Precise measurement of emittance in the Muon Ionization Cooling Experiment

MICE collaboration

EMITTANCE MEASUREMENT STATUS

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MICE CM52

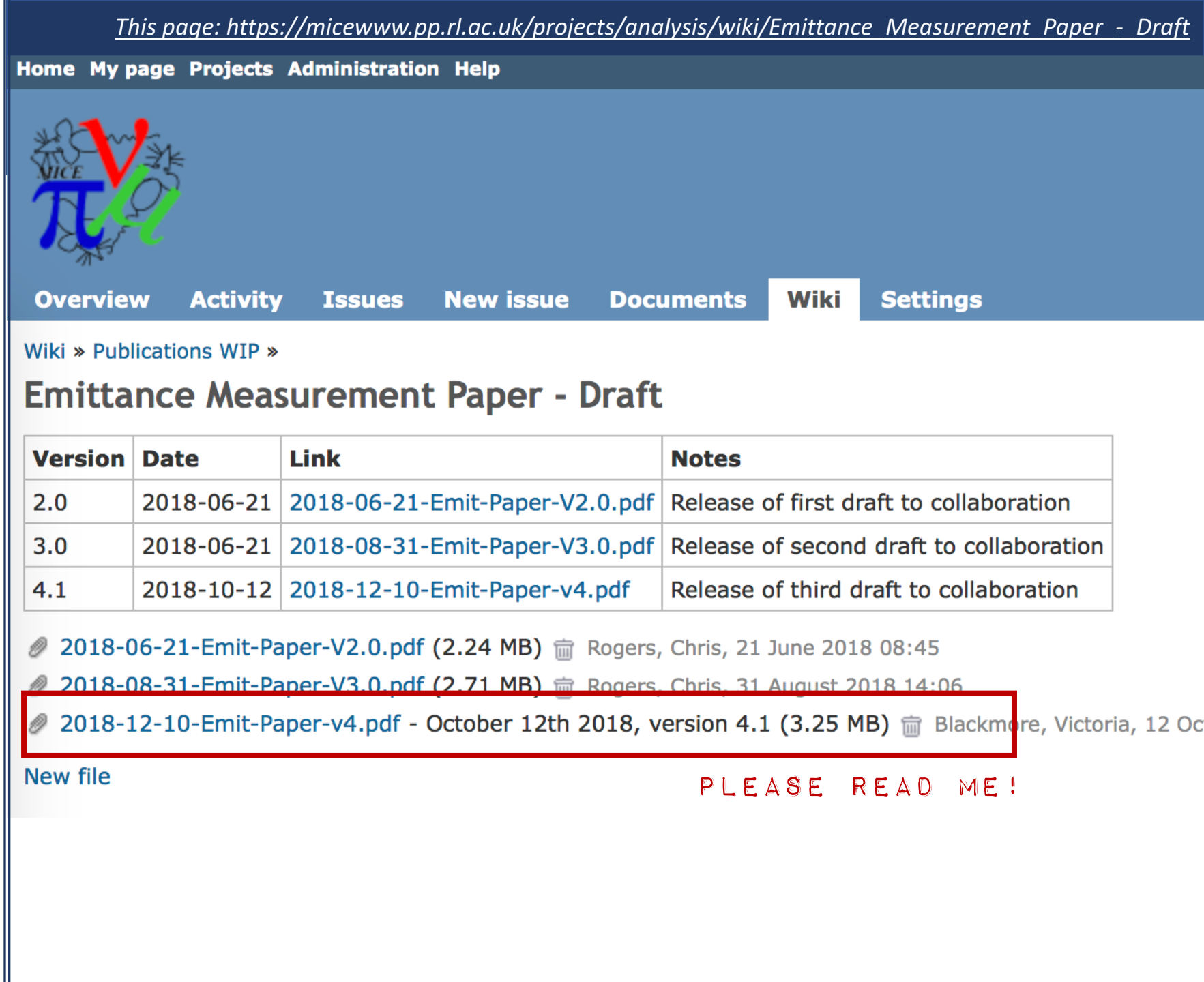
12TH OCTOBER 2018

HISTORY

One last draft for everyone to look at, including:

