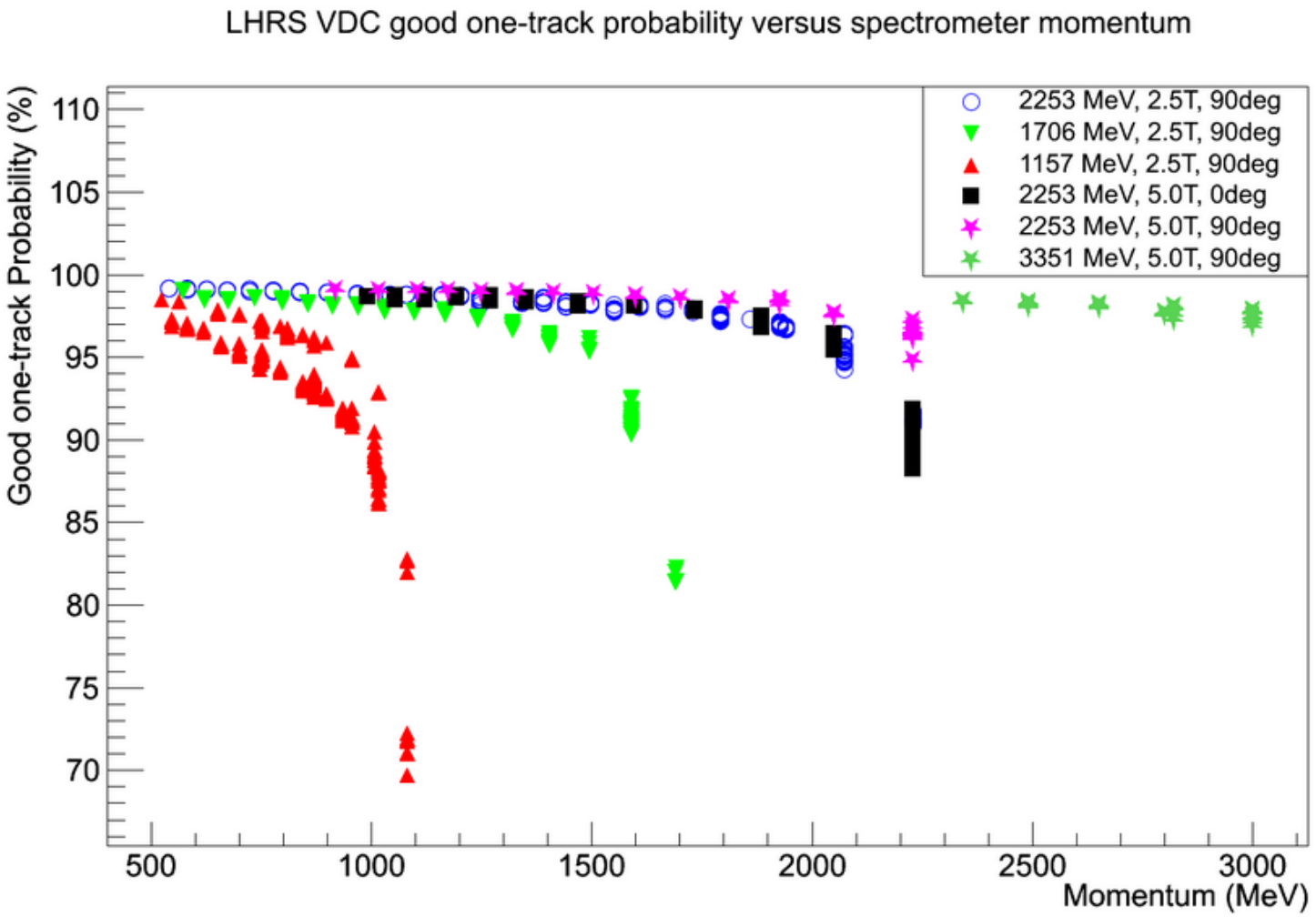
Multi-track efficiency

➢ Outline

- **Review:**
  a. One-track VDC misconstruction
  b. Add electron+ background cut (will not be used)
  c. New sample

- **New for VDC efficiency:**
  a. Another new method
     Deposited energy contamination between tracks
  b. Systematic include inefficiency
     0-track, mismatched cluster in track, background track

Why do we study multi-track efficiency?



- Absolute cross section need absolute number good electrons

How

➢ Step

Electron sample —Reconstruct in lead glass→ at-least-one-good track probability

❑ **Sample selection rule:**

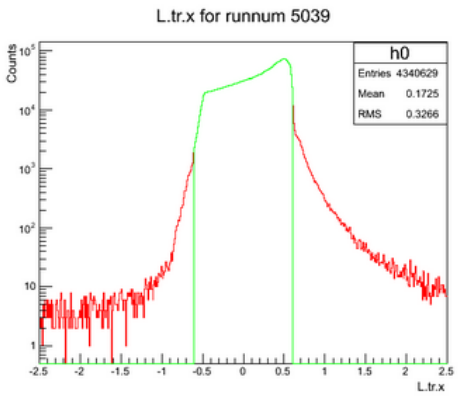
- Cerenkov cut:
  L.cer.asum_c>200
- Pion rejector cuts:
  L.prl1.e>prl1_cut
  Etot>Etot_cut
- At least one track within acceptance
- 0-track events included

