Testbeam Measurements for the Mu3e Experiment

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The Mu3e experiment searches for the lepton flavor changing decay $\mu \rightarrow eee$ aiming for a sensitivity of $1 \times 10^{-14}$ decays, four orders of magnitude better than previous searches by the SINDRUM experiment. This sensitivity is achieved by a novel experimental design based on silicon pixel detectors and scintillating fibers and tiles. The principal component of the experiment is a high precision tracking detector based on thin high voltage monolithic active pixel sensors (HV-MAPS) optimized for the low momentum decay electrons. We present results from testbeam measurements with the MuPix4 HV-MAPS prototype performed in October 2013 at DESY using a 1-6 GeV electron beam.

1) arXiv:1301.6113 [physics.ins-det]

### Abstract
- High rates
- Excellent momentum resolution
- Great vertex resolution
- Good timing resolution
- Extremely low material budget

### Requirements
- Single vertex
- Coincident
- Vanishing total momentum

### Backgrounds
- Internal Conversion
- Coincident
- Combinatorial
- Not coincident

### Testbeam Results
- First working prototype
- High efficiency ~ 99% almost everywhere
- Small non-uniformity due to non-optimal tuning

### MuPix4 Prototype
- 40x32 pixels
- 92x80 $\mu$m pixel size
- Binary readout
- Global threshold
- Additional per-pixel tune-DACs
- Developed by Ivan Peric, ZITI Mannheim

### Expected Performance in Phase 2 (simulated)
- Single Track
- Momentum Resolution
- Signal Decay
- Mass Resolution
- RMS: 0.52 MeV/c
- $\sigma_{1}: 0.31$ MeV/c
- $\sigma_{2}: 0.71$ MeV/c
- $\sigma_{3}: 0.37$ MeV/c

### Magnet & Cooling
- Solenoid Magnet ~ 1T
- Cooling using gaseous Helium

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