- Corrections received so far
- New MC
- Higher statistics MC

Link to last draft: https://micewww.pp.rl.ac.uk/attachments/download/10559/2018-12-10-Emit-Paper-v4.pdf



NEW PLOTS & TABLES

What's new? *(since CM51)*

1. Total momentum distribution tuned to better match data
    - Why:
        - ISIS operated at 700MeV for the 7469 data set (along with many others)
        - Different population of particles at different momenta
    - Solution:
        - Reweight total momentum distribution of MC at D2---ask C. Hunt for details

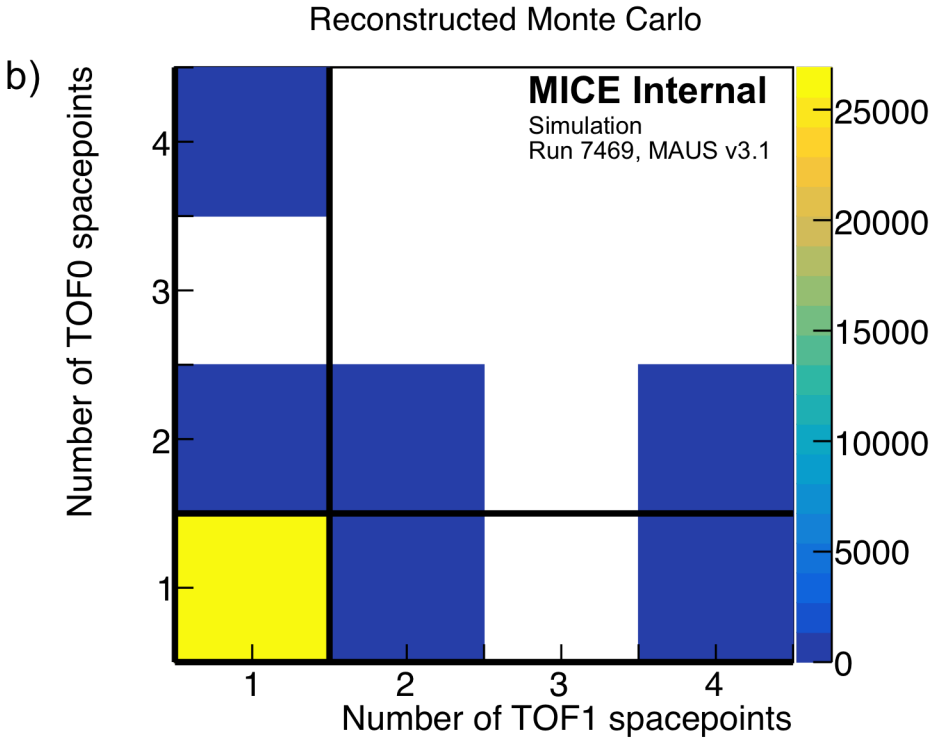
2. Cooling channel shifted by 1cm in y (vertical, down)
    - Why:
        - There was a ~1cm difference in the mean of the vertical distribution measured in the tracker between data and MC
        - Most probable cause is difference in position of diffuser aperture
    - Solution:
        - Move cooling channel down by 1cm in y in the MC---as P. Franchini for details

