He B1236 Monte Carlo truth studies

Analysis meeting 22.04.2024

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Applied selection:

IsPhysicsTrigger

TOF: Nº beta clusters = 4

TOF: $X^2_{coo} < 4$

TRK: Nº of track ≥ 1

TRK: $q_{inner} \epsilon$ [1.7, 2.4]

TRK: $q_{L1} \epsilon$ [1.6, 3.0]

TRK: L1 && L2 && (L3||L4) && (L5||L6) && (L7||L9)

TRK: X^2_{inner}(GBL) ≤ 10

TOF: $q^{upper\text{-}tof} \epsilon$ [1.5, 3.0]

TOF: $q^{lower\text{-}tof} > 1.5$

IsPhysicsTrigger	20576755	0.4411
BetaPos(0)	20081487	0.4304
NTOFBetaClusters(4)	15820433	0.3391
BetaChi2Coo(4)	11517382	0.2469
NTrTrack(1)	11517382	0.2469
HasGBLFitInner	11500592	0.2465
ChargeInnerTrackerYJ(1.7,2.4)	10023099	0.2148
CheckFiducialInner	8626826	0.1849
ChargeLayer1(1.6,3)	7528113	0.1614
IsInsideL1Fiducial	7246890	0.1553
CheckTrackPattern(5)	3962189.0000	0.0849
Chi2Y_GBL_InnerOnly(10)	3803199.0000	0.0815
ChargeUpperTof(1.5,3)	3765870.0000	0.0807
ChargeLowerTof(1.5,30)	3737905	0.0801

Work strategy:

The goal:

Identify charge confusion sources (i.e. *large angle scattering*) using Monte Carlo truth.

Work strategy:

1. Use the tracks propagator in the AMS-02 magnetic field (extracted by P. Zuccon from gbatch).
2. Get the initial conditions for the propagator from the MC truth of primary at L2.
3. Follow the progression of the primary inside the inner tracker.
4. Compare the MC truth with the propagator output.
5. Primary are divided into two classes depending on the reconstructed rigidity with the inner tracker.

AMS propagator

GitLab repository: AMSTkProp

Initial conditions:

1. position (x_{in}, y_{in}, z_{in}).
2. direction (ϑ_{in}, φ_{in}).
3. particle charge.
4. particle rigidity.
5. particle mass.

Outputs:

1. position (x_{out}, y_{out}, z_{out}).
2. direction (ϑ_{out}, φ_{out}).

Given the initial conditions, the track is propagated up to a specified z coordinate.

Energy losses and **multiple scattering (MS) are not considered**.

MC truth and propagator output comparison

Primary true position and momentum can be retrieved **at each of the inner tracker layer**.

MC truth and propagator output can be confronted **as function of generated rigidity.**

The differences are expected to be small, thus the logarithm of the difference has been used (i.e. $\log_{10}(|Y^{prop} - Y^{true}|)$.

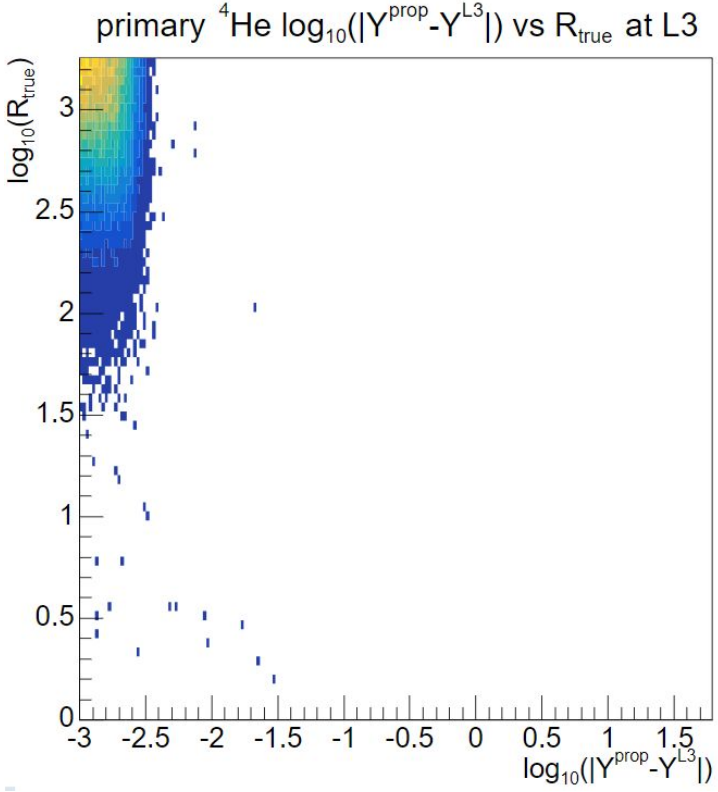
Primaries are divided in **two classes based on the inner reconstructed rigidity**:

