

Impact of wrong matching on tracking efficiencies

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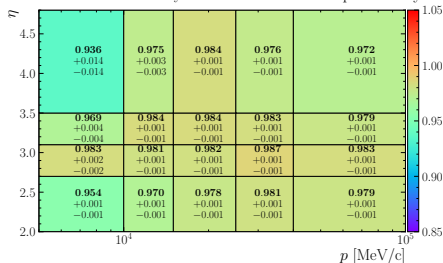
Current work:

- Study discrepancy between Combined and MuonUT methods
 - Discrepancies up to 2%, mostly at low p and low η
 - Effect present in data and MC, but much worse in data
 - Not fully cancelled in the data/MC ratio
- Currently looking into how wrong long track matching affects the tracking efficiencies in MC
 - Get an understanding of MC discrepancies, which may help us understand the discrepancies in data

Block 5 tracking efficiencies

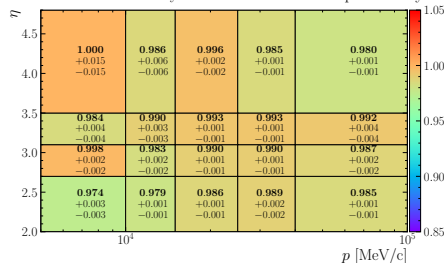
Combined method efficiency MC

LHCb preliminary



MuonUT method efficiency MC

LHCb preliminary



- Effect is worse in data
- Does not seem to cancel in data/MC ratio

Current work: Try to understand why this discrepancy exists in MC, and whether or not it could explain some of the discrepancy in data

- Different kinematics?
 - Finer bins still show discrepancies
- MuonUT charge asymmetry bug?
 - Fits split by charge consistent with charge integrated results
- Bad fit model or counting bias?
 - Truth matched MC still shows discrepancies
- Problem must be somewhere further upstream...
 - ... so I looked into how the matching is performed

Checks performed

Matching is performed by compared hits in each subdetector

Method	Velo	UT	SciFi	Muon
VeloMuon	0.4	–	–	0.4
Downstream	–	–	0.4	0.4
MuonUT	–	–	–	0.4

- Probe track is perhaps matched to a random long track
- Especially for MuonUT, which only has 4 hits in the Muon system, this effect should be checked
- Strategy: Copy Rowina's AP on MC and add long track truth info
 - Compare TRUEKEY between probe track and long track
- Only one file available on the AP, sufficient for preliminary checks
 - AP still running

Tracking efficiencies on truth matched yields

Calculate tracking efficiencies on truth matched yields (no fitting)

Method	Charge	$N_{\text{pass}} (\times 10^4)$	$N_{\text{fail}} (\times 10^4)$	ϵ
VeloMuon	μ^+	9.144 ± 0.030	0.265 ± 0.005	0.9719 ± 0.0005
Downstream	μ^+	6.426 ± 0.025	0.0420 ± 0.0020	0.99351 ± 0.00032
Combined	μ^+	—	—	0.9656 ± 0.0006
MuonUT	μ^+	1.617 ± 0.013	0.0304 ± 0.0017	0.9815 ± 0.0010
VeloMuon	μ^-	9.187 ± 0.030	0.269 ± 0.005	0.9715 ± 0.0005
Downstream	μ^-	6.426 ± 0.025	0.0471 ± 0.0022	0.99272 ± 0.00033
Combined	μ^-	—	—	0.9644 ± 0.0006
MuonUT	μ^-	1.490 ± 0.012	0.0282 ± 0.0017	0.9814 ± 0.0011

Fraction of wrongly matched tracks

How often is the matched long track wrong?

Method	Charge	N_{pass}	$N_{\text{pass}}^{\text{wrong}}$	Correction
VeloMuon	μ^+	91438 ± 302	67 ± 8	0.99927 ± 0.00009
Downstream	μ^+	64251 ± 253	1569 ± 40	0.9756 ± 0.0006
MuonUT	μ^+	16169 ± 127	670 ± 26	0.9586 ± 0.0016
VeloMuon	μ^-	91868 ± 303	89 ± 9	0.99903 ± 0.00010
Downstream	μ^-	64247 ± 253	1428 ± 38	0.9778 ± 0.0006
MuonUT	μ^-	14901 ± 122	533 ± 23	0.9642 ± 0.0015

Correction factor: $(N_{\text{pass}} - N_{\text{pass}}^{\text{wrong}})/N_{\text{pass}}$

Corrected tracking efficiencies on truth matched yields

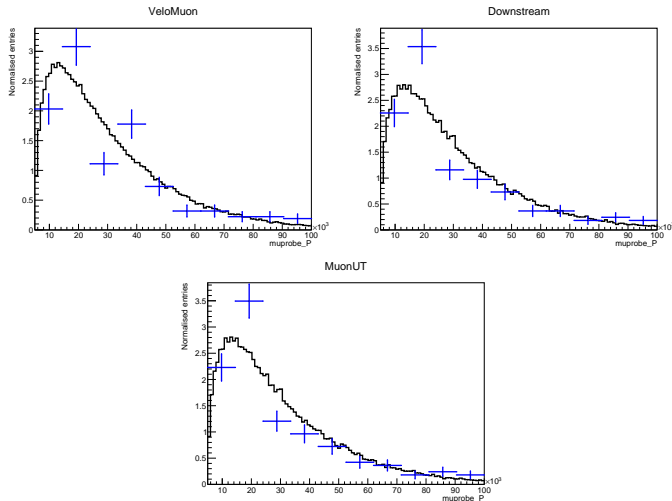
Multiply tracking efficiencies with correction factors

