Cut-Based Beam Selection

Illinois Institute of Technology

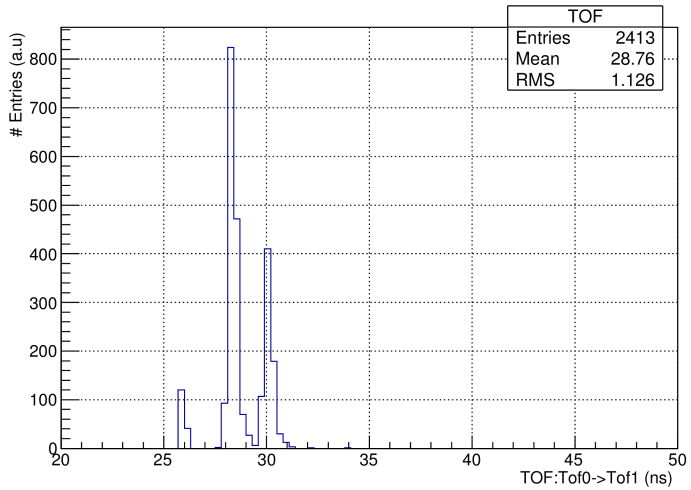
Tanaz A. Mohayai

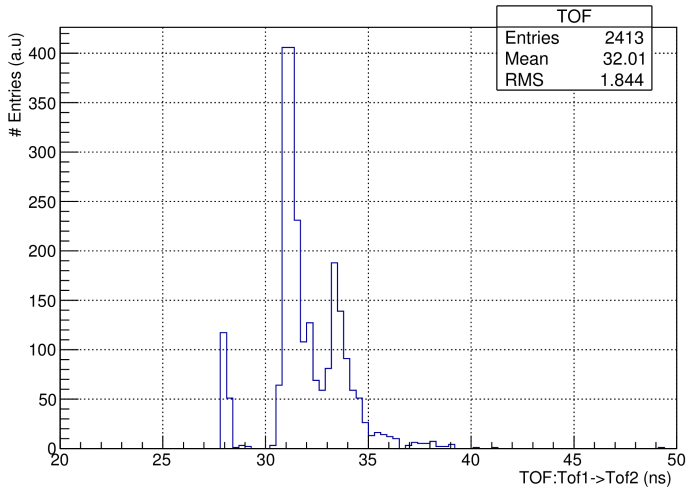
March 30, 2016

ILLINOIS INSTITUTE OF TECHNOLOGY

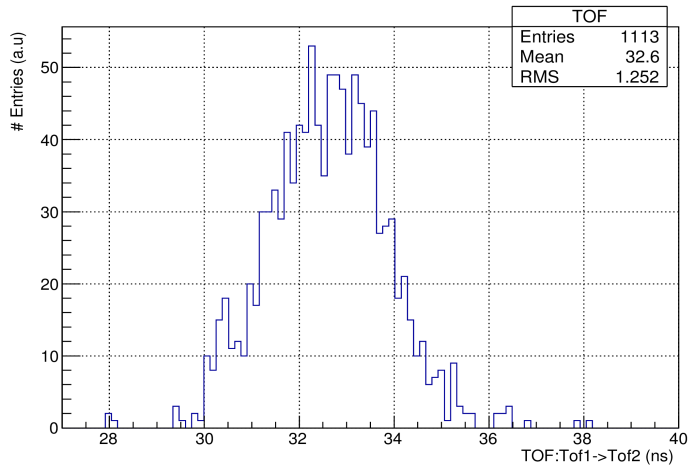
Problem at Hand

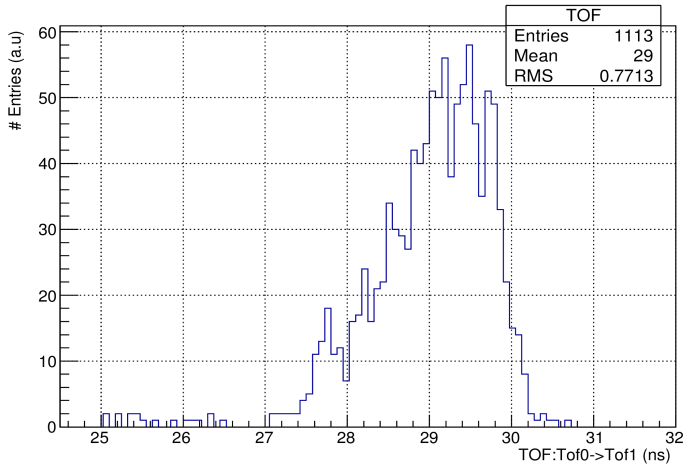
- Objective → differentiate between muons and other particle contaminations in different MICE runs using cuts.
- Muons, pions and electrons generally well distinguished in a calibration run (ToF histogram below from 7475),





