Optics Status Update

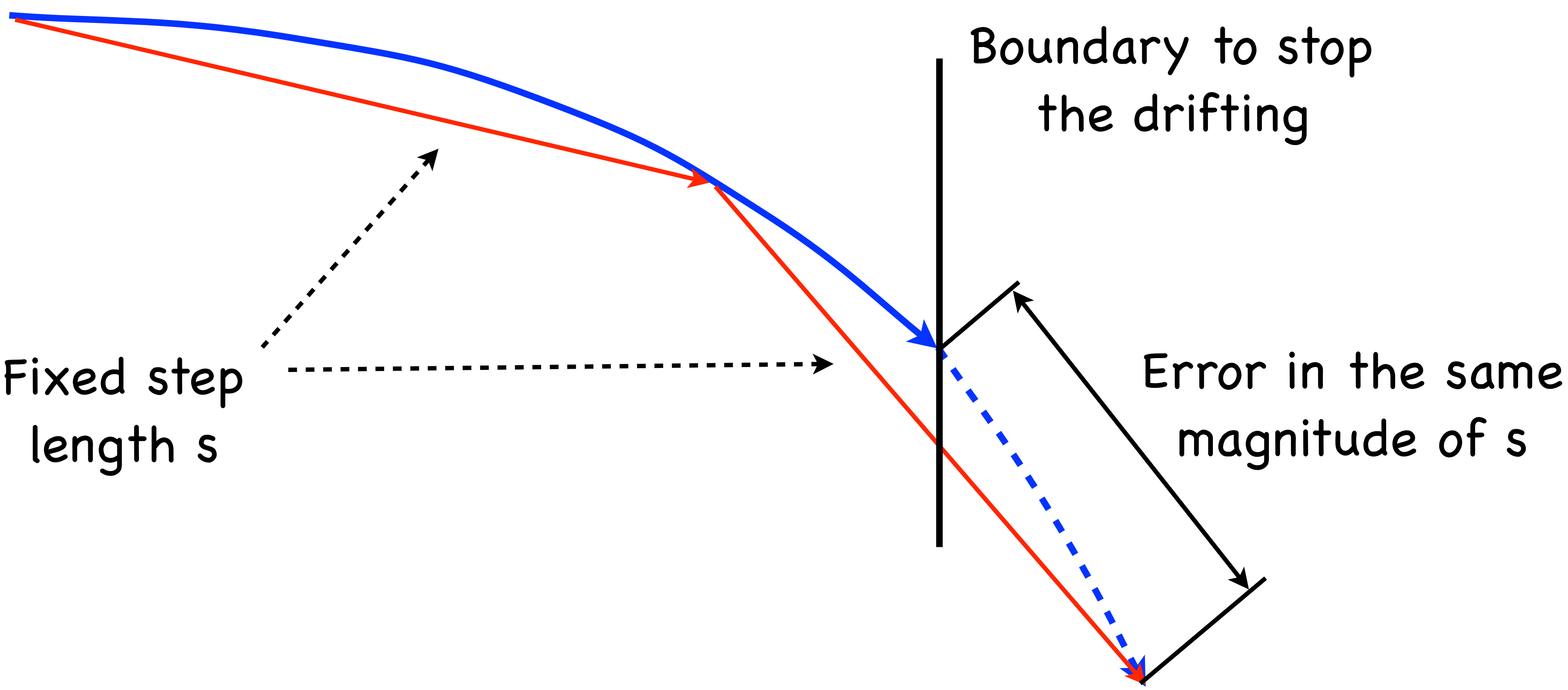
Chao Gu

Simulation Package

- Simulation package update
  - Change the algorithm of drifting electrons in magnetic field, ~95% faster
- Procedure of the simulation and some improvement
- First try to get the distribution weighted by cross section

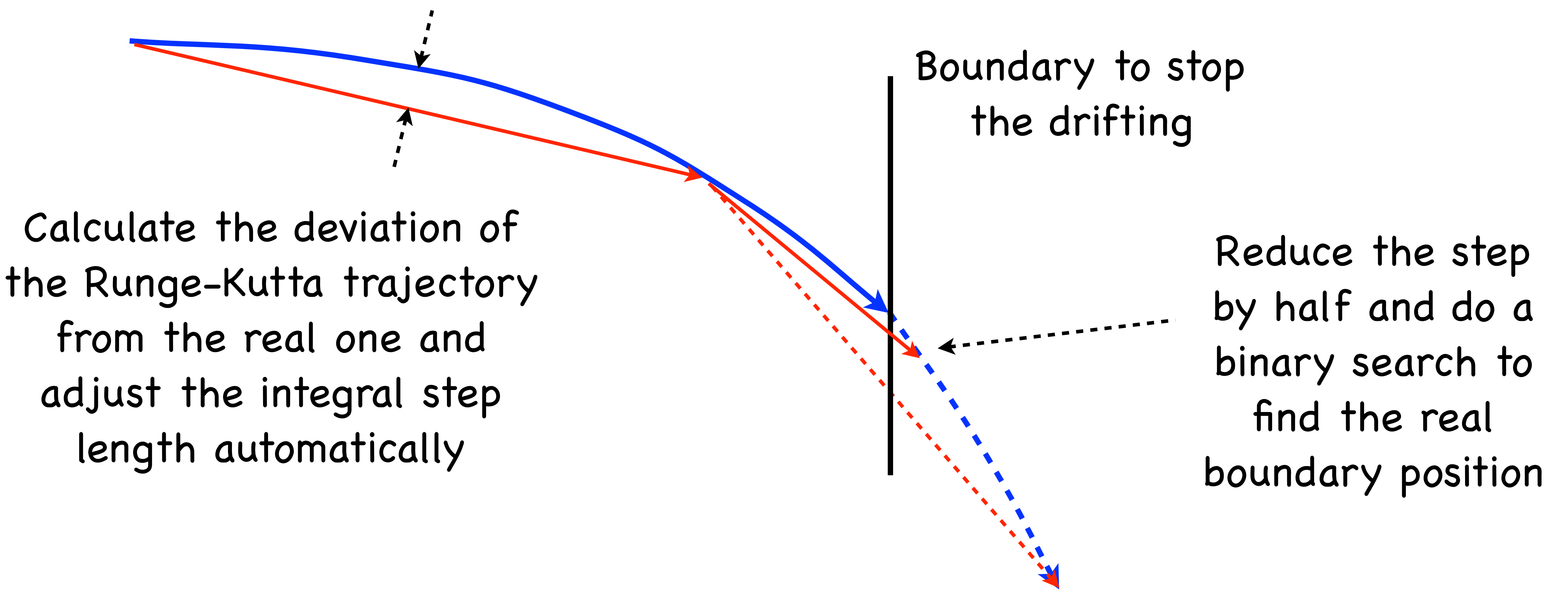
Simulation Package

- Drifting electrons in the target field
- Before: normal Runge-Kutta method
  - Problem: the last step may cross the boundary and this will dominate the error
  - To reduce error, set the integral step length to be very small (0.1mm) -> slow

