

Muon HIP Alignment Constants Sign-Off

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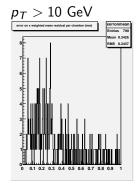


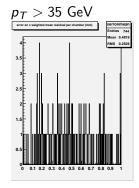
- ▶ Claim before going into the exercise: 10 pb⁻¹ is just beginning to be enough data for a good track-based alignment
- \triangleright Result: it's true, but with large QCD μ statistics, the procedure works better than expected
- Detector studies: observed dependence of residual width (per chamber) on p_T
- ▶ But figure of merit (stdev/ \sqrt{N}) is optimized for minimum p_T cut (high statistics is better than clean tracks)
- Great bug-finding exercise (I have a to-do list after the exercise)



- ▶ p_T cuts from 10 GeV to 35 GeV (10 GeV is best)
- ▶ Barrel $xyz\phi_x\phi_y\phi_z$ endcap $xy...\phi_y\phi_z$ and barrel $xy...\phi_z$ endcap $xy...\phi_z$ (best)
- Wheels and rings only and Chamber-by-chamber (best)
- $\blacktriangleright~\chi^2$ and DOF cuts on extrapolated tracker tracks (new)
- ► Event sample: MuonPT5

Figure of merit: $stdev/\sqrt{N}$ per chamber (data-only)



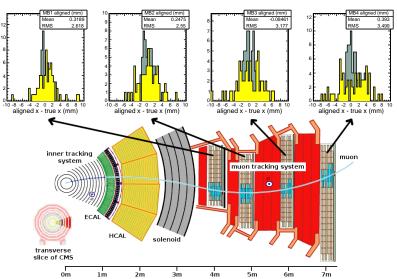


Barrel aligned positions

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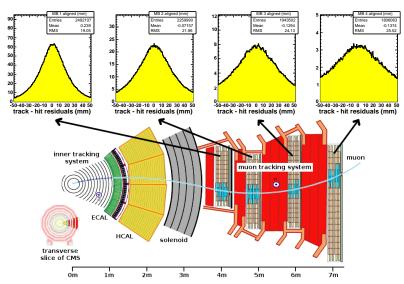


Barrel track residuals

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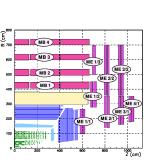
Barrel positions: x, y, ϕ_z 6/13 Jim Pivarski MB3 aligned (mm) Mean -0.08461 RMS 2.618 RMS RMS 3.177 3,499 -10 -8 -6 -4 -2 0 2 4 6 8 aligned x - true x (mm) -10 -8 -6 -4 -2 0 2 4 6 8 10 aligned x - true x (mm) -10 -8 -6 -4 -2 0 2 4 6 8 10 aligned x - true x (mm) -10 -8 -6 -4 -2 0 2 4 6 8 aligned x - true x (mm) MB1 aligned (mm) MB2 aligned (mm) MB3 aligned (mm) MB4 aligned (mm) 0.5885 -0.06876 -1.852 RMS 2.534 RMS 3.024 RMS 3.274 RMS 2.297 -10 -8 -6 -4 -2 0 2 4 6 8 10 -10 -8 -6 -4 -2 0 2 4 6 8 10 -10 -8 -6 -4 -2 0 2 4 6 8 10 aligned y - true y (mm) MB1 aligned (mm) MB2 aligned (mm) MB4 aligned (mm) MB3 aligned (mm) 0.2739 -0.4196 -0.2409 RMS 2.362 RMS 1.634 RMS 1.925 RMS 2.939 -10 -8 -6 -4 -2 0 2 4 6 8 aligned ϕ - true ϕ (mrad) -10 -8 -6 -4 -2 0 2 4 6 8 1 aligned \(\phi \) - true \(\phi \) (mrad) -10 -8 -6 -4 -2 0 2 4 6 8 1 aligned \(\phi \) - true \(\phi \) (mrad) -10 -8 -6 -4 -2 0 2 4 6 8 1 aligned \(\phi \) - true \(\phi \) (mrad)

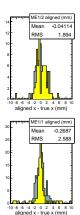
Endcap aligned positions

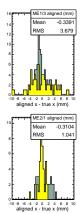
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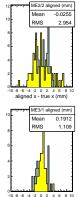




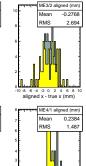








aligned x - true x (mm)



-10 -8 -6 -4 -2 0 2 4 6 8 10

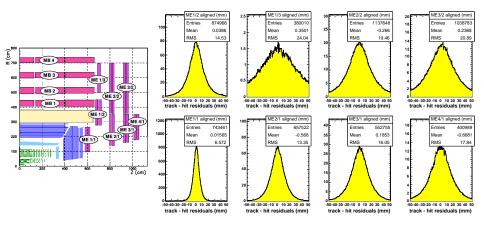
aligned x - true x (mm)