- Muons and pions not as well distinquished in a data-taking run (from run 7469),



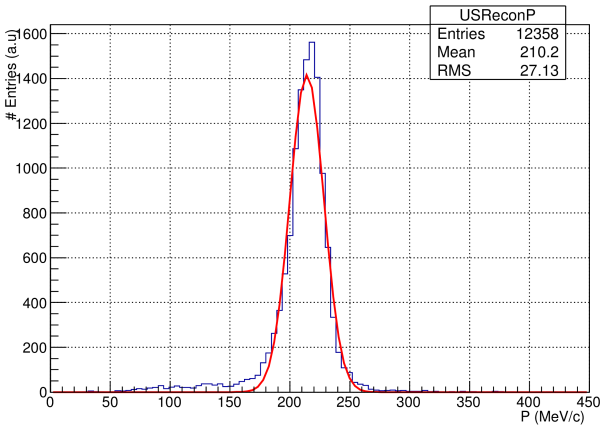


Problem at Hand cont.

- A closer look at pions in a muon run:
- According to MICE note 473, primary pions leak through D2 at the ~ 1% level.
- These pions decay to high-momentum muons – “a different muon production mechanism than muons from pion decays upstream of D2”
- Use Ckov NPE information to find these pions or their high momentum decay muons.
- Main goals → figure out the cuts that correspond to muons and validate those cuts by solving for mass.