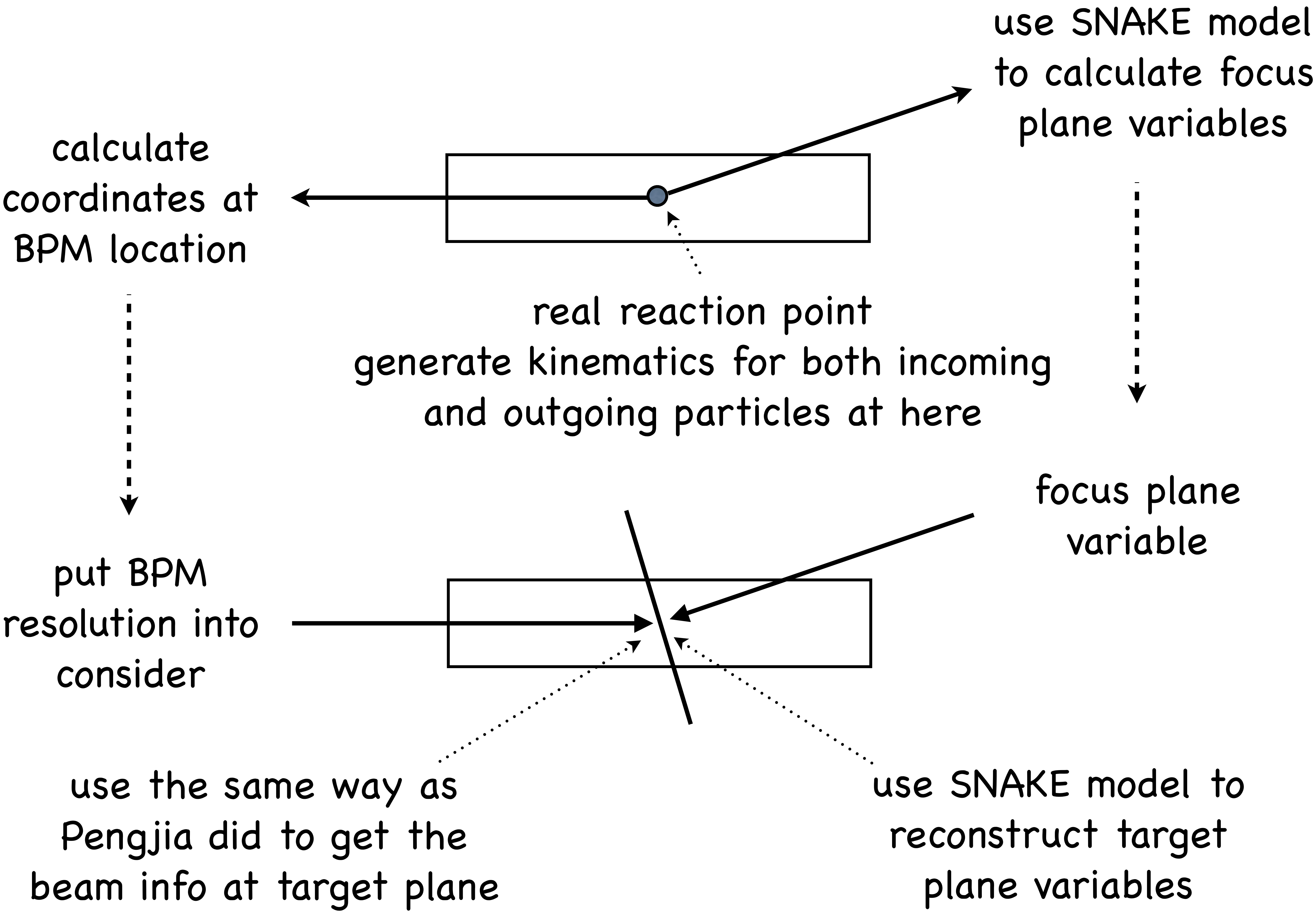


Simulation Package

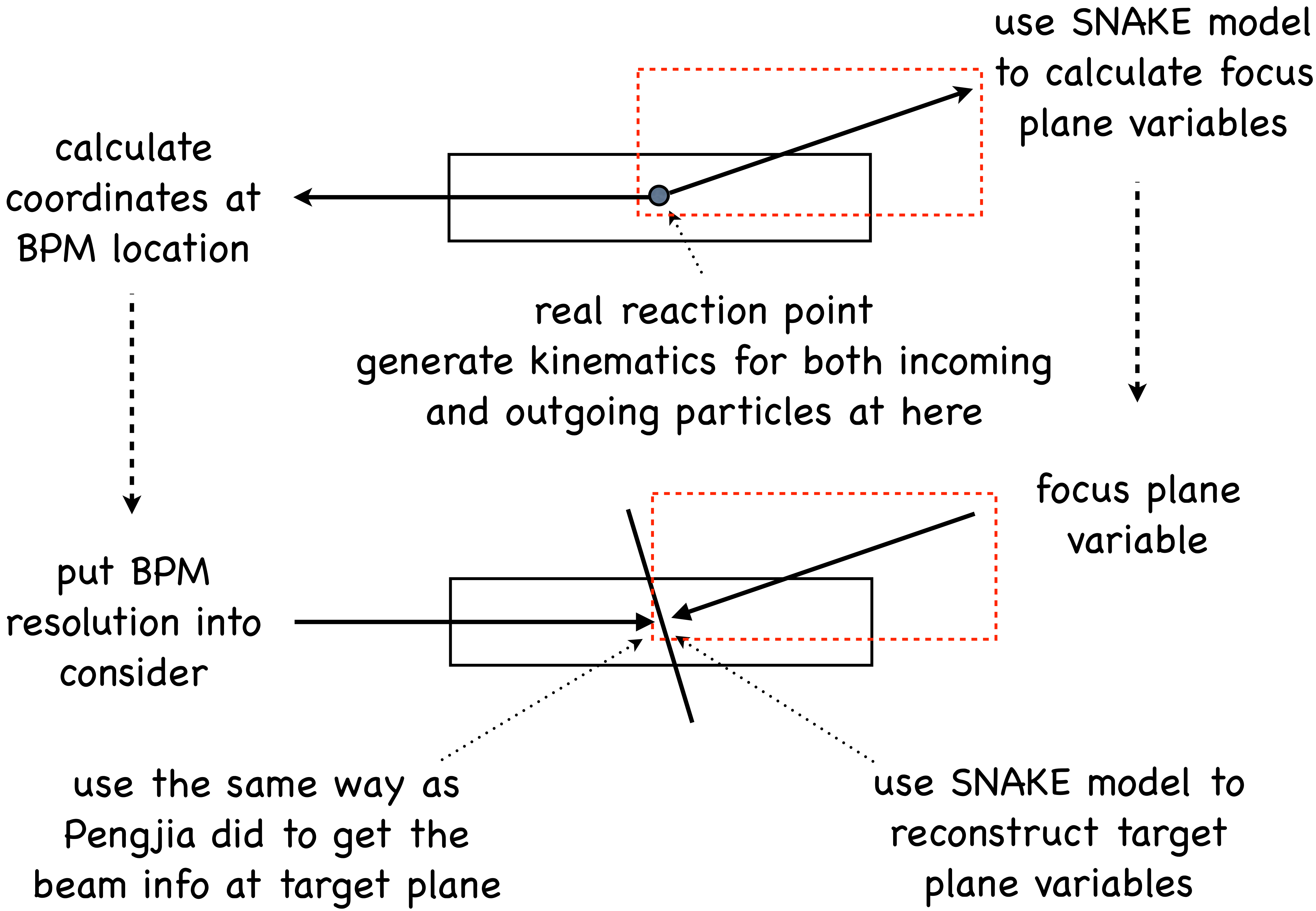
- Improvement:
  - reduce the integral step length to a very small number only for the last step to keep the accuracy
  - Automatically adjust the integral step length to reduce the calculation, typically a 1mm-2mm step length will already be enough (the deviation < 1um)
- Significant improvement: 20ms for each event -> 1ms



Simulation


use SNAKE model to calculate focus plane variables
calculate coordinates at BPM location
real reaction point generate kinematics for both incoming and outgoing particles at here
focus plane variable
put BPM resolution into consider
use the same way as Pengjia did to get the beam info at target plane
use SNAKE model to reconstruct target plane variables

