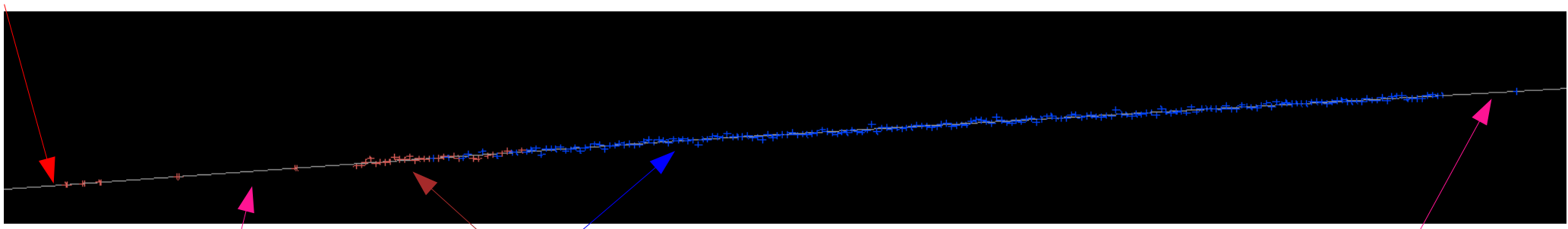
kinked tracks

$\chi_2^+ \rightarrow \chi_1^+ +$ invisible



2 MarlinTrk tracks
(slightly overlapping)

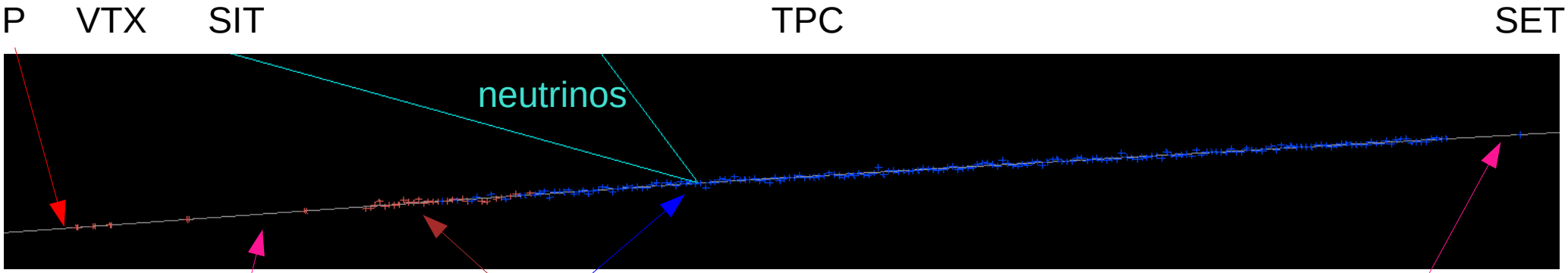
m = 150 GeV chargino
E = 247.95 GeV

m = 152 GeV chargino
E = 249.50 GeV

Daniel Jeans, 2020/11/20

kinked tracks

$\chi_2^+ \rightarrow \chi_1^+ +$ invisible



2 MarlinTrk tracks
(slightly overlapping)

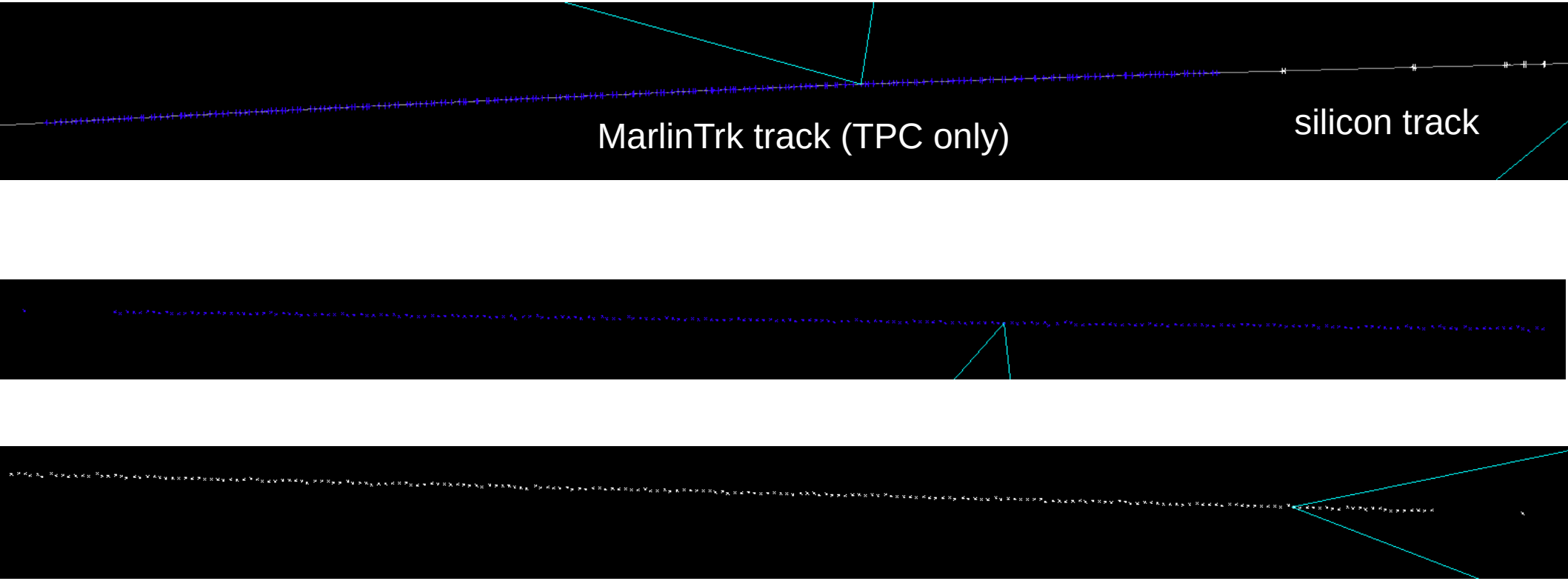
m = 150 GeV chargino
E = 247.95 GeV

m = 152 GeV chargino
E = 249.50 GeV

standard tracking often breaks track
at wrong place

kink is often not found

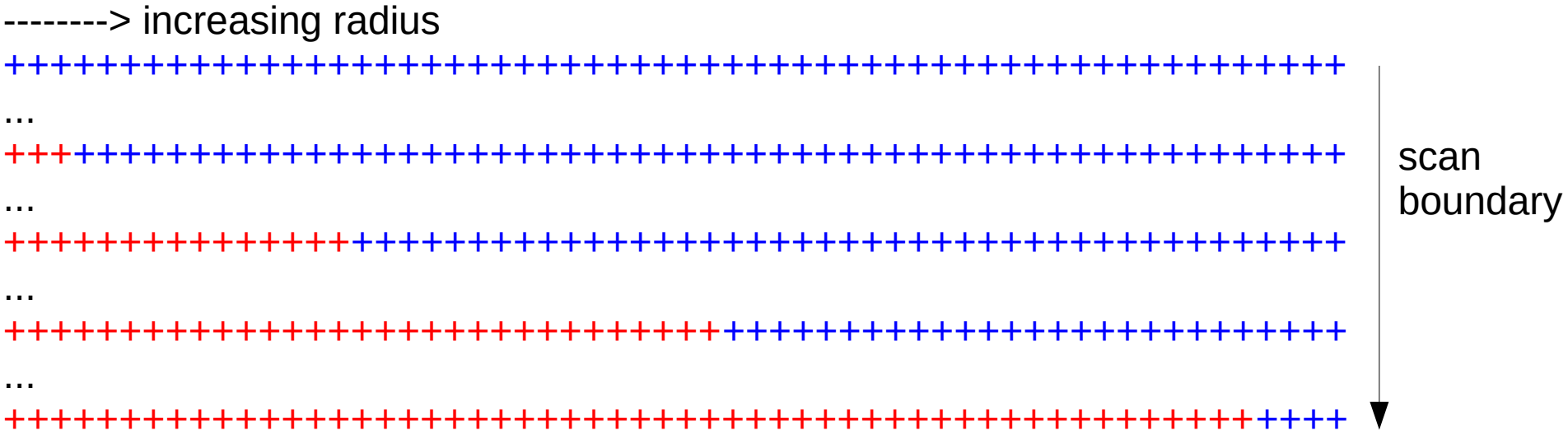
(sometimes causes break between TPC and silicon)



can we find kinks more effectively?

for now, consider only TPC hits (adding si hits will probably help a lot, though)

split TPC hits into 2 track candidates, fit them separately:



and compare the two tracks

[I guess there is a smart way to remove/add hits to the track fit,
rather than refitting all each time…?]

++

fit each set of hits

- fit chi2 for each track
  - chi2 probability for each track
  - combined chi2 probability = Prob(chi2,ndf) * Prob(chi2,ndf)

- compare the track parameters
  - to make this easier, I include the boundary hit in both tracks
  - → track state at end of red track
    - has same reference point as
    - track state at start of blue track
      - → easier to compare parameters

