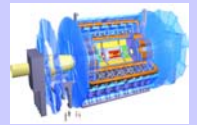




Study of the response of the ATLAS Monitored Drift Tubes to heavily ionizing particles and of their performance with cosmic rays.



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Abstract

The BIS Monitored Drift Tube (MDT) chambers form the inner most station of the Muon Spectrometer of the ATLAS detector and are constructed in Greece by three Universities. The performance of a BIS chamber (Module 0) with cosmic muons has been extensively studied at the University of Thessaloniki. In this work we report on the properties of chamber i.e. drift times, resolution, efficiencies as well as gain properties under different high voltage operation conditions. The experimental results are also confronted with expectations from GARFIELD simulations and are in good agreement. A systematic study of the behavior of the ATLAS Monitored Drift Tubes (MDTs) under controlled irradiation by alpha particles has been performed. The aim of the study was to quantify the response of the drift tubes to alpha particles and consequently to heavily ionizing particles. The energy deposition of the alpha and beta rays of the source inside the tube was computed by simulating the drift tube geometry.

Cosmic Ray Set up

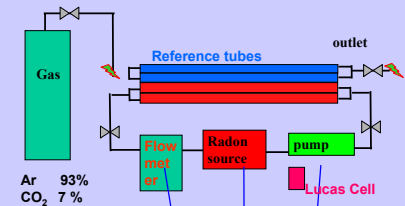


Alpha Particle Irradiation Set up

Use of a radioactive gas (Radon) in order to enrich the tube gas and irradiate the MDTs internally

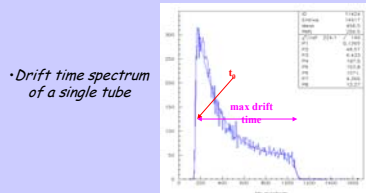
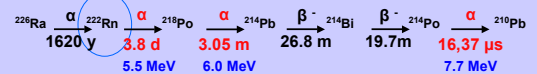
alpha particles

Have equivalent ionization to neutron recoil atoms and may imitate the single charge recoil nuclei very good.



Advantages

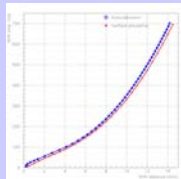
- Uniform internal irradiation
- No deterioration of the electric field in the tube
- Known ^{222}Rn activity



Time spectrum

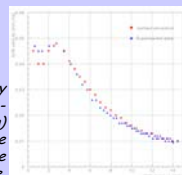
• Drift time spectrum of a single tube

r-t

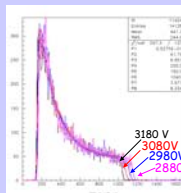


The *r-t* relation from the autocalibration and the GARFIELD simulation.

Drift velocity (autocalibration - GARFIELD simulation) as a function of the distance from the wire.

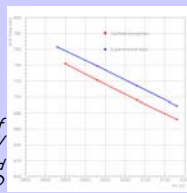


Drift velocity



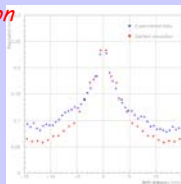
Time spectra of a tube for 4 different HV values

t_{max} as a function of applied HV
Exp. Data and GARFIELD



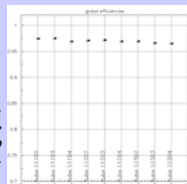
$t_{\text{max}} - HV$

Resolution



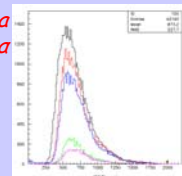
Single tube resolution as a function of the drift path.

Single tube efficiency for a sample of 9 tubes of the chamber.

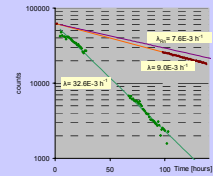


Efficiency

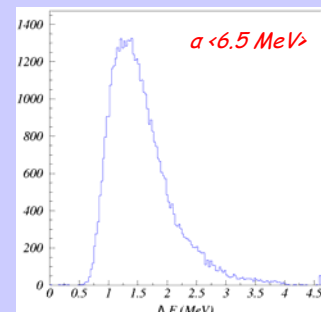
ADC spectra due to α



Radon Monitoring for 8 days
HV: 2 kV
Gas Gain: 120



Activity in Lucas Cell and MDTubes



$\alpha < 6.5 \text{ MeV}$

Energy scale has been calibrated by comparison with the charge collected from soft γ

An α (6.5 MeV) produces 73 times more charge than a photon γ (17.4 keV)