Simulation


use SNAKE model
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use the same way as
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use SNAKE model to
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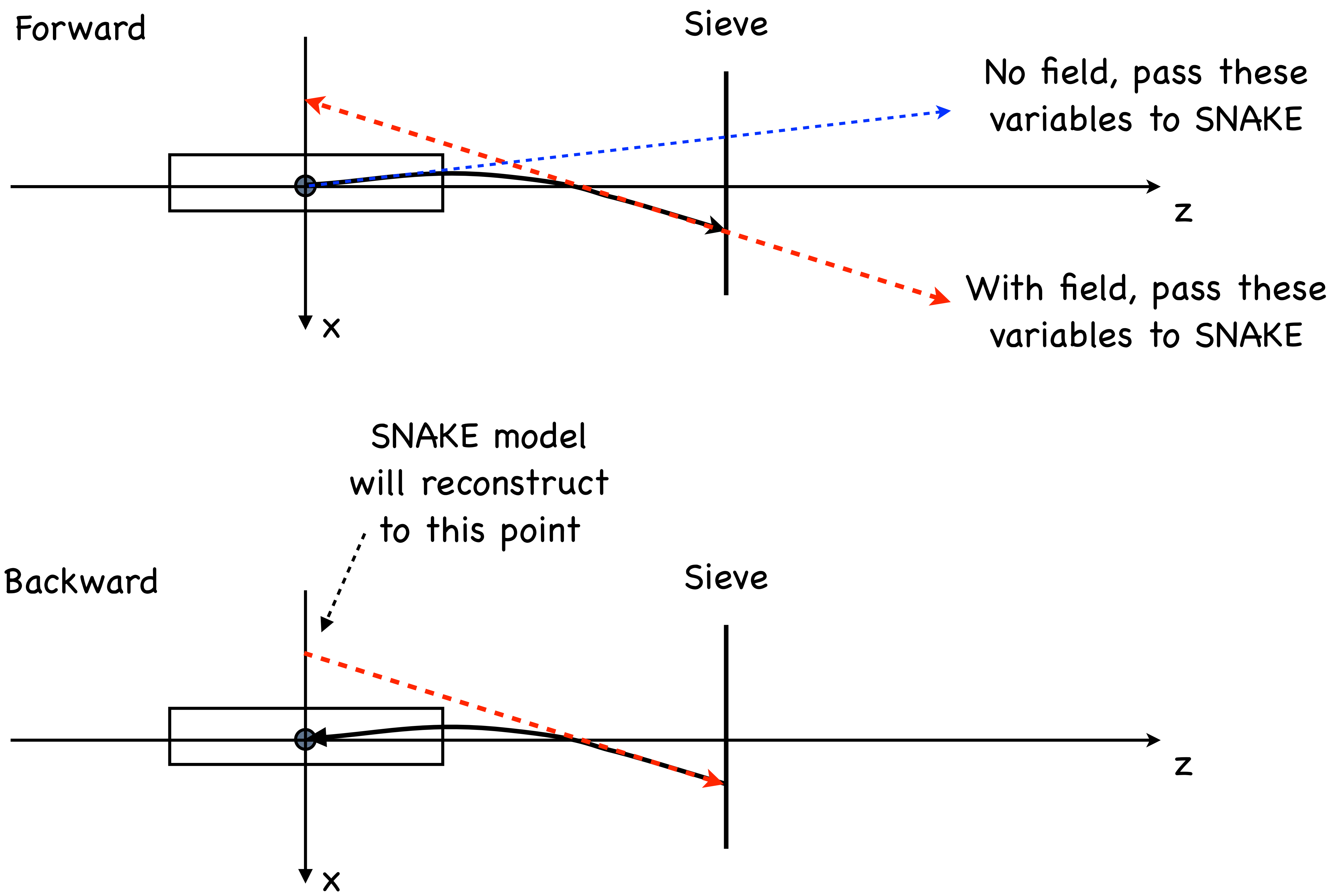
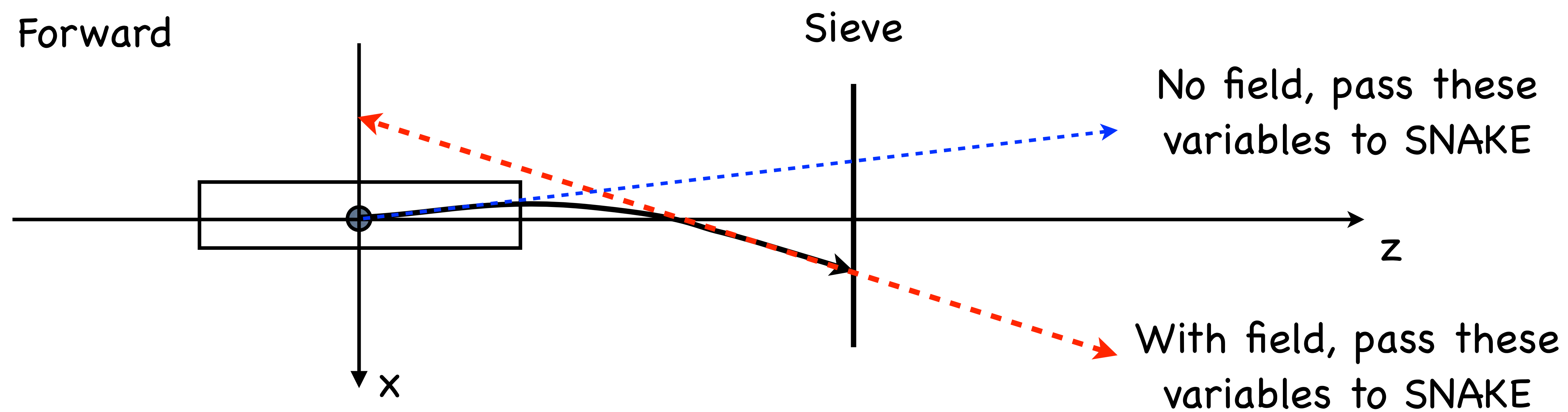
Simulation


Forward
Sieve
No field, pass these
variables to SNAKE
z
With field, pass these
variables to SNAKE
x
SNAKE model
will reconstruct
to this point
Backward
Sieve
z
x

Simulation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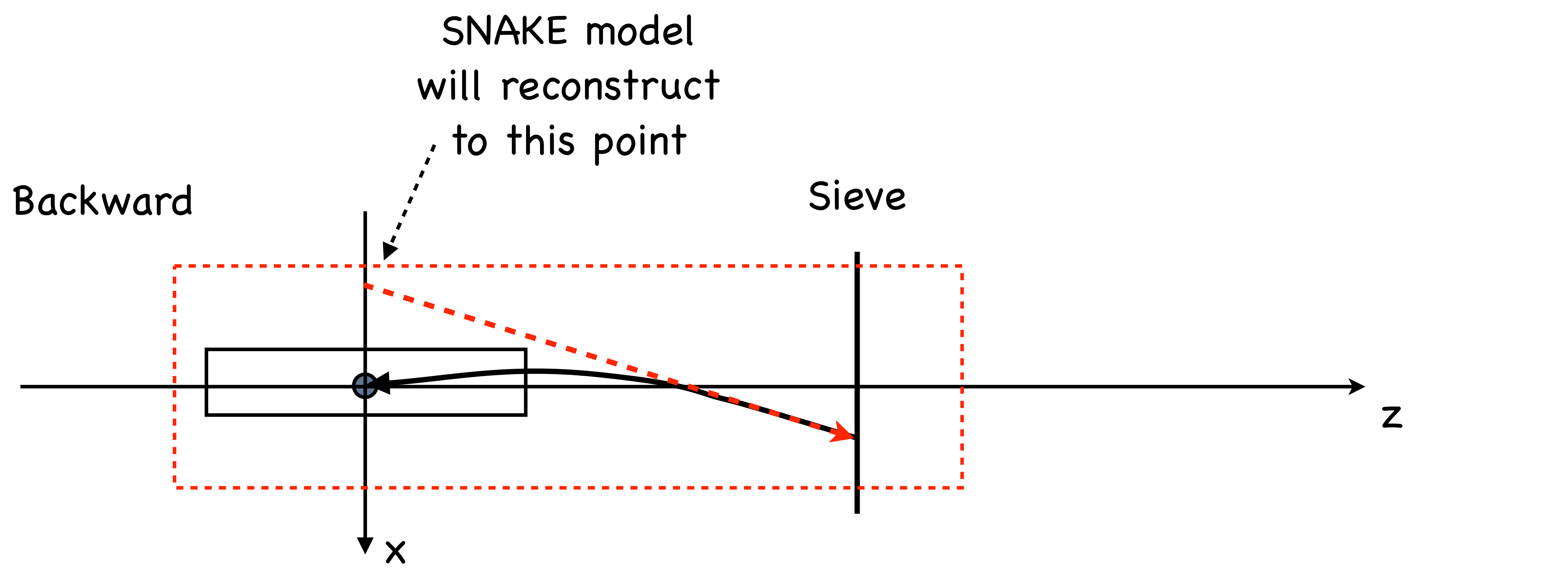
SNAKE model
will reconstruct
to this point
Backward
Sieve
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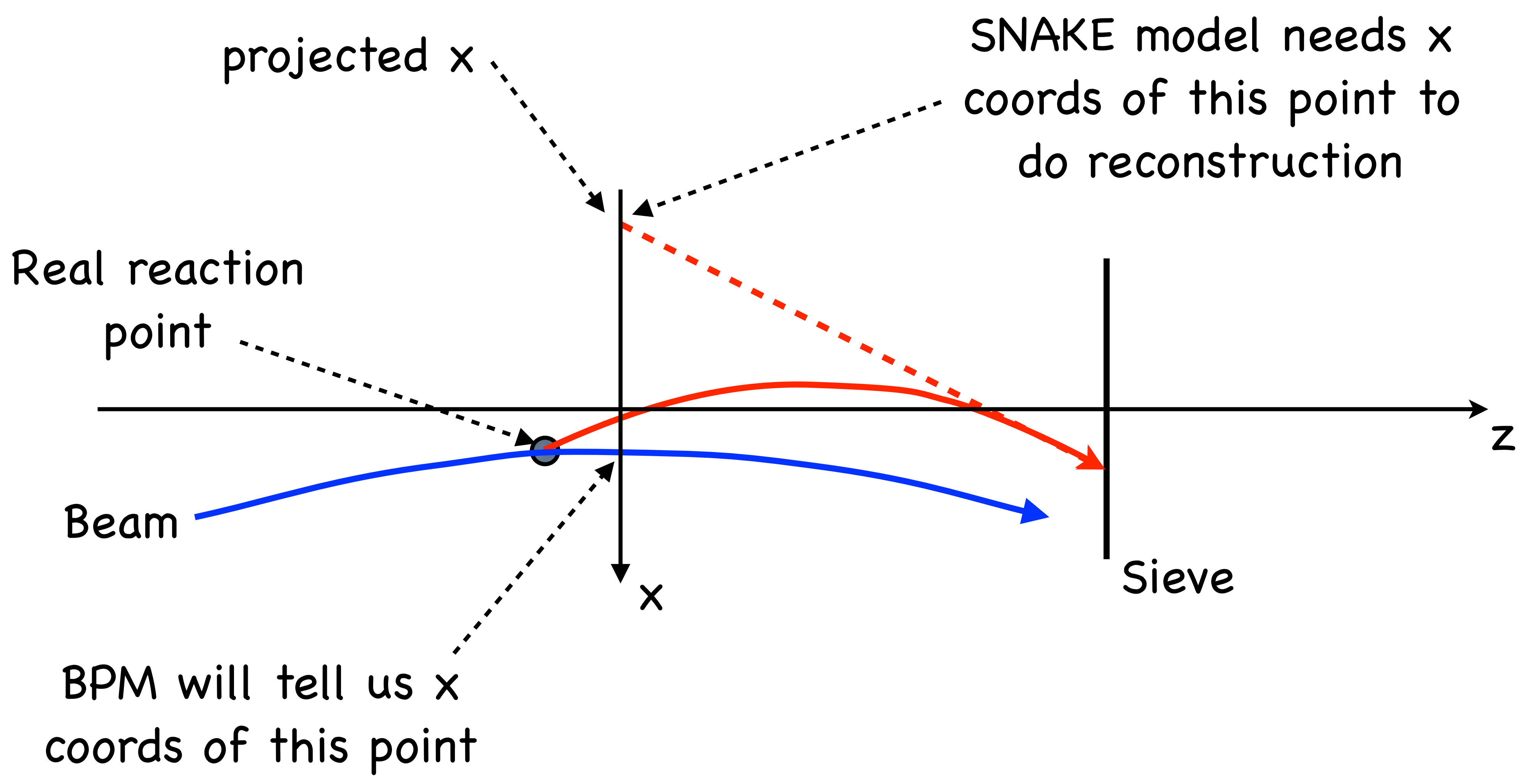
x