Method	Charge	ϵ
VeloMuon	μ^+	0.9712 ± 0.0005
Downstream	μ^+	0.9692 ± 0.0007
Combined	μ^+	0.9413 ± 0.0008
MuonUT	μ^+	0.9409 ± 0.0018
VeloMuon	μ^-	0.9706 ± 0.0005
Downstream	μ^-	0.9707 ± 0.0007
Combined	μ^-	0.9421 ± 0.0008
MuonUT	μ^-	0.9463 ± 0.0018
Combined	μ^\pm	0.9417 ± 0.0006
MuonUT	μ^\pm	0.9436 ± 0.0013

Wrong matching kinematic dependence

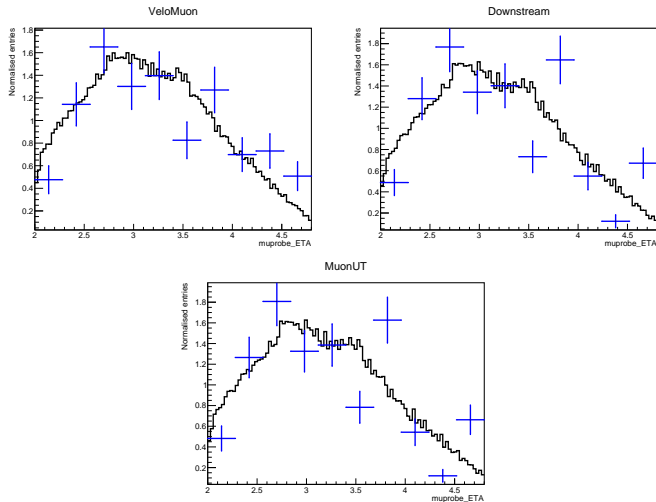
- I also checked in p and η bins, but didn't have time to make plots
- Still see discrepancies within each bin, so I still need to understand what's going on...

Wrong matching kinematic dependence



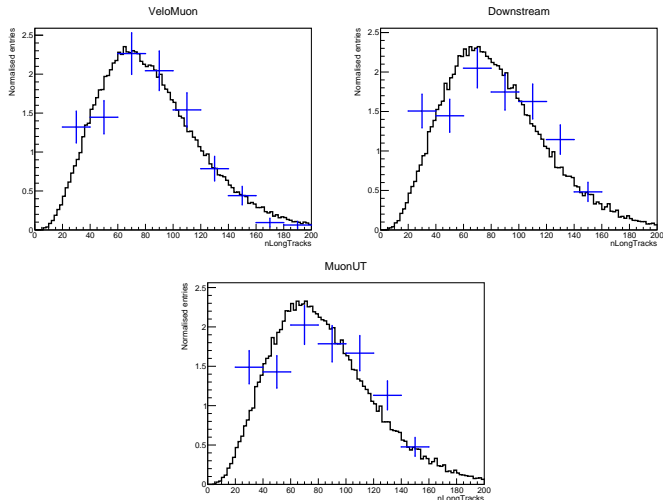
- No clear kinematic dependence with current statistics...
- Correctly matched in black, wrongly matched in blue

Wrong matching kinematic dependence



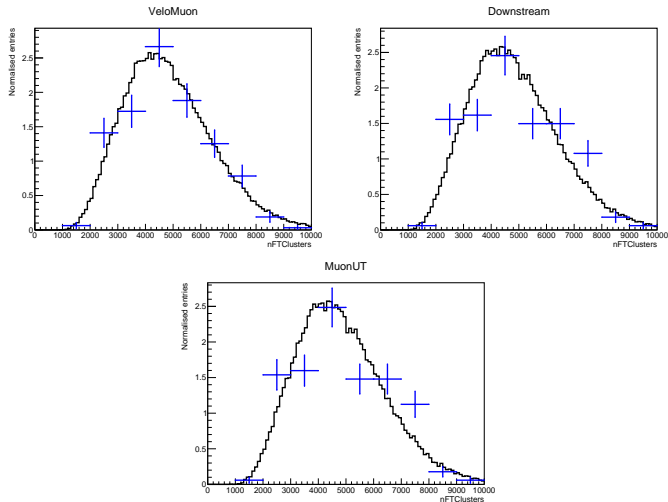
- No clear kinematic dependence with current statistics...
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Wrong matching kinematic dependence



- No clear kinematic dependence with current statistics...
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Wrong matching kinematic dependence



- No clear kinematic dependence with current statistics...
- Correctly matched in black, wrongly matched in blue

Summary and next steps

- Matching to the wrong long track occurs more often with MuonUT method, potentially leading to biased tracking efficiencies
- After correcting for this using MC truth information, discrepancy seems to be gone
- No clear kinematics dependence, but waiting for more statistics
 - AP with more MC is currently running
- Next steps:
 - 1 Figure out if there is any other kinematic dependencies
 - 2 Understand if this effect cancels in the data/MC ratio?

Thanks for listening!