charged confused events → $R_{inner} < 0$

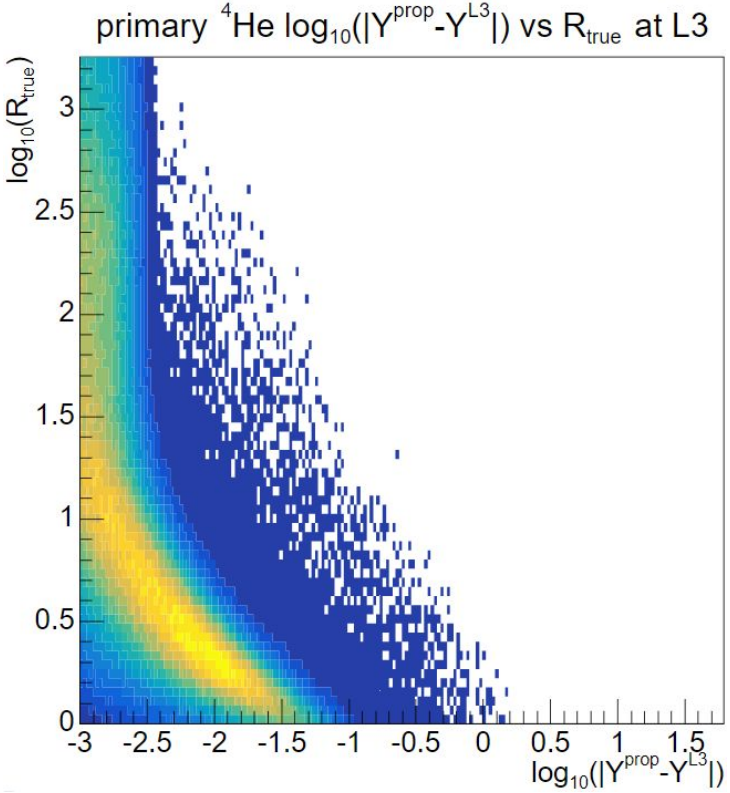
$R_{inner} > 0$ ← events with the correct charge sign

