University of Michigan

MIPP

Monte Carlo Neutron Update

Fluka: N_n / N_p ratio is less than 0.8

Fluka: HCAL acceptance for neutrons is about 0.85

Remained questions:

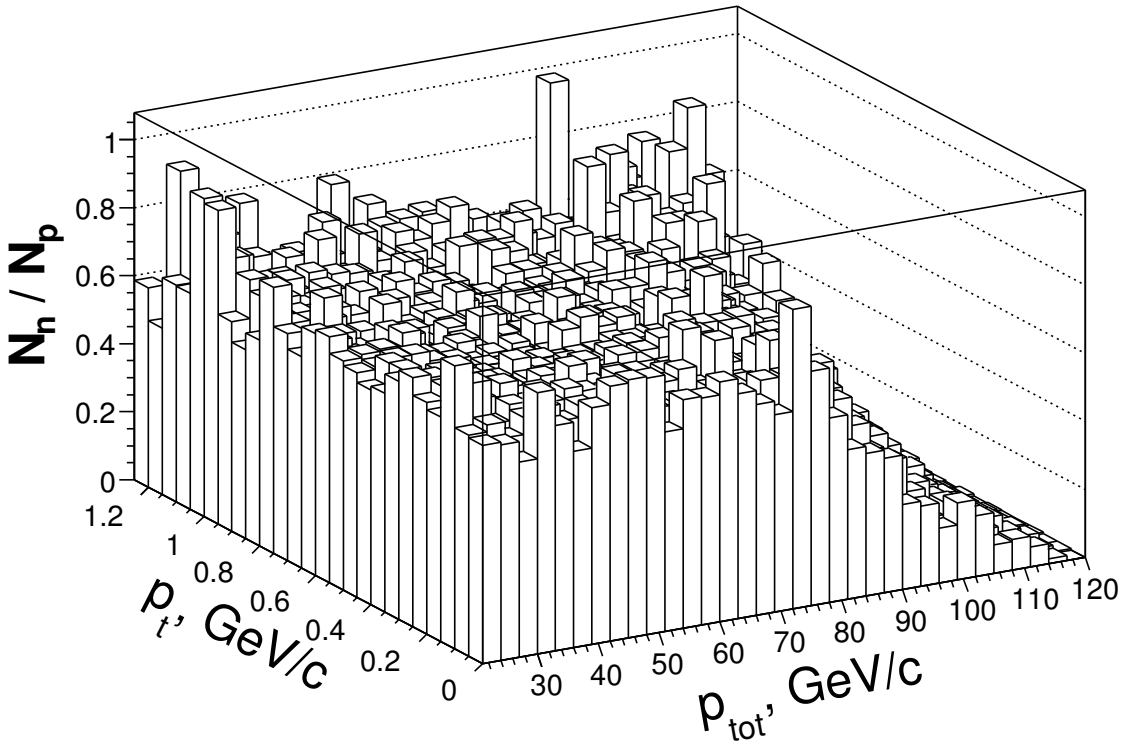
- What is the neutron absolute efficiency?
- What is the proton absolute efficiency?
- What is N_n / N_p ratio based on our reconstruction?

Note: previous studies were made with the assumption that the vertex reconstruction for both channels are equal. What will happens if I drop this assumption?

