

# Effect of magnetic field displacement on track momentum reconstruction

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# Goal of study

- To evaluate the influence of positioning error in magnetic field measurement on the reconstructed track momentum.
- To this end, a few simulations were carried out in which the magnetic field during event reconstruction was shifted relative to its position during event generation.

# Simulation parameters

- SpdRoot (development branch)
- Magnetic field during reconstruction stage is substituted by:
  - a) original field (as during generation);
  - b) field shifted in y direction by 1 cm or 10 cm;
  - c) field shifted in z direction by 1 cm or 10 cm.
- Artificial samples consisting of tracks with  $P = 1$  or  $5 \text{ GeV}/c$ ,  $\phi = 90^\circ$ , and various  $\theta$  are used. (10 000 tracks in each sample).
- Tracking system: DSSD + STRAW

# Magnetic field in SpdRoot

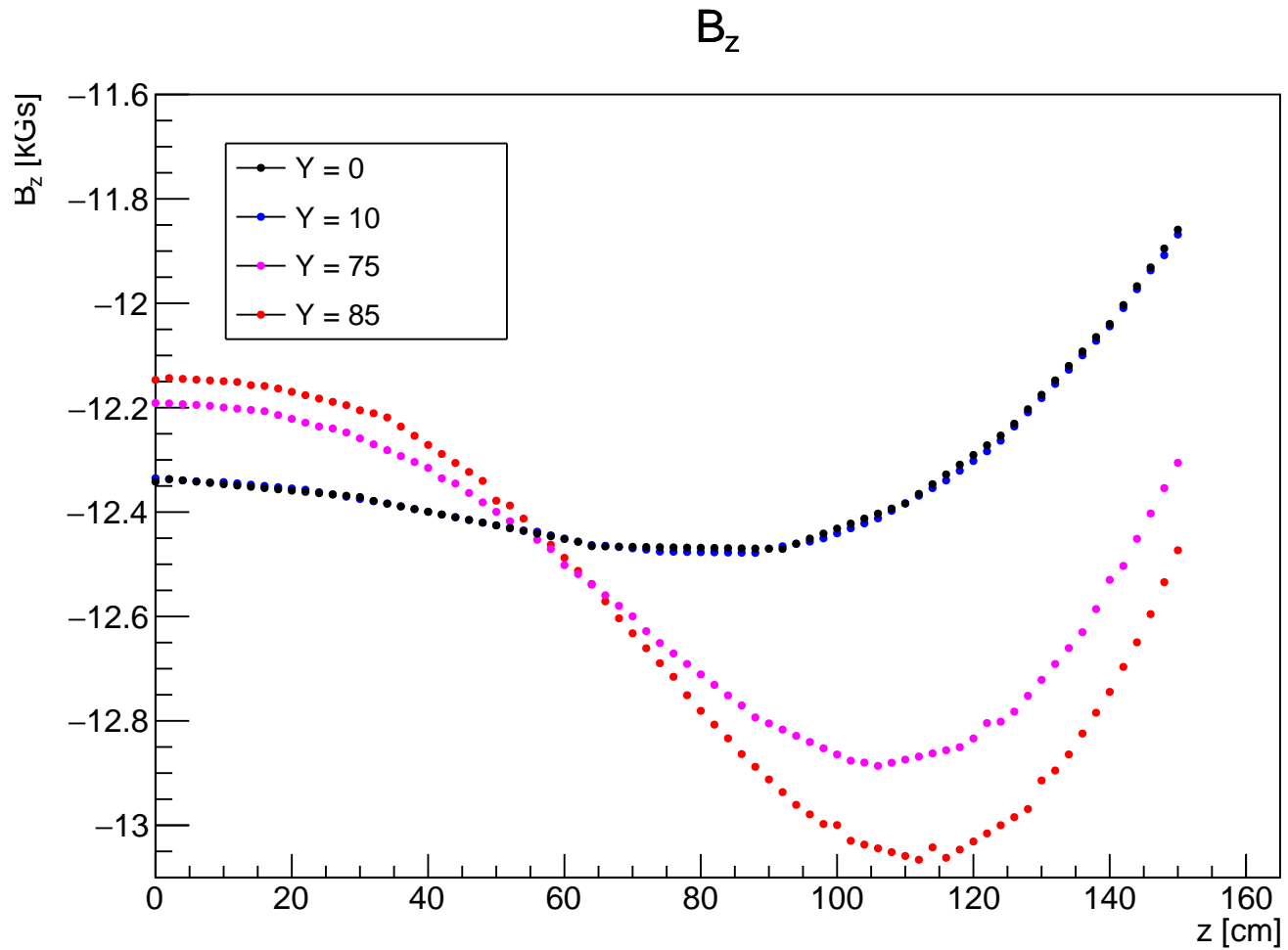
- `SpdField` — abstract base class
- `SpdFieldMap1_8` - main class actually used.

The magnetic field is defined in one octant of space ( $x > 0, y > 0, z > 0$ ) on a grid with a step of 2 cm. In the rest of the space it is determined using symmetry considerations.

- `SpdGFMagneticField` — interface class used by GenFit during track fitting, extrapolation, etc.