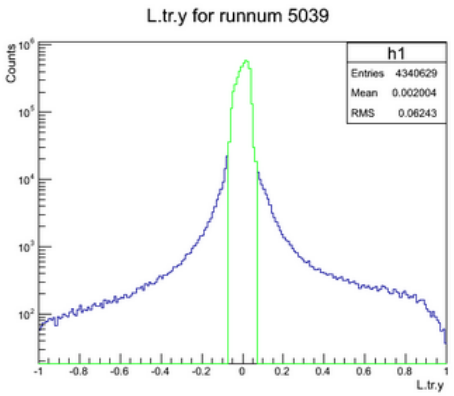
❑ **PID cuts:**

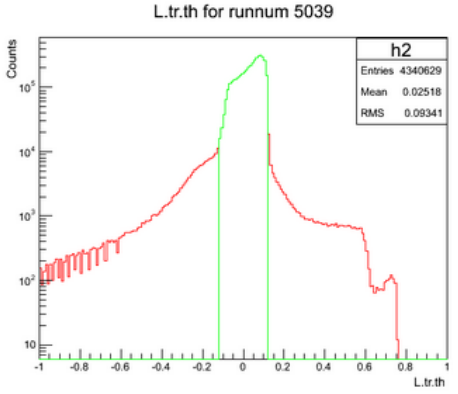
At-least-one track satisfy:

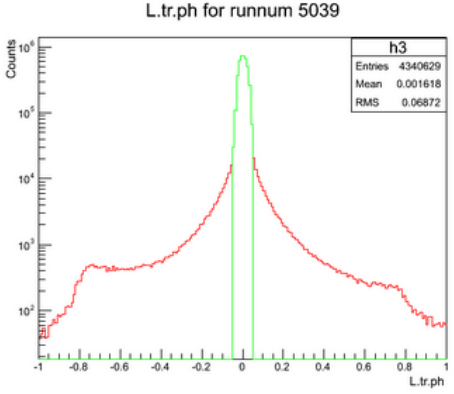
- Cerenkov cut:
  L.cer.asum_c>200
- Pion rejector cuts:
  L.prl1.e>prl1_cut
  Etot>Etot_cut
- This track should within acceptance cut

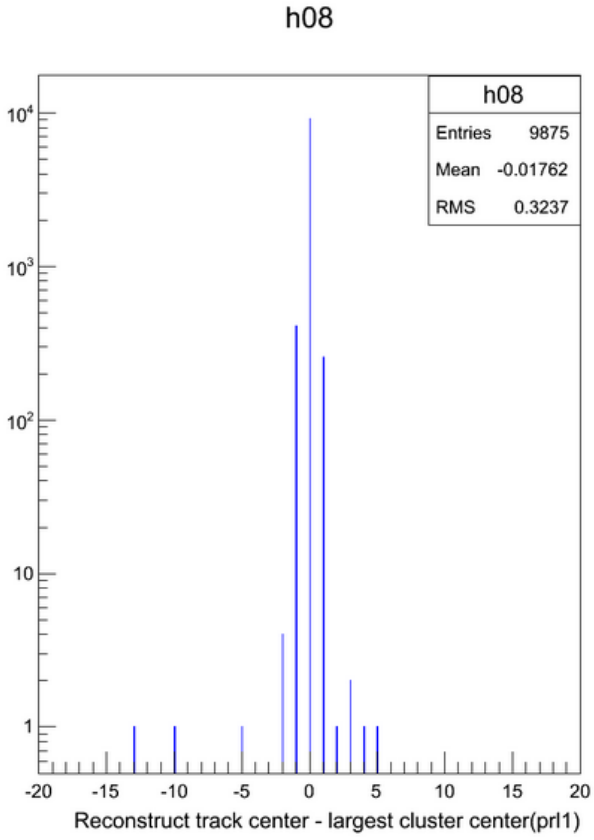
Why this sample











Acceptance cuts

Mismatched cluster for one-track events reduced from 1.4% to 0.1% in PRL1

→ clean sample

Mismatched track: Energy deposited cluster center is far away from the VDC pointing center

Multi-track efficiency systematic study

- Track probability in electron sample for 1.157GeV, 1081.97MeV, 2.5T

Number of tracks	0	1	2	3	4	5	6	7	More than 7
LHRS	0.00112	0.71366	0.18048	0.07134	0.02103	0.00762	0.00283	0.00108	0.00084

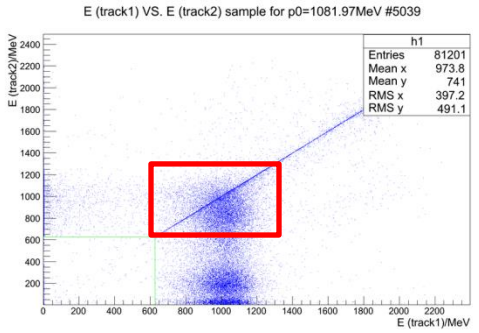
Zero track: half consider as inefficiency, put into uncertainty
$0.00056 \pm 0.00056(sys.)$

One track: uncertainty comes from mismatched track
$0.71102 + 0.00264(\mathrm{sys.})$

Multi-tracks?

- If two tracks come into Pion rejector within 1-block distance, they will share the energy when reconstruct the cluster in lead glass. It's hard to tell which part of the cluster energy from the track you considered.