University of Michigan

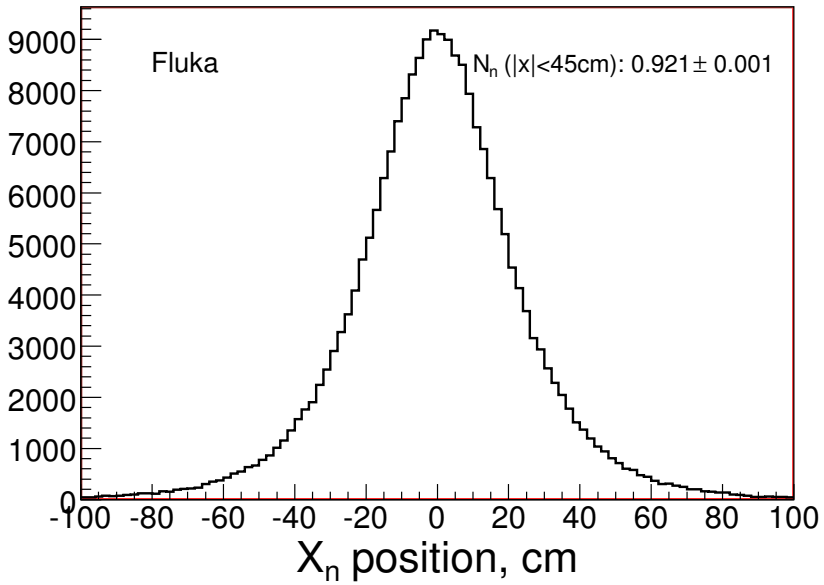
MIPP

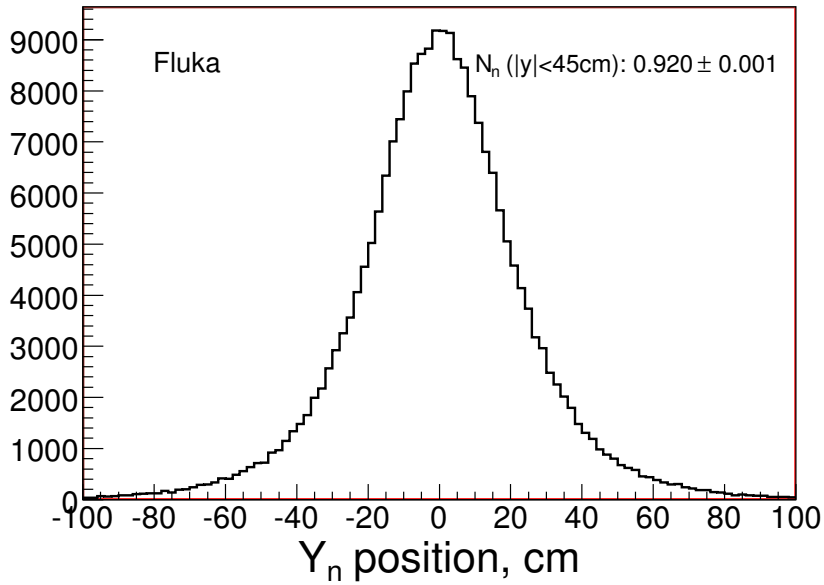
Fluka: N_n / N_p ratio



Fluka N_n / N_p ratio prediction. One can see that $N_n/N_p \approx 0$ at $p_{tot}=p_{beam}$, rise up to it's maximum at $p_{tot} \approx 0.6 * p_{beam}$ then it has a plateau shape at lower p_{tot} values . The ratio looks uniform vs p_t values.

Fluka: neutron X and Y positions

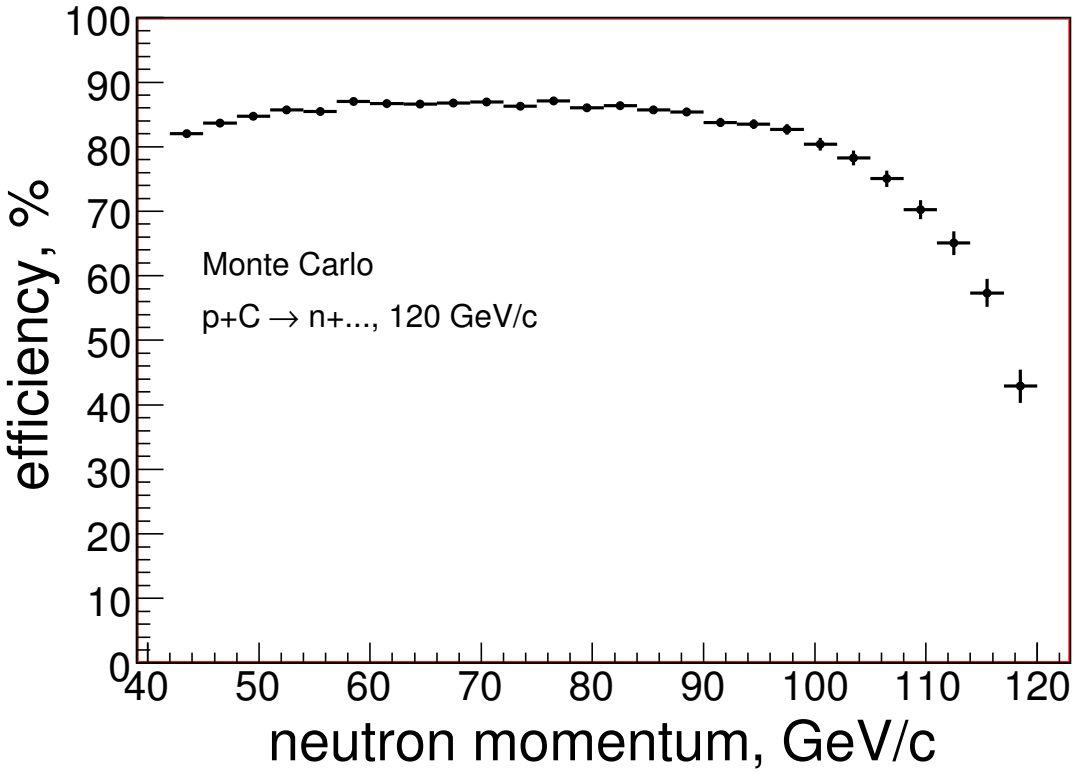




Fluka neutron X (on left) and Y (on right) positions at Z_{HCAL}. Fluka HCAL acceptance is