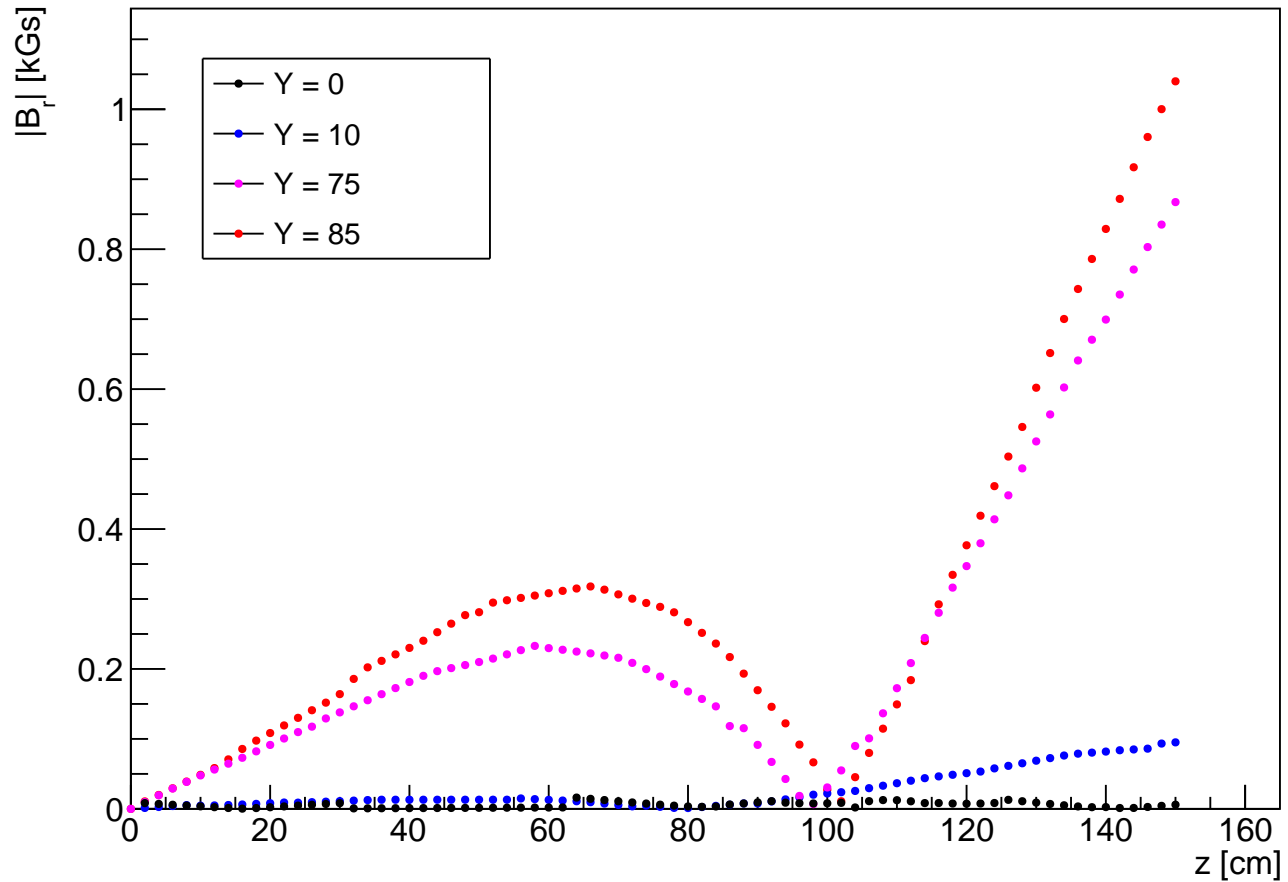
I modify it to obtain shifted field.