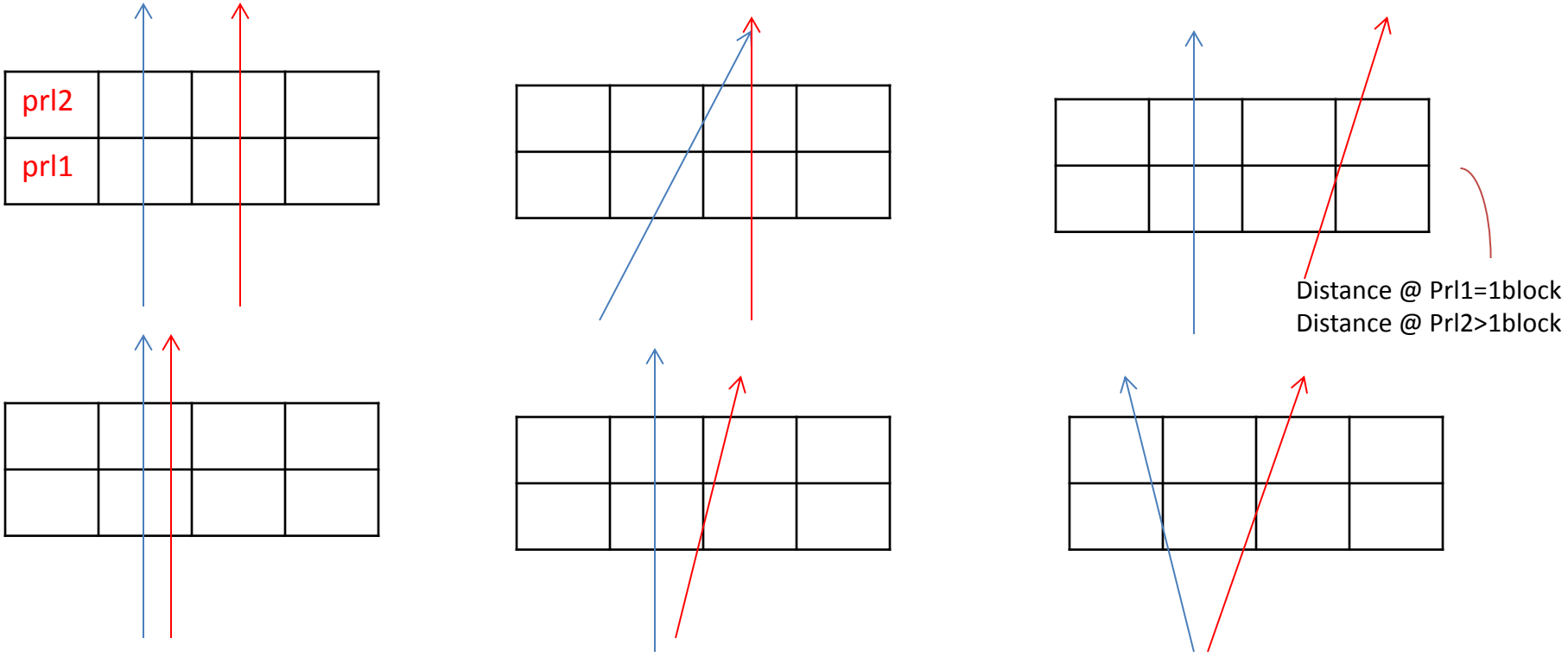
defined



Energy contamination between tracks

Multi-tracks?

- Energy contamination between two tracks



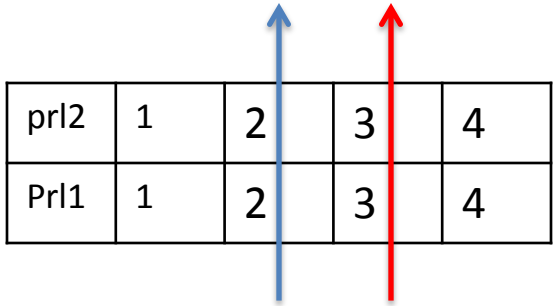
- Arrow is track path.
- Energy contamination depends on the distance in prl1 and prl2 (only neighbour share)
- Three configuration for each pion rejector layer:

✓ Distance =0 or distance =1 or distance >1 block distance

Multi-tracks?

- Energy contamination between two tracks

For example:

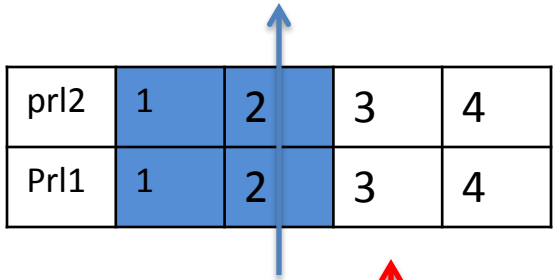


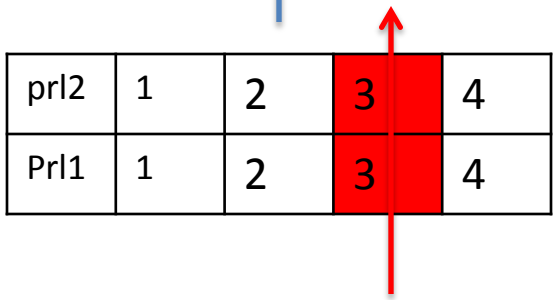
Blue track good:

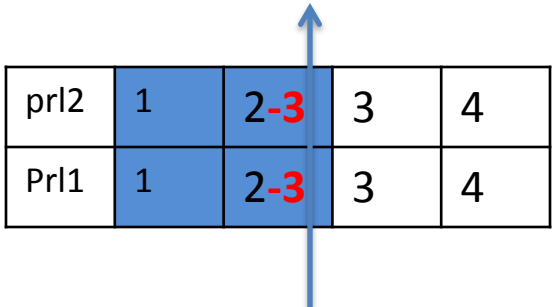
a. Blue track energy:

substract

Red track contamination





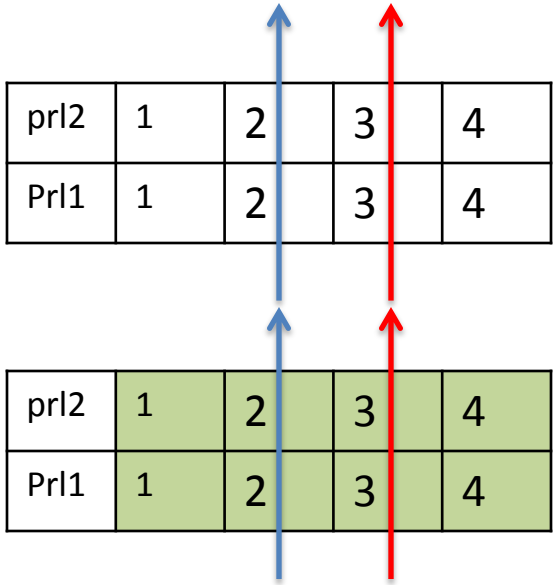


Satisfy electron cut

Multi-tracks?