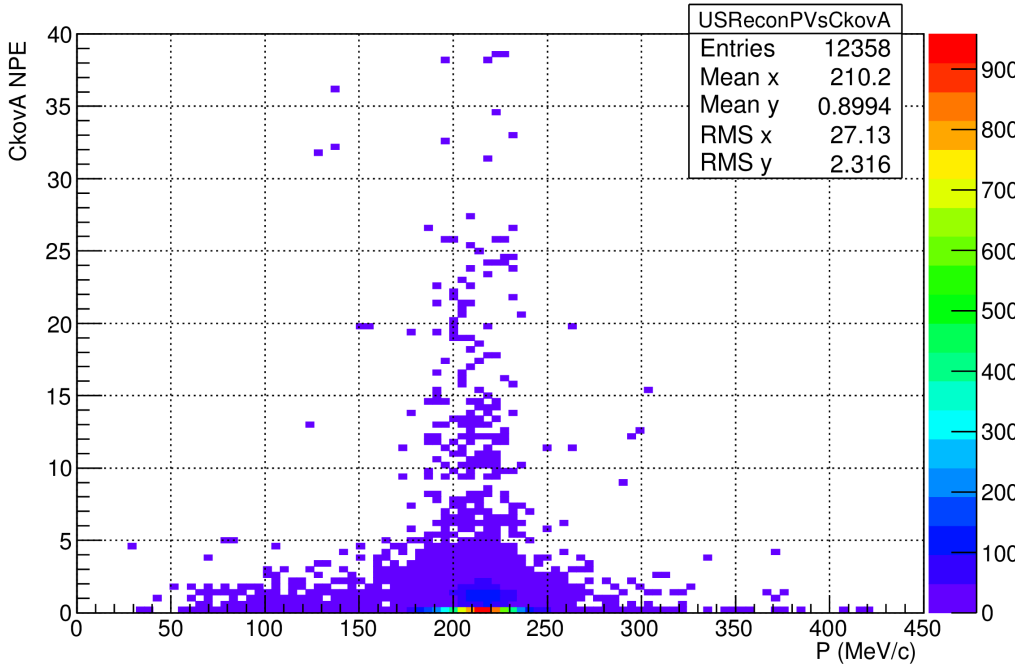
Cherenkov NPE vs. Tracker P – Run 7475

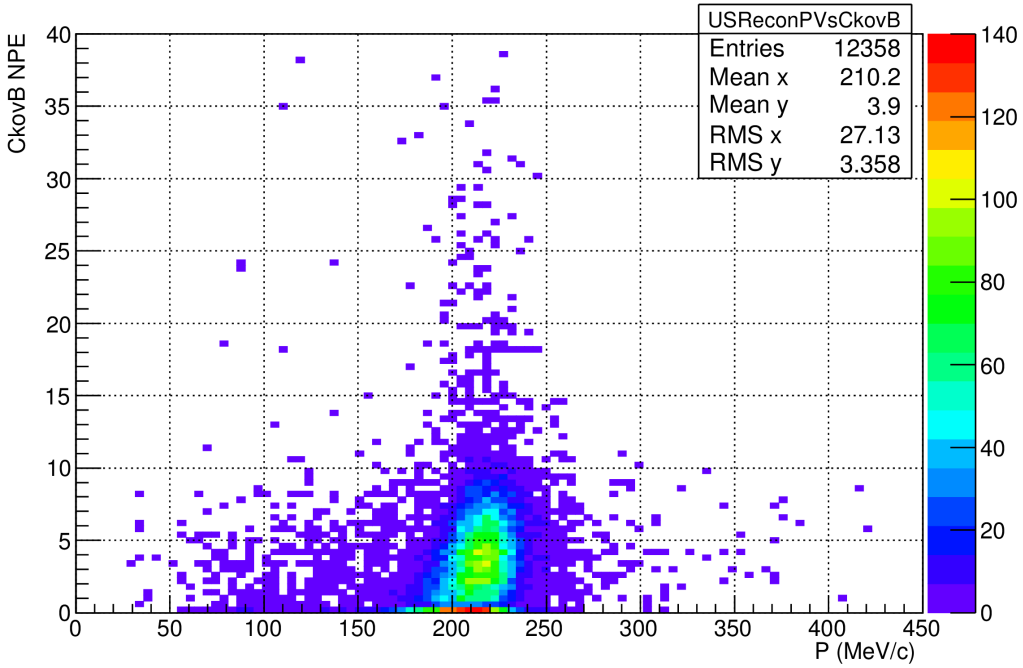
- Run 7475 → muon ToF01 range: ~27 ns and 29 ns.
- Validate this using a combination of p-NPE (eq 2 from MICE Note 473) and p-mass relations,



$$N_{pe} = N_{\beta=1} \times (1 - (\frac{p_{th}}{p})^2) \longrightarrow p = p_{th} \times \sqrt{\frac{1}{1 - \frac{N_{pe}}{N_{\beta=1}}}}$$