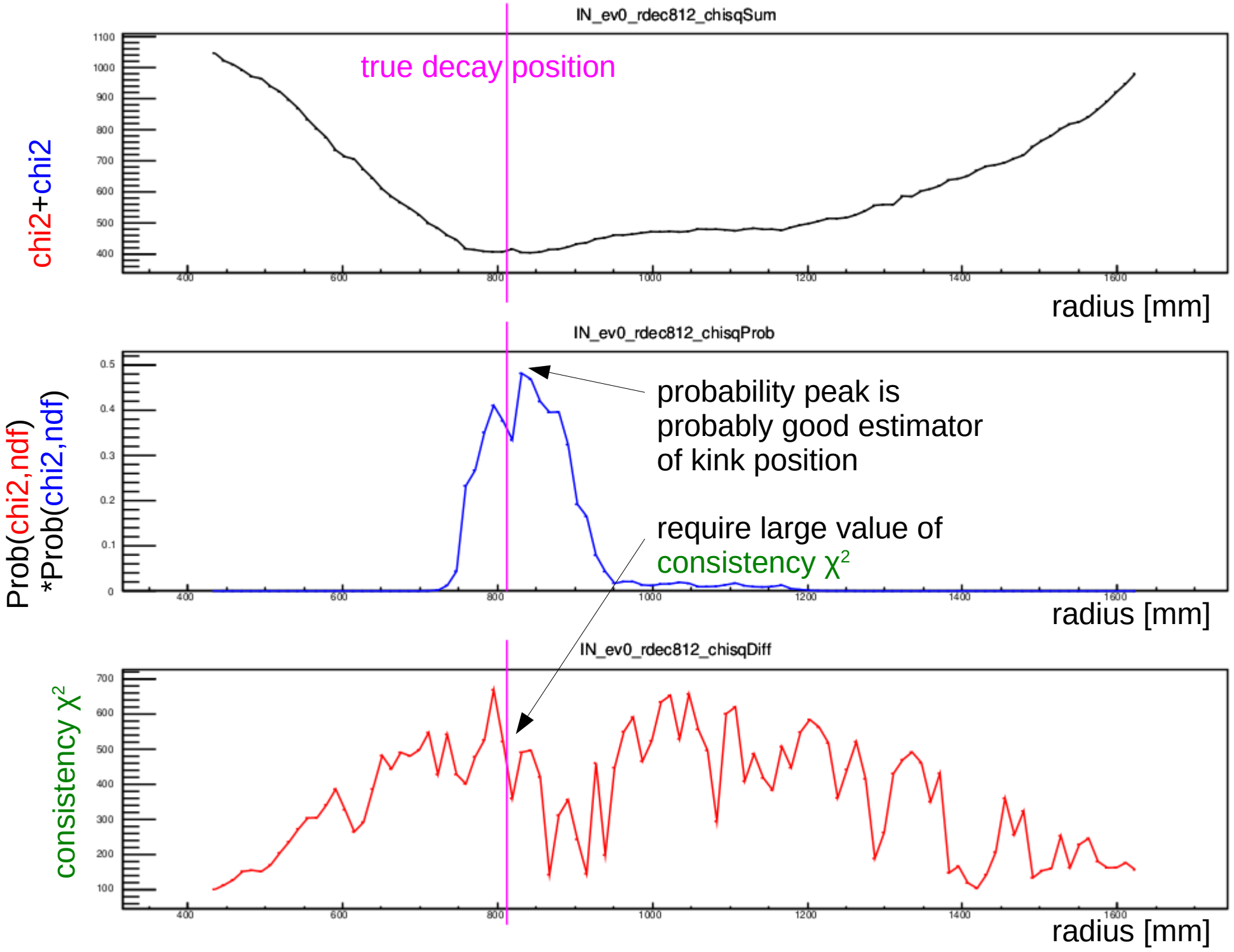
5 track parameters

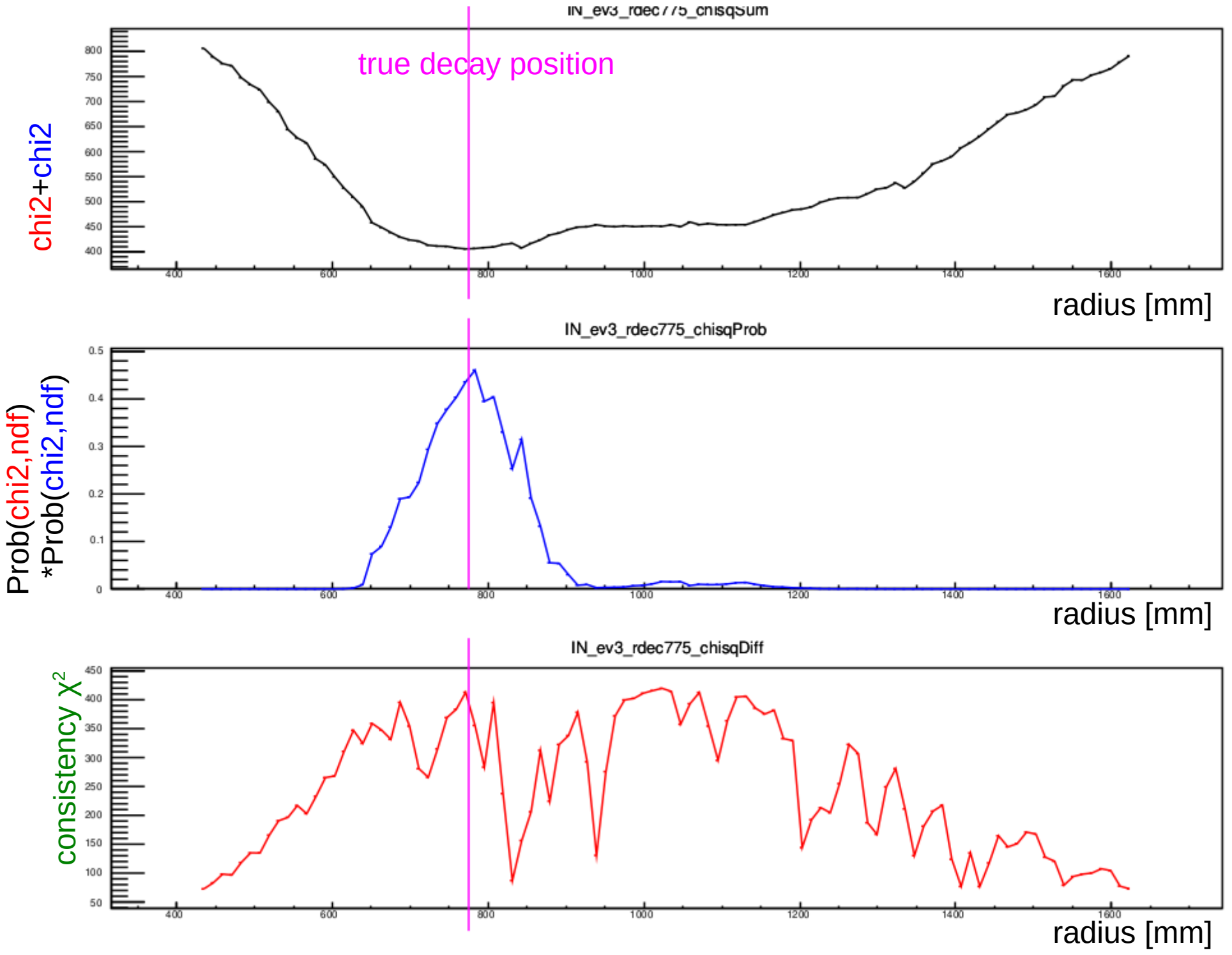
$$\delta P = \begin{Bmatrix} d0 \\ z0 \\ phi0 \\ omega \\ tanl \end{Bmatrix} - \begin{Bmatrix} d0 \\ z0 \\ phi0 \\ omega \\ tanl \end{Bmatrix}$$