Y coordinate at L3

$R_{inner} < 0$

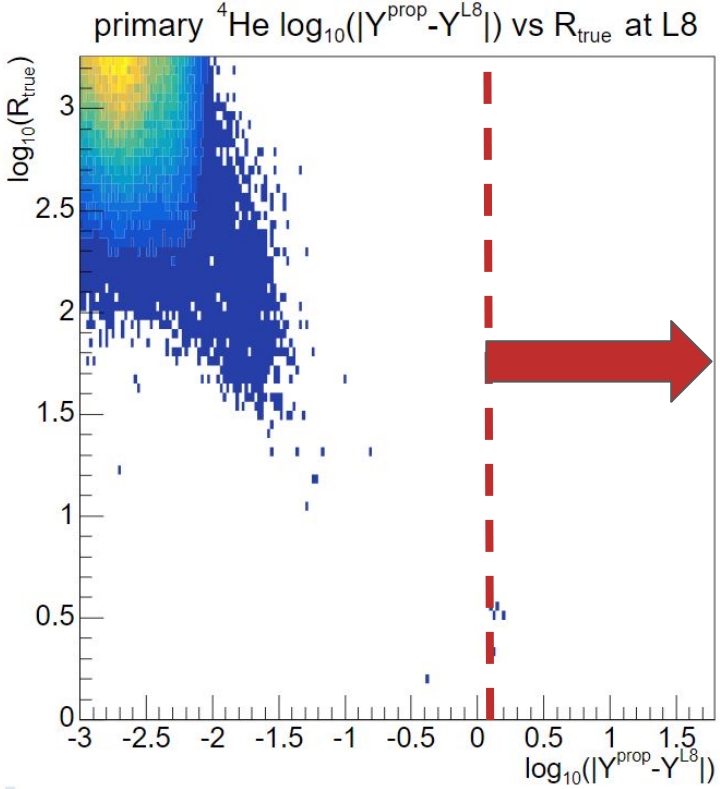


$R_{inner} > 0$

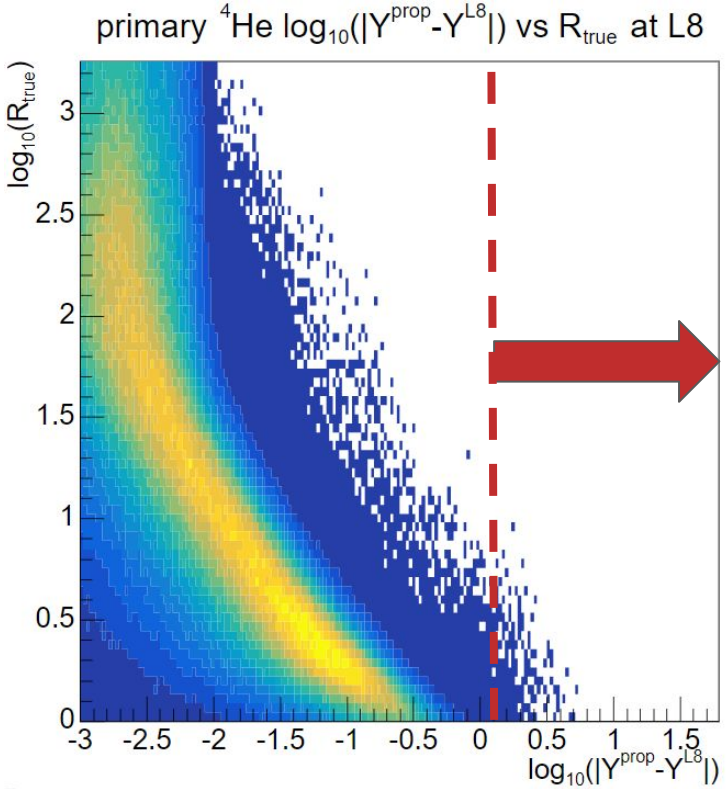


Y coordinate at L8

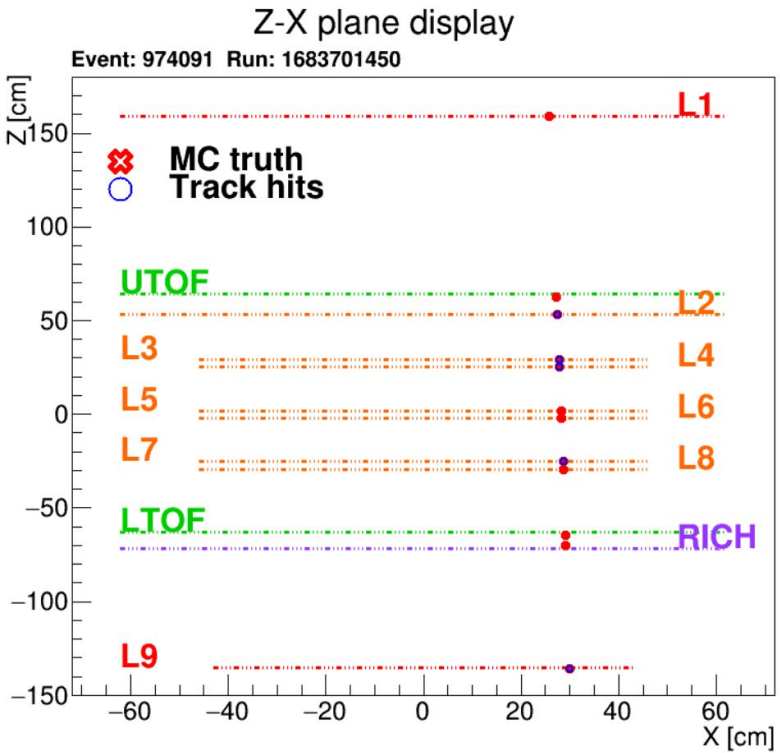
$R_{inner} < 0$

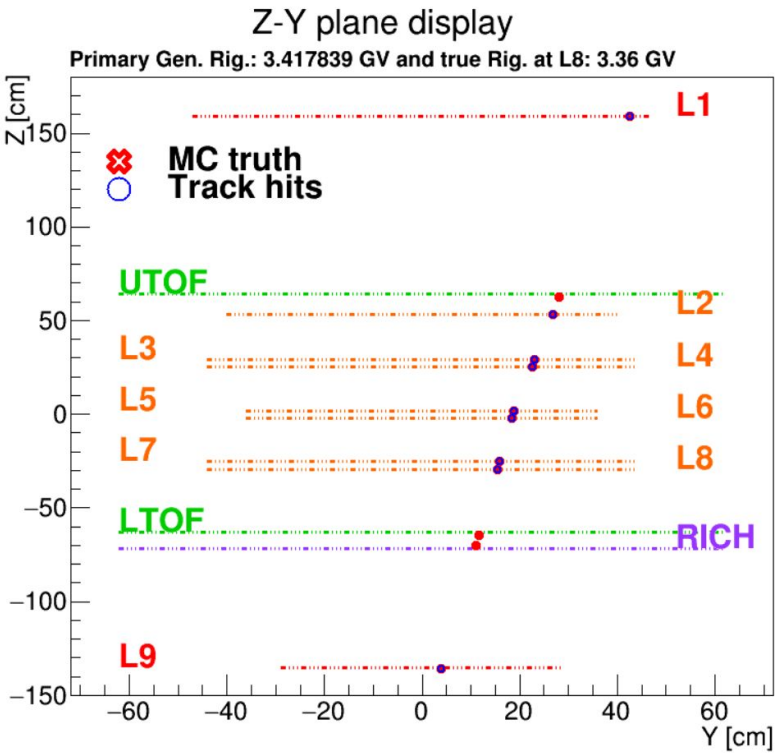


$R_{inner} > 0$



Simple event display for $R_{inner} < 0$ and $\log_{10}(|Y^{prop} - Y^{L8}|) > 0.1$





