Gas Detectors for muon spectroscopy beamlines at ISIS



Gas Electron Multipliers (GEM) for muon beamlines

- Able to operate
 - at high rate (~MHz/mm²)
 - in strong magnetic fields (4 T)
- Available in almost any shape and size with virtually no dead area
- Pixelate/use of ASICs
- Position Resolution
- Time Resolution



Detector Prototype on HiFi

















Signals



3 readout channels 10x50 mm²/ch Bipolar preamps Digitised at 500 MS/s



Efficiency



Operation in Magnetic Field



Resonance Frequency Experiments

As a positive muon shares some similarities with a proton an NMR like technique can be performed within a sample. The muon spin initially precesses around the magnetic field (on the Y-Z diagonal), then

a signal with a comparatively large frequency is applied through a coil around the sample forming a magnetic field in the x direction.





By using the applied signal for a set length the muon spin can be left in a state of free precession.





Muonium Experiments



In some samples, e.g. Quartz, muons interact with electrons to form muonium. In muonium the spins couple together forming a larger magnetic moment so the precession frequencies are higher. The higher frequencies require greater time resolution.

By measuring the response in the asymmetry it can be seen how well the detector keeps up with fast frequencies.



Dead Time



The dead time of the detector increases with count rate but plateaus at approximately 50ns which is the FWHM of the pulses.

This dead time occurs due to an overlapping of signals which a simple threshold discriminator cannot account for.

The dead can be reduced however by increasing the speed of the electronics to reduce the width of the signals.

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Next

- Evaluate effect of magnetic field in the direction at 90° to the direction of the electrons
- Measure dead time using different pixel size and BeeBeans ASICs (Japan)
- Evaluate other micro-pattern gas detectors