combine (sum) the track covariance matrices,
(this assumes no correlation: not strictly true because 1 hit is shared)
invert to get error matrix **E**

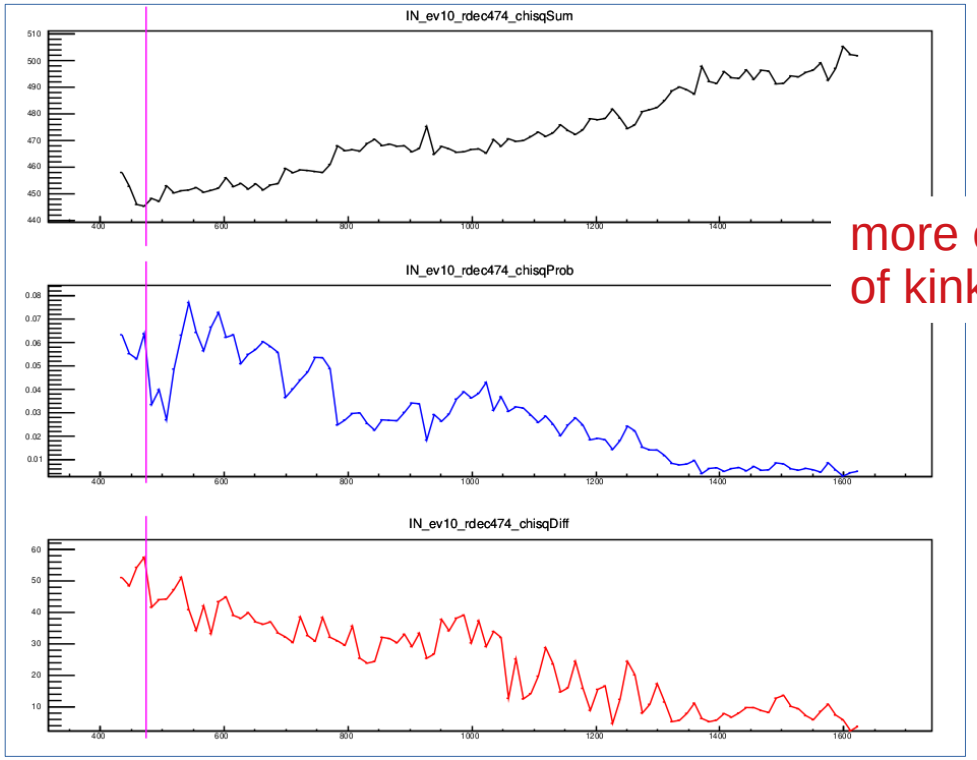
then "consistency χ^2" = $(\delta P)^T$ **E** (δP)

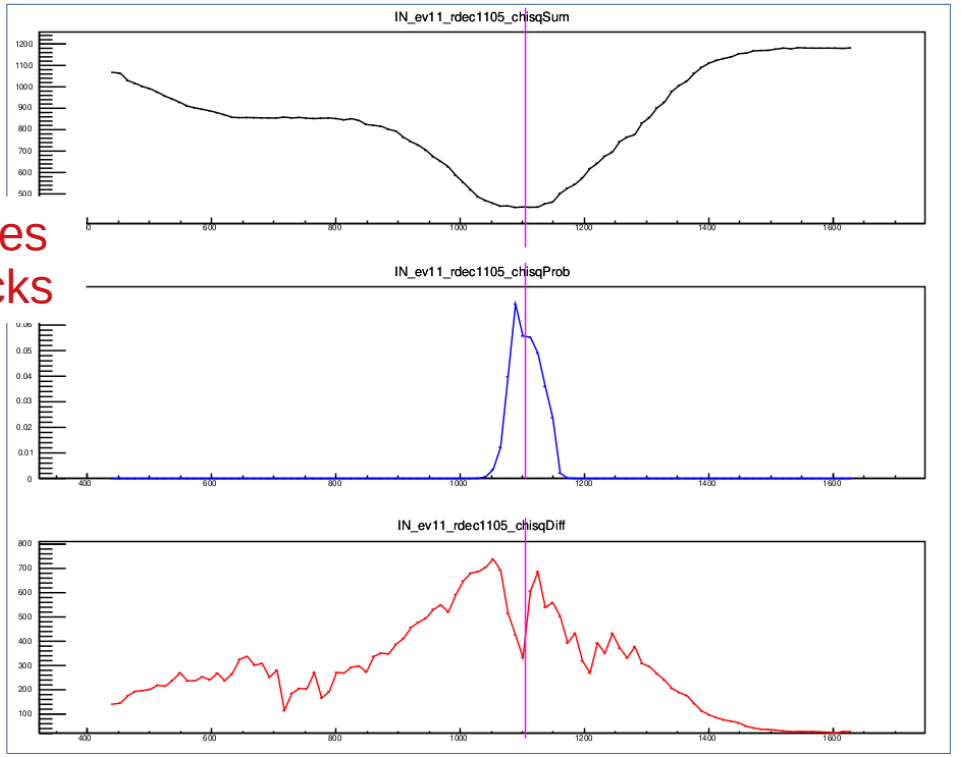
check if parameters of 2 tracks are consistent:
- small χ^2 → consistent, could be same track
- large χ^2 → not consistent