0.92^2=0.85

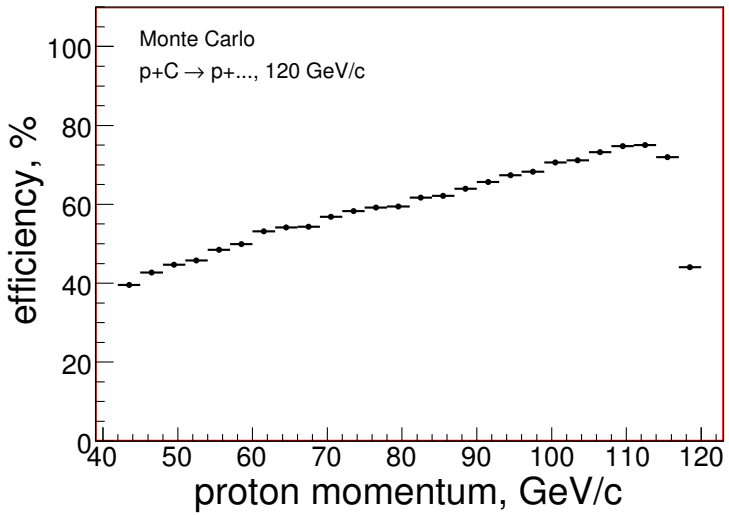
neutron absolute efficiency

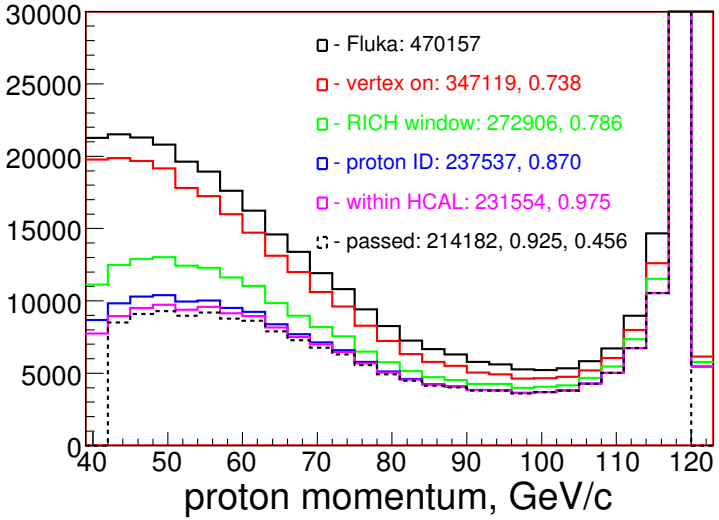


The neutrons absolute efficiency vs it's momentum. Calculation based on the Monte Carlo data. The neutron momentum smearing has been applied according to formula:

$$\left[\frac{\sigma}{E}\right]^2 = 0.0558^2 + \frac{0.2948^2}{E} + \frac{1.98^2}{E^2}$$

proton efficiency



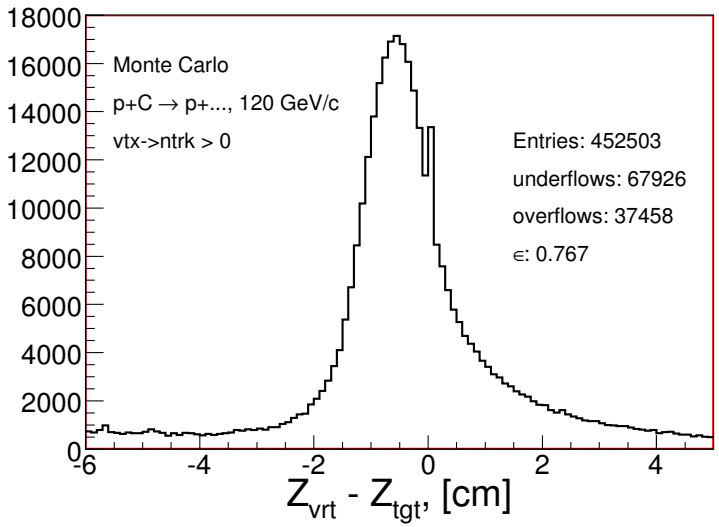


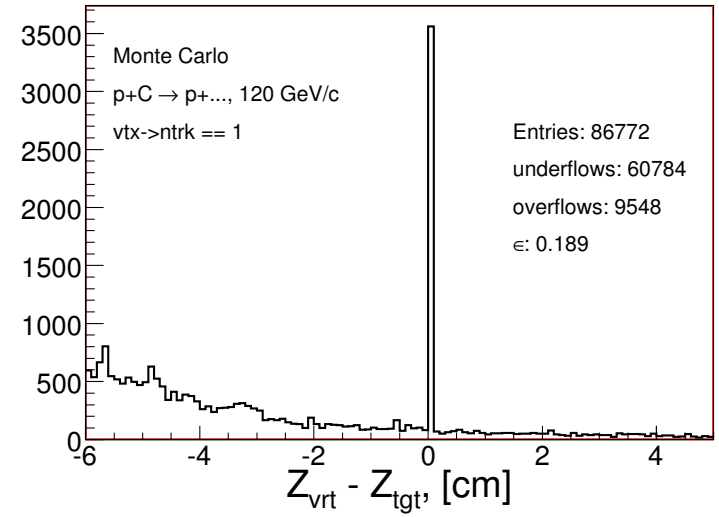
Top plot - an absolute proton efficiency vs it's momentum (without cut on the TPC hits). It looks low. What is a reason?