Endcap track residuals

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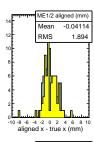


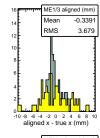
Endcap positions: y

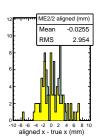
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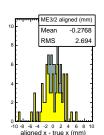


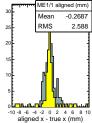


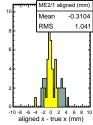


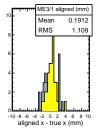


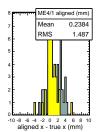








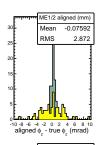


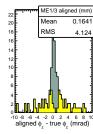


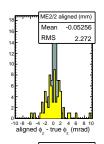
Endcap positions: ϕ_z

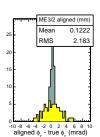
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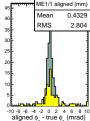


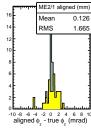


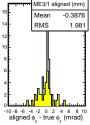


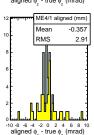














- ▶ We have a tool for selecting aligned chambers by hand: I would have selected MB1, ME1/1, ME1/2, ME2/1, ME2/2, ME3/1
- Discovered a bug in handling of angles, so we didn't use it

Software to-do list

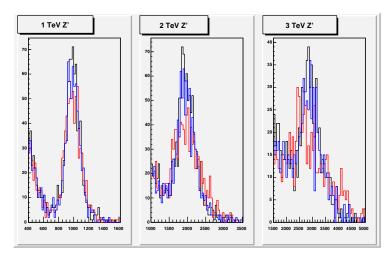
- Fix geometry-merging tool
- ▶ Implement selection: take only chambers with stdev/ \sqrt{N} < 1 mm
- ▶ Make tracker χ^2 and DOF cuts formal (selection module)
- ▶ APE of hits is $\sqrt{2}$ larger than what is applied in configuration file!
- Update monitoring plots in CVS

Global Muon reconstruction: Z' Jim Pivarski 12/13





- initial constants
- ► HIP tracks-only alignment
- ► MillePede-survey in barrel, HIP in endcap





Use MillePede-survey for the barrel, tracks-only for the endcap

- endcap alignment (especially inner ring) is better than barrel because of statistics
- \triangleright if we only had 1 pb⁻¹ of real data, we would rely heavily on survey information (Muon0invPbScenario = Muon1invPbScenario)

On the other hand...

- \triangleright it means we worsen the resolution relative to 0 pb⁻¹ scenario
- ▶ the MillePede-survey result is effectively a scenario like the 0 pb^{-1} scenario, but with updated constants

Conclusions

Nevertheless, a very useful exercise, and we'll be using these event samples for more detector studies!

MillePede-survey: x, y, ϕ_z 14/13 Jim Pivarski MB3 aligned (mm) Mean -0.008662 MB1 aligned (mm) Mean 0.08584 -0.0005159 1.138 RMS 1.011 -3 -2 -1 0 1 2 3 aligned x - true x (mm) -3 -2 -1 0 1 2 3 -3 -2 -1 0 1 2 3 aligned x - true x (mm) -3 -2 -1 0 1 2 aligned x - true x (mm) aligned x - true x (mm) MB1 aligned (mm) MB2 aligned (mm) MB3 aligned (mm) MB4 aligned (mm) -0.4419 0.08837 0.09274 0.04819 RMS 1.235 RMS 0.6645 0.5945 0.6329 -3 -2 -1 0 1 2 3 -2 -1 0 1 2 3 4 -3 -2 -1 0 1 2 3 -3 -2 -1 0 1 2 3 aligned y - true y (mm) MB1 aligned (mm) MB2 aligned (mm) MB4 aligned (mm) MB3 aligned (mm) -0.04716 0.004795 -0.06213 RMS 0.4728 RMS 0.5757 0.5016

-2 -1.5 -1 -0.5 0 0.5 1 1.5 2 aligned \(\phi \) - true \(\phi \) (mrad) -2 -1.5 -1 -0.5 0 0.5 1 1.5 aligned φ - true φ (mrad)

2 -1.5 -1 -0.5 0 0.5 1 1.5 aligned φ - true φ (mrad)

2 -1.5 -1 -0.5 0 0.5 1 1.5 aligned ϕ - true ϕ (mrad)

MillePede-survey residuals

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