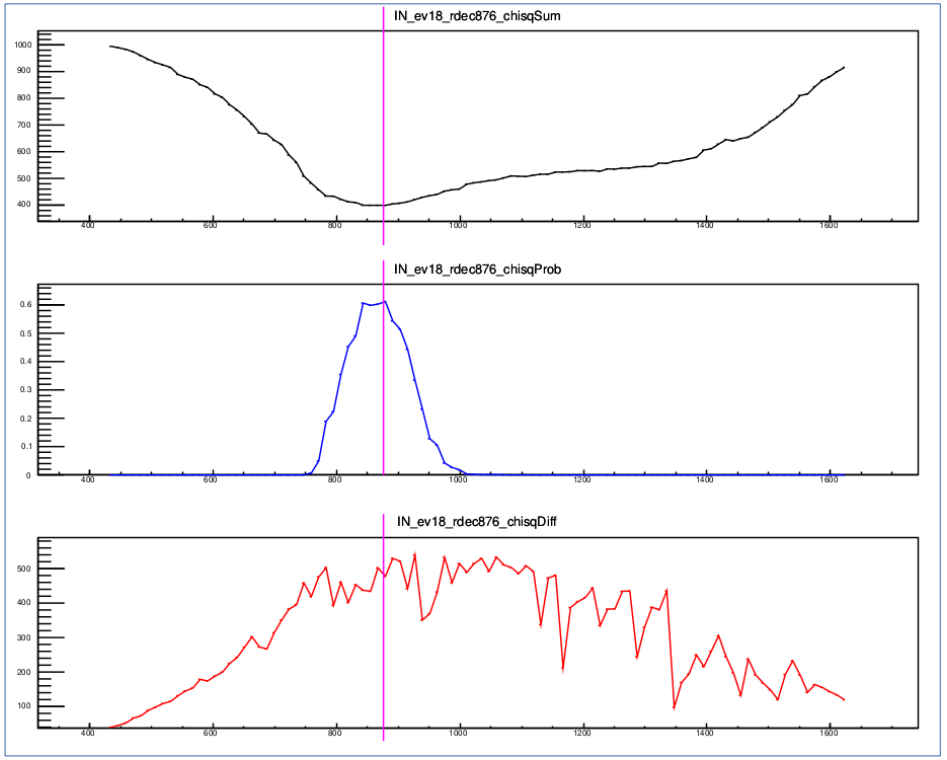

IN_ev0_rdec812_chisqSum
true decay position
chi2+chi2
radius [mm]
IN_ev0_rdec812_chisqProb
Prob(chi2,ndf)
*Prob(chi2,ndf)
probability peak is
probably good estimator
of kink position
require large value of
consistency χ²
radius [mm]
IN_ev0_rdec812_chisqDiff
consistency χ²
radius [mm]