# Magnetic field in SpdRoot



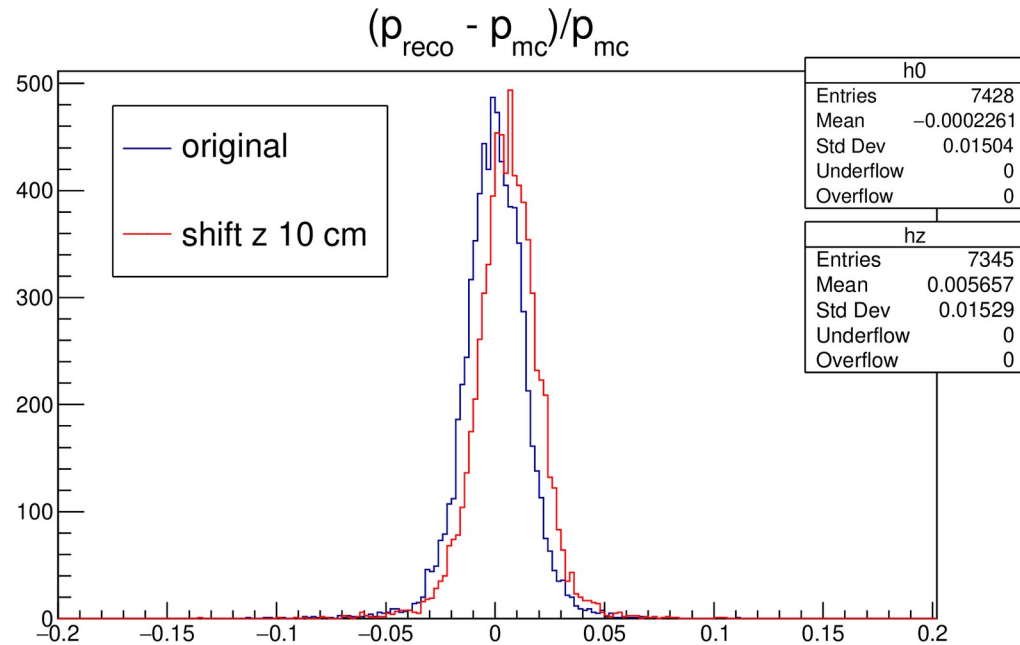
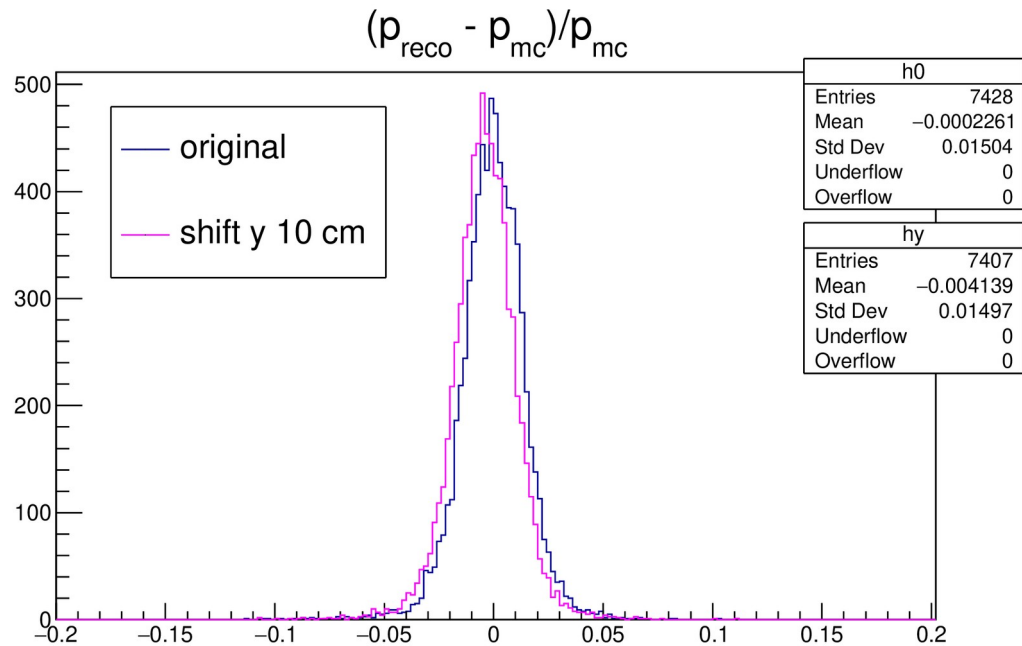
# Magnetic field in SpdRoot

$|B_r|$



# Comparing reconstructed and MC momentum

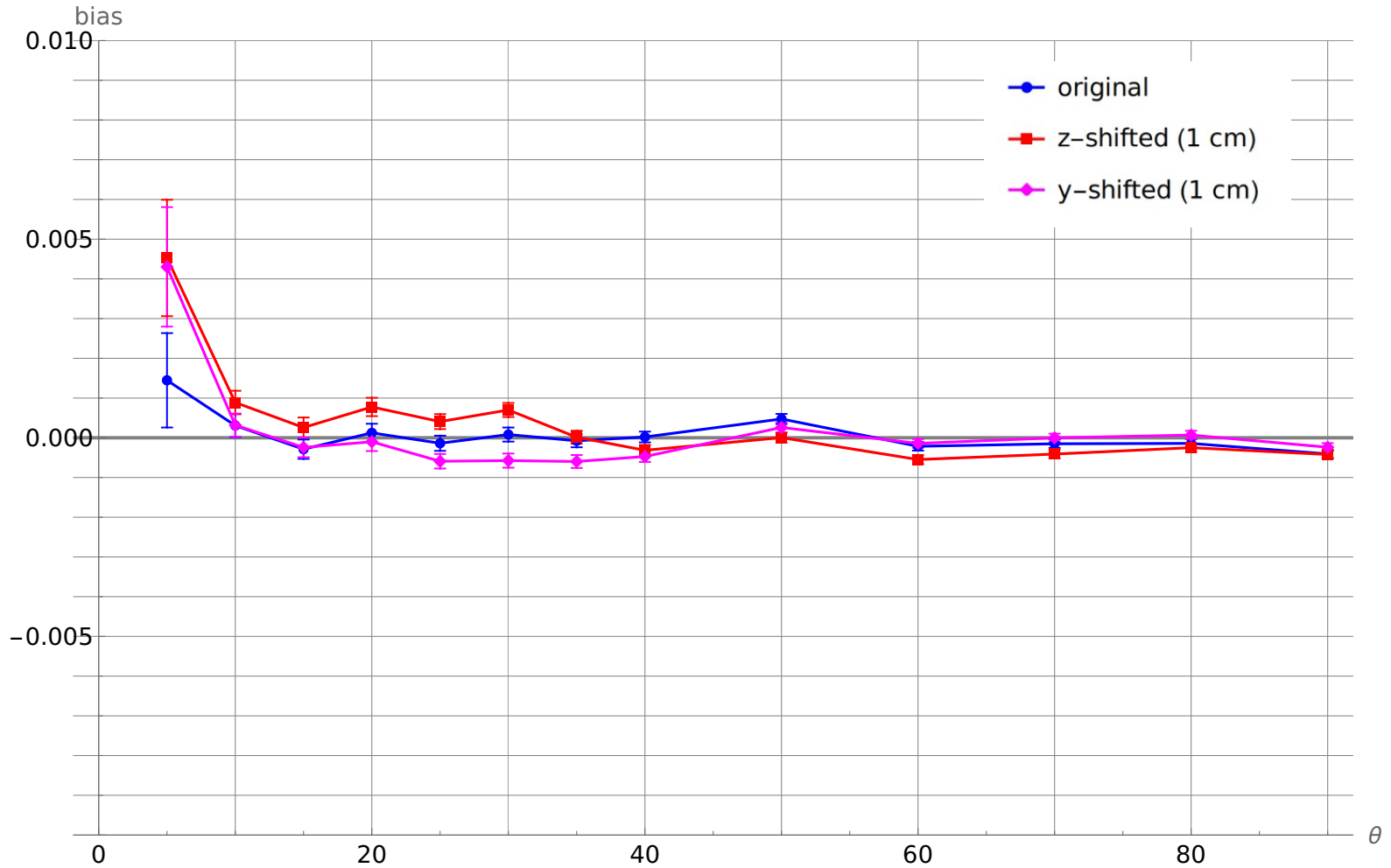
Example:  $P = 1 \text{ GeV}/c$ ,  $\theta = 30^\circ$ ,  $\phi = 90^\circ$