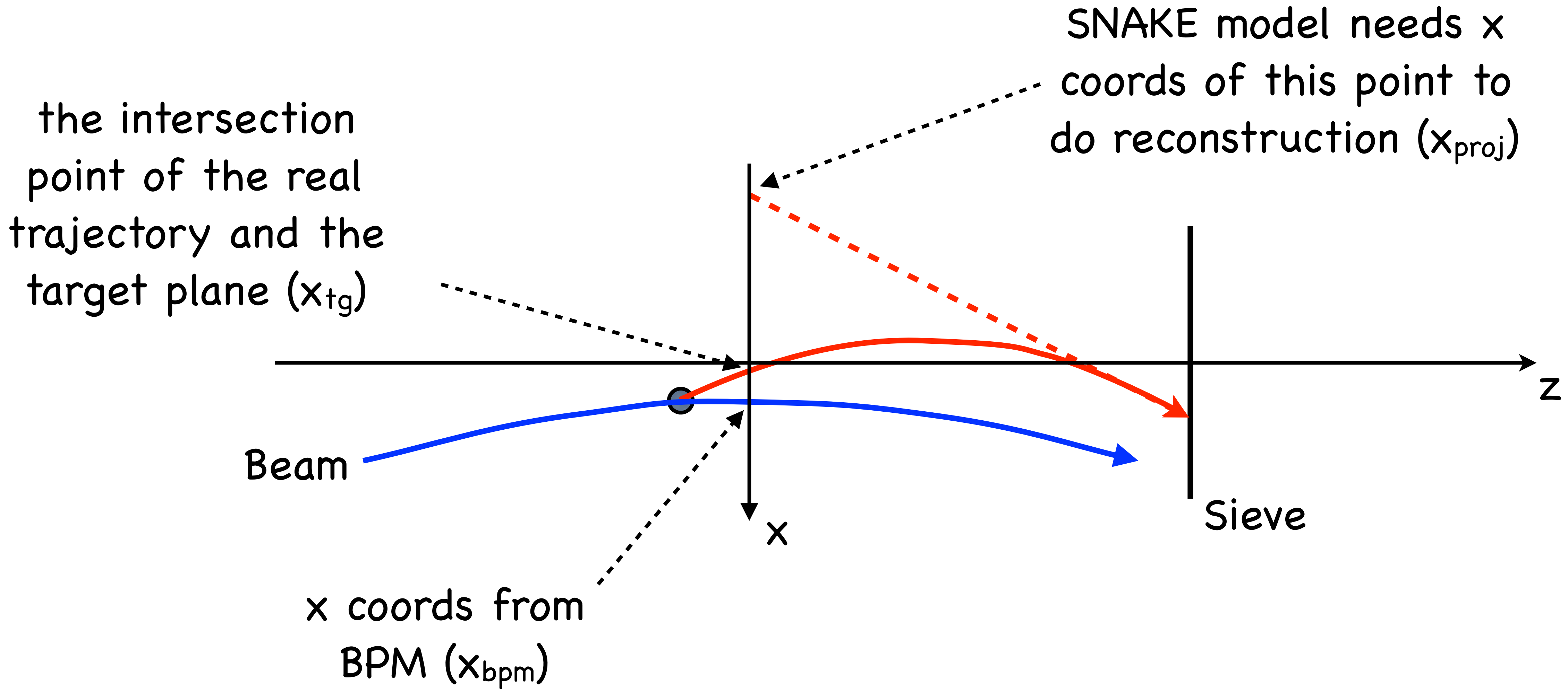
Reconstruction with SNAKE model

- SNAKE model will use the focus plane x, θ, y, φ, and target plane x to do reconstruction
- With target field, SNAKE model need the projected x at target plane to do reconstruction, not the x from BPM



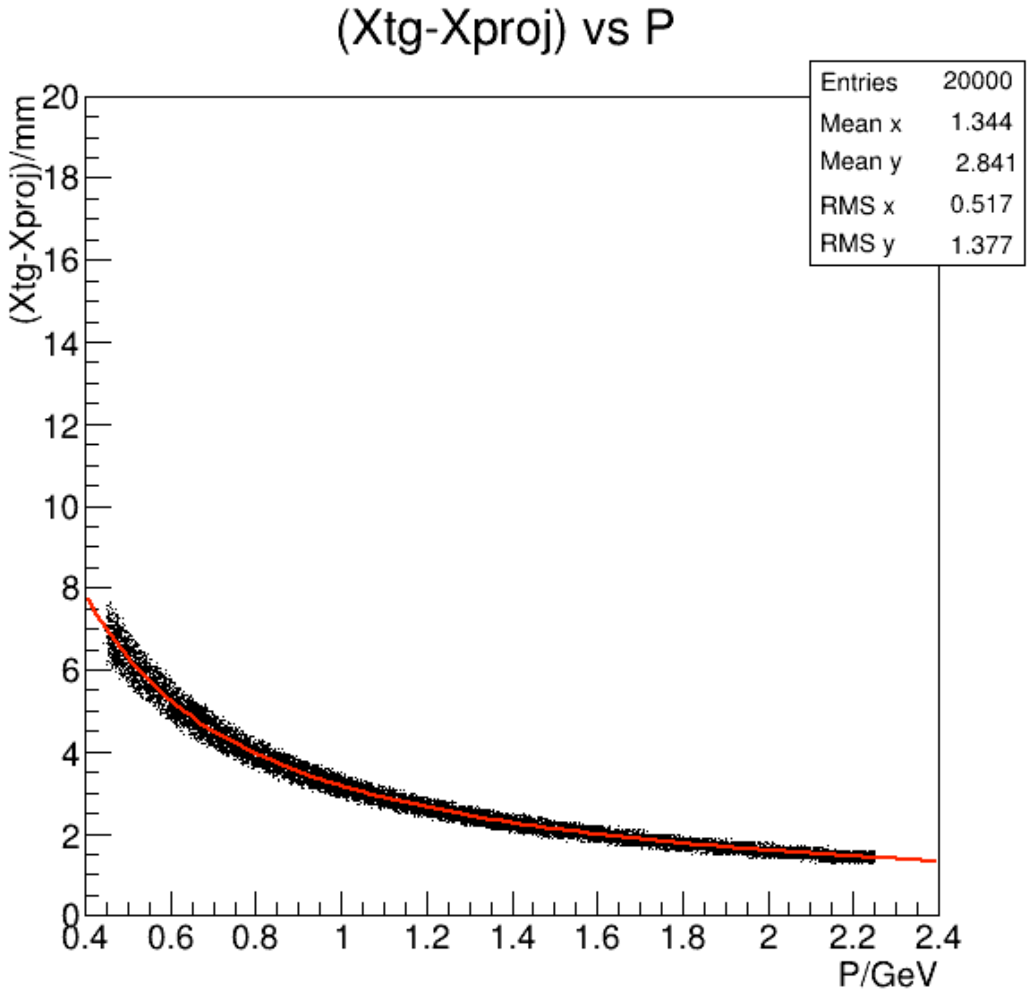
Reconstruction with SNAKE model

- Can not directly use x from BPM
- Need to find a relation between the projected x and the BPM x
- 2 step to study this relation