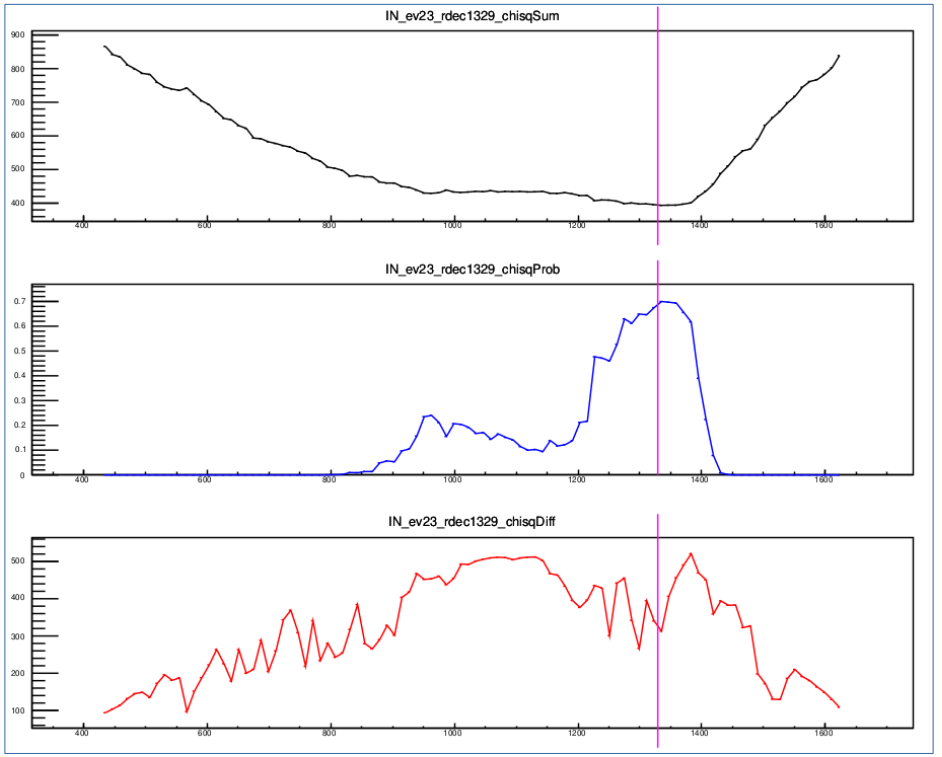

IN_ev3_rdec775_chisqSum
true decay position
chi2+chi2
radius [mm]
IN_ev3_rdec775_chisqProb
Prob(chi2,ndf)
*Prob(chi2,ndf)
radius [mm]
IN_ev3_rdec775_chisqDiff
consistency χ2
radius [mm]