Bottom plot illustrates what contribute to the proton inefficiency (without cut on the TPC hits). Following cuts contributes most:

- vertex Z position - 0.74
- RICH window - 0.79
- proton ID by RICH - 0.87 (I have no idea how to improve)

vertex Z position





Top plot - vertex Z position distribution, the number of tracks in vertex $>$ 0. Fraction of survived events - 0.77

Bottom plot - the vertex Z position distribution, N_{trk}=1. Fraction of survived events - 0.19. The Z cut for the high momentum straight through track has no meaning. It is quit necessary if the high angle track only.

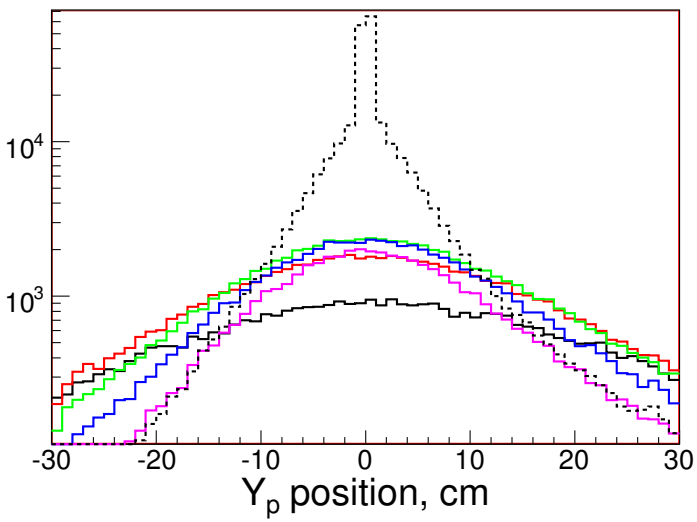
Require Z within the target size if:

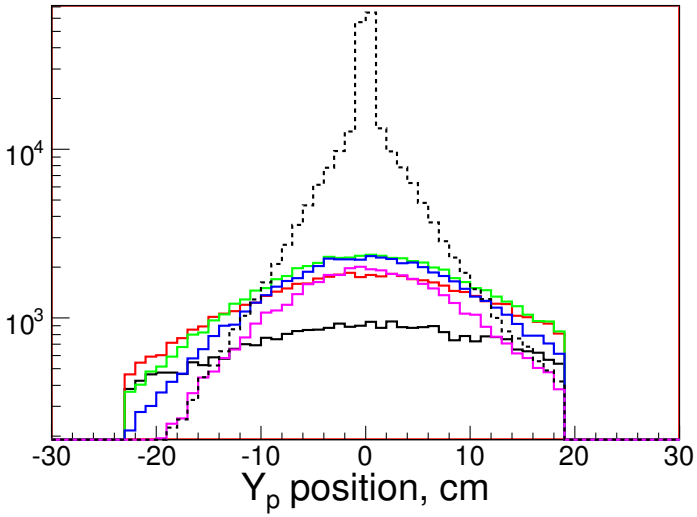
N_{trk} $\geq$2 or

N_{trk}=1 and p_{tot} $<$20 GeV/c and p_t $>$0.1 GeV/c

ϵ: 0.74 $\longrightarrow$ 0.88

RICH entrance window



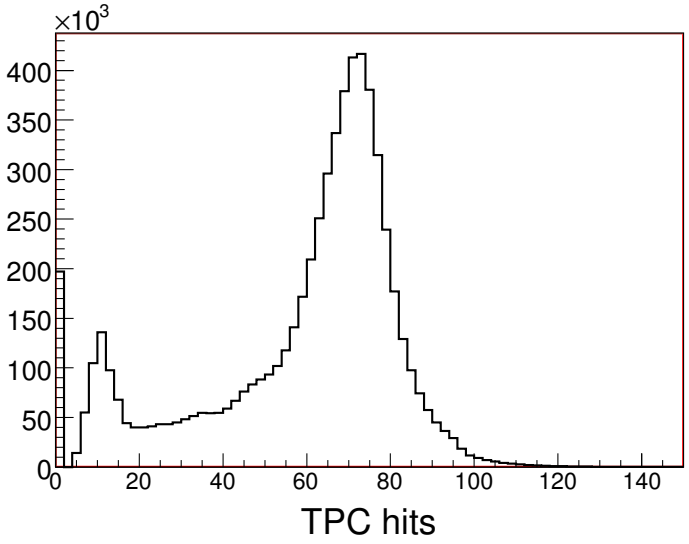


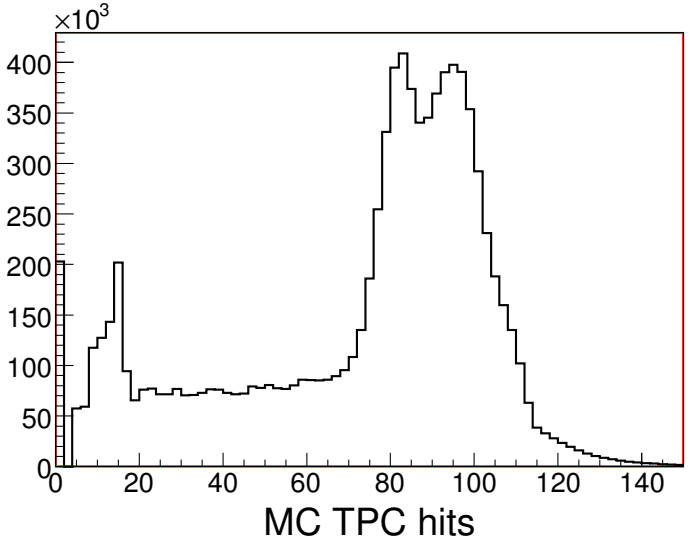
Top plot - proton Y positions at RICH entrance window. The black solid plot is most lowest momentum, the black dashed plot - most highest momentum.

Bottom plot - proton Y positions survived the window cut

p, GeV/c	Entries	Passed	Fraction
10 - 20	44368	30127	0.68
20 - 30	68568	53785	0.78
30 - 40	74721	62344	0.83
40 - 50	64305	55837	0.87
50 - 60	47899	42855	0.89
70 -120	243963	239060	0.98

tpc hits

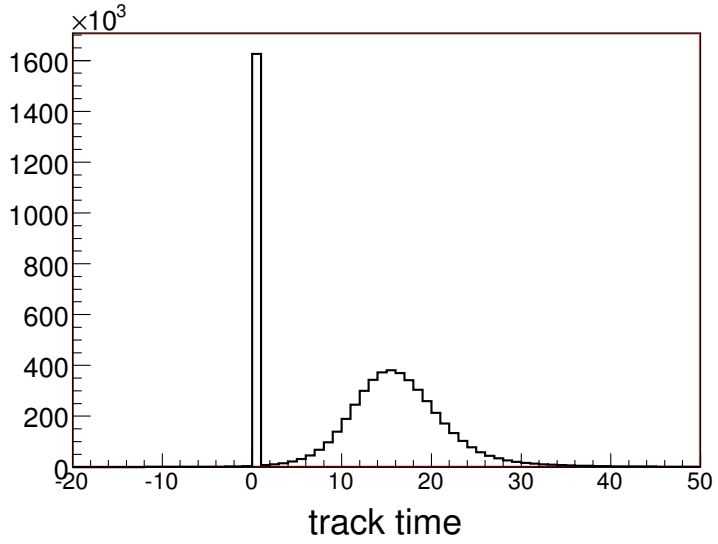


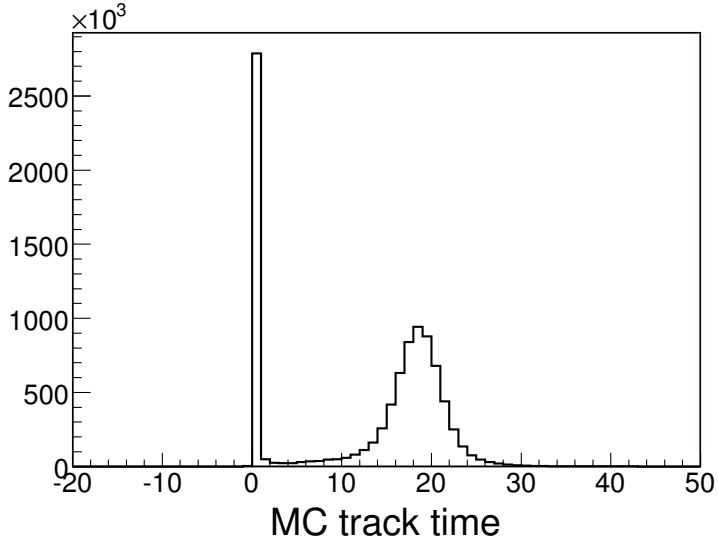


Top plot - the number of TPC hits on data. The tracks within 5-100 range used for the analysis.