- Energy contamination between two tracks

For example:



Blue track good:

b. Total track energy:

Satisfy two electron deposited energy cuts

C. Others count as inefficiency

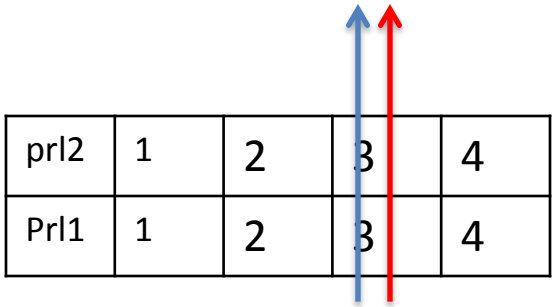
Multi-track efficiency systematic study

- Track probability in electron sample for 1.157GeV, 1081.97MeV, 2.5T

Number of tracks	0	1	2	3	4	5	6	7	More than 7
LHRS	0.00112	0.71366	0.18048	0.07134	0.02103	0.00762	0.00283	0.00108	0.00084

Two track:

$$0.1772 \begin{cases} -0.0078(sys.) \\ +0.0033(sys.) \end{cases}$$



- the upper limit comes from inefficiency
- Most of the lower part limit (0.0062 of 0.0078) from this right type
- Right configuration: total: 0.0093
  good: 0.0031 satisfy two electron deposited energy cuts

Multi-track efficiency systematic study

- Track probability in electron sample for 1.157GeV, 1081.97MeV, 2.5T

Number of tracks	0	1	2	3	4	5	6	7	More than 7
LHRS	0.00112	0.71366	0.18048	0.07134	0.02103	0.00762	0.00283	0.00108	0.00084

Two track:

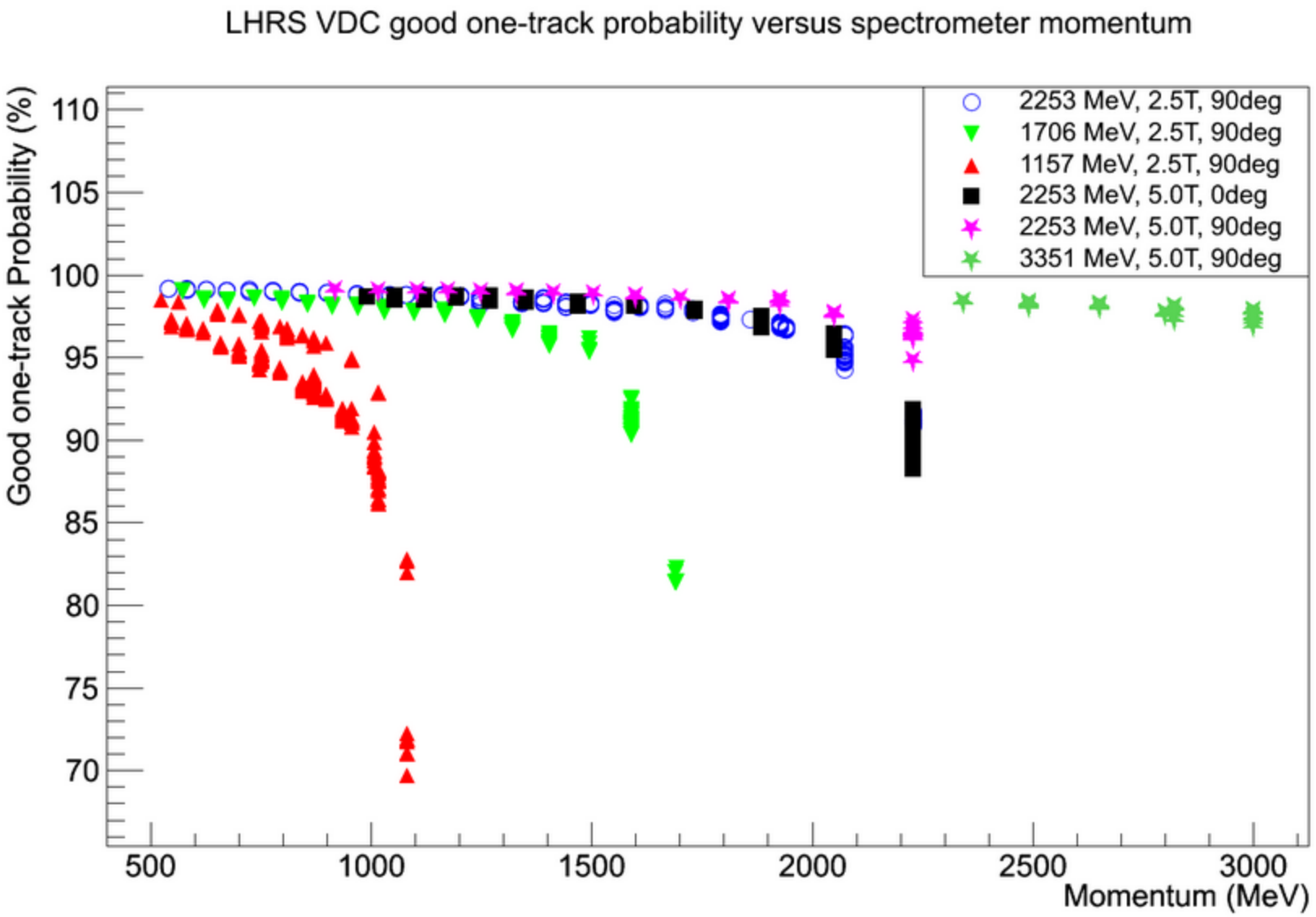
$$98.81\,\% \begin{cases} -1.67\%\ (sys.) \\ +1.19\%\ (sys.) \end{cases}$$