R_{true} = 3.41 GV

R^{rec}_{inner} = -0.622 GV

$R^{rec}_{inner-L1}$ = -0.638 GV

Next steps

1. Increase statistics and run over all the He B1236 ntuples.

2. Look directly at outliers events with an event display.

3. Propagate tracks with the wrong-reconstructed rigidity and evaluate residuals with MC truth and reconstructed track.

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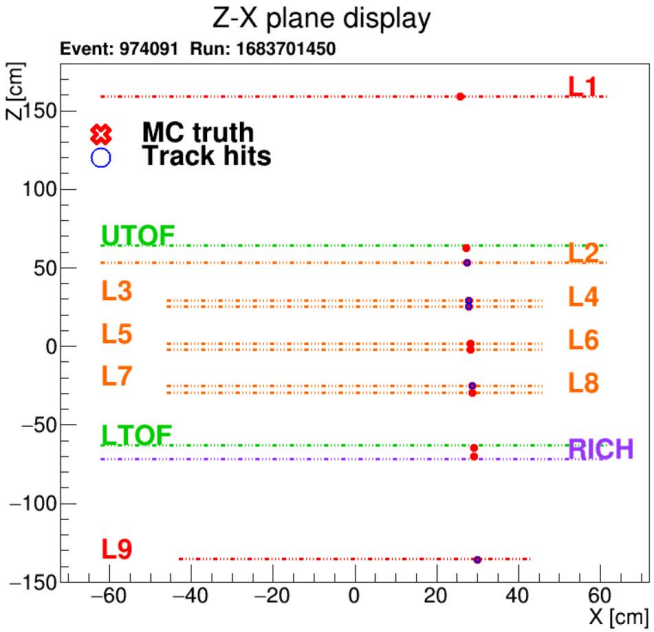
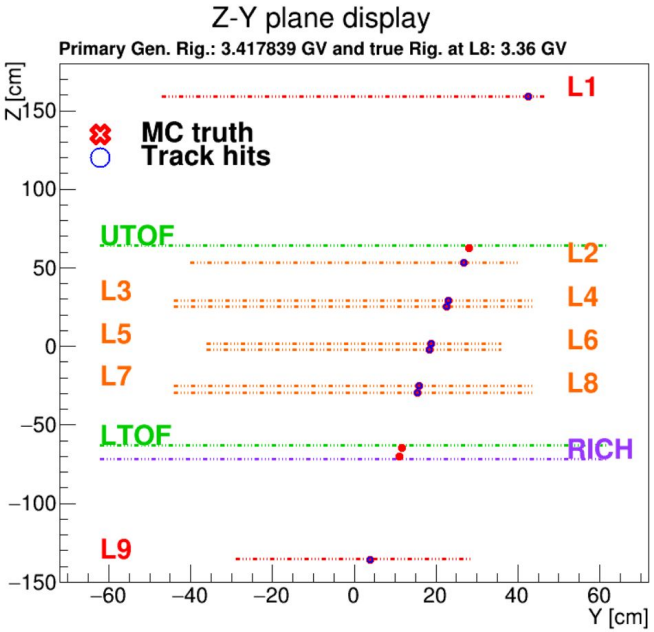
Thank you for your attention!

BACKUP

Simple event display for $R_{inner} < 0$ and $\log_{10}(|Y^{prop} - Y^{L8}|) > 0.1$






```
==========
L 1 Y difference : 0.007187
==========
L 2 X difference = 0.003010 Y difference = 0.001579
==========
L 3 X difference = 0.002443 Y difference = 0.014999
==========
L 4 X difference = 0.002666 Y difference = 0.014999
==========
L 5 Y difference : 0.006917
==========
L 6 Y difference : 0.001764
==========
L 7 X difference = 0.003975 Y difference = 0.011770
==========
L 8 Y difference : 0.011845
==========
L 9 X difference = 0.001219 Y difference = 0.013245
Reconstructed Inner Rigidity: -0.621743
Reconstructed Inner-L1 Rigidity: -0.638347
```

