the ATLAS detectors, after installation is complete, imposes a high standard Quality Assurance for these units. For this purpose three cosmic ray teststands have been built at INFN Napoli[3], Lecce, and Roma 2, each one allowing to certify a tower of eight RPC units at once. The Lecce site uses a standalone cosmic ray trigger and tracking system built with 4 pre-tested ATLAS units ( Figure 1 ). The advantages of this setup is a complete coverage of the chambers under test, avoiding time consuming position scans, allowing only one readout system, and to monitor RPC behaviors in the long term for the trigger chambers.

## 2 Experimental setup and software components

Our apparatus consists of several subsystems: gas distribution, high voltage distribution, low voltage distribution, trigger logic, VME readout, and data acquisition. A large number of independent gas lines (one for each gas volume layer), high voltage and low voltage channels (one for each readout panel) are present, in order to easily isolated defective detectors.

The cosmic rays are selected with a loose trigger request and further refined on-line requiring a minimum number of hits in the trigger RPC, resulting in an acquisition rate of about 50 Hz. Events are then analyzed looking for straight tracks (85% of the events contain good track candidates). Those tracks are then used for efficiency computation of the RPCs under test and monitoring purposes.

The monitor, control, and readout software is based on Labview, while, the analysis software is written in object oriented C++ language. In addition, configurations, runs and results are managed by MySQL databases and presented via web interface. Finally, the data are displayed by PAW and ROOT macro's.

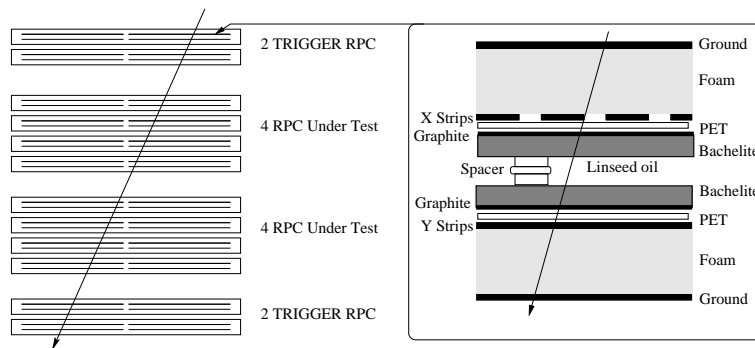


Figure 1: *Cosmic ray teststand at INFN Lecce (left). Single gap ATLAS RPC (right). ATLAS RPC units consist of two layers of one or two adjacent single gap RPC.*

## 3 Quality control tests

The certification of the chambers is accomplished by a sequence of several measurements: a gas volume leak test, a HV ramp-up and ramp-down current curves, efficiency versus high voltage (at different front-end voltage threshold values), single rate counts versus front-end voltage thresholds (at different high voltage values), and finally, chamber tomography. The whole procedure (both for on-line and off-line DAQ processing) is almost automatic, takes about 24 hours, and starts after

2-days of gas flowing (94.7% $C_2H_2F_4$ -5% $C_4H_{10}$ -0.3% $SF_6$ ).

During the gas volume leak test the differential pressure is monitored for two hours

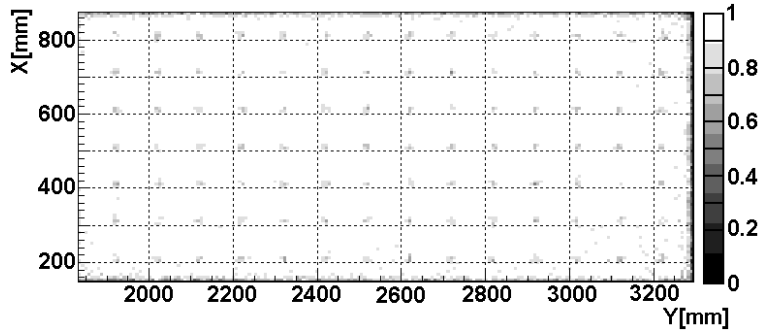


Figure 2: *Tomography of a ATLAS RPC gas volume.*

after imposing about 3 mbar of over-pressure and closing the gas inlet and outlet. The runs with cosmic ray triggers (plateau curves and tomography plot) and with random trigger (noise rates) allow a complete characterization of the chambers. Up to now we tested about 100 units. Accepted chambers should have high gap efficiency ( $> 97\%$  where about 2% loss can be accounted due to the spacers) and relatively low single rate counts (about  $1 \frac{Hz}{cm^2}$ , much less than the expected ATLAS cavern background). Figure 2 shows a gas volume RPC tomography obtained with our system, proving the good 3D tracking capability of ATLAS RPC's (about 7 mm projected track spatial resolution in both projections). In fact, localized dead regions, due to the 1 cm diameter spacers, are clearly visible. Moreover, the current versus high voltage allows to detect defective gap, looking for large leakage current.

## 4 Conclusions

The cosmic ray teststand at INFN Lecce is now capable of routinely testing ATLAS RPC detector units. Its complexity is such that the system is a good test bench for operating with a large number of RPC's.

## References

1. R. Santonico and R. Cardarelli, Nucl. Instrum. and Meth. **187**, 377 (1981).
2. ATLAS detector and physics performance. Technical Design Report (May 1999).
3. M. Alvigi *et al*, Nucl. Instrum. and Meth. **A518**, 79 (2004).