3. More MC statistics

NEW PLOTS & TABLES

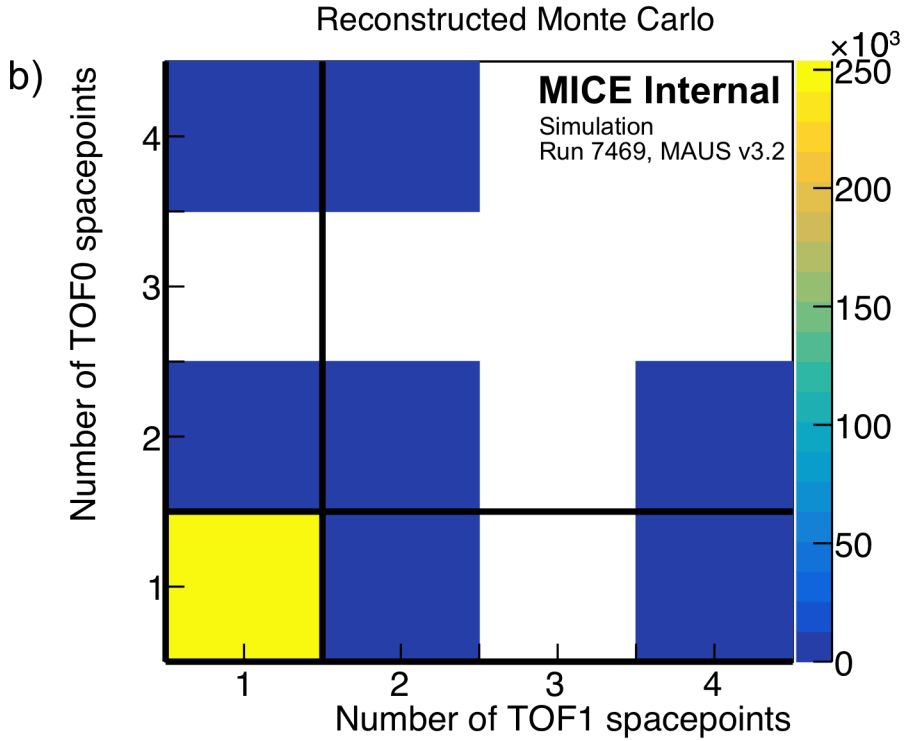
All cuts *except* the requirement to have *one and only one* spacepoint at TOF0 and TOF1

Version 3: Figure 3b



Version 4: Figure 3b

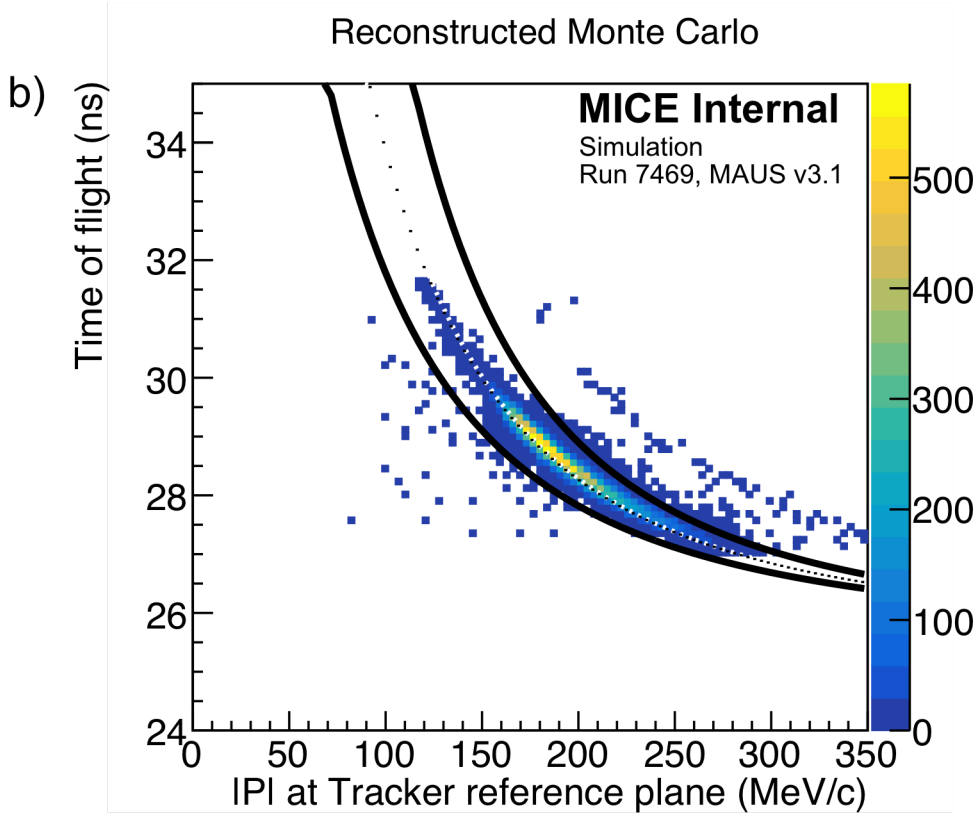
Not really any difference other than stats