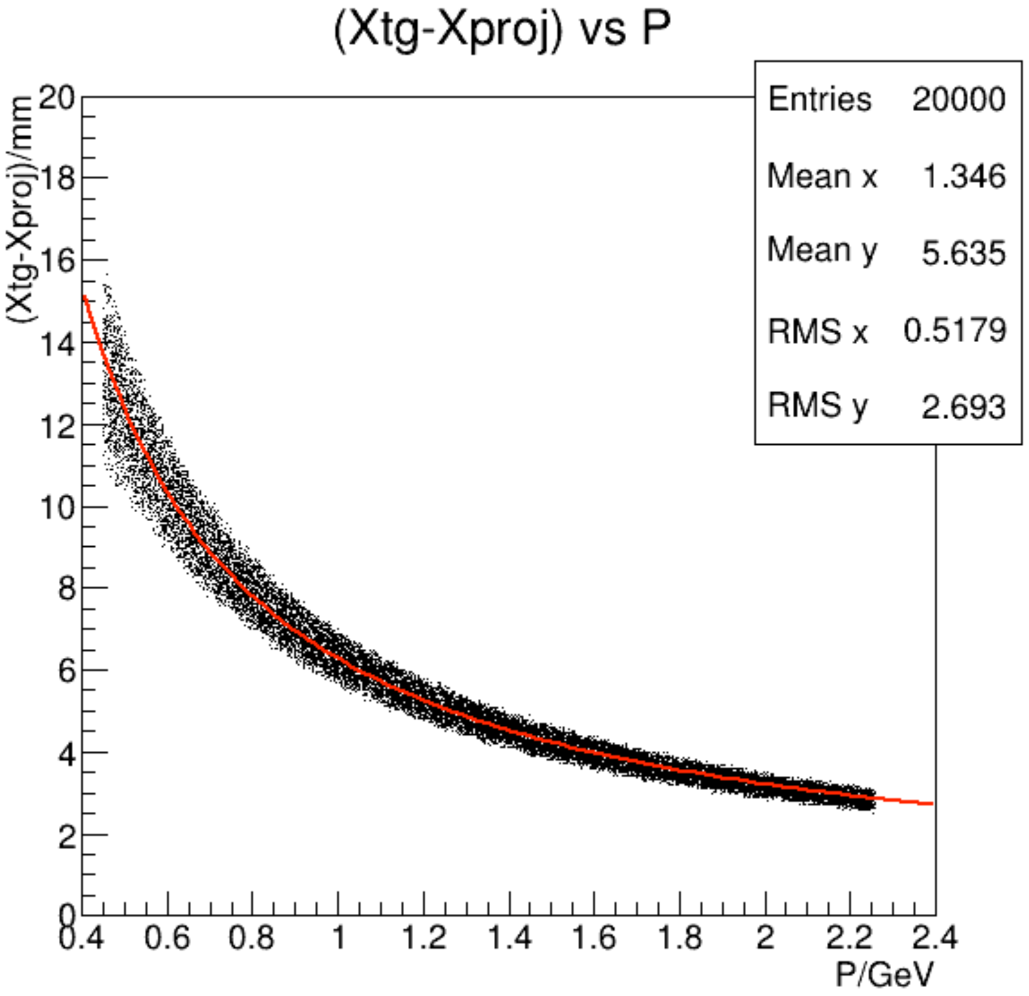


Reconstruction with SNAKE model

- First get the relations between x_{tg} and x_{proj}
- Only the drifting in target field process will influence the relations between these 2 variables
- Drifting a particle in the field only dependent on the momentum of the particle



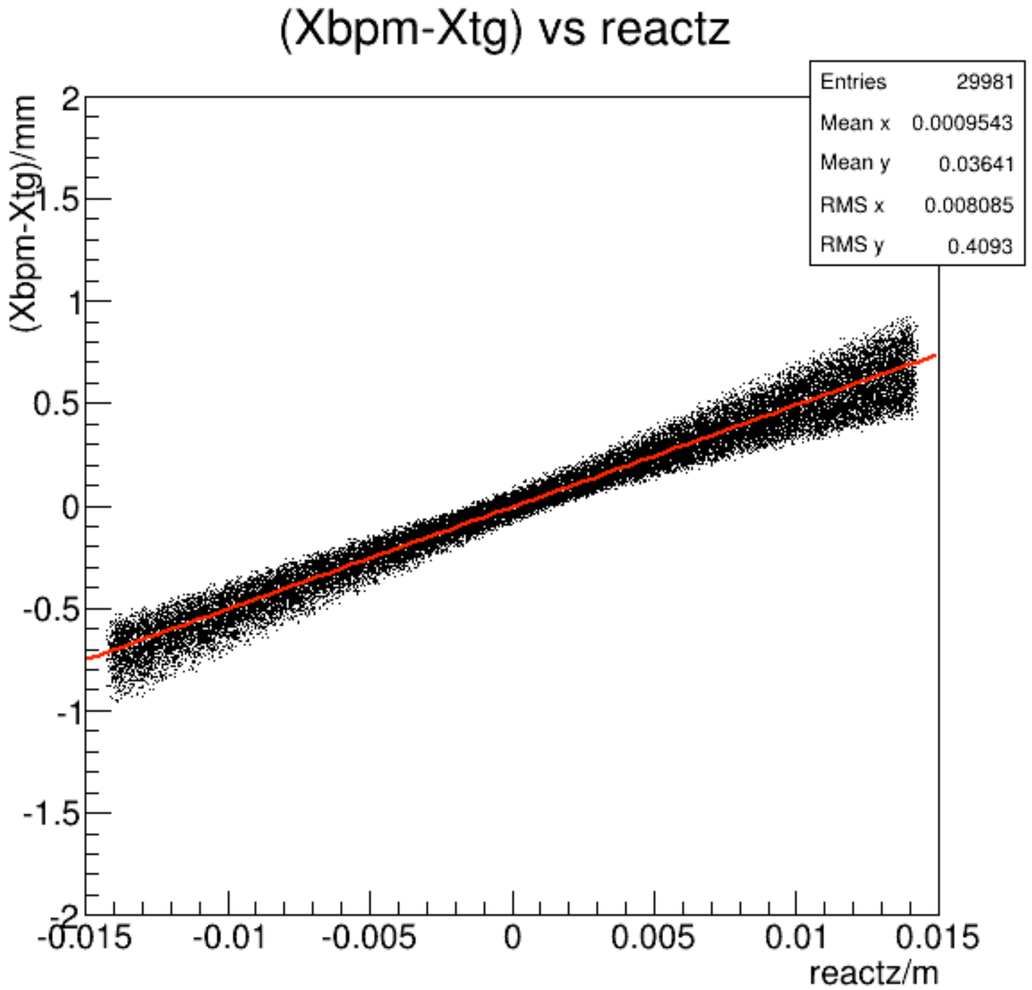
2.5T, y=0.018+3.149/x



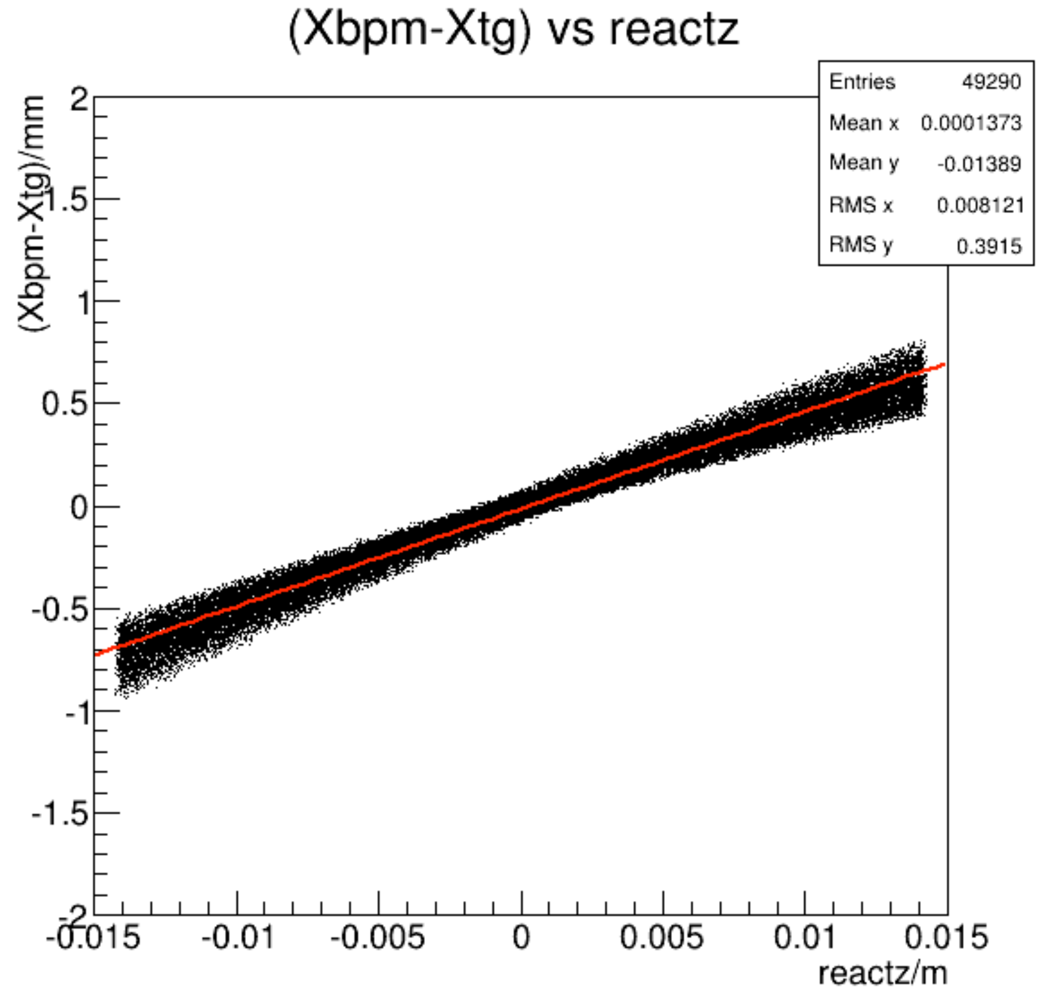
5.0T, y=0.141+6.128/x

Reconstruction with SNAKE model

- For x_{bpm} and x_{tg}, we could see a significant correlation respect to reaction Z
- However, since Z resolution is always bad, we will directly assume Z=0