Consider all kinds of track inefficiency

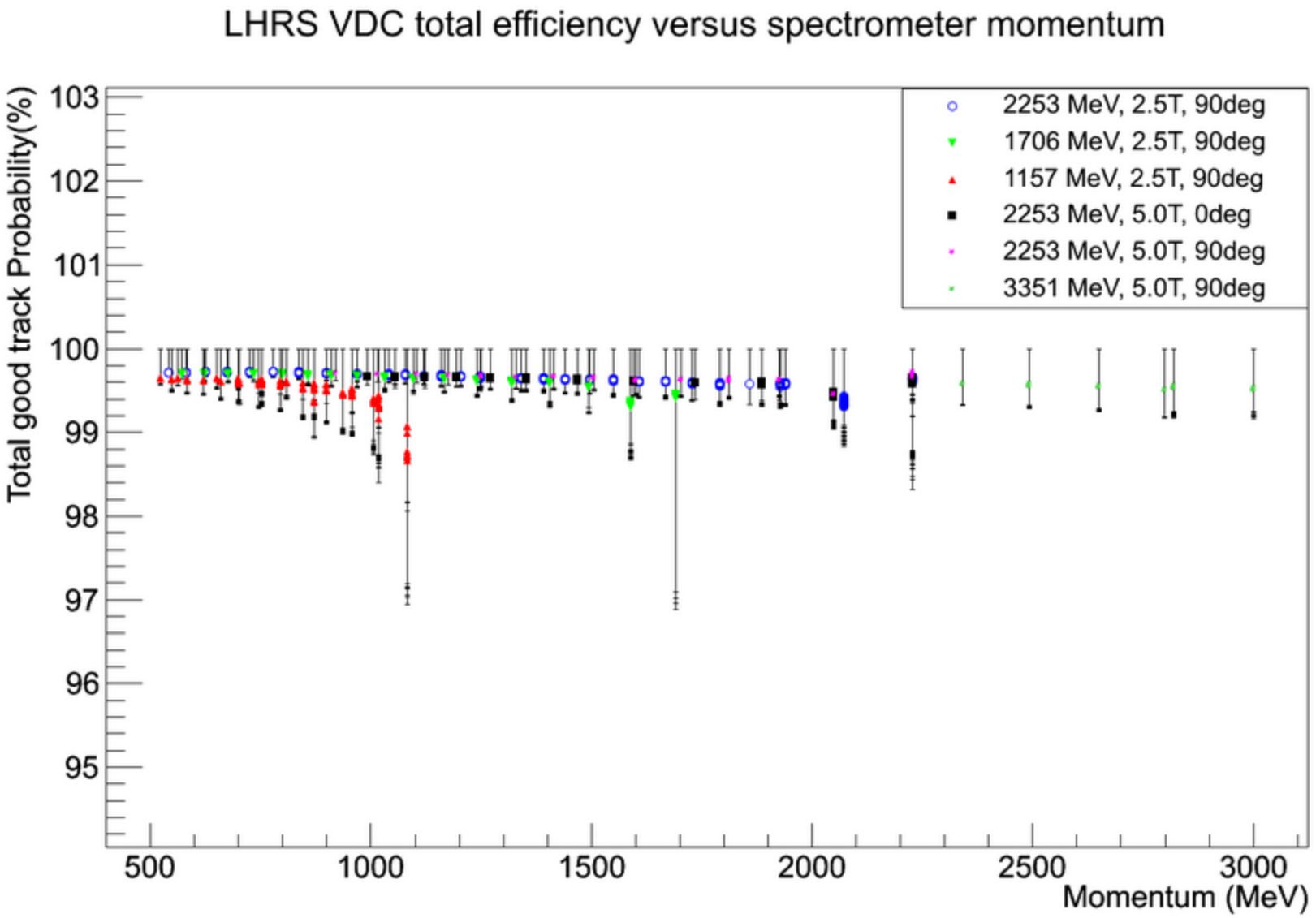
Just electron PID cuts (no background cuts)