NEW PLOTS & TABLES

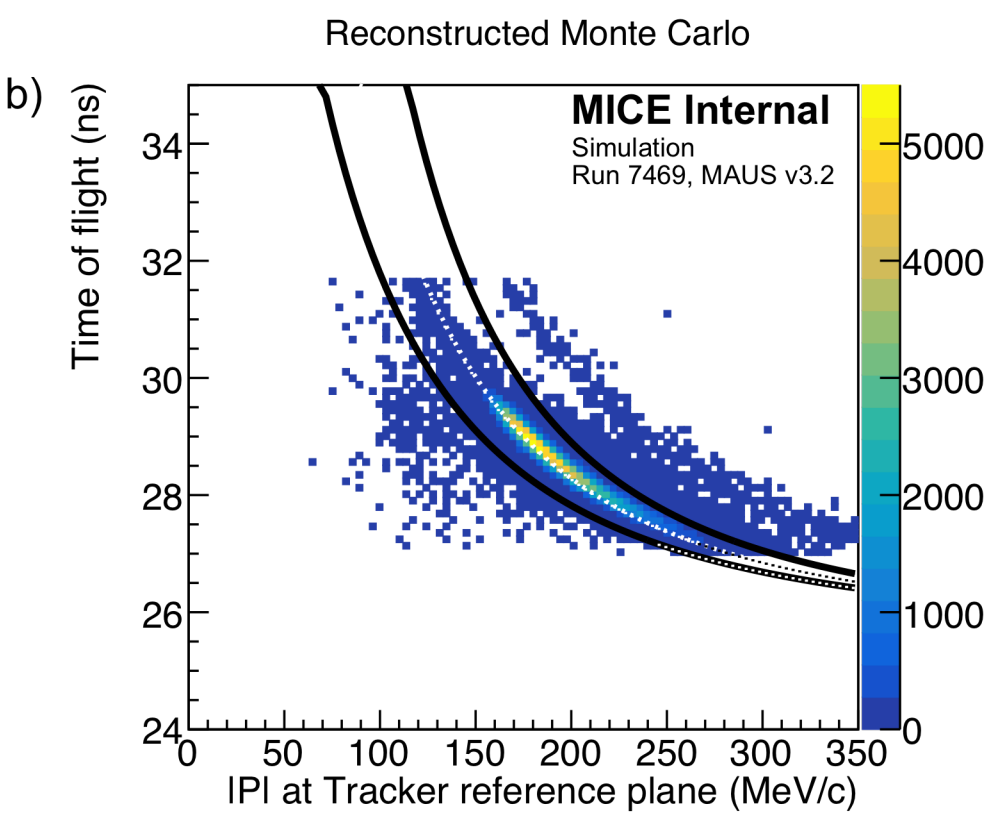
All cuts *except* the requirement that particles have a muon-like (P, tof) relationship

