AMS-02 Tracker Performance

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- Introduction
- Test Beam setups
- Spatial Resolution
- Identification Capabilities
- Summary & Conclusions
Introduction

- AMS-02 is a magnetic spectrometer → See talk from S. Gentile (OG 1.5-10)
- The core of the spectrometer is composed by:
  - Superconducting magnet (0.87 T) → See talk from B. Blau (OG 1.5-12)
  - Silicon tracker → This talk and poster 2-P-297

- 8 layers arranged in 5 planes.
  - 2 external layers (2 planes) on top and bottom the magnet
  - 6 internal layers (3 planes) inside the magnet
- 192 elements called *ladders*
What’s a ladder?

- 7-15 double sided silicon sensors (300 $\mu m$ width)
  - S-side = p-side
  - K-side = n-side
- 8200-16500 microbonds per ladder
- Sensor relative position known better than 4$\mu m$

<table>
<thead>
<tr>
<th>Pitch</th>
<th>p-side</th>
<th>n-side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implantation</td>
<td>27.5$\mu m$</td>
<td>104$\mu m$</td>
</tr>
<tr>
<td>Readout</td>
<td>110$\mu m$</td>
<td>208$\mu m$</td>
</tr>
</tbody>
</table>
Plane structure

- Carbon fiber and aluminum honeycomb sandwich
- Same planes used for AMS-01
  - Inner planes modified to attach ladders on both sides
  - Bags for laser diodes on external planes.
- Layers 2 and 3 ready to be installed on Plane 2

<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
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<tbody>
<tr>
<td>L1</td>
<td>L2</td>
<td>L3</td>
<td>L4</td>
<td>L5</td>
<td>L6</td>
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<tr>
<td>30</td>
<td>24</td>
<td>22</td>
<td>20</td>
<td>22</td>
<td>24</td>
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Measurements

- Together with the magnet will allow 3D reconstruction of particle trajectories.
  - Two position measurements per hit.
  - Measurement of the momentum
  - Measurement of the sign of the charge
- Each hit in a sensor will provide two measurements of the energy deposition.
  - Determination of particle charge.

- Possibility to measure converted photons (MC studies)
  - 1 GeV-400 GeV. Limited by double track resolution
  - Energy resolution modest (bremsstrahlung)
  - $0.6^\circ @ 1 \text{ GeV} - 0.12 \text{ mrad} @ 300 \text{ GeV}$
- Method tested in AMS-01. Limited by rate and geometry.
Test Beam setups

120 GeV muons SPS (CERN)

$\mu @ 120 \text{ GeV}$

scin \hspace{1cm} x \hspace{1cm} y \hspace{1cm} x \hspace{1cm} y \hspace{1cm} xy \hspace{1cm} x \hspace{1cm} y \hspace{1cm} x \hspace{1cm} y \hspace{1cm} scin

20 GeV/u Pb+Be SPS (CERN)

Pb \hspace{1cm} 20 \text{ GeV/u} \hspace{1cm} Be

Fragments

Dipole

A/Z=ct

Tracker 6 planes

Scin

RICH

TOF

AMS-02 Tracker Performance
Spatial Resolution

- Precise alignment performed prior to compute residuals
- S/N ratios $\sim 10$ for both sides

<table>
<thead>
<tr>
<th>Particle</th>
<th>p-side</th>
<th>n-side</th>
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<tbody>
<tr>
<td>$\mu$ 120 GeV</td>
<td>8.5(\mu)m</td>
<td>29.5(\mu)m</td>
</tr>
<tr>
<td>$p$ 20 GeV</td>
<td>11.6(\mu)m</td>
<td>29.2(\mu)m</td>
</tr>
<tr>
<td>$He$ 20 GeV/A</td>
<td>7.1(\mu)m</td>
<td>22.1(\mu)m</td>
</tr>
</tbody>
</table>
Identification Capabilities

- Each plane provides two measurements of energy deposition
- 6 planes in test beam (8 planes in AMS-02)
- Up to $Z=10$ if only one side used
- Up to $Z=13$ combining informations from both sides.
Conclusions

• A Silicon Tracker composed by 192 ladders with 6.4 m² is being constructed.
• The detector has been tested in two test beams at the CERN SPS with MIPS and heavy ions
• Spatial resolution of 8.5 $\mu$m on p-side and 30$\mu$m on n-side have been obtained
• Allow to identify up to Z=13 (Z=10 using only one side)
• New tests foreseen during 2003 and 2004.
  • 10 GeV $p$ @ PS (CERN). June 2003
  • 20 GeV/u In @ SPS (CERN). October 2003
  • 800 MeV/u C @ FRS (GSI). November 2003
  • Electron or photon beam. 2004.