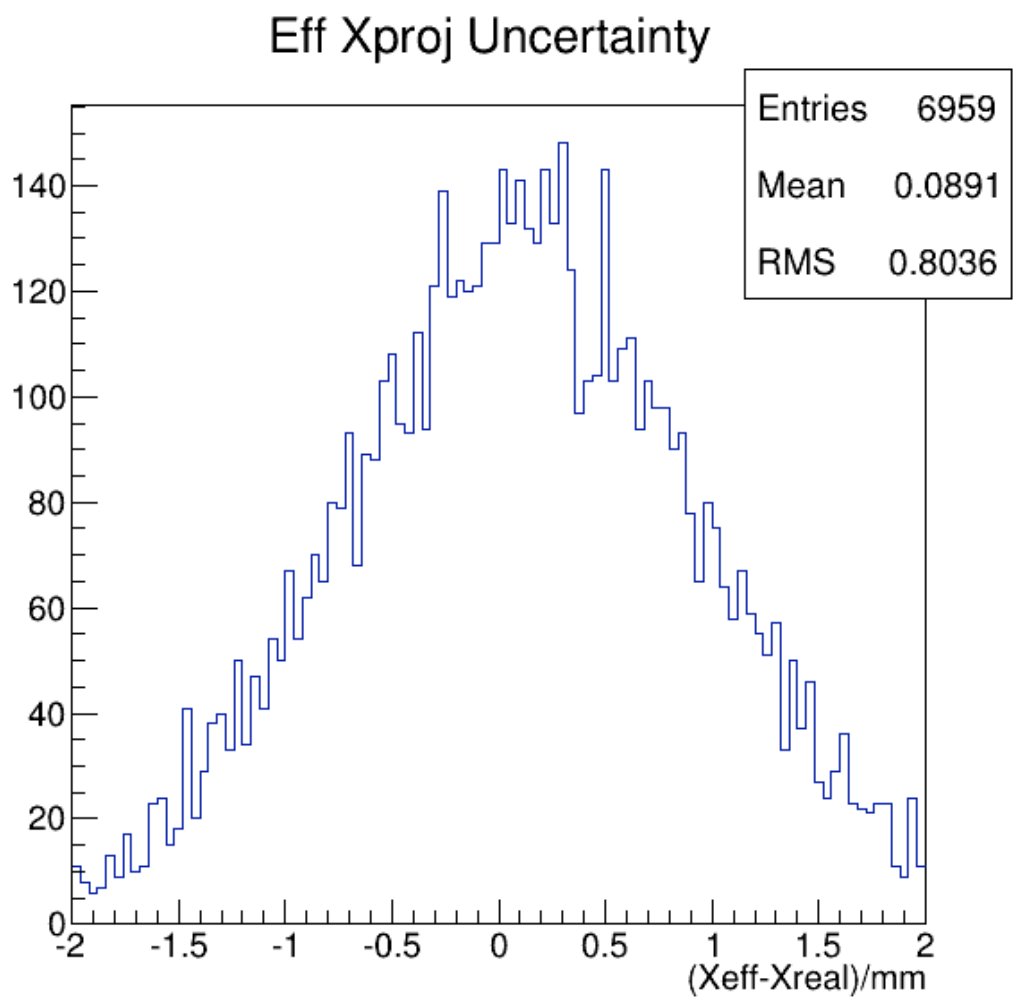
HRS setting 2.2GeV

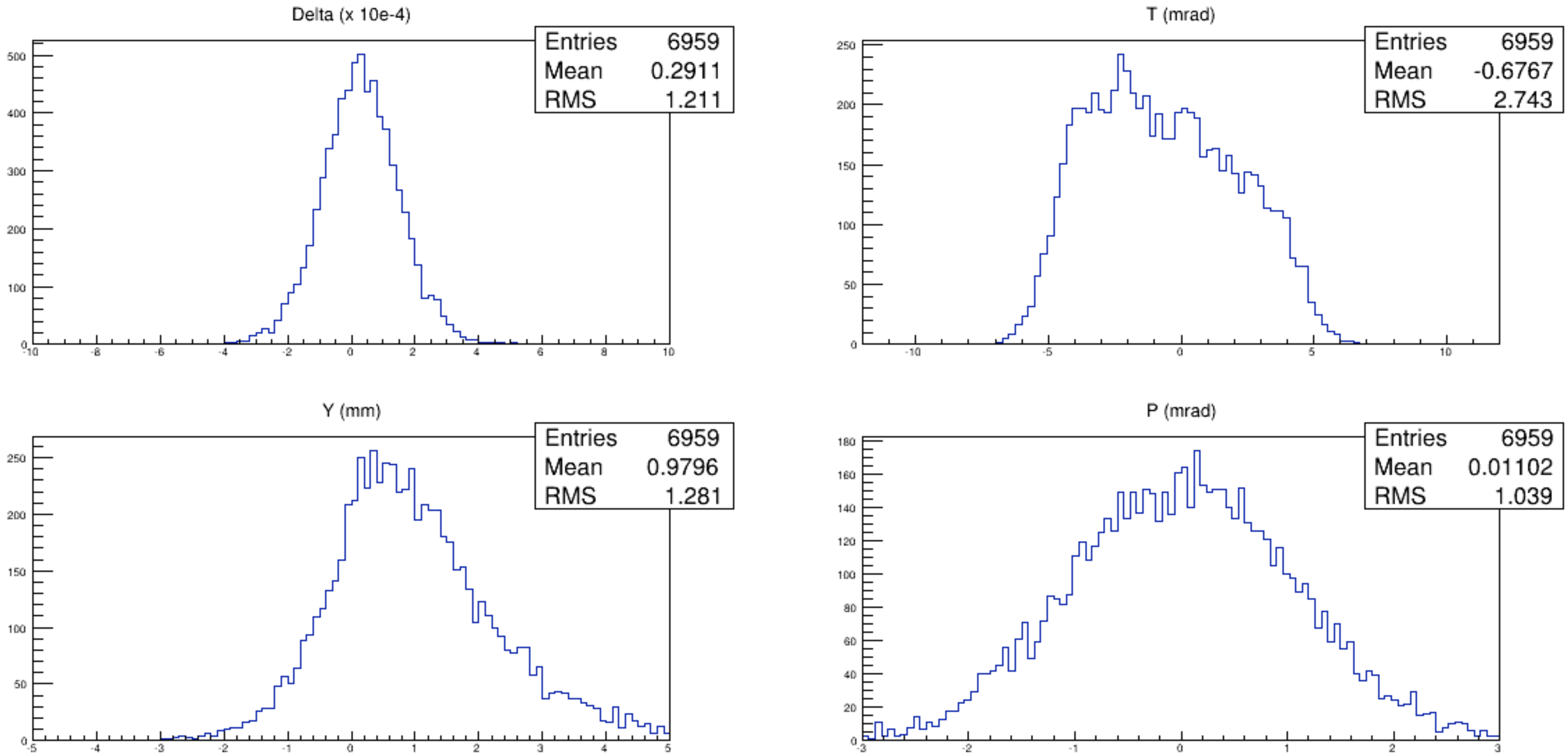


HRS setting 1.1GeV

Reconstruction with SNAKE model

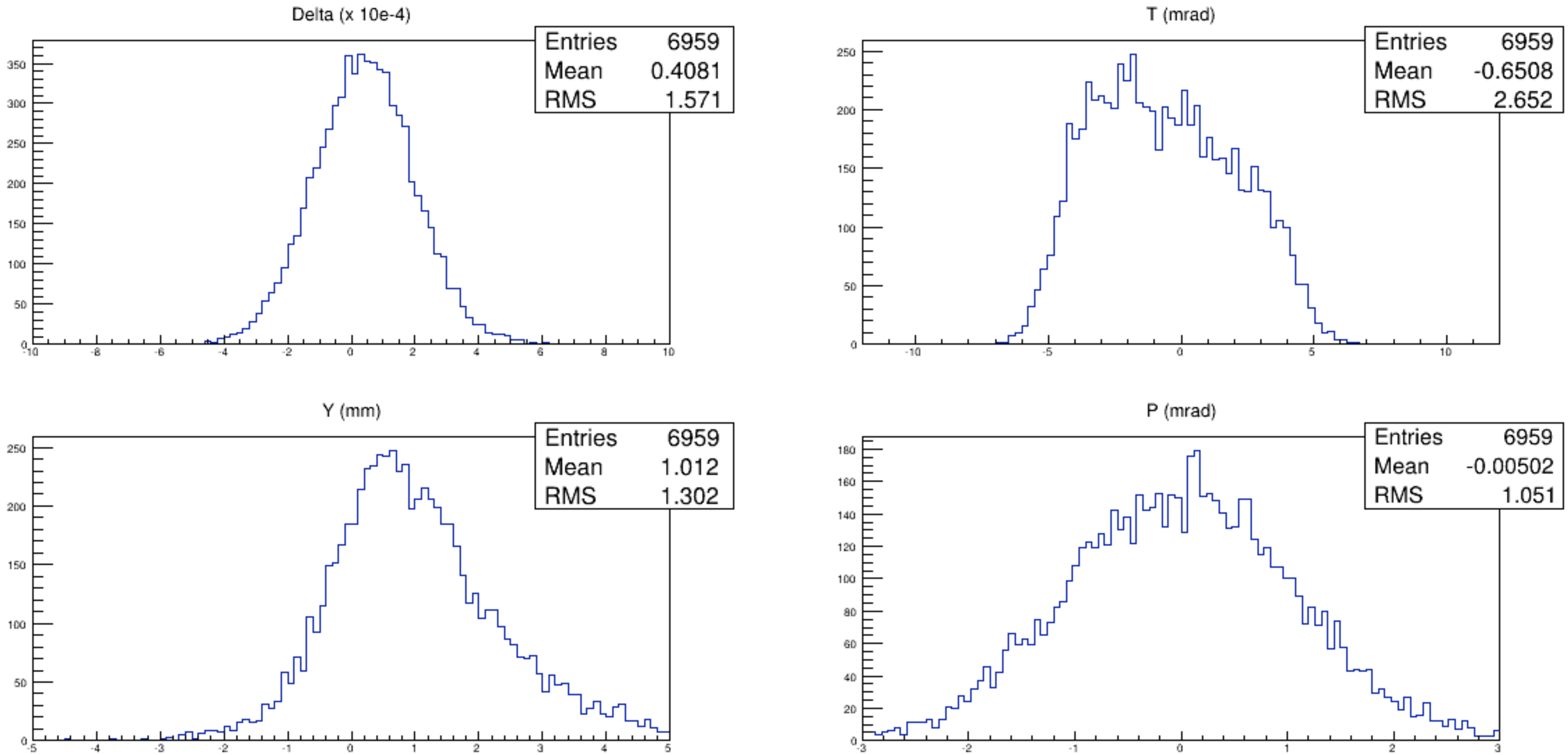
- Finally we are able to give an estimation of x_{proj} when we know x_{bpm} and δ,
- We need to do several iteration to get the effective x_{proj} :