Version 3: Figure 4b



Version 4: Figure 4b

Not really any difference other than stats



NEW PLOTS & TABLES

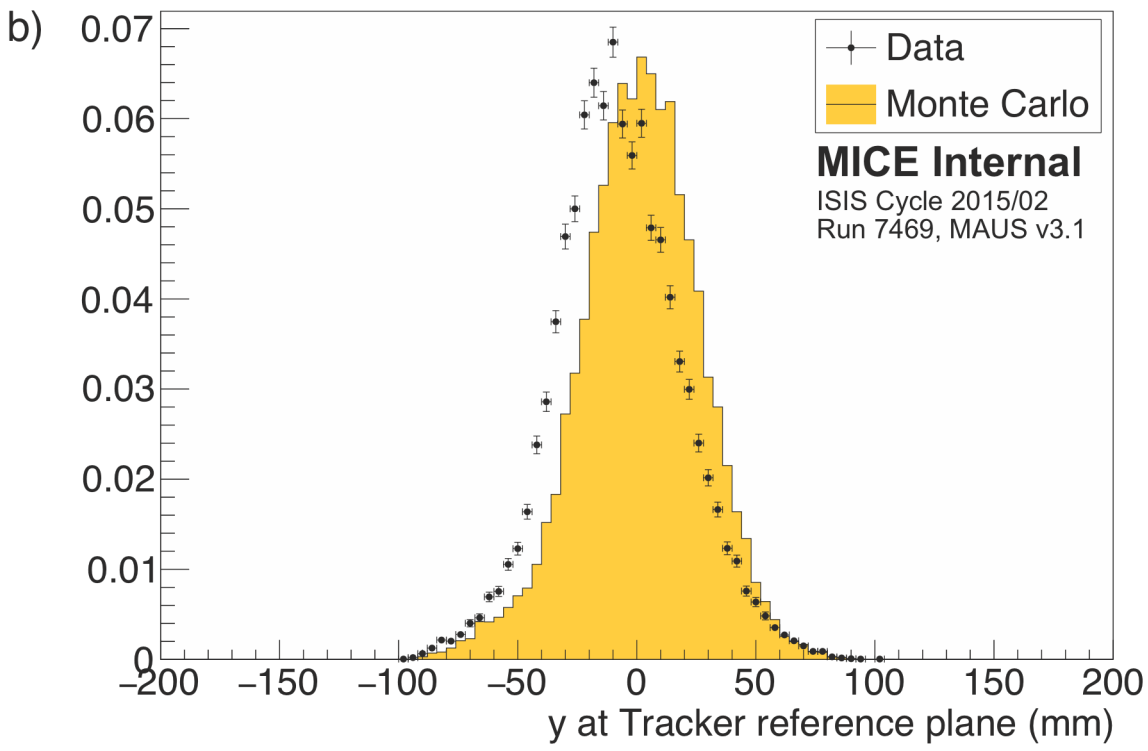
Table 2: The number of reconstructed electrons, muons, and pions at the upstream tracker that survive each cut in the Monte Carlo simulation. Application of all cuts removes almost all positrons and pions in the reconstructed Monte Carlo sample. A total of 253 504 particles pass all of the described cuts in the Monte Carlo simulation.

Cut	e	μ	π	Total
None	14 912	432 294	1 610	463 451
One space-point in TOF0 and TOF1	11 222	353 613	1 213	376 528
Relative Time of flight in range 0—6 ns	757	369 337	1 217	379 761
Single reconstructed track with $\frac{\chi^2}{N_{\mathrm{DOF}}} \leq 4$	10 519	407 276	1 380	419 208
Track within fiducial volume of tracker	14 527	412 857	1 427	443 431
Tracked radius at diffuser $\leq$ 90 mm	11 753	311 076	856	334 216
Muon hypothesis (above lower limit)	3 225	362 606	411	367 340
Muon hypothesis (below upper limit)	12 464	411 283	379	424 203
Muon hypothesis (overall)	2 724	358 427	371	361 576
All	22	253 475	5	253 504

NEW PLOTS & TABLES

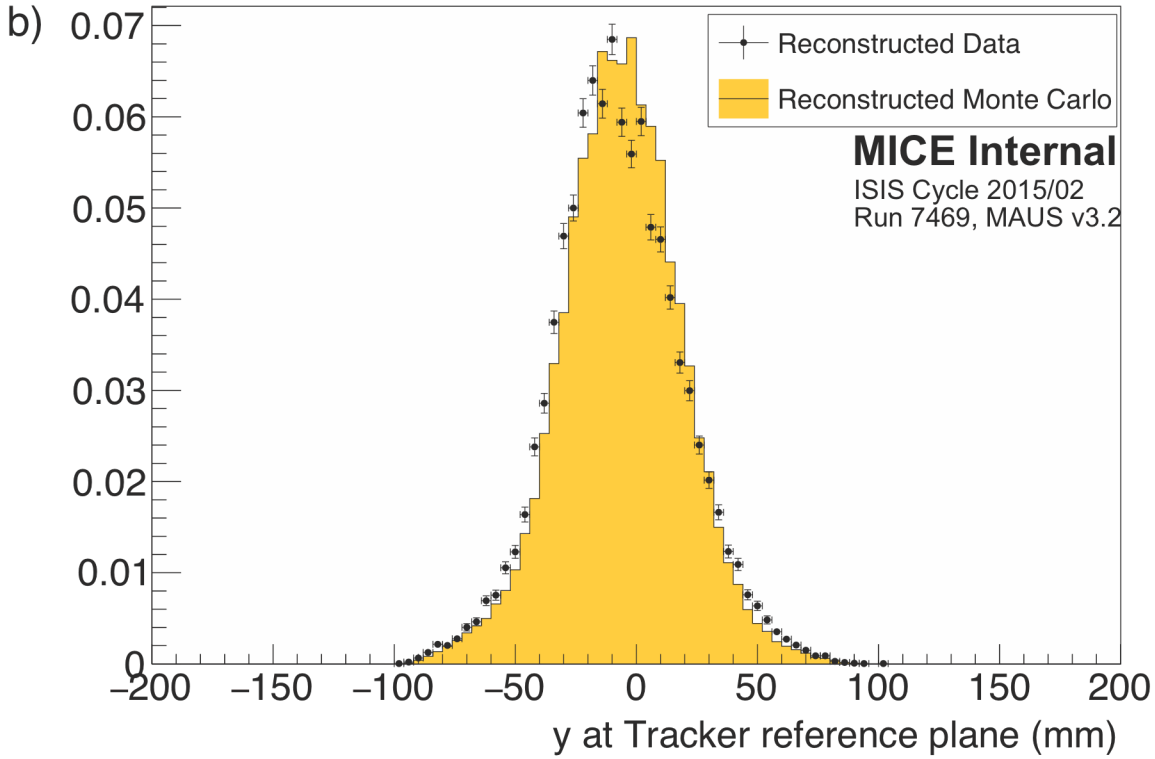
y-distribution shows better agreement after cooling channel shift