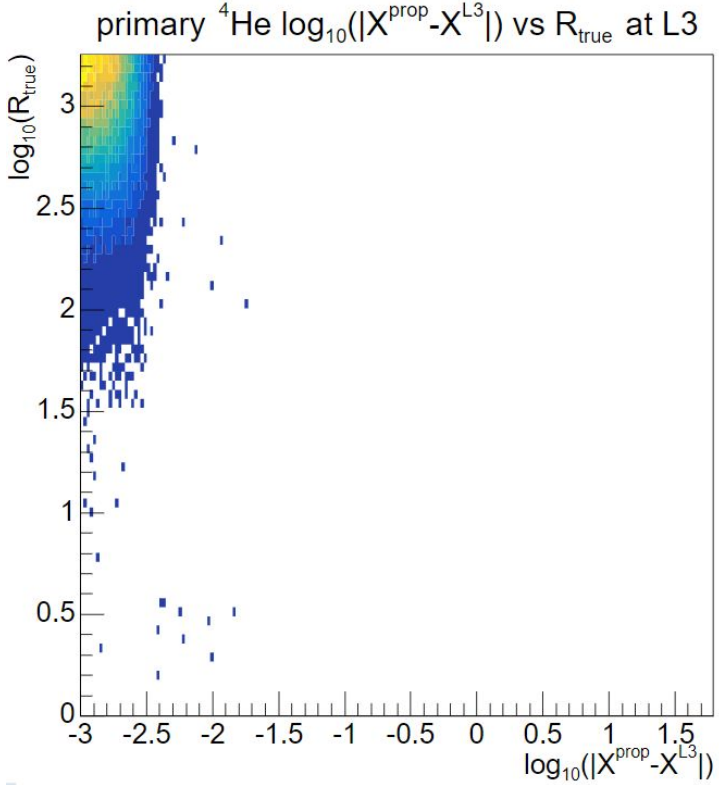
R_{true} = 3.41 GV

R^{rec}_{inner} = -0.622 GV

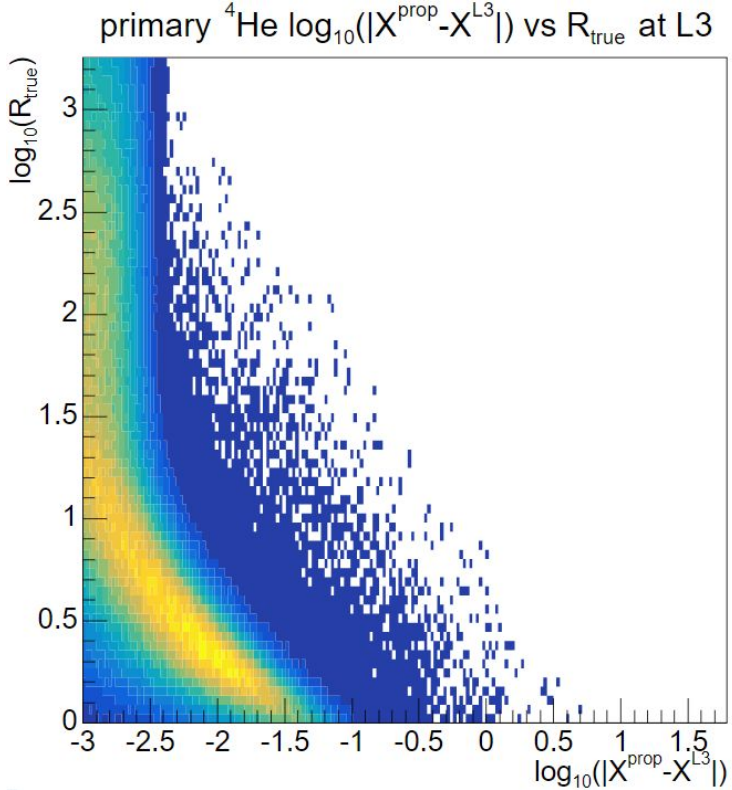
$R^{rec}_{inner-L1}$ = -0.638 GV

X coordinate at L3

$R_{inner} < 0$

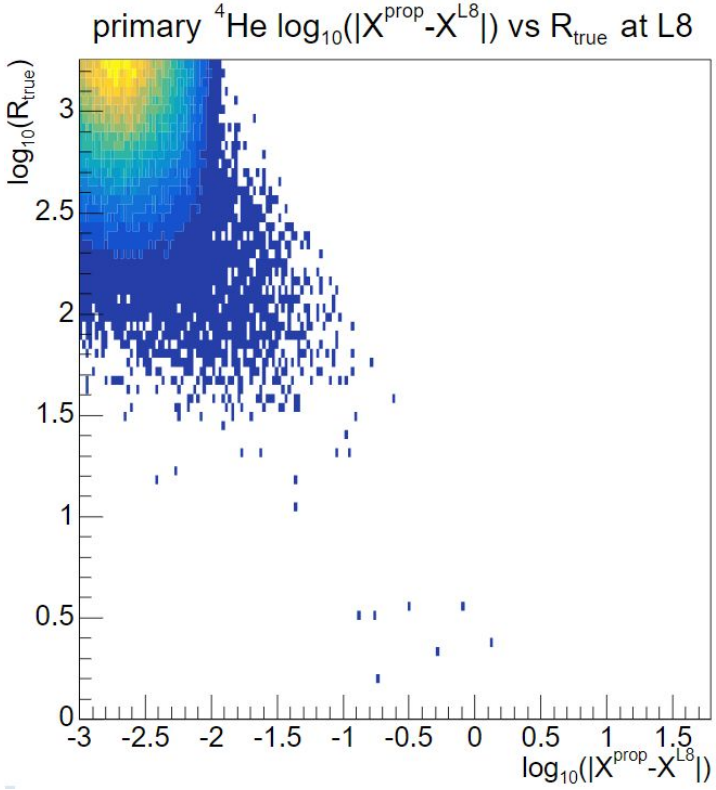


$R_{inner} > 0$



X coordinate at L8

$R_{inner} < 0$



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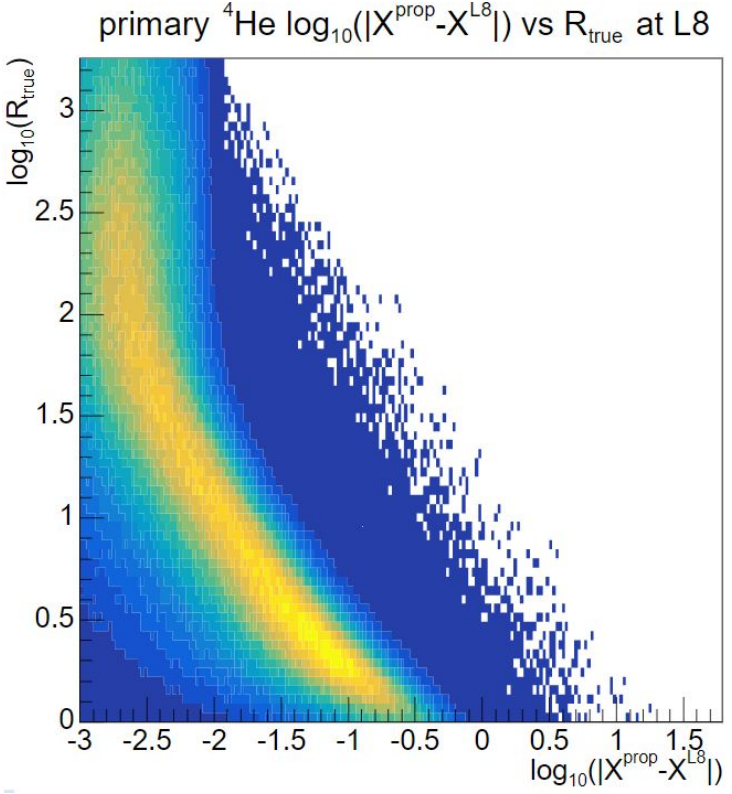
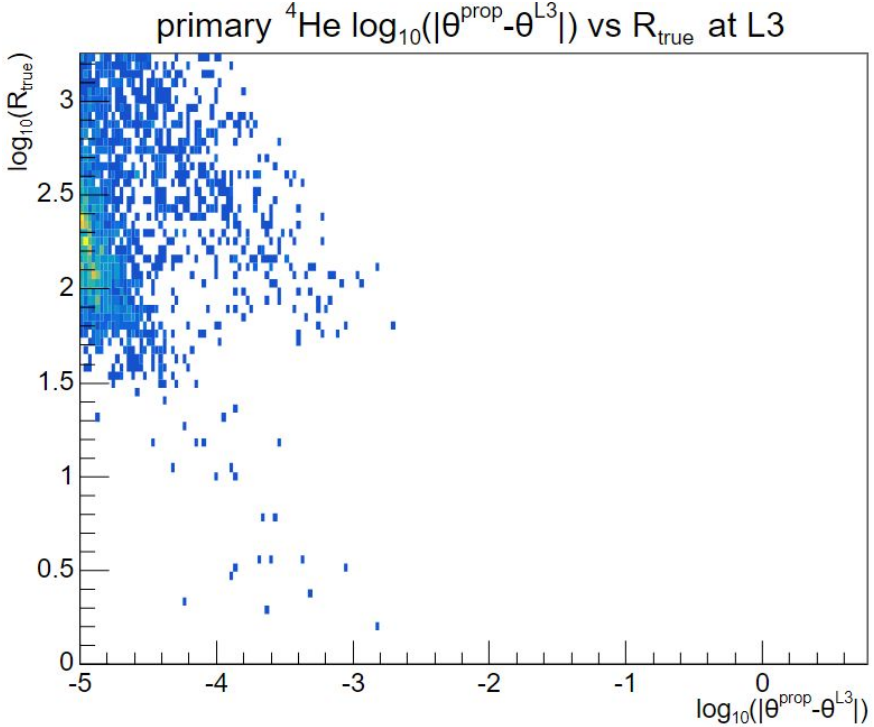