The following quality cuts on tracks were applied: convergency == 1,  $\chi^2/\text{ndf} < 2$ .

# Momentum bias

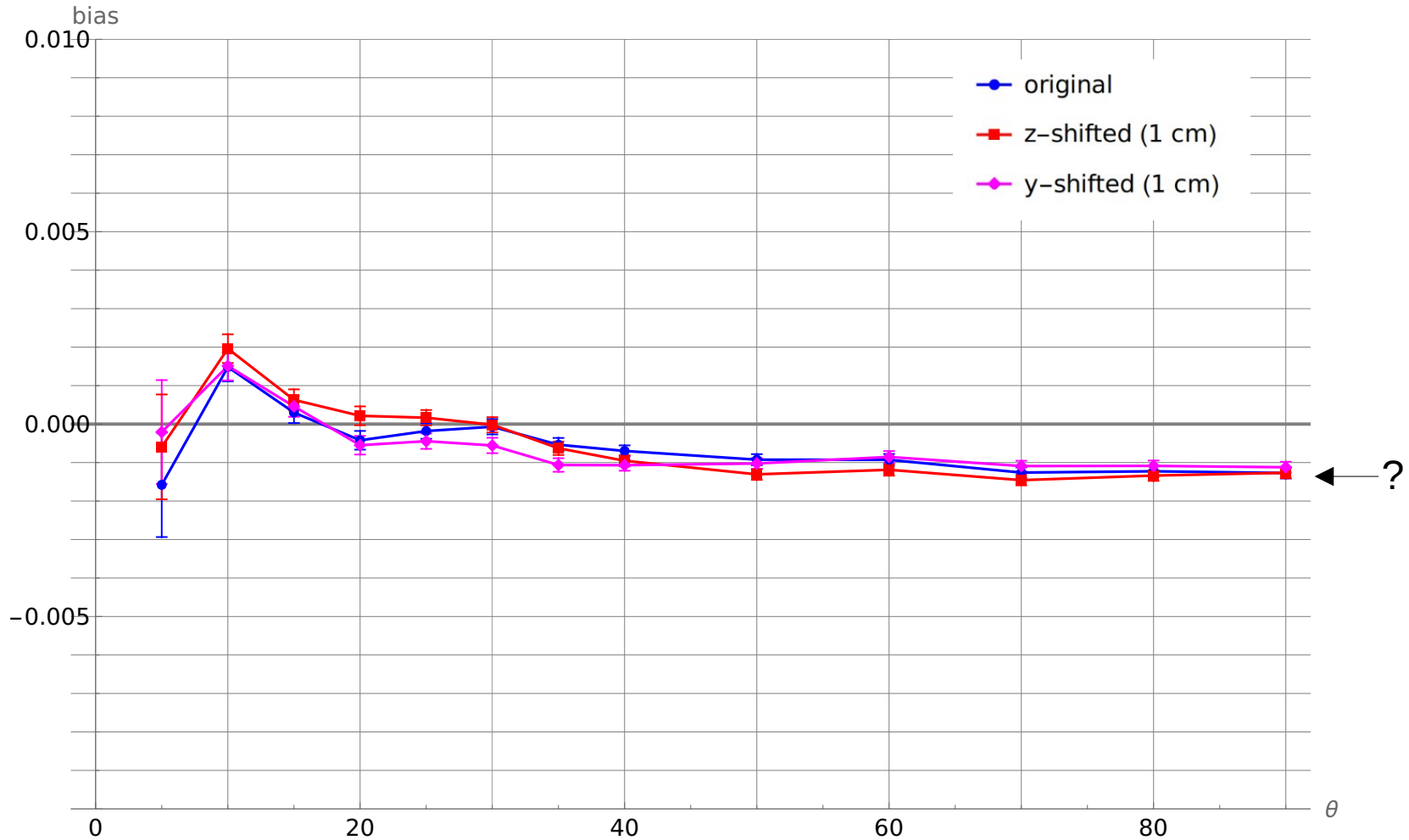
( $p = 1 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )





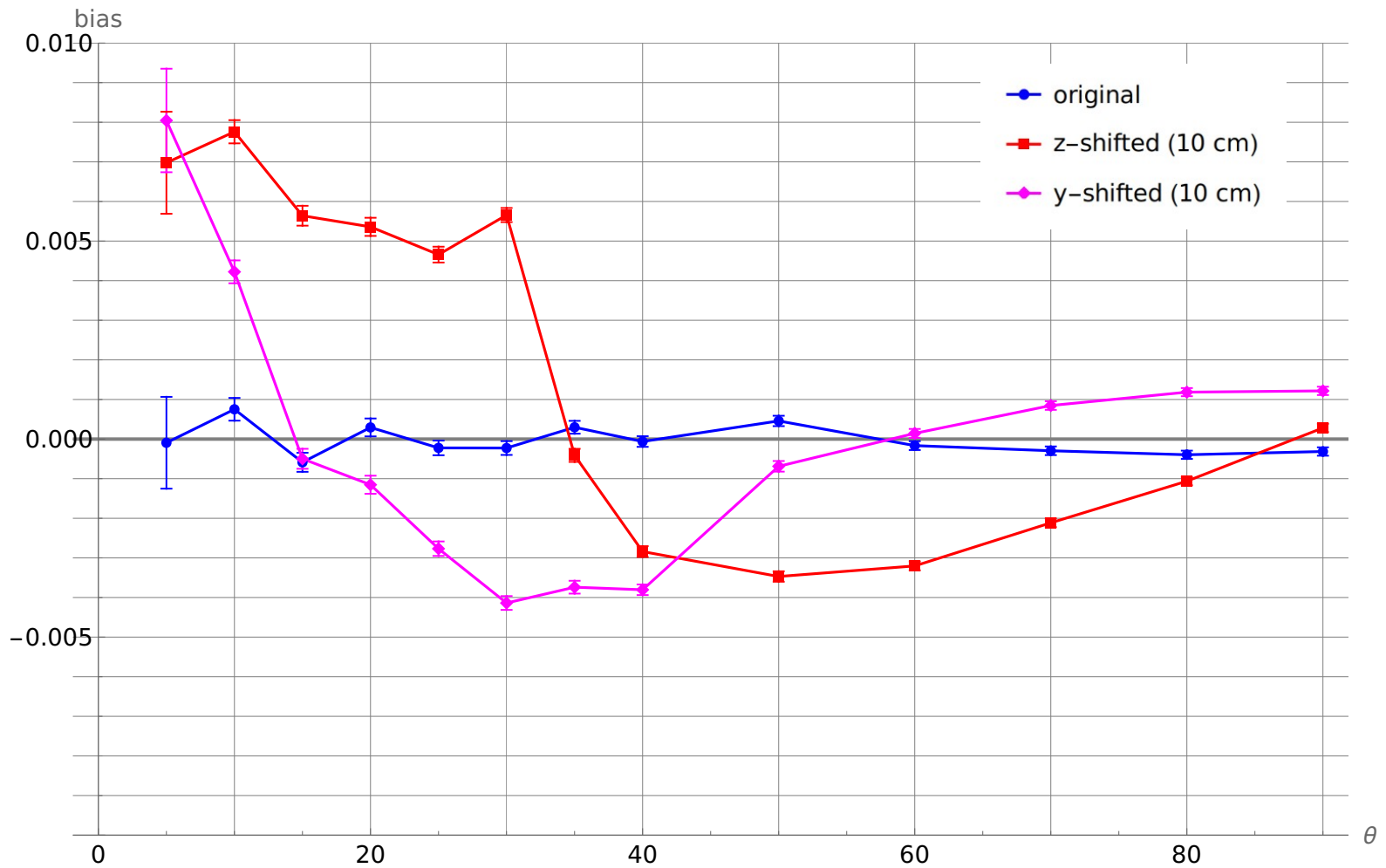
# Momentum bias

( $p = 5 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )



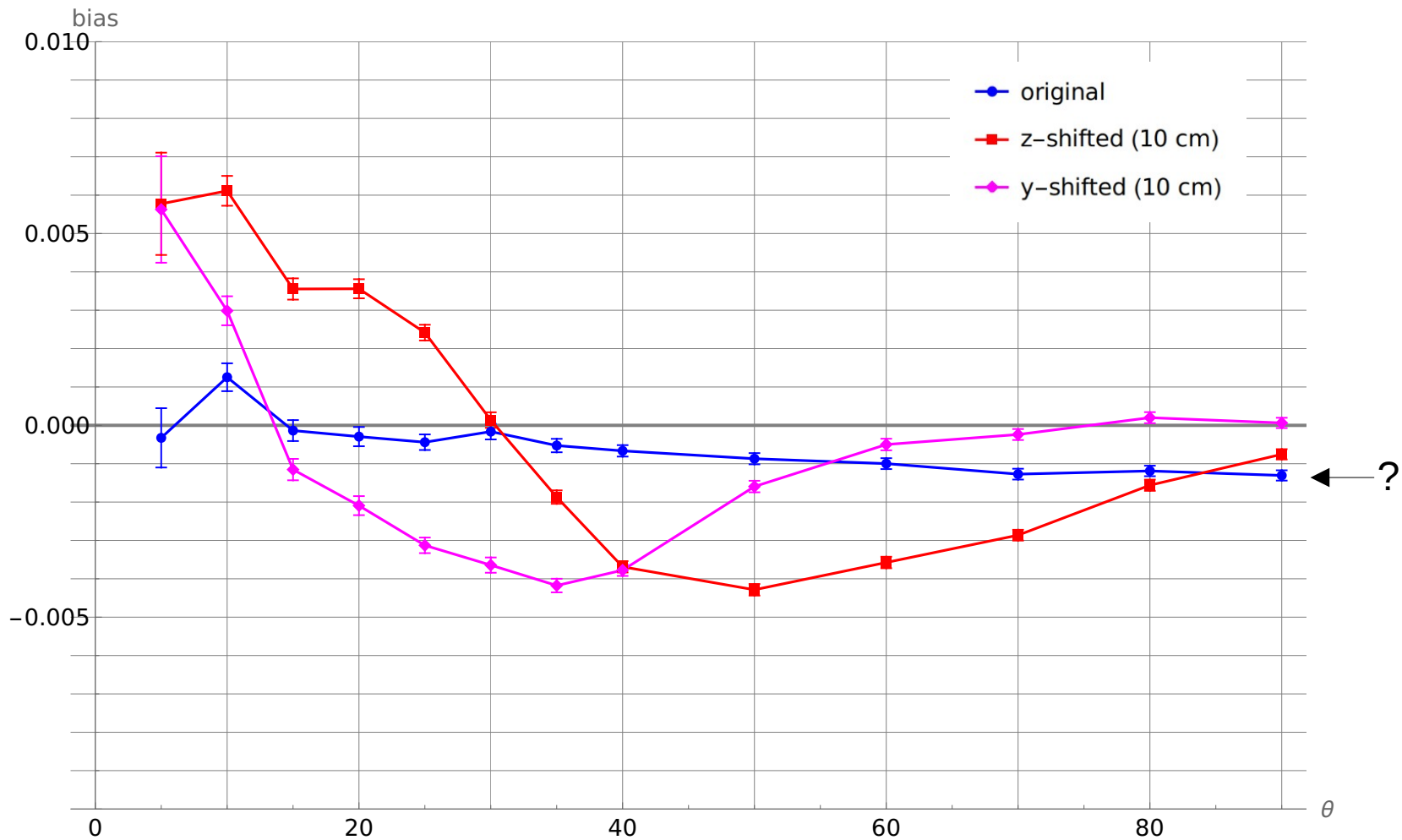
# Momentum bias

( $p = 1 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )



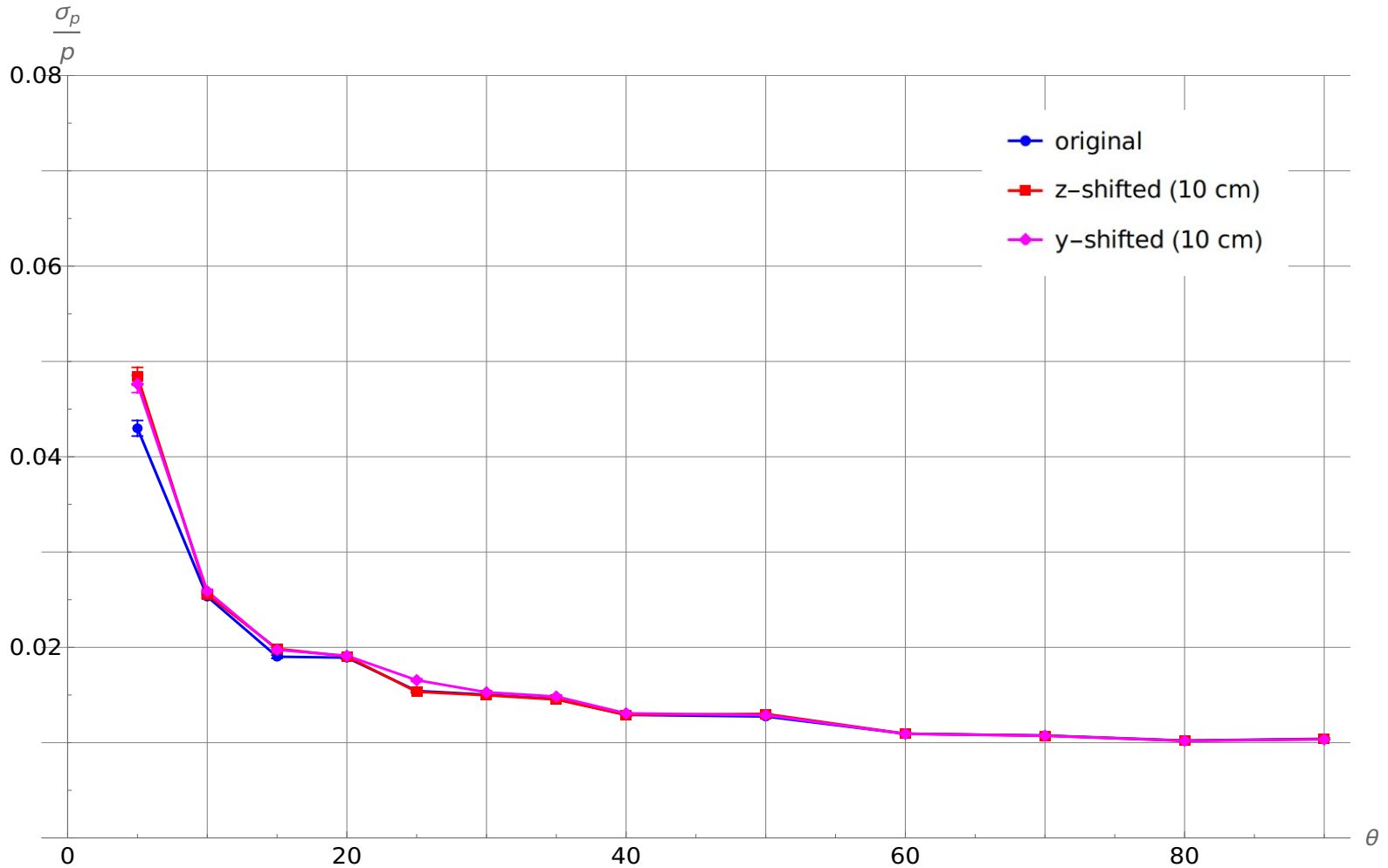
# Momentum bias

( $p = 5 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )



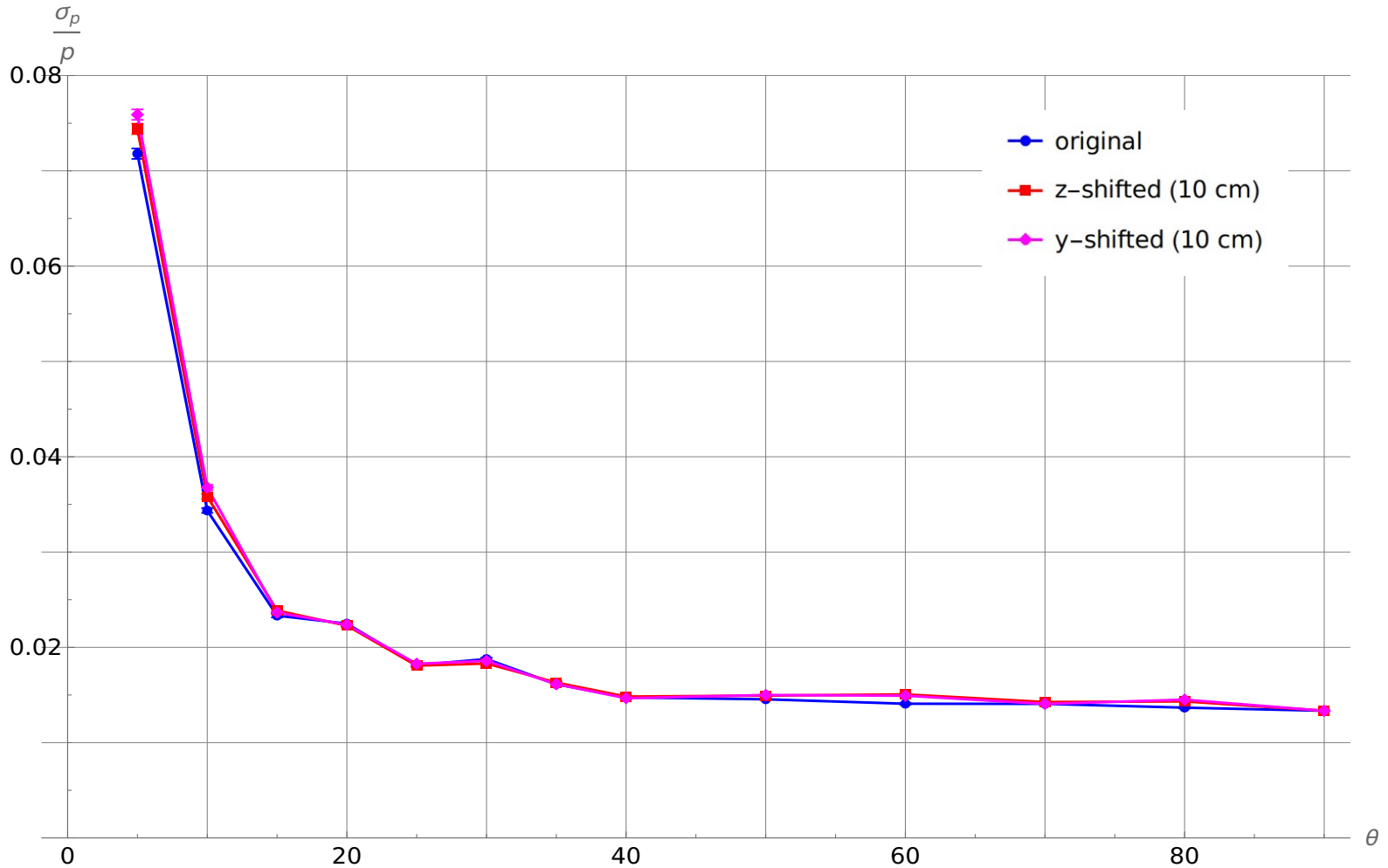
# Momentum resolution ( $\sigma_p/p$ )