Version 3: Figure 5b



Version 4: Figure 5b

Shifting MC cooling channel by 1cm down

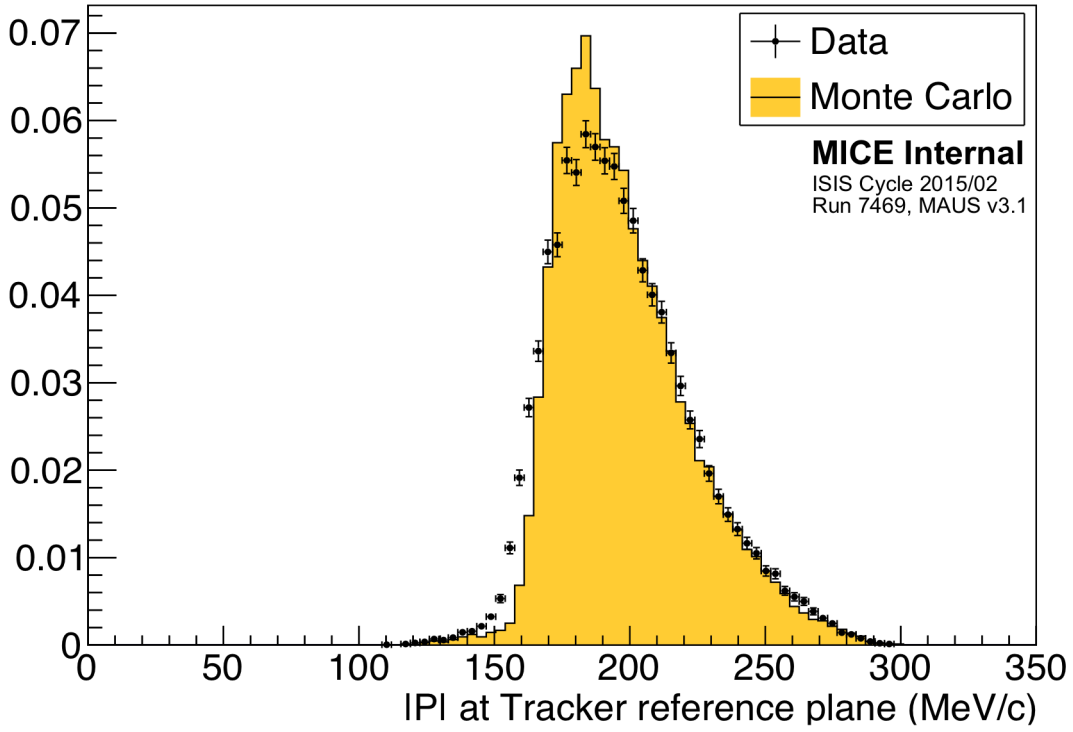


NEW PLOTS & TABLES

p-distribution shows better agreement after reweighting around D2