ϑ coordinate at L3

$R_{inner} < 0$



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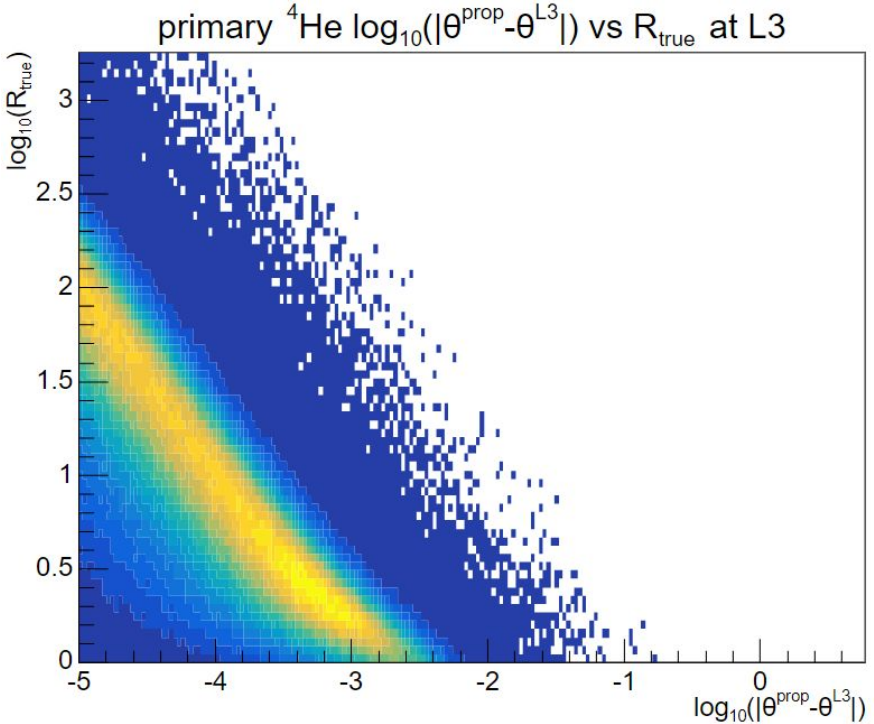

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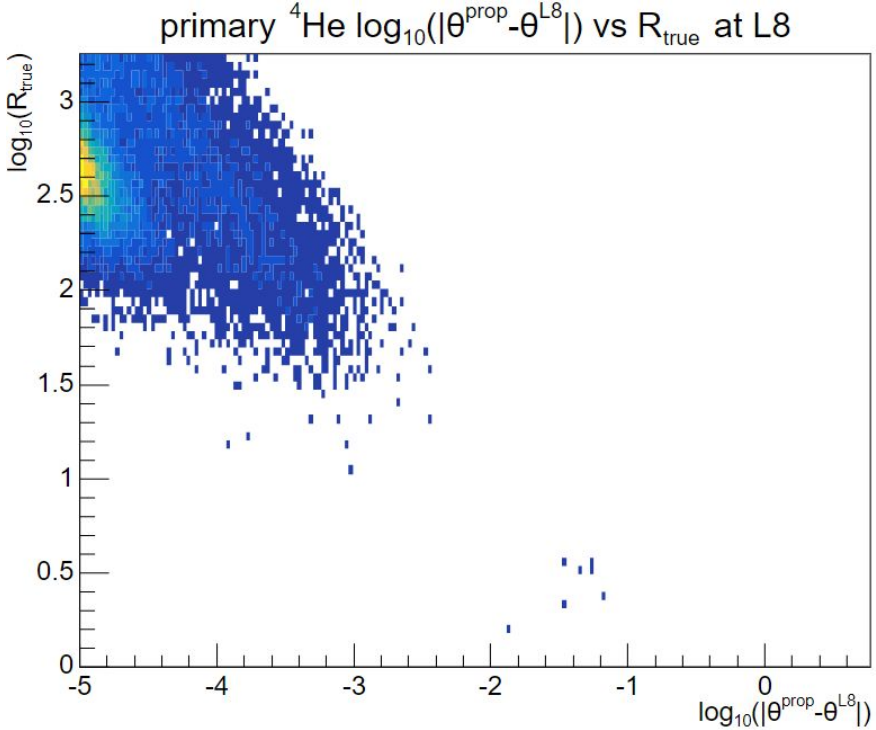