Very conservative results

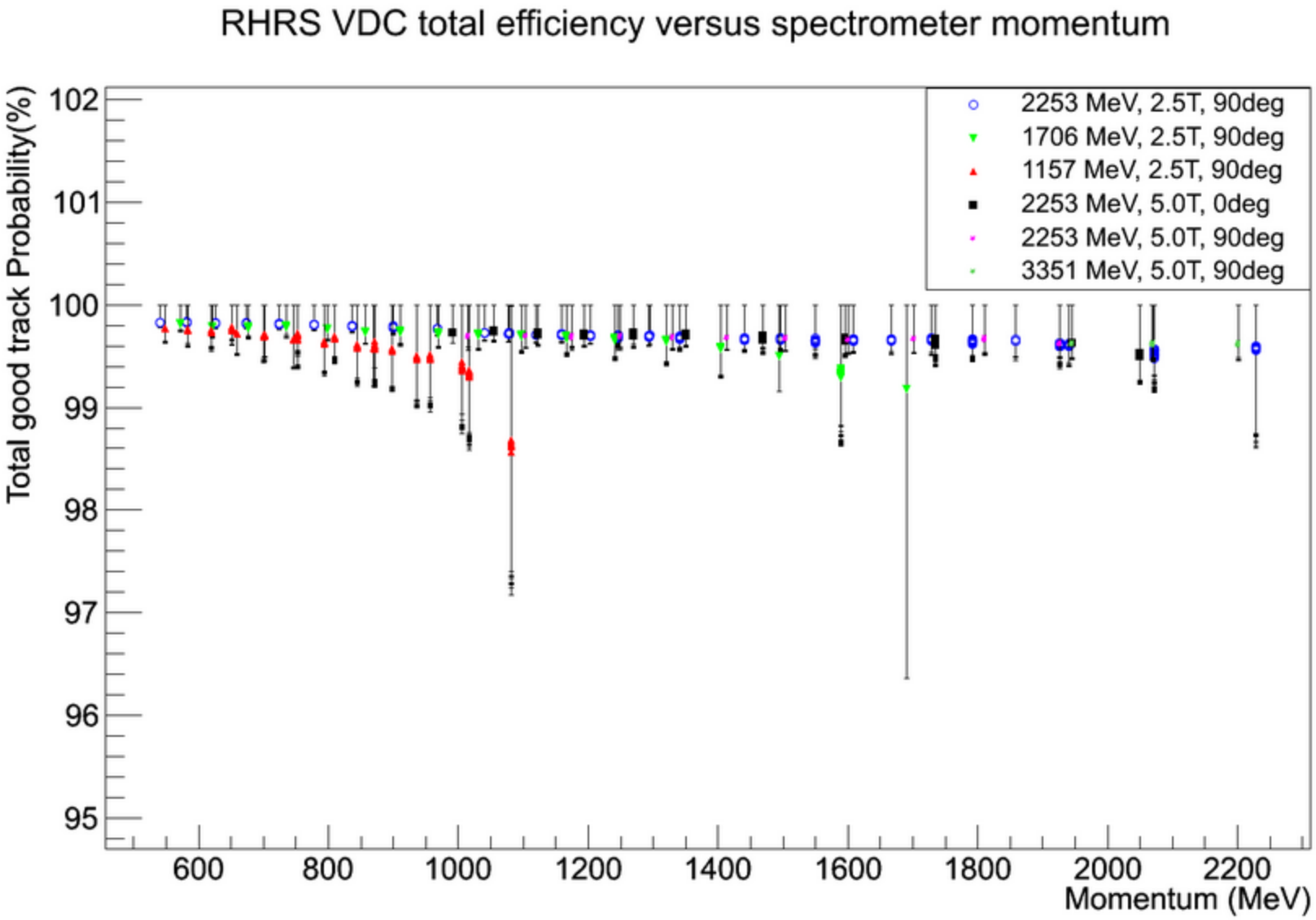
LHRS good one-track



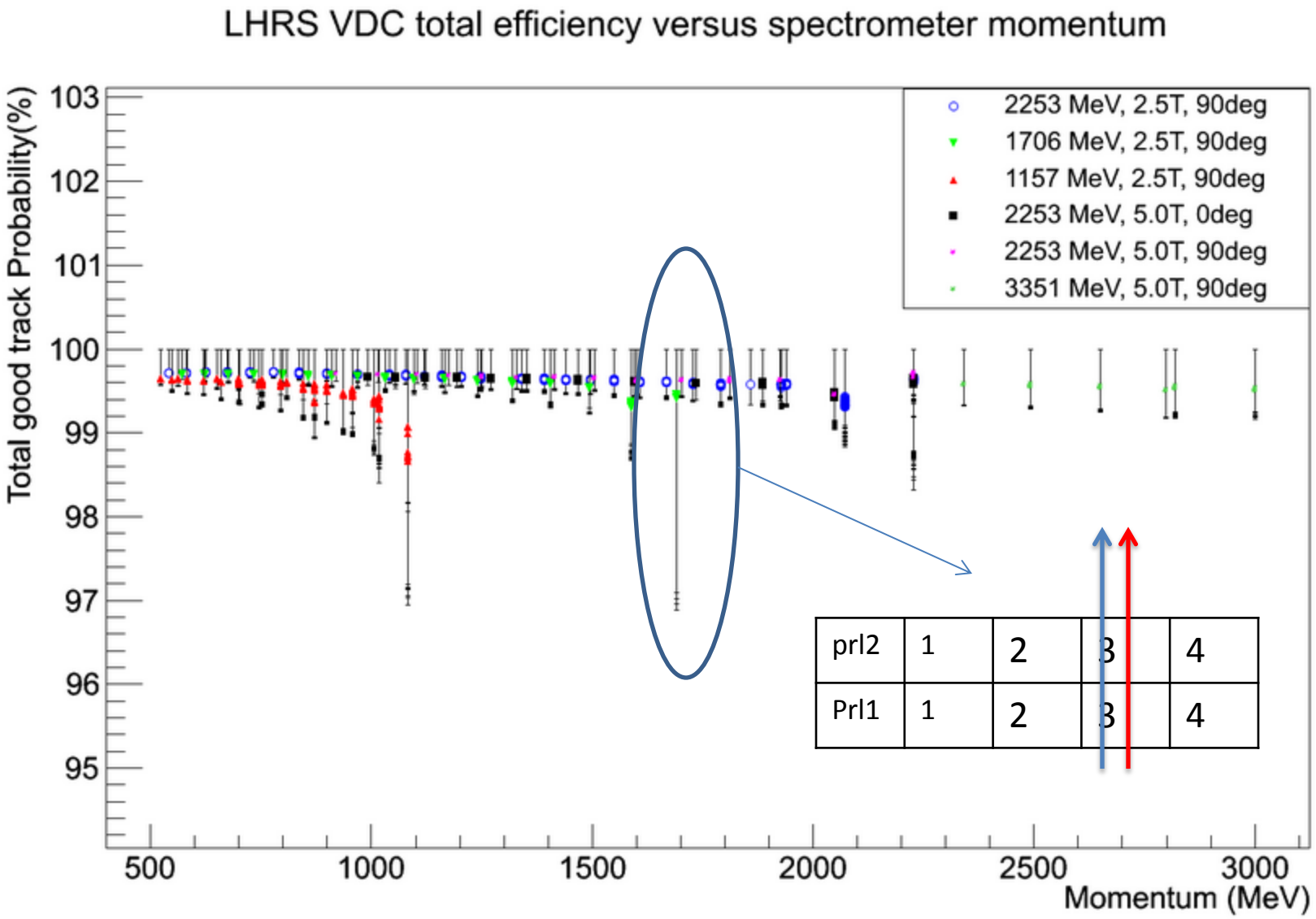
LHRS total good track with systematic



RHRS total good track with systematic



LHRS total good track with systematic

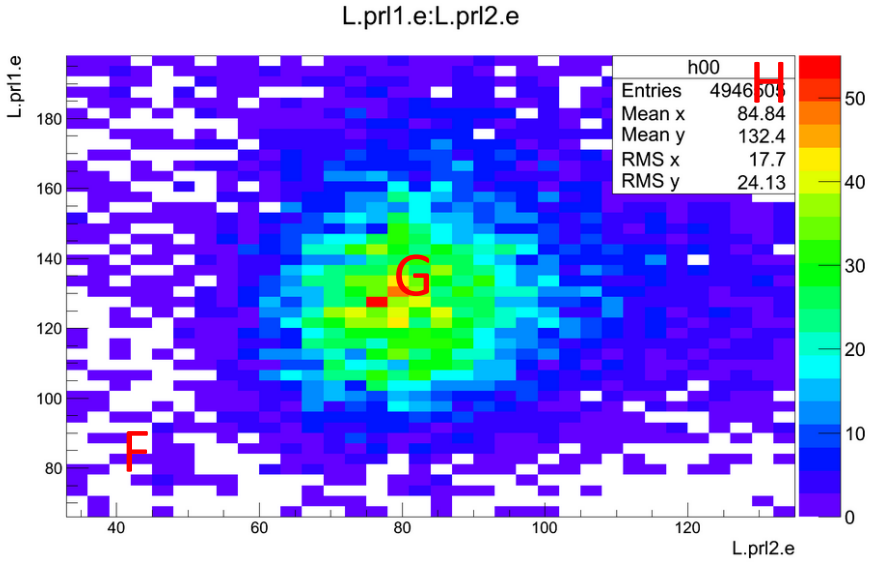


Background cuts?

- For two track events, have 3 types:

a. One good electron+ one good electron
b. One good electron+ one background
c. One background+ one background

- The above kind “a” and “b” have at least one good electron
- The above kind “c” have no good electron tracks
- The previous analysis use the boundary between “a” with” b, c”
  Two track total energy> 2 electron deposited energy cut
- we can find a relative boundary between “a, b” with “c”



