Muon Beam modelling and diagnostics

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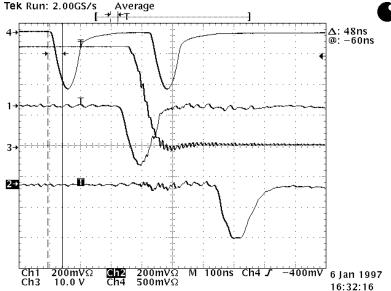
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Aims

- Beamline diagnostics and tuning – development and evaluation
- Instrument and beam simulation codes, including sample environment.
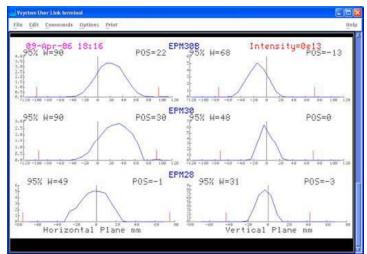- NeXuS instrument definition file, permitting simulation.
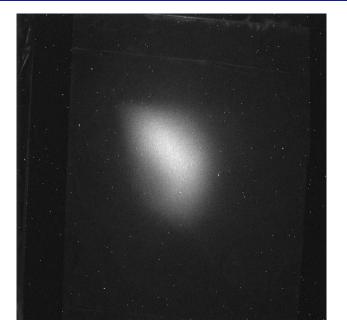
Beam diagnostics

- Rate at sample position (also asymmetry and background)
- Rate at intermediate slits (stopped muons)
- Timing of pulsed beam and kickers
- Scan slit opening or counter position to give profile
- Must distinguish muons from other particles
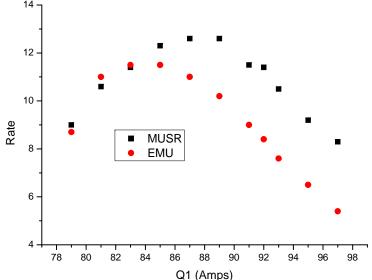
Beam profiling / imaging

- Direct measurement (wire grids, transformers)
  - Protons µA-mA, muons pA
- Scintillator grids and photomultipliers/photodiodes
- Scintillator screen and camera
- Direct semiconductor detectors
- Wire chambers
- Identify particles and their momentum?
- High field compatible

Beam tuning

- Optimise performance
- Rate / spot size / polarisation / momentum / beam contamination?
- Correct for variations in beam steering, stray fields
- Start of cycle, start of experiment, or continuous adjustment?
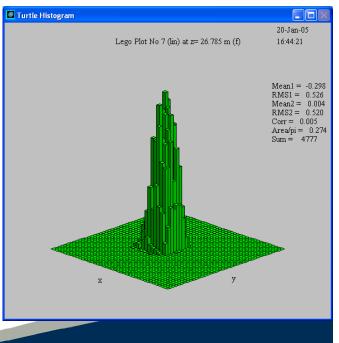- Automatic procedure?

Hardware

- Automatic control and monitoring of beam magnet currents, separator and kicker voltages

- Remote operation of slits, profile monitors and cameras

- Remotely adjustable degraders

Beam modelling

- Tracking charged particles through quadrupoles/dipoles
- Matrix methods (TRANSPORT)
- Ray tracing
  - TURTLE (sequential)
  - GEANT4 (full 3D)
- Model "imperfect" beam?

Experiment simulation

- Track muons into sample
  - Background fraction (sample holder, windows)
- Track positrons out of sample to detectors
  - Degrading effect of sample itself, holder, cryostat
  - Double count fractions
- Predict a_0 and α and correct for applied magnetic fields
- Can a real experiment be modelled accurately enough?
  - Empirical model

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Recording beam settings

- Standard format (NeXuS)
- Magnet settings (amps), separator (kV)
- Magnet readback log?
- Main geometry and layout (to reproduce TRANSPORT file)?
- Full design of beam (windows, slits, reproduce GEANT4 model)?
- Log signals from slits, profile monitors, proton beam current, etc?