Preparation for a Test-Beam Facility for the ATLAS Muon Spectrometer ◇

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1. The ATLAS Muon Spectrometer

The ATLAS [1] Collaboration has proposed a general purpose detector for an experiment at the Large Hadron Collider (LHC), recently approved by the CERN management. The muon spectrometer consists of three air-core superconducting toroid magnets, namely a barrel and two identical end-cap toroids, covering the rapidity range $|\eta| \leq 3$, to insure a high resolution muon momentum measurement over a p_T range from 5 to about 1000 GeV/c.

The design consideration with the strongest impact on the design of the ATLAS muon spectrometer is the requirement for stand-alone measurement capability. This safeguards against any unanticipated backgrounds and ensures a good discovery potential in the presence of unexpected event topologies due to unknown physics at the TeV scale. To accomplish a good momentum measurement even at low momenta, this requirement leads to the choice of an air-core magnet system, which however puts high demands on the muon chamber system due to unavoidable field inhomogenities and the relatively low fields in such systems.

The open structure of the barrel toroid allows to reconstruct the muon momenta from a measurement of the sagitta in three muon stations in front, in the center and behind the magnetic field in the range $|\eta| < 1.4$. In the forward region the muon momenta are obtained from a point-angle measurement with one point in front and two points behind the endcap toroid cryostats. To achieve the required momentum resolution at high momenta (the sagitta for a $1TeV$ muon is about $500\mu m$) two requirements have to be fulfilled: the muon chambers have to provide a position measurement accuracy of about $50\mu m$ per station and the alignment of the three stations with respect to each other has to be known to about $30\mu m$.

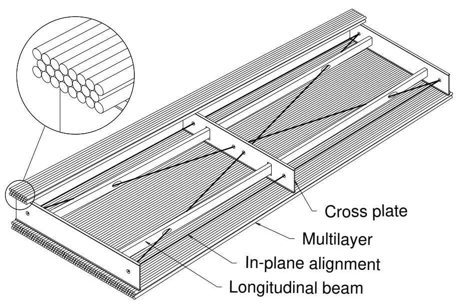

Fig. 1: MDT chamber with part of the top multilayer removed to show the chamber support.

To achieve the first goal a system of high pressure (3 bar absolute) proportional drift tubes - the Monitored Drift Tubes [2] - has been chosen. An MDT Chamber consists of six layers of drift tubes, arranged such that three layers of closely-packed tubes (multilayers) are mounted on each side of a support structure. The two multilayers and the support structure form a chamber, see Fig. 1. MDT chambers cover almost all the rapidity range but a very small region at high rapidity where the expected rates are higher than 100 Hz/cm^2. In this region, to reduce occupancy, CSC chambers (Cathode Strip Chambers) are used because of their finer granularity. The MDT system consists of 880 chambers which covers an area of $\sim 5500\ m^2$; the total number of tubes is ~ 300000.

2. X-ray study of the muon tube wire positions

Together with the MPI in Munich we want to build seventy MDT chambers starting in 1998. Prior to assembling the MDT chamber the accuracy of the wire position in each tube has to be measured. Therefore we want to use a dental X-ray system and dental film to measure the distribution in wire position with respect to the center of the tube as defined by the cradle in which the tube is held using X-ray images. The system will verify the wire location in single muon tubes and will be set up at the University of Munich. The system will consist of a pair of X-ray sources, an X-ray V-block with fiducial wires and a CCD readout system. The V-Block will be machined to have a contact surface identical to the tube supports used in the MPI chamber assembly method. The installation of the X-ray system will be set up at the University of Munich and ready by March 1997.

3. Cosmic-Ray Test beam stand for muon chambers

After measuring the wire position of the single tubes the MDT chamber will be assembled at MPI. Before transporting the MDT chambers to CERN we want to set up a database consisting of the x-y positions with an accuracy of $10\mu m$ of each wire of the chamber. To do so we are going to install a cosmic-ray test beam stand in Garching by begin of 1998. The MDT chamber to be measured will be placed inside a reference system of two MDT chambers. A coincidence of two hodoscope planes will constitute the main trigger for our measurements. The hodoscope will cover an area of $2.3 \times 4.0\,\mathrm{m}^2$, each plane consisting of 40 partly overlapping scintillators. Also we have to ensure for the quality including gas tightness and functionality of the electronics.

References

[1] The ATLAS Collaboration; ATLAS, technical proposal for a generalpurpose pp experiment at the Large Hadron Collider at CERN; CERN/LHCC/P2, 1994

[2] The ATLAS Muon Group; Monitored Drift Tubes for Muon Spectroscopy in ATLAS; ATLAS Internal Note MUON-NO-044, 1994

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