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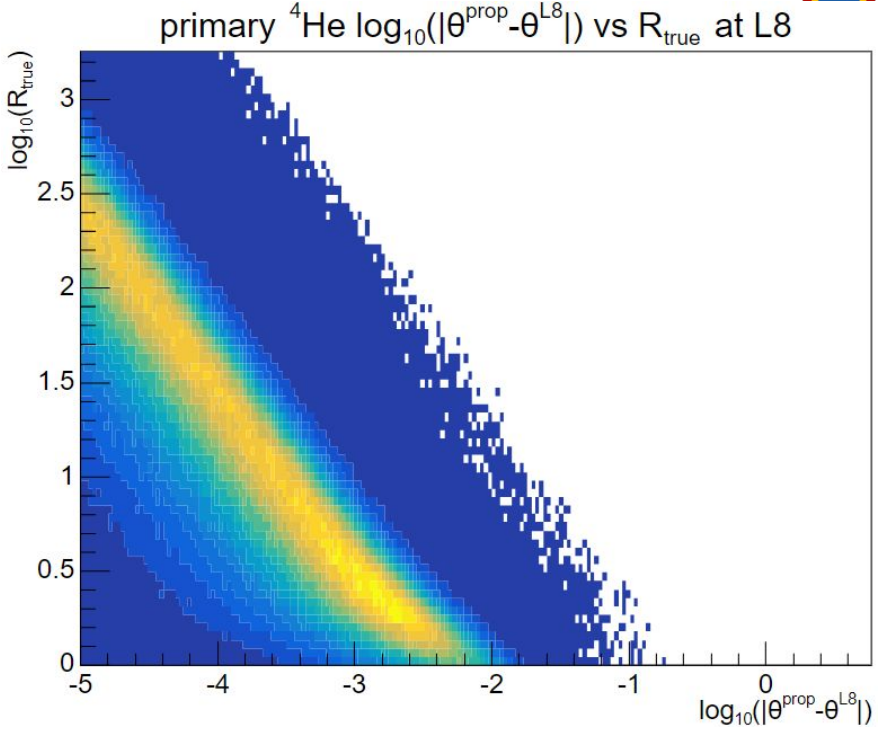
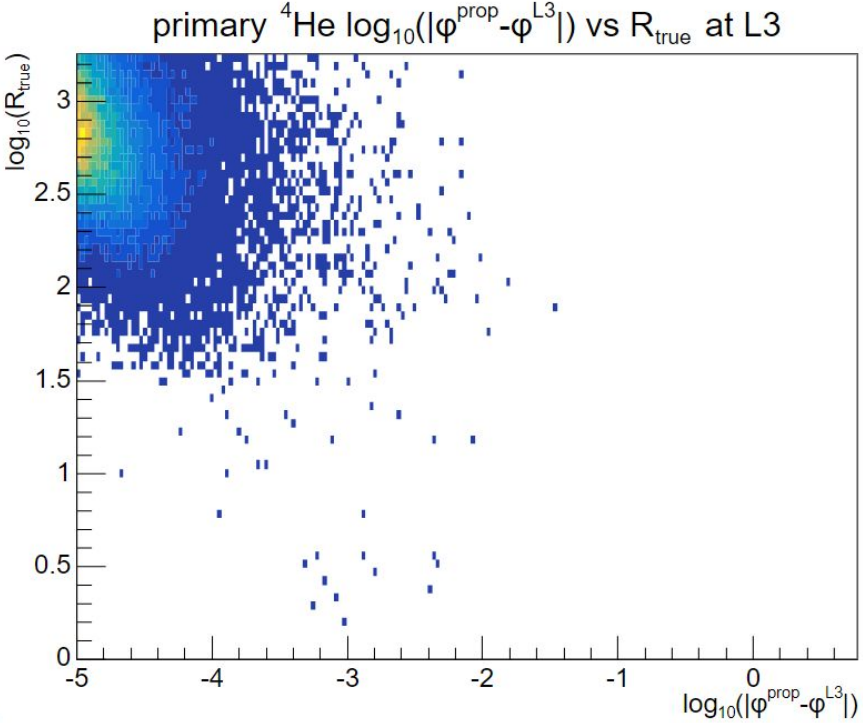