Bottom plot - the number of TPC hits on Monte Carlo. The tracks within 5-140 range used for the analysis. N_{hits}=0 tracks, probably, are based on the downstream chambers only.

track time

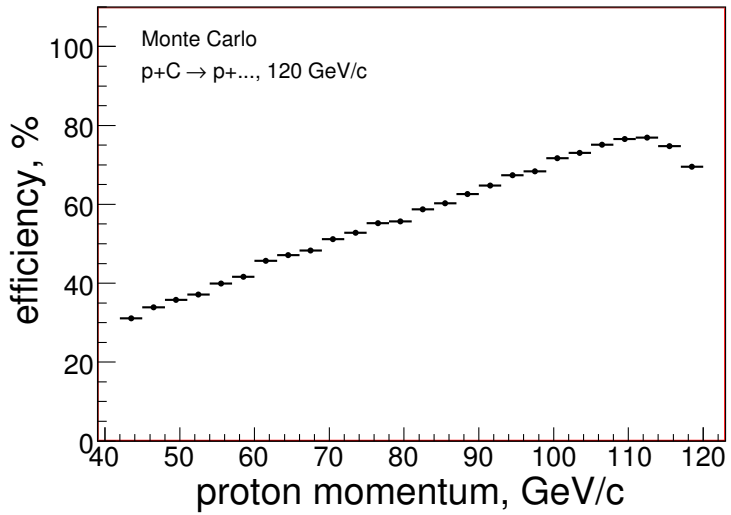


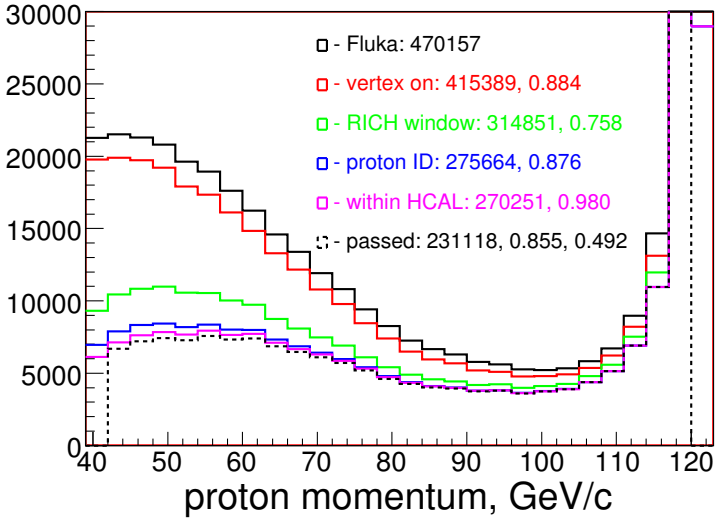


Top plot - the track time distribution on data. The tracks from -10ns up to +50ns range used for the analysis.

Bottom plot - the number of TPC hits on Monte Carlo. The tracks from -10ns up to +50ns range used for the analysis. There is no significant difference between data and Monte Carlo.

final proton efficiency

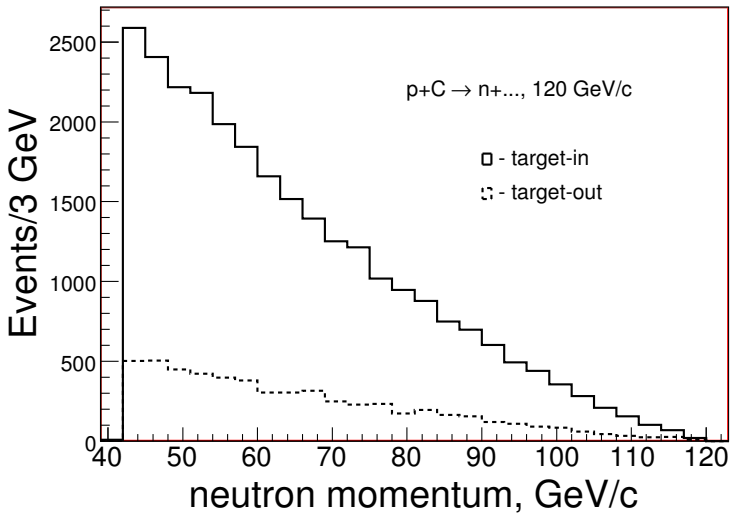


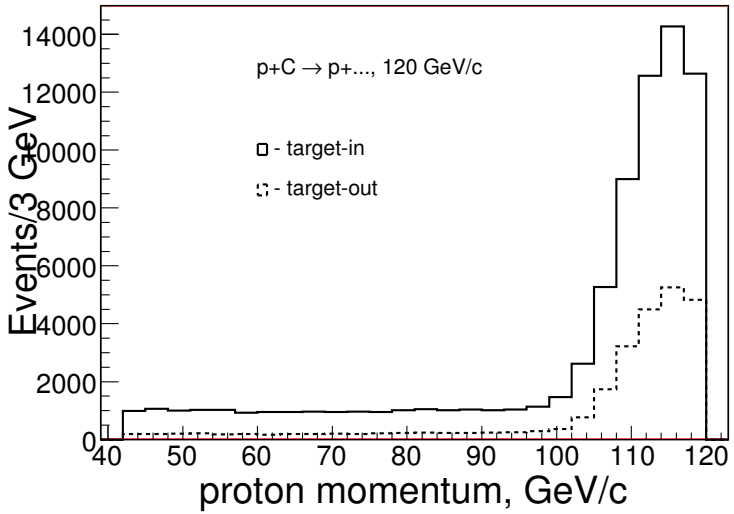


Top plot - the final proton absolute efficiency vs it's momentum. The shape of the momentum dependence defined by the RICH Y-view window cut. An average efficiency is 0.49