Version 2: Figure 5f

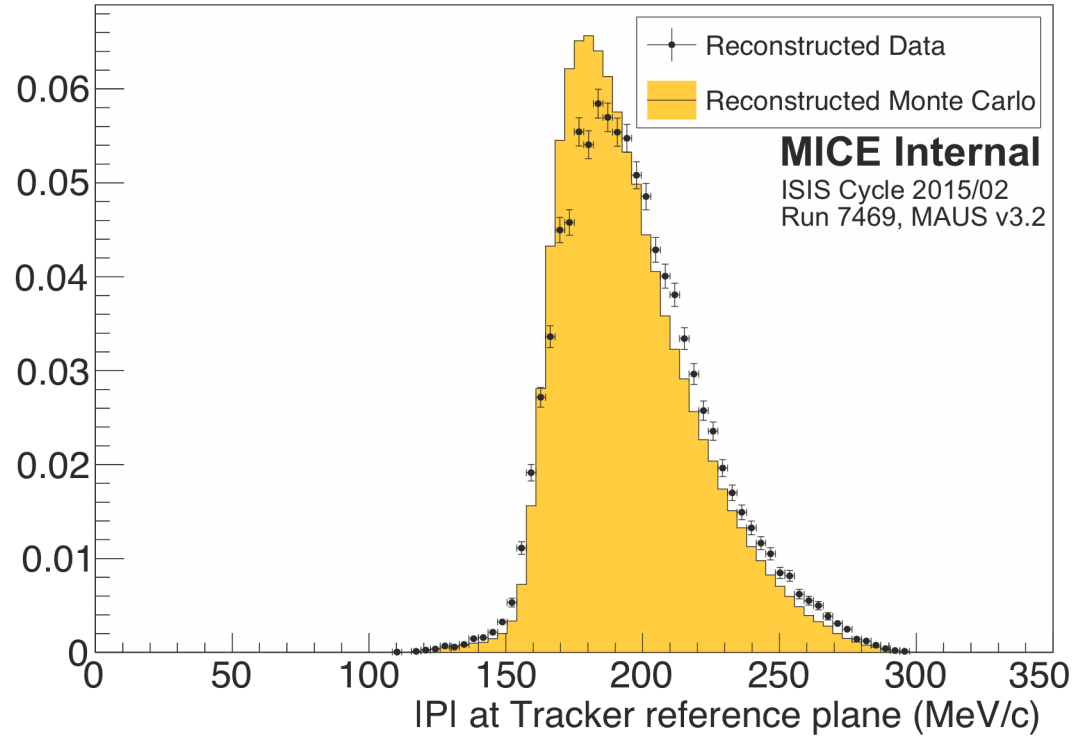
(This was included in v3 of the paper)



Version 4: Figure 5f

Reweighting of input p-distribution at D2

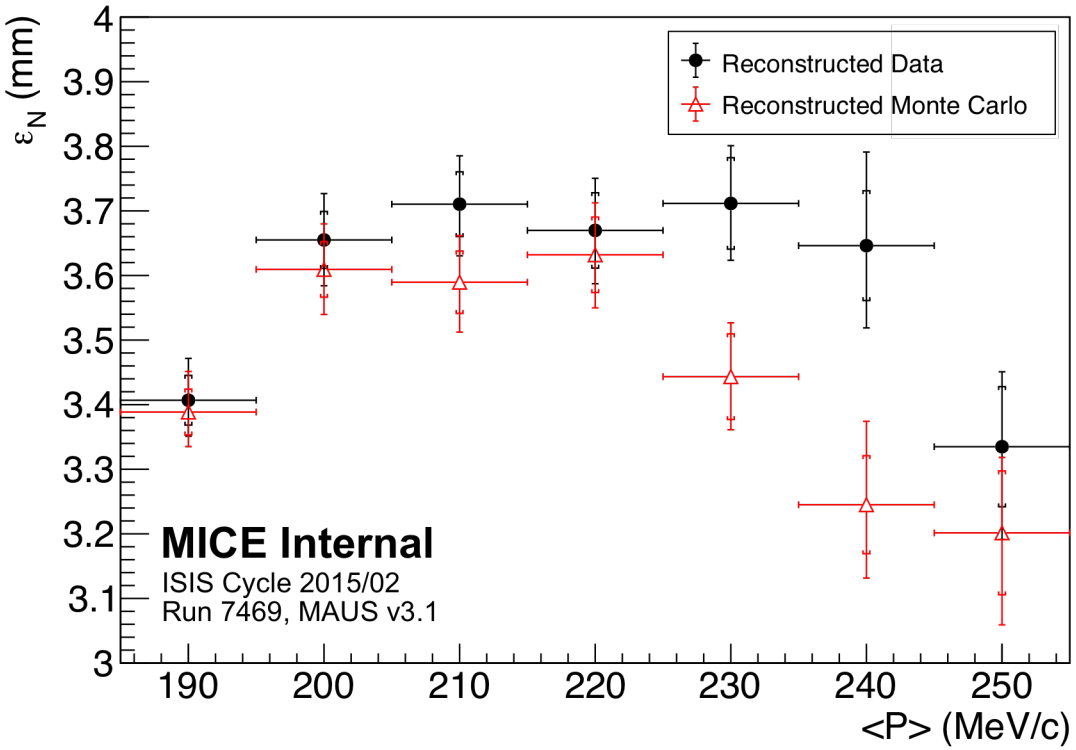
f)