more examples
of kinked tracks

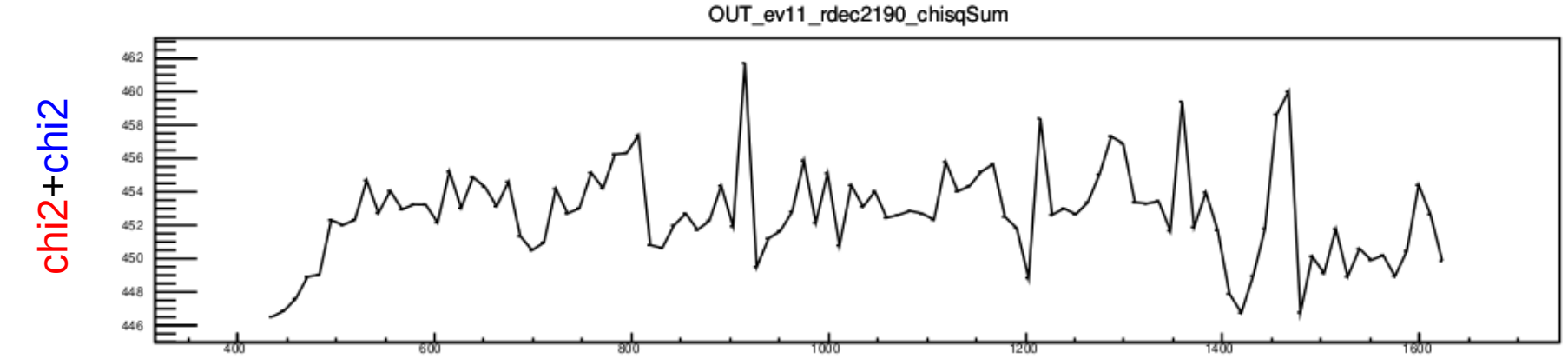


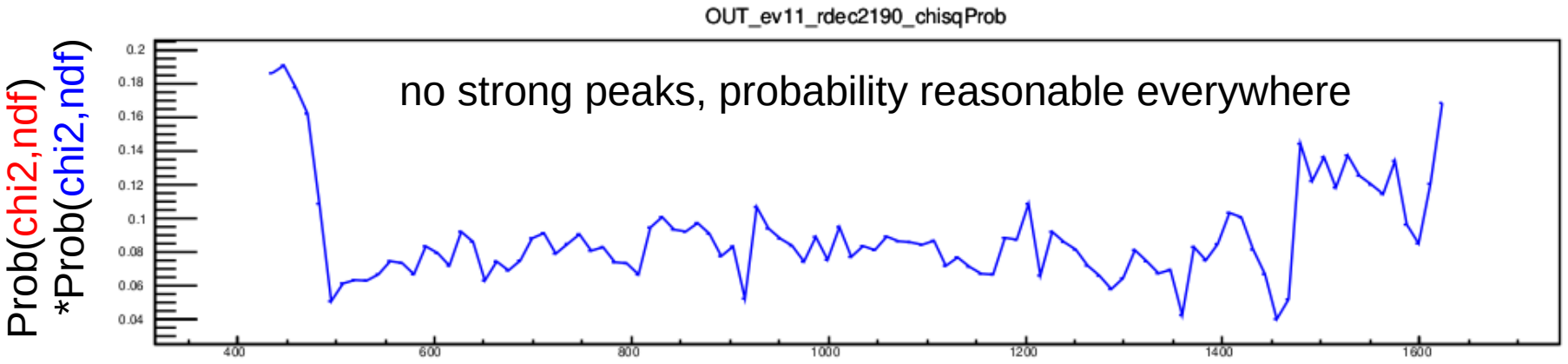


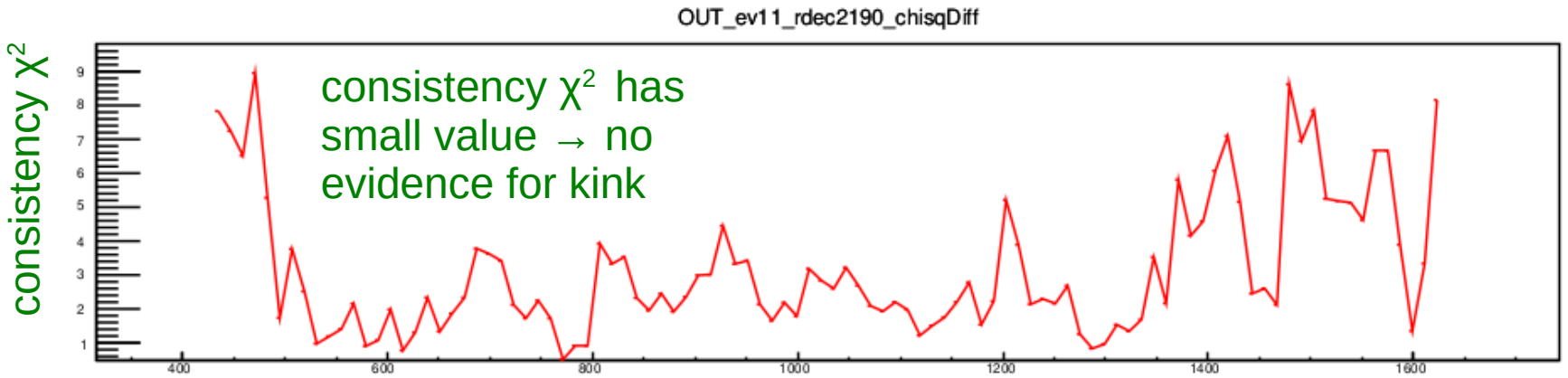




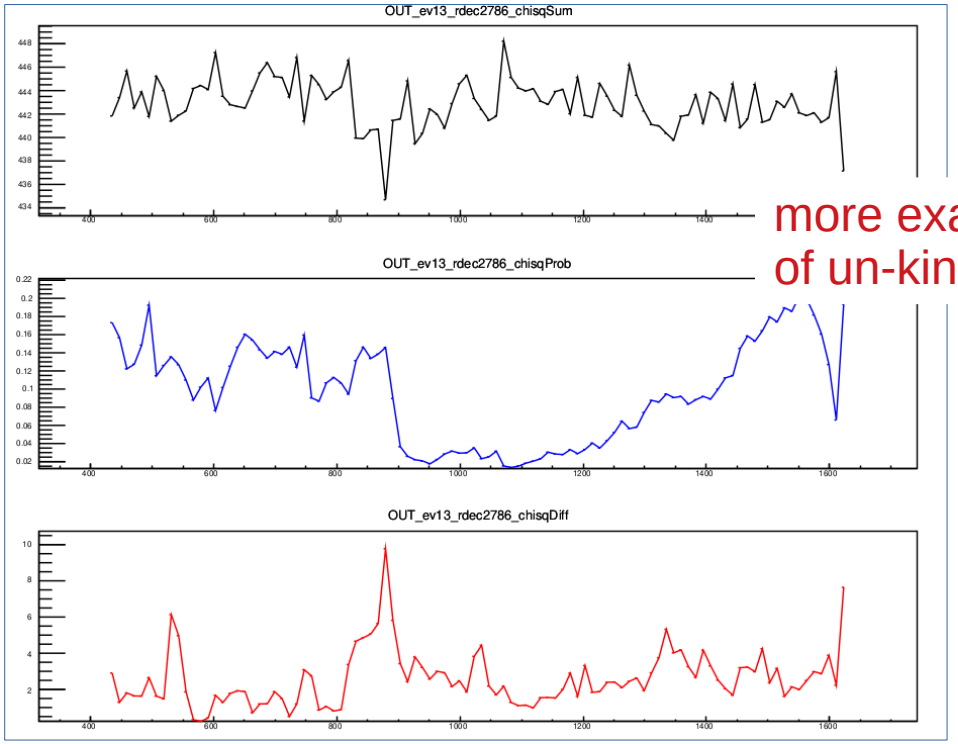
how about un-kinked tracks? (we don't want to find fake kinks)