Bottom plot illustrates what contribute to the proton inefficiency.

p_{tot}: target-in vs target-out

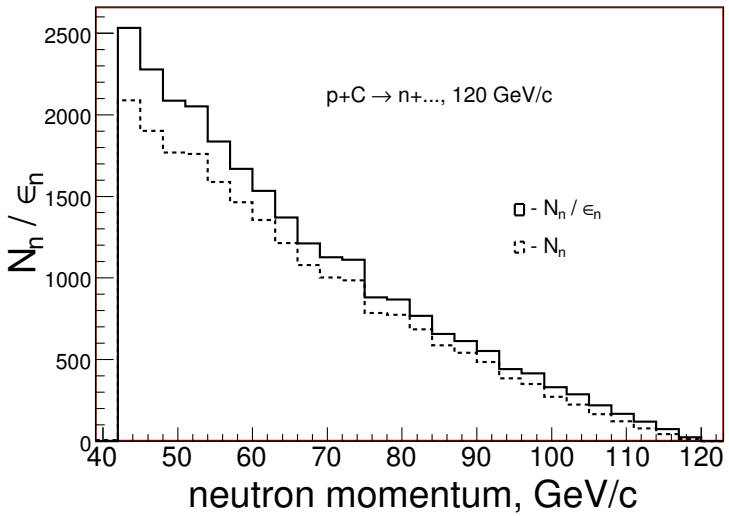




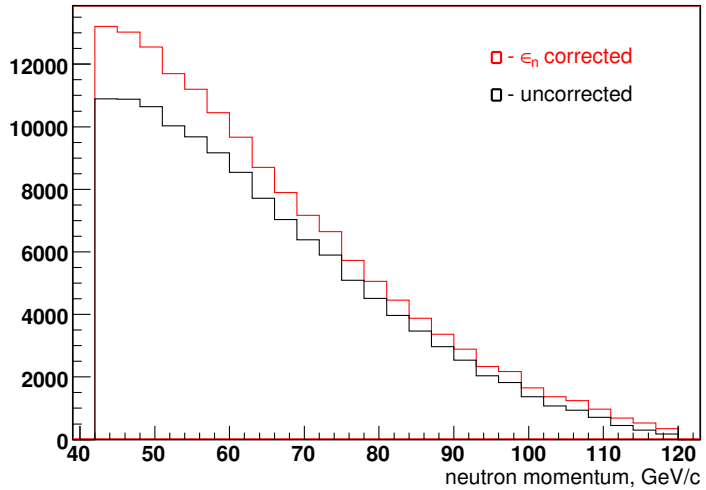
Top plot - the neutron momentum distributions from data.

Bottom plot - the proton momentum distributions from data. The shape changed significantly. One of the reasons - dropped Z-vertex cut for the single strait through tracks. Yield at the low momentums remains same.

neutrons: data vs Monte Carlo

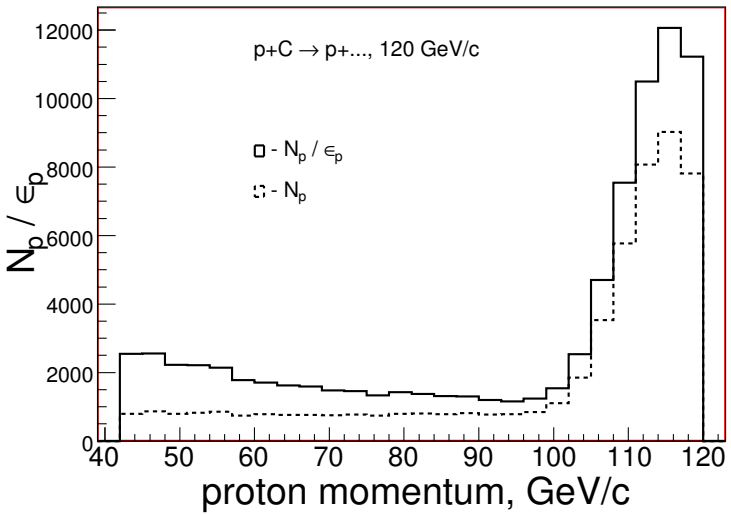


Top plot - the neutron momentum distributions using real data: the black solid plot - corrected for the neutron reconstruction inefficiency, dashed plot - without correction. The target-out data has been subtracted.