φ coordinate at L3

$R_{inner} < 0$



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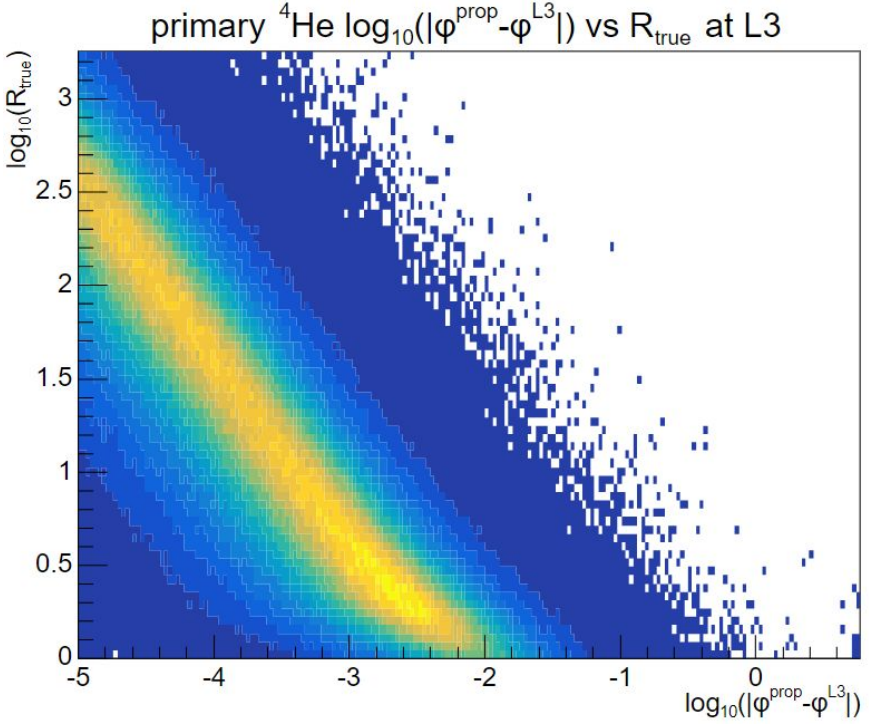

φ coordinate at L8

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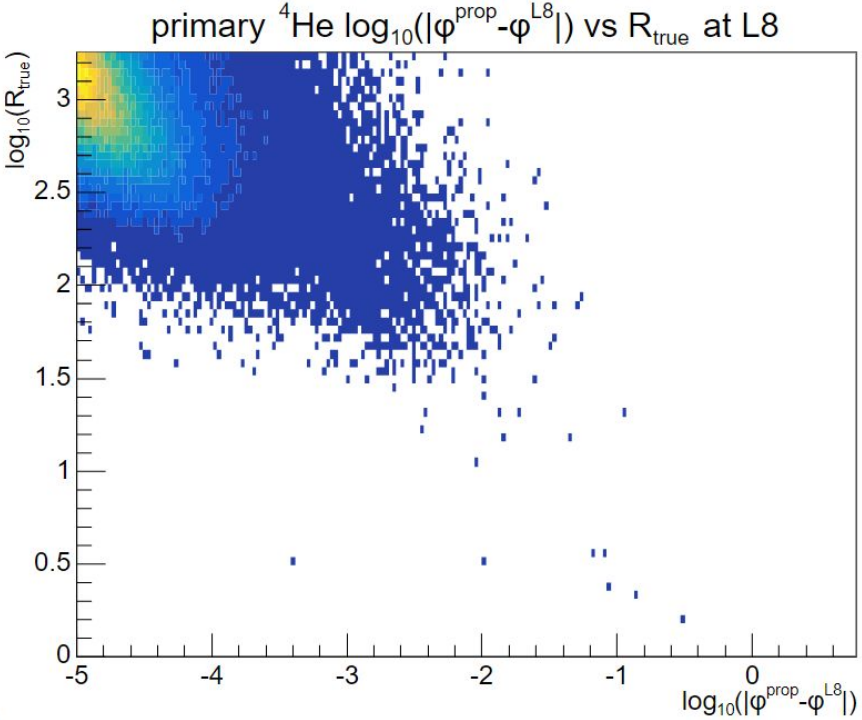
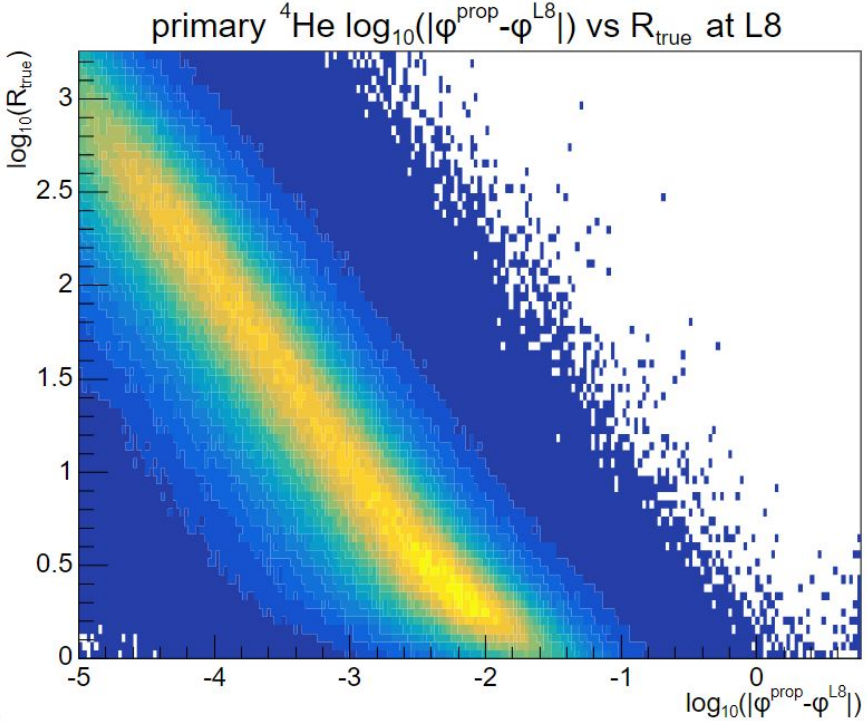
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