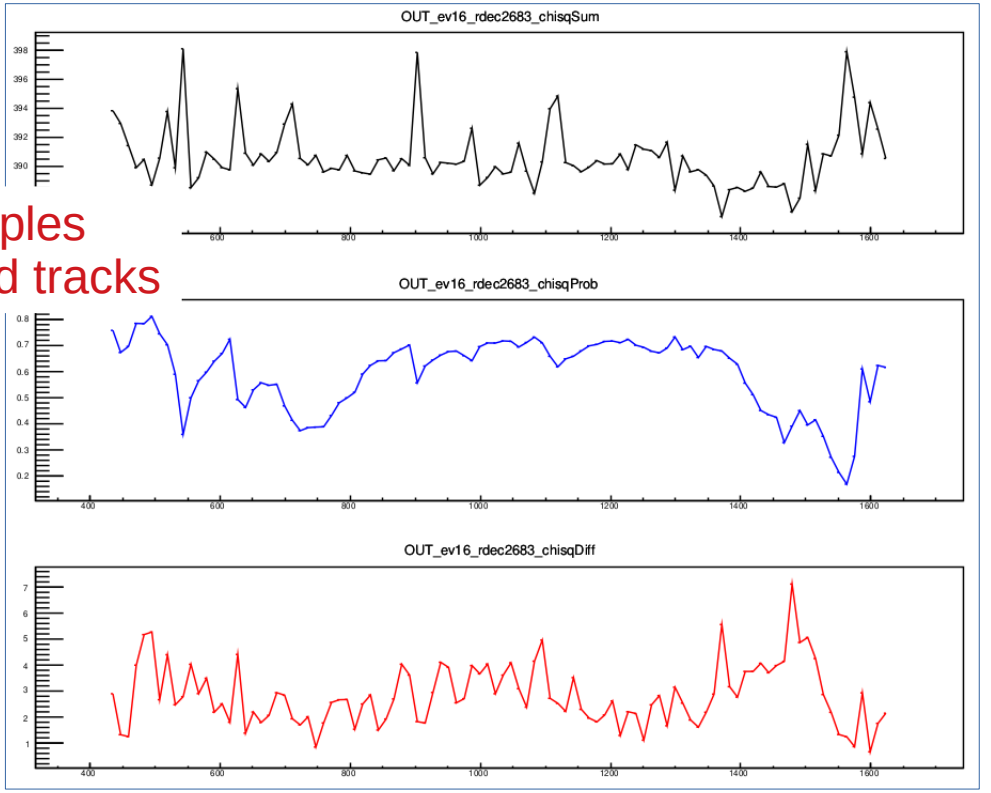


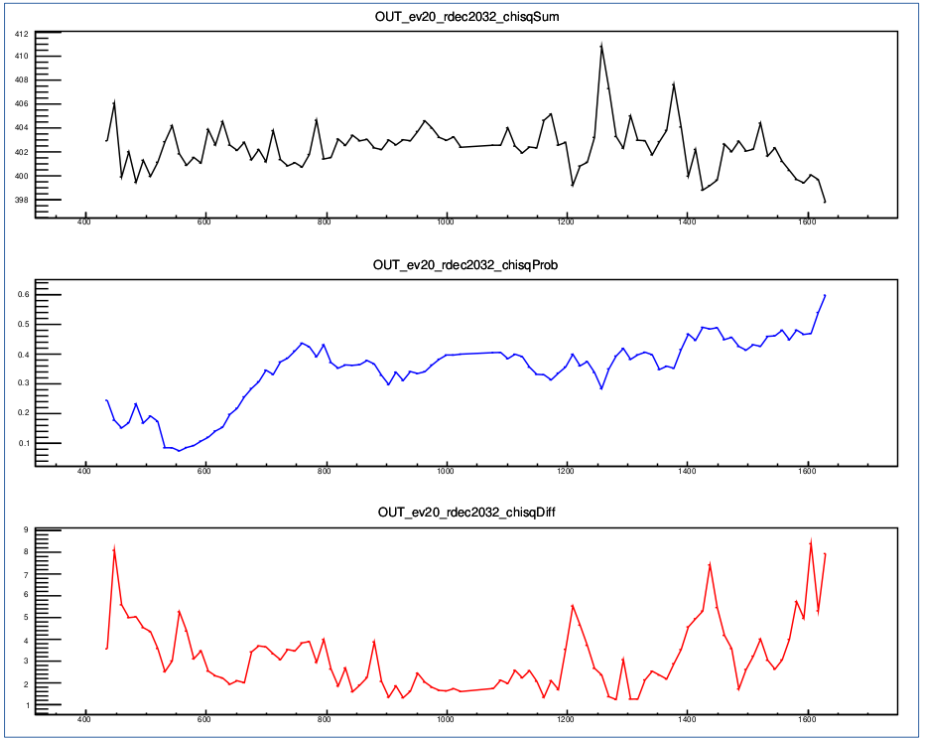


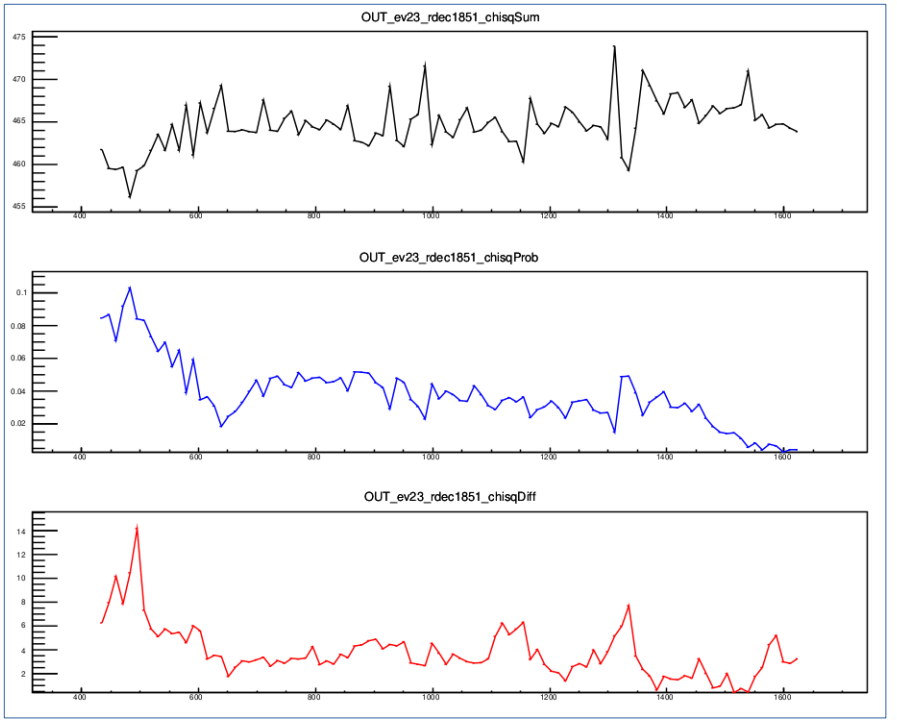


more examples
of un-kinked tracks









Summary

first ideas on how to identify and localise kinks

I think this looks quite promising
→ nice demonstration of TPC capabilities

plans:

make computationally more efficient

implement criteria; study efficiency and fake rates

add silicon hits