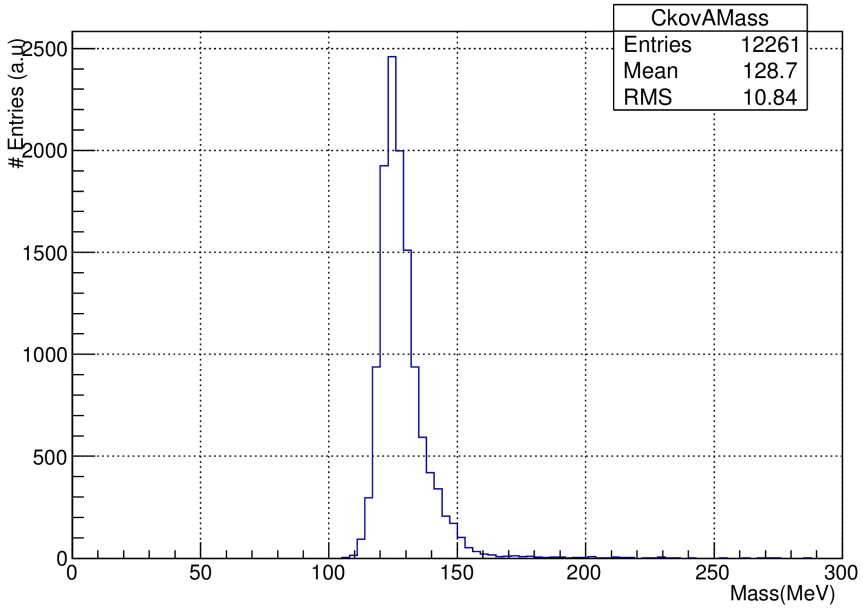
$$m = \frac{p}{\gamma \times \beta}$$

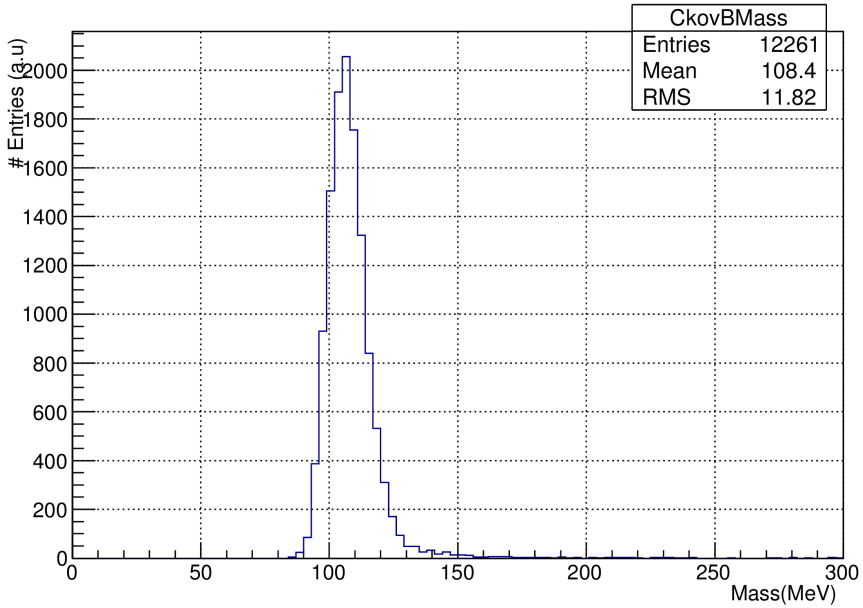




Ckov Mass Reconstruction - 7475

- Mass from CkovA and CkovB using the two equations in last slide. Distance between ToF0 and ToF1 taken as 7.6 m for velocity calculation.
- To ckeck validity of ToF cut for muons, we check whether we get mass ranges expected of a muon.