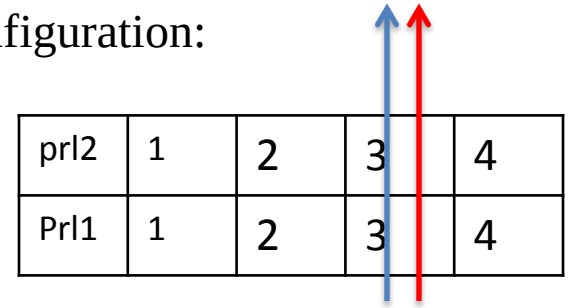
- Choose the background deposited energy @H
  prl1 deposited 190MeV, prl2 deposited 110MeV

- So the total energy cuts:

➢ Total energy > one electron deposited energy + one background deposited energy

➢ Prl1 energy> one electron@ prl1 deposited energy + one background @ prl1 deposited energy

➢ Apply to this configuration:



prl2	1	2	3	4
Prl1	1	2	3	4

Multi-track efficiency systematic study

- Track probability in electron sample for 1.157GeV, 1081.97MeV, 2.5T

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LHRS	0.00112	0.71366	0.18048	0.07134	0.02103	0.00762	0.00283	0.00108	0.00084

Two track:

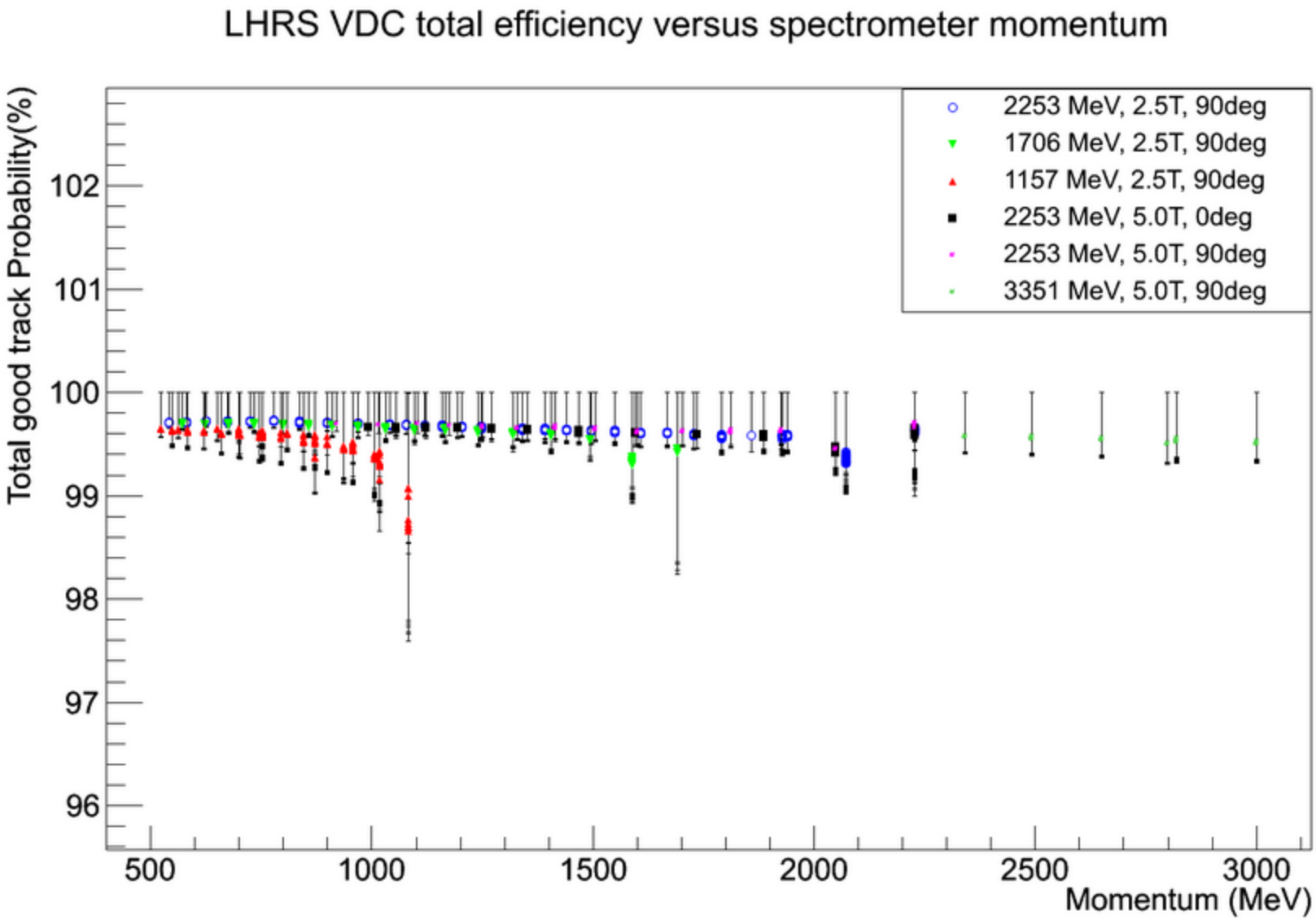
$$98.81\ \% \begin{cases} -1.03\%\ (sys.) \\ +1.19\%\ (sys.) \end{cases}$$

