



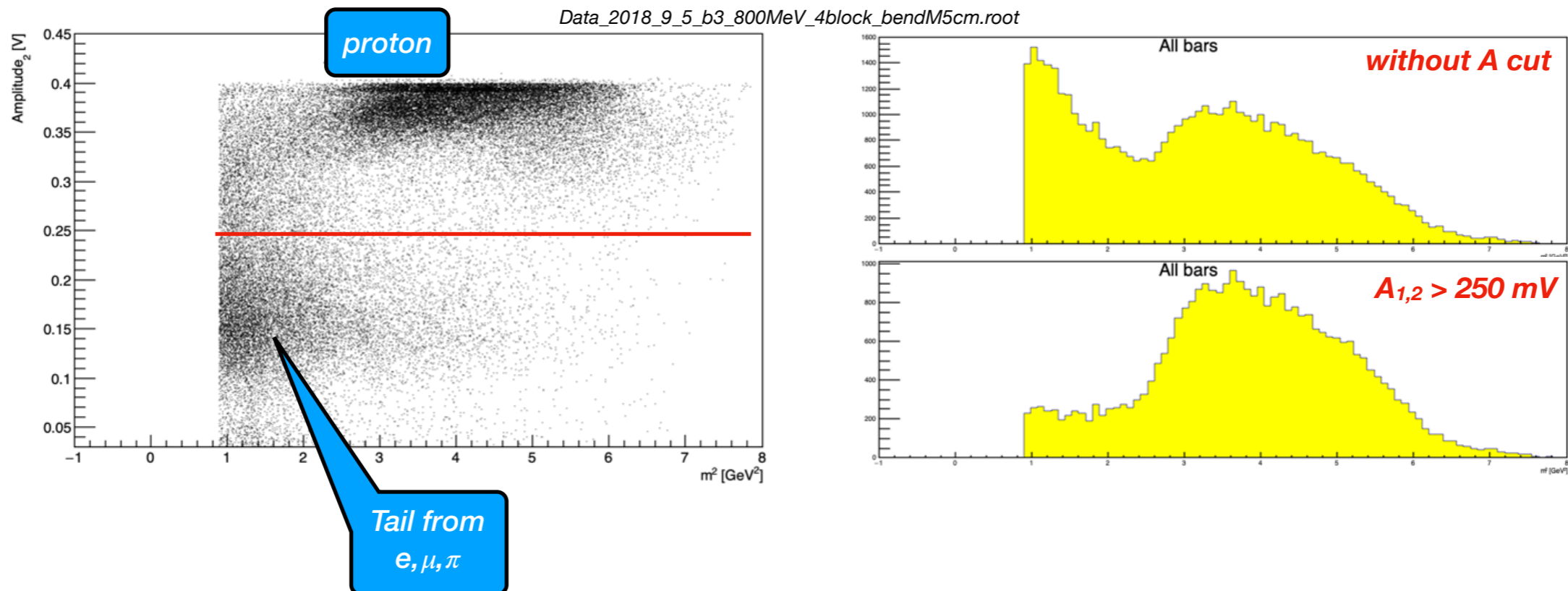
Update for the uToF calibration and analysis

Alexander Korzenev, Uni Geneva

HPTPC analysis and soft meeting
Feb 8, 2019

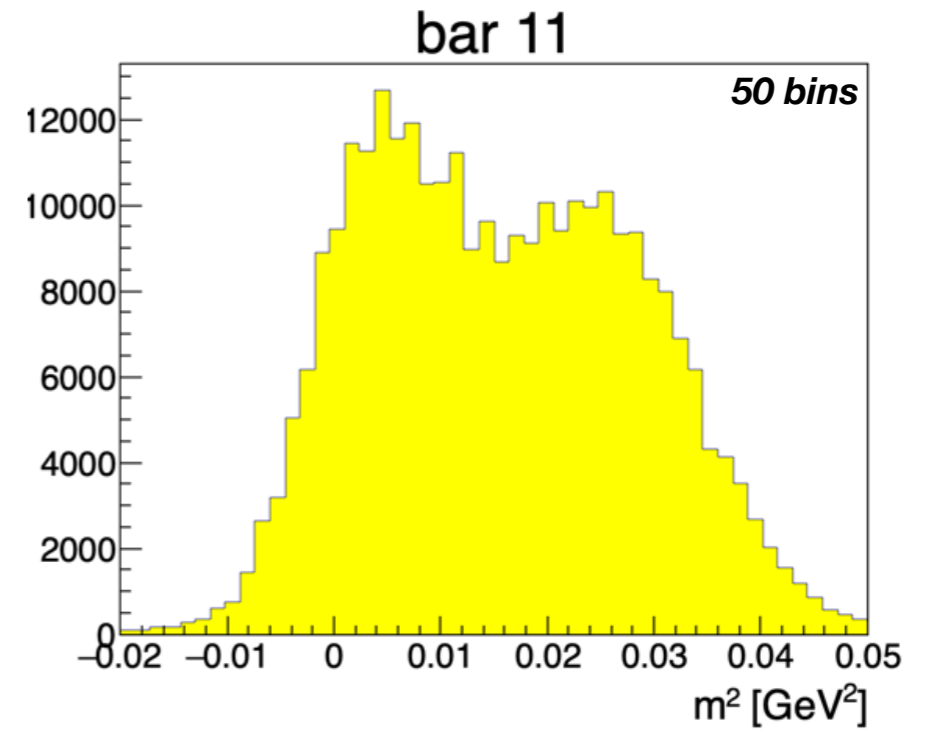
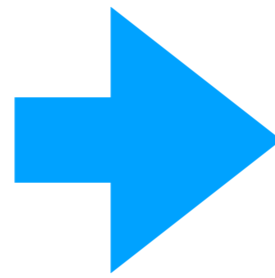