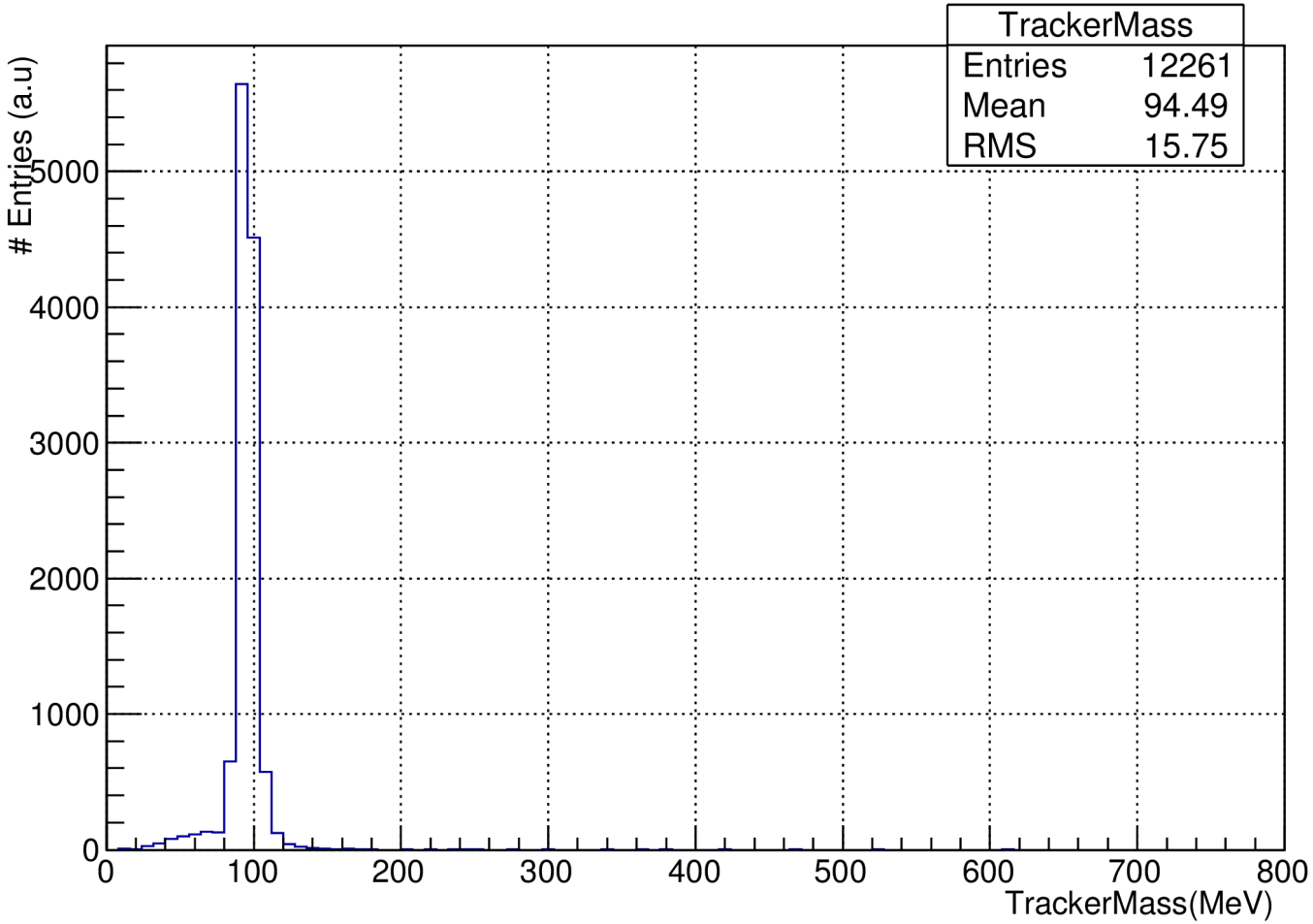




Tracker Mass Reconstruction - 7475

- A different mass approach using tracker p directly,

$$m = \frac{p}{\gamma \times \beta}$$

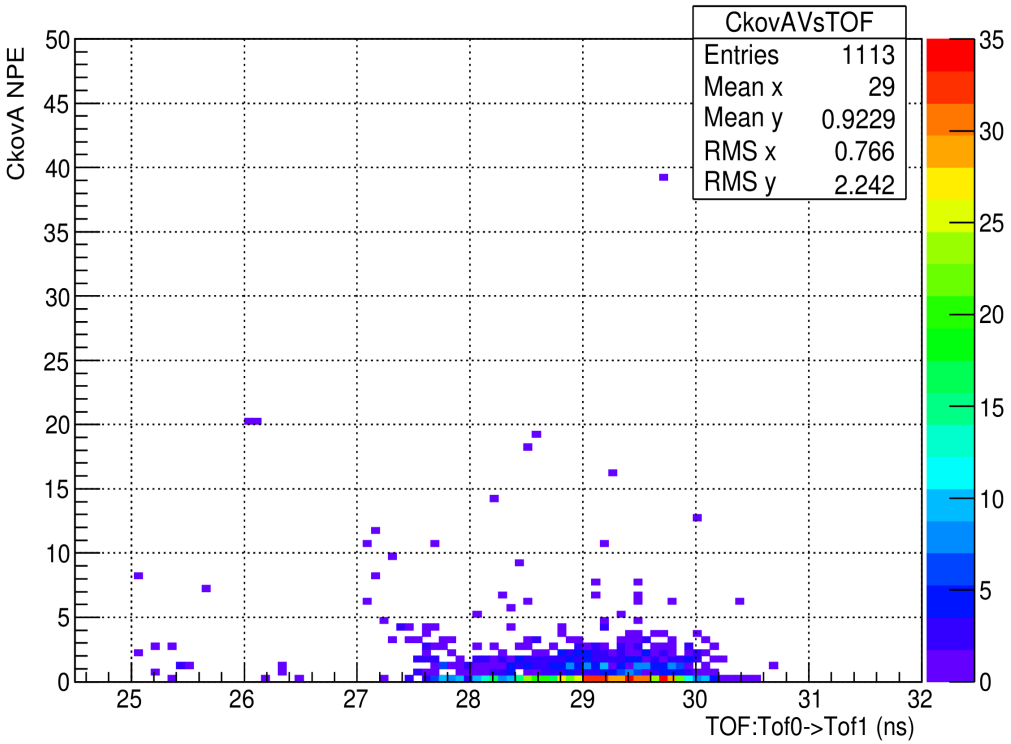