Consider all kinds of track inefficiency

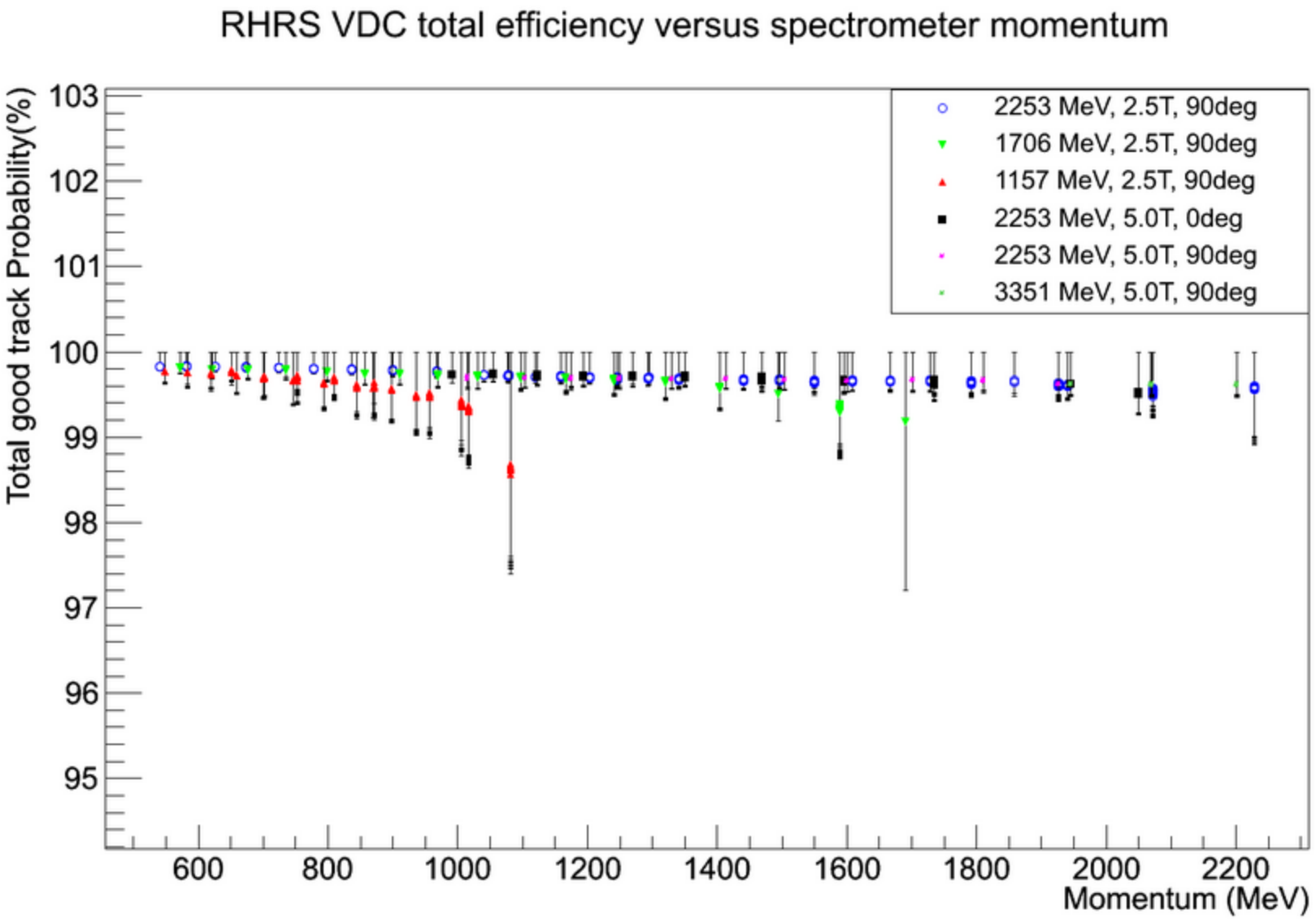
Consider one electron + one background cuts)

Background cuts dependent

LHRS total good track with systematic (add background cuts)



RHRS total good track with systematic (add background cuts)



Conclusion

- The previous result (no background cuts) is a more confident result.
- Adding the background, the systematic uncertainty reduce around 20%, but cuts position dependent, and not 100% sure.
- Suggest to use the previous result