( $p = 1 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )



# Momentum resolution ( $\sigma_p/p$ )

( $p = 5 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )



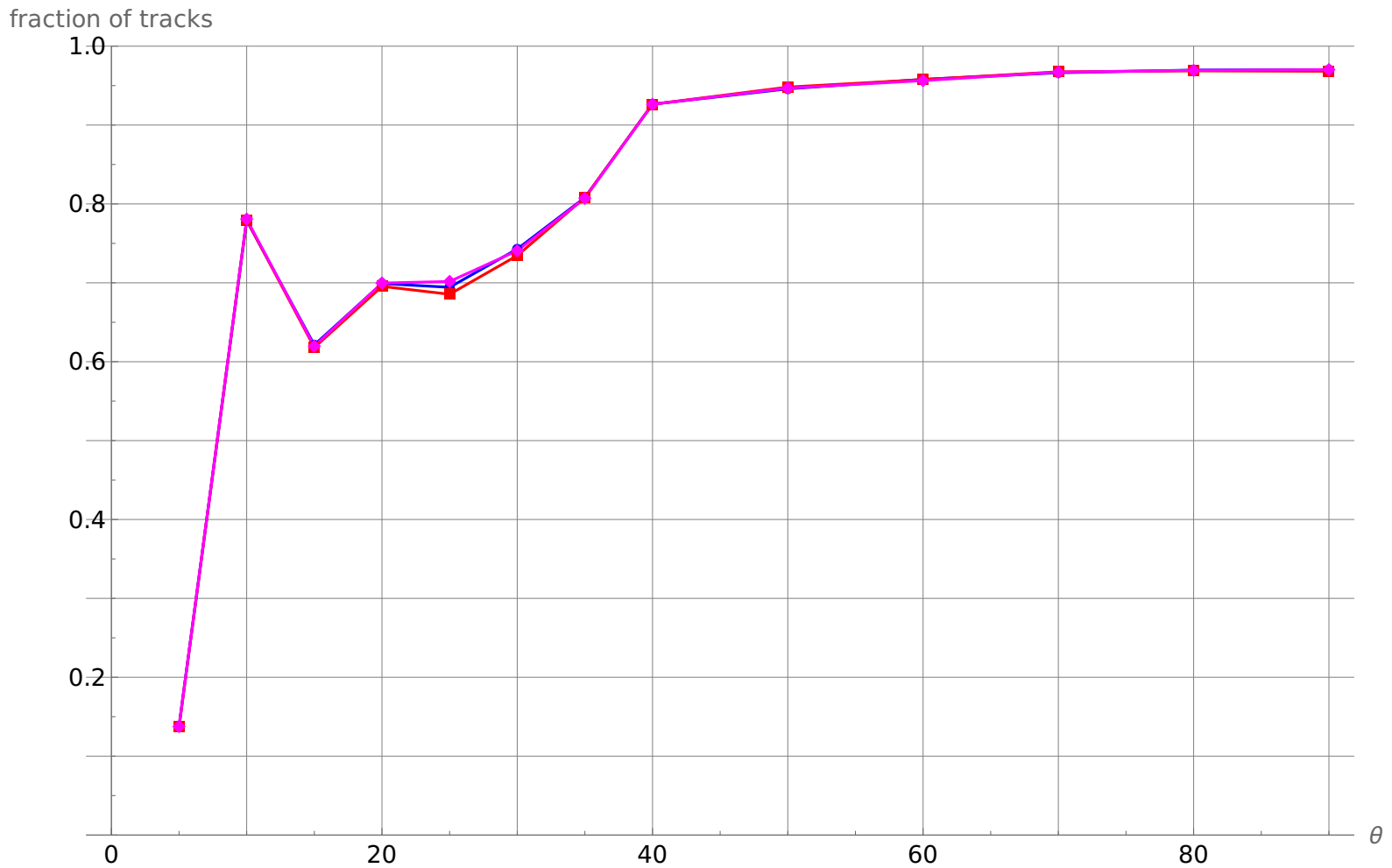
# Conclusions

- Magnetic field shift in reconstruction procedure leads to a bias of reconstructed momentum, which depends on track direction.
- For (unrealistically large) shift = 10 cm this bias is up to 0.8%.
- For shift = 1 cm, the bias is  $\leq 0.1\%$ .
- Momentum resolution ( $\sigma_p/p$ ) is not affected by magnetic field shift.

# Backup slides

# Fraction of tracks after quality cuts

( $p = 1 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )





# Fraction of tracks after quality cuts

( $p = 1 \text{ GeV}/c$ ,  $\phi = 90^\circ$ )