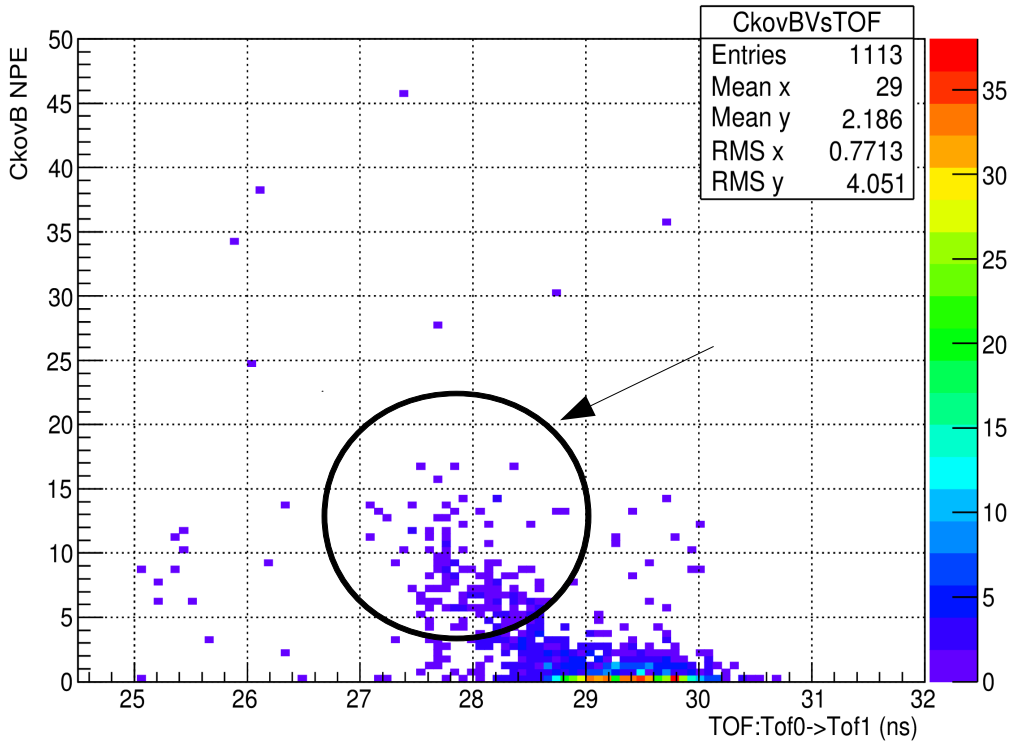
Cherenkov NPE vs. ToF - 7469

- Now run 7469:

➔ Run 7475 as template tells us → in ToF01 range of 28 to ~29 ns, we should have muons and above that pions.