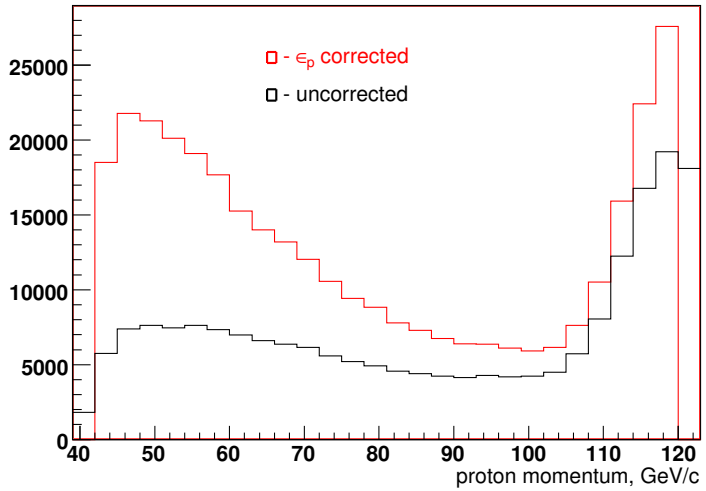


Bottom plot - the neutron momentum distributions using Monte Carlo data: red plot - corrected for the neutron reconstruction inefficiency, black plot - uncorrected.

protons: data vs Monte Carlo

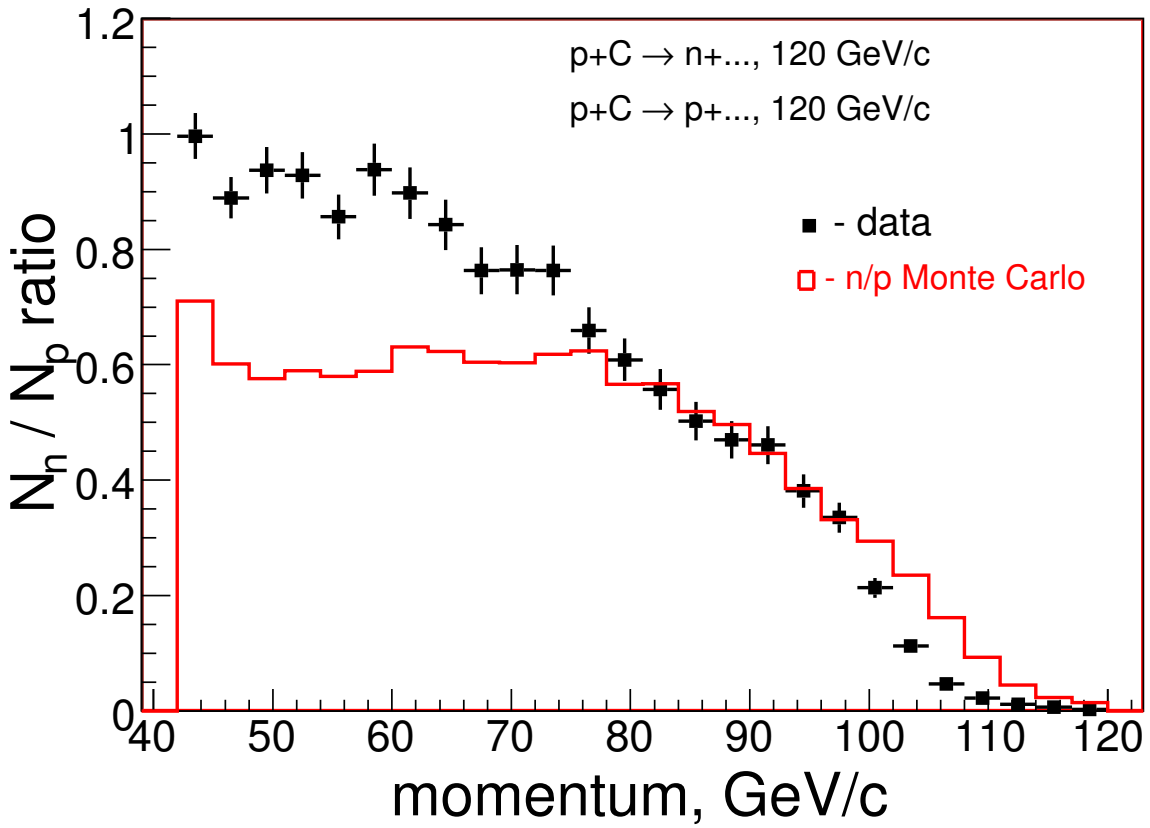


Top plot - the proton momentum distributions using real data: the black solid plot - corrected for the proton reconstruction inefficiency, dashed plot - without correction. The target-out data has been subtracted.



Bottom plot - the proton momentum distributions using Monte Carlo data: the red plot - corrected for the proton reconstruction inefficiency, black plot - without correction.

N_n / N_p ratio, SciHi triggers



N_n / N_p ratio for inclusive neutrons and protons. Red plot - Monte Carlo n/p ratio prediction.