  - Assume δ=0, calculate x_{proj} with the help of x_{bpm}, and do 1st reconstruction
  - use the reconstructed δ, calculate x_{proj} again, and do 2nd reconstruction
  - repeat until accurate enough





Reconstructed target variable uncertainty

(Use x_{proj} from the forward simulation)

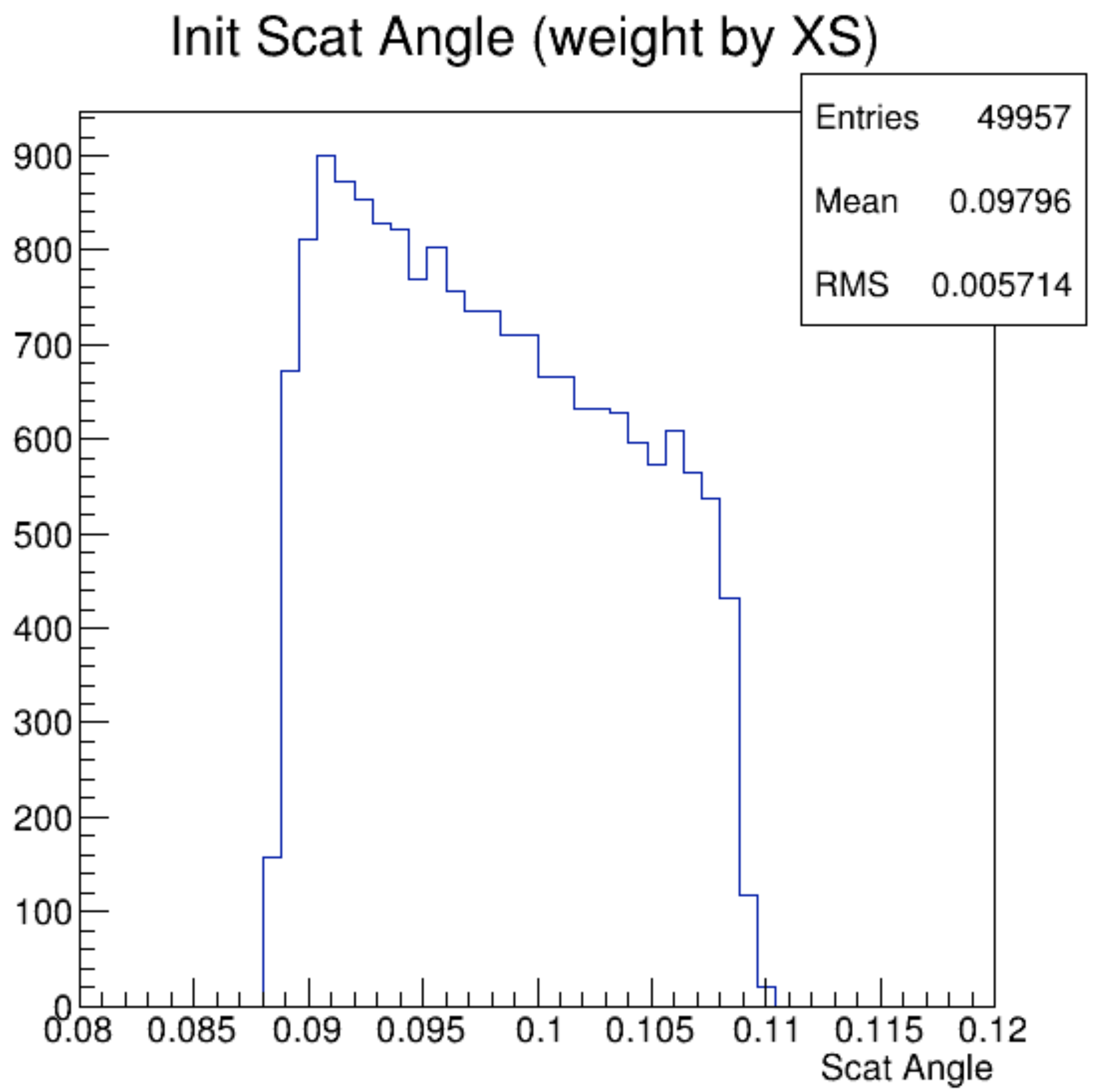


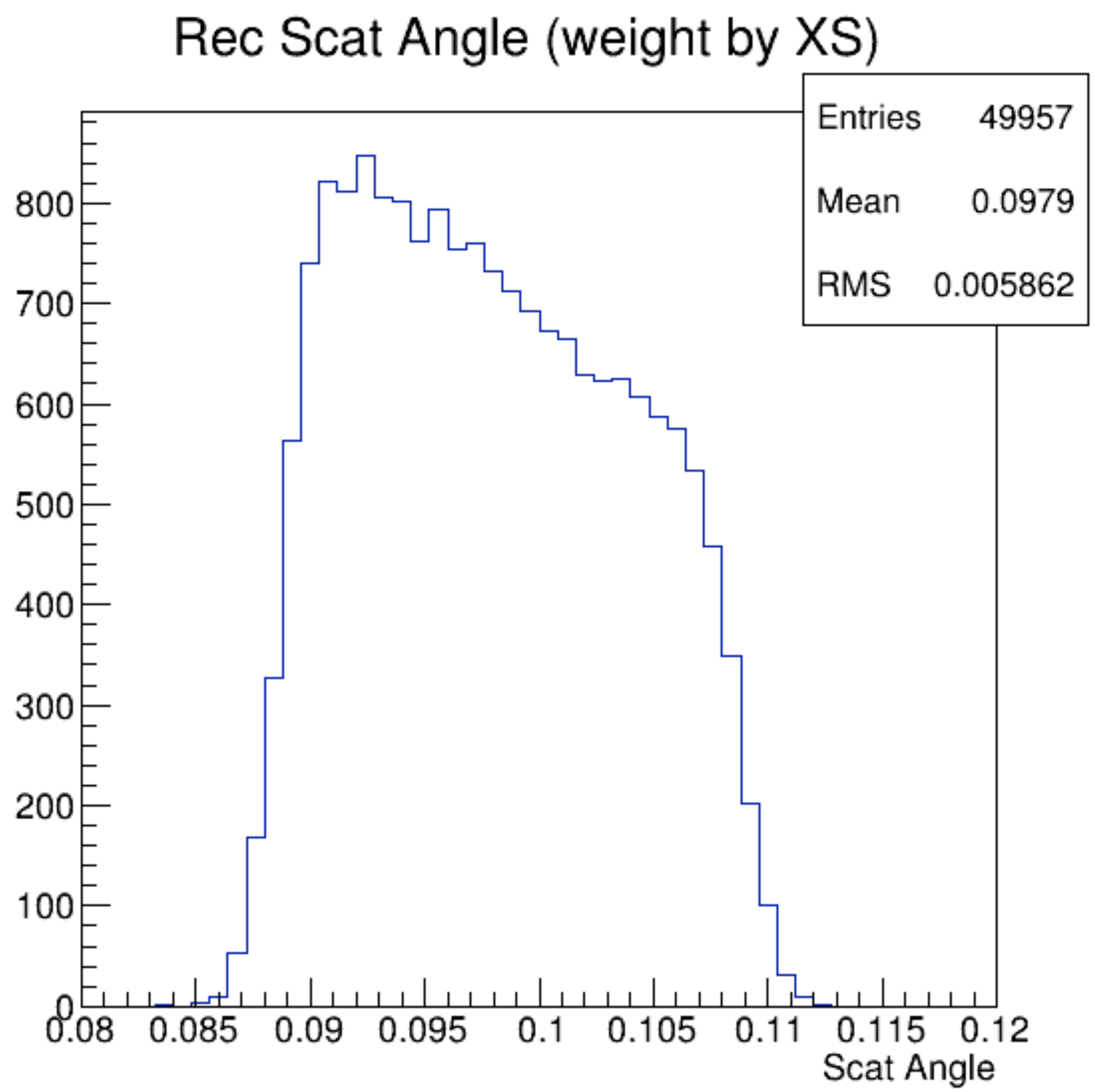
Reconstructed target variable uncertainty