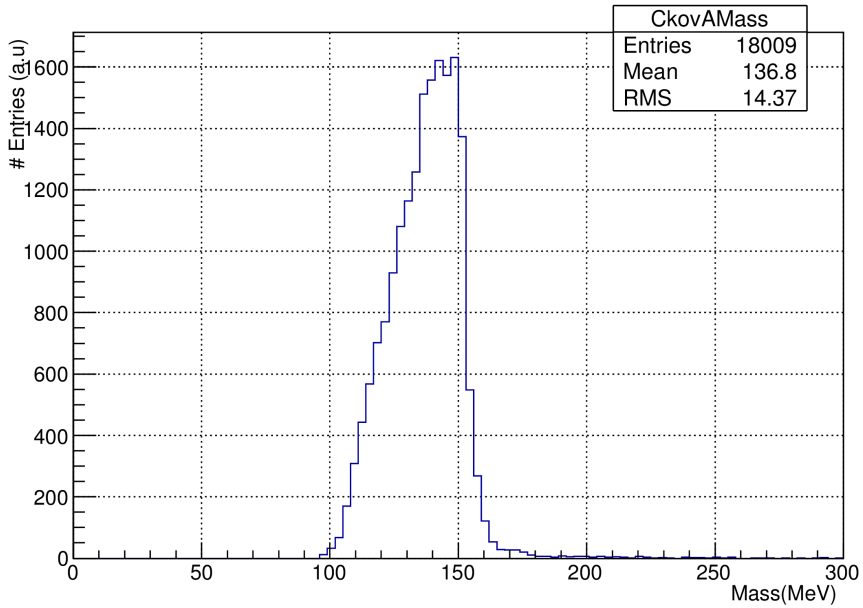
➔ Possible cut format for discarding pions in muon runs → 27 ns < ToF01 < 29 ns.