NEW PLOTS & TABLES

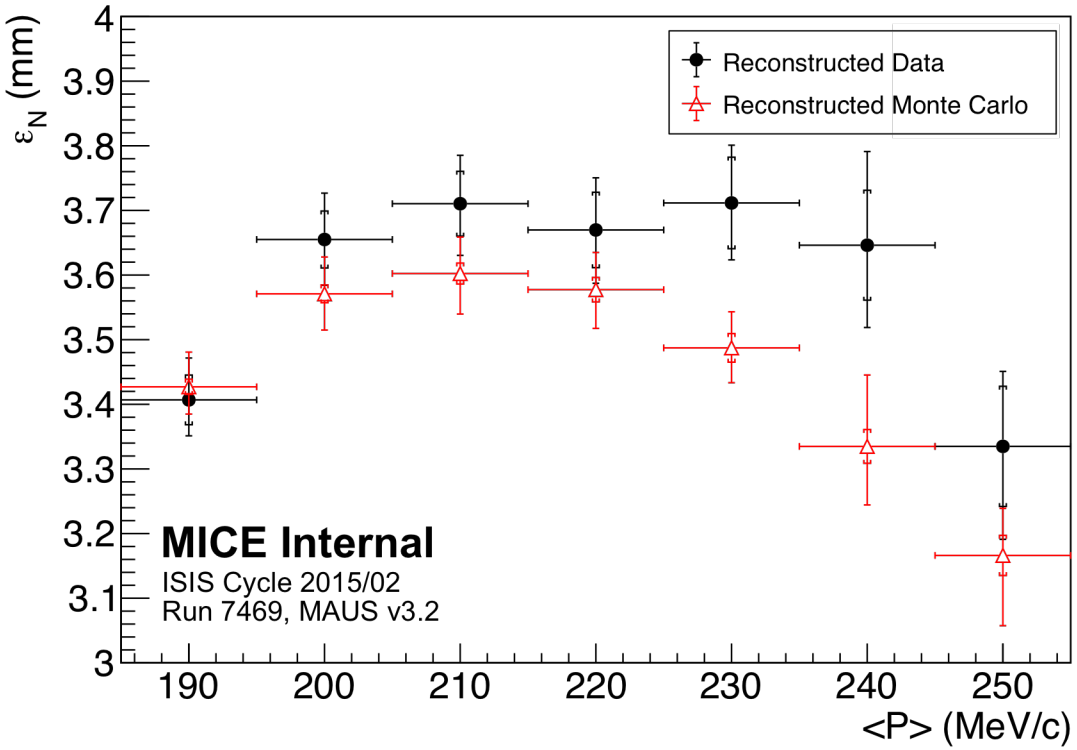
p-distribution shows better agreement after cooling channel shift

Version 3: Figure 9



Version 4: Figure 9

More MC stats



SUMMARY

- At the end of the analysis road
- Paper available to read: https://micewww.pp.rl.ac.uk/attachments/download/10559/2018-12-10-Emit-Paper-v4.pdf
- Please read!