(Use x_{proj} calculated from x_{bpm})

Distribution weighted by XS

- Only tried with QFS, will try with P. Boosted Model later





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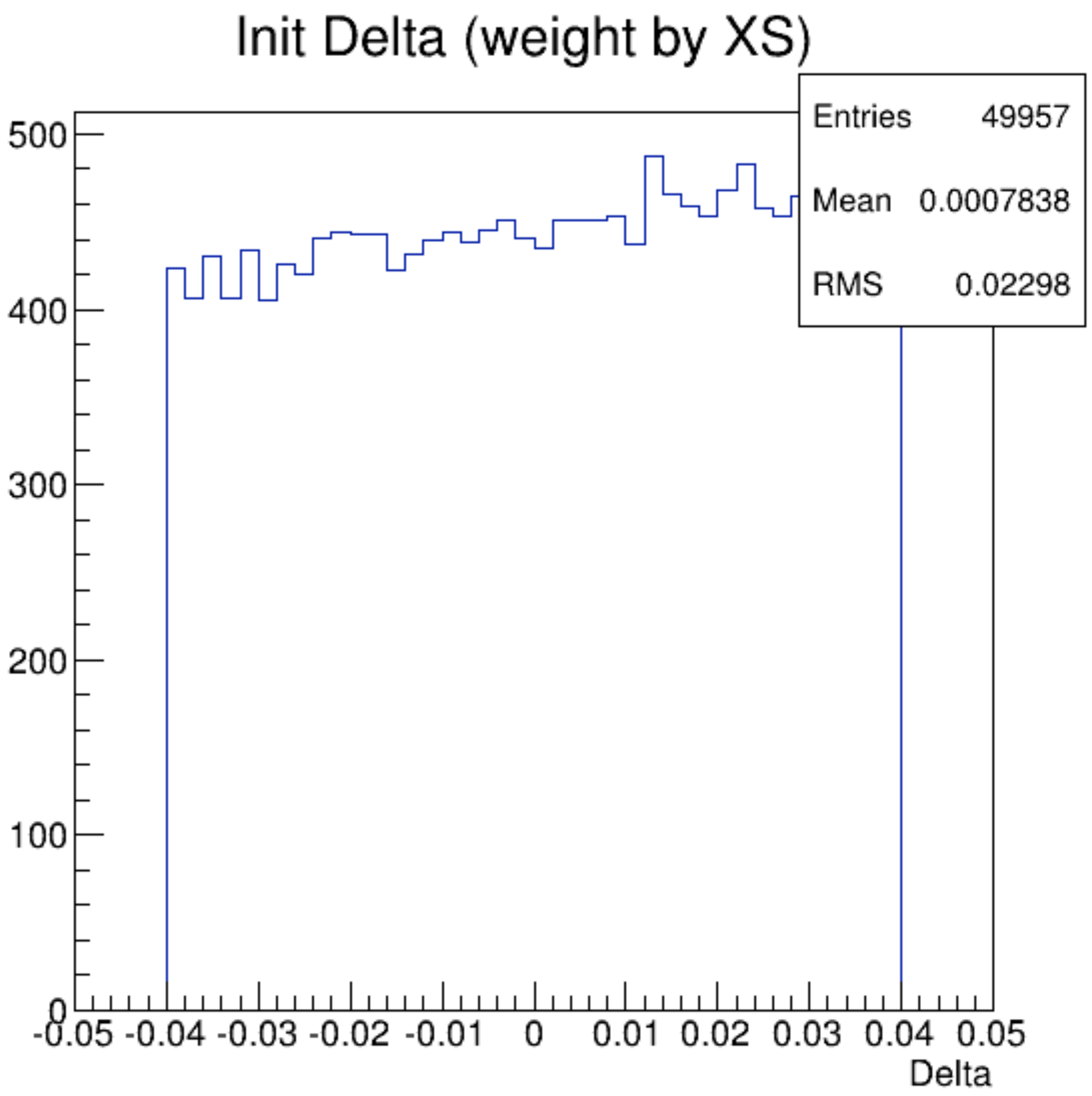

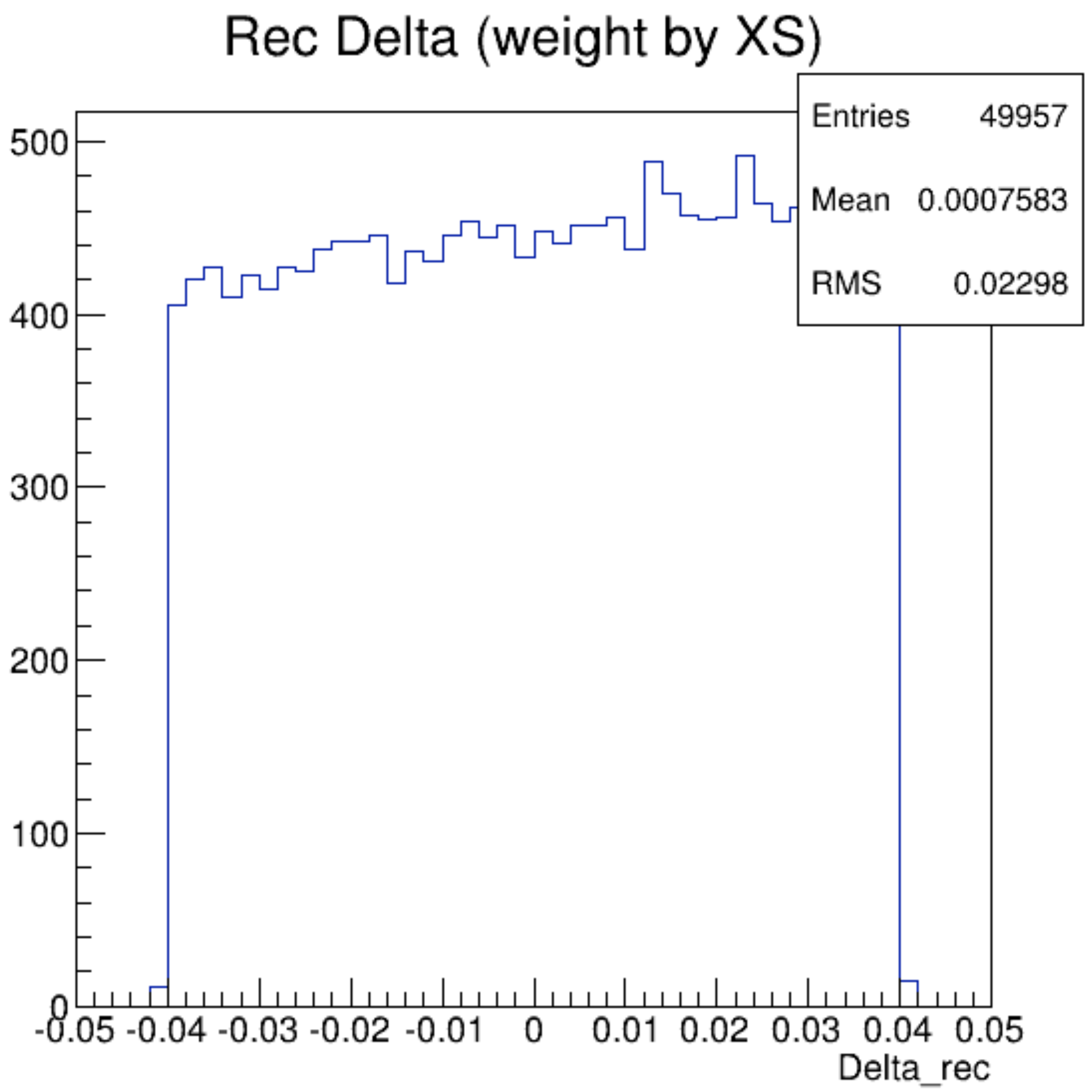

Summary

- TODO:
  - Any suggestions from the meeting
  - Move to the optics data at 484816 septa setting with target field to check the reconstruction method