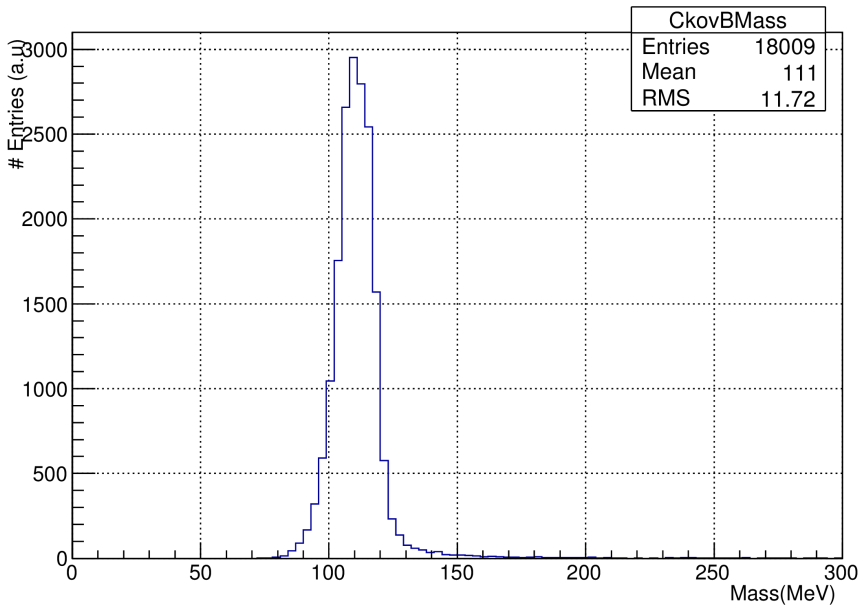




Ckov Mass Reconstruction - 7469

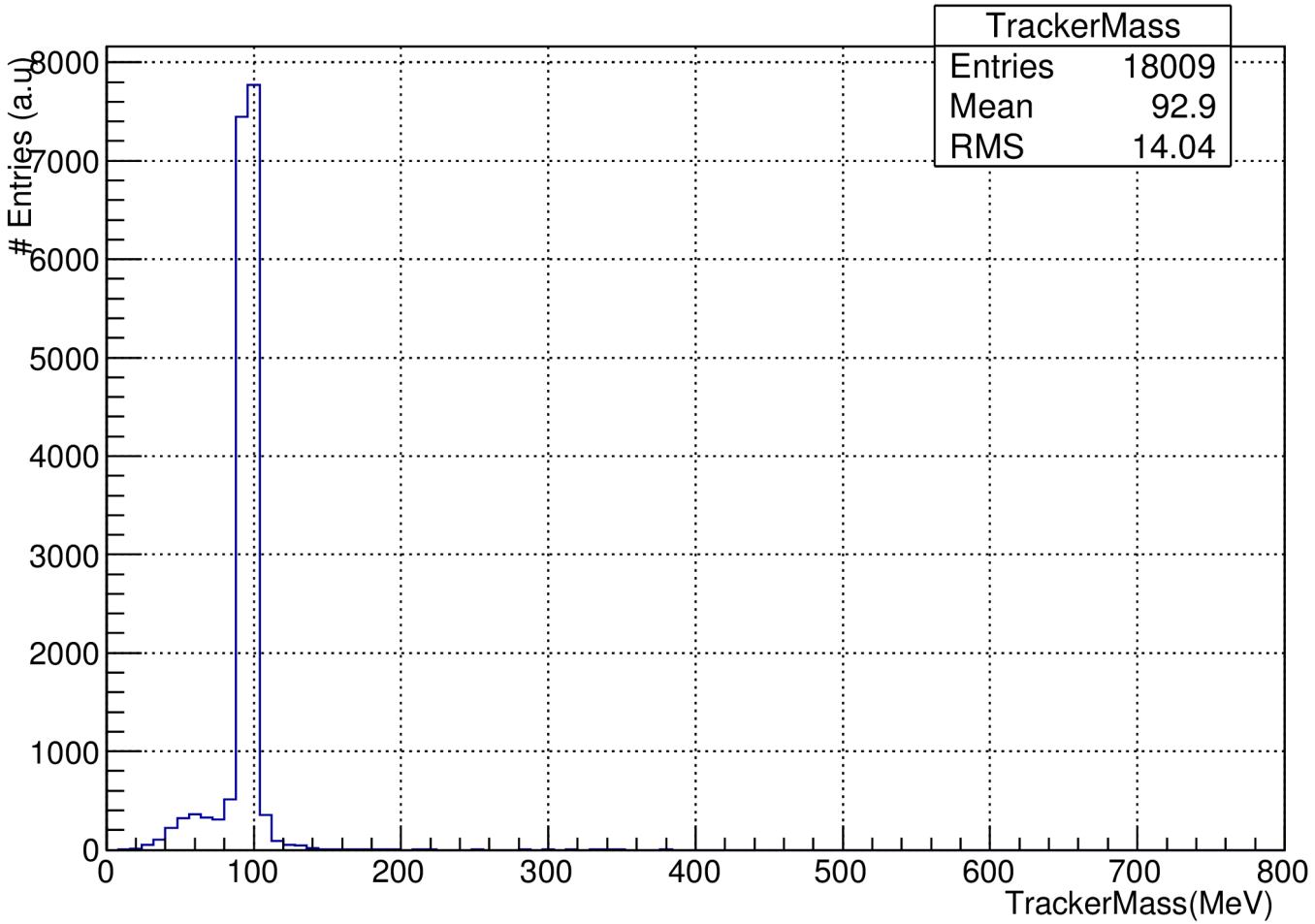
- Mass from CkovA and CkovB using the two equations on slide 4. Distance between ToF0 and ToF1 taken as 7.6 m for velocity calculation.
- To ckeck validity of ToF cut for muons, we check whether we get mass ranges expected of a muon.





Tracker Mass Reconstruction - 7469

- Mass approach using tracker p directly.



Looking Ahead

- Improve the mass measurement routine.
- Test this routine with other cuts.
- Update the plots for Emittance Measurement MICE note.