Development of a Workflow Manager for the ATLAS SM1 module production at LNF

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1. Introduction

Large size resistive Micro Mesh gaseous (MicroMegas) detectors [2] will be employed for the first time in an HEP experiment, and specifically for the Phase-I Muon Spectrometer [3] upgrade of the ATLAS [4] experiments at CERN. This upgrade focuses on the End-Cap region to improve tracking and triggering systems using New Small Wheels (NSW) which are made by 2 x 8 layers of sTGC and MicroMegas chambers. The MicroMegas, as high-rate capable detectors, have been chosen to work at HL-HLC luminosity (up to $3 \cdot 10^{34}$ cm^{-2} s^{-1}). The NSW is a set of precision tracking and trigger detectors able to work at high rates with excellent spatial and time resolutions. These detectors can improve the muon Level-1 trigger exploiting a good angular resolution on online track segments, in order to confirm that muon tracks originate from the interaction point (IP) and thus drastically reducing fake tracks. The NSW consists of 16 detector planes arranged in two multilayers. Each multilayer consists of four small-strip Thin Gap Chambers (sTGC) and four Micromegas (MM) detector planes. In April 2016, the first full size prototype of a NSW MicroMegas chamber, the so called SM1 Module0, has been completed by the INFN NSW collaboration.

2. The Micromegas for the ATLAS NSW

The MM detectors for the NSW differ in at least two points from the original MM scheme. First a resistive-strip protection scheme is used, then instead of applying negative HV on the amplification mesh and keeping the resistive strips at ground potential, positive HV is applied to the resistive strips and the amplification mesh is connected to ground. This scheme resulted in a more stable operation of the detectors. Thus sparks cease to cause concern. The spark-induced current can be evacuated very quickly to ground through the mesh and the mesh potential does not change. Further advantages of the modified HV scheme are the better focusing of the field lines between the amplification mesh and the resistive strips, leading to a better charge collection on the resistive strips, and a considerable simplification in the detector construction. Contrary to most of the MM detectors now in operation, in the present implementation the amplification mesh is not integrated in the readout structure. The advantages for large-area detectors are the following: the mesh size is only limited to the mesh fabrication size and stretching machines and not to the size of the individual PCBs; it facilitates detector opening and cleaning; it separates PCB production from mechanical construction. Fig.1 shows schematically the internal structure of a readout PCB. The readout strips are drawn on 0.5 mm thick PCBs and then covered by a 64 μm thick layer of insulator, followed by the resistive strips. On top of the resistive strips the mesh support pillars are deposited. The mesh sits on these support pillars, however it is not a part of the readout PCB but a part of the drift panel. The MM detectors

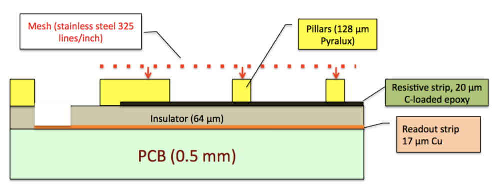

Figure 1. the ATLAS NSW MicroMegas PCB. Internal structure of the MM readout boards, note that the mesh is not part of the readout PCB.

in the New Small Wheel are arranged in large and small sectors. The dimensions of the sectors are chosen such that approximately the same azimuthal overlap of the active areas as in the current Small Wheel is achieved. Each sector comprises of eight MM detection layers, grouped into two multiplets of four layers each (hence quadruplets), separated by a 40 mm thick spacer. Fig. 2 shows schematically the arrangement of the detectors in a sector. The MM sectors in the radial direction are split in two smaller modules (SM1 and SM2 for the small sectors and LM1 and LM2 for the large sectors). For each of the single modules, different PCBs will be glued together to each stiffening panel. The SM1 module type have been assigned to the italian part of the Collaboration (INFN). Each multiplet contains four active layers, grouped into two pairs, as illustrated in Fig. 3. In each pair the detectors are mounted back-to-back. With such an arrangement background will not be collinear in the two neighboring planes and thus can be easily rejected and a systematic shifts of the reconstructed particle positions, due to Lorentz angle cancel out.

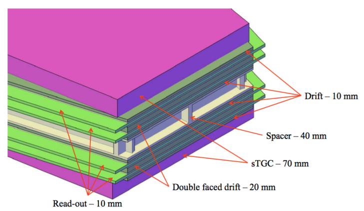

Figure 2. arrangement of the sTGC and MM detectors in a sector

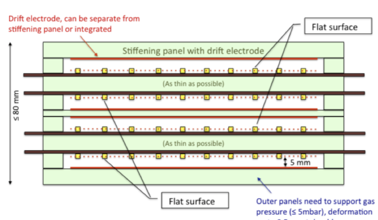

Figure 3. Arrangement of the MM detectors in a multiplet

3. Workflow Manager Development

NSW is designed to use MM quadruplets with very large coverage in η and ϕ per single module, which translates in several manufacturing challenges in order to achieve the high level of precision and resolution required by the collaboration. For this reason a software has been developed dedicated to workflow management for Drift Panel completion operations in the LNF construction site, with the idea to extend it to the complete production process. The software works as an online manual for operations to be done during the construction and as an input interface and manager for Quality Assurance and Quality Control (QA/QC) measurements, such as mesh tension and gas pressure measurements. The software is already in working condition (as shown in Fig. 4) and is being constantly modified and developed to include the management of the completion procedures as soon as they are defined in full detail. All information gathered by the software are currently stored in *logfiles*, allowing for simple extraction of the information for input in the QA/QC database at CERN as well as in a local database maintained by INFN.

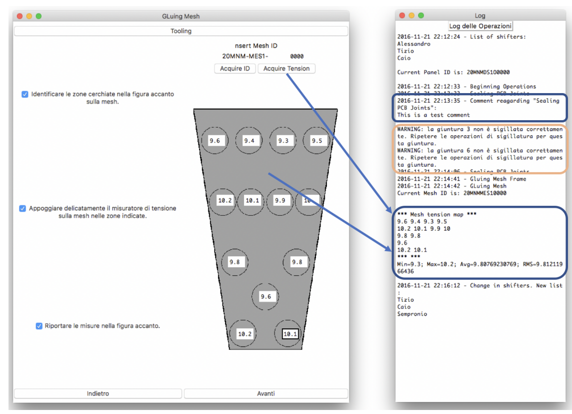

Figure 4: Sample view of Workflow Manager Software showing an example of input interface for measurements (here mesh tensions) and its respective logfile

REFERENCES

1. ATLAS Collaboration is made of about 3000 Physicists coming from about 180 Institutions of the following countries: Argentina, Armenia, Australia, Austria, Azerbaijan Republic, Republic of Belarus, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, France, Georgia, Germany, Greece, Hong Kong, Israel, Italy, Japan, Morocco, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, Turkey, UK, USA, CERN, JINR
2. Y. Giomataris et al., Nucl.Instrum.Meth. **A376** (1996) 29-35
3. ATLAS Collaboration, CERN-LHCC-2013-006, ATLAS-TDR-20-2013, June 2013
4. ATLAS Collaboration, JINST 3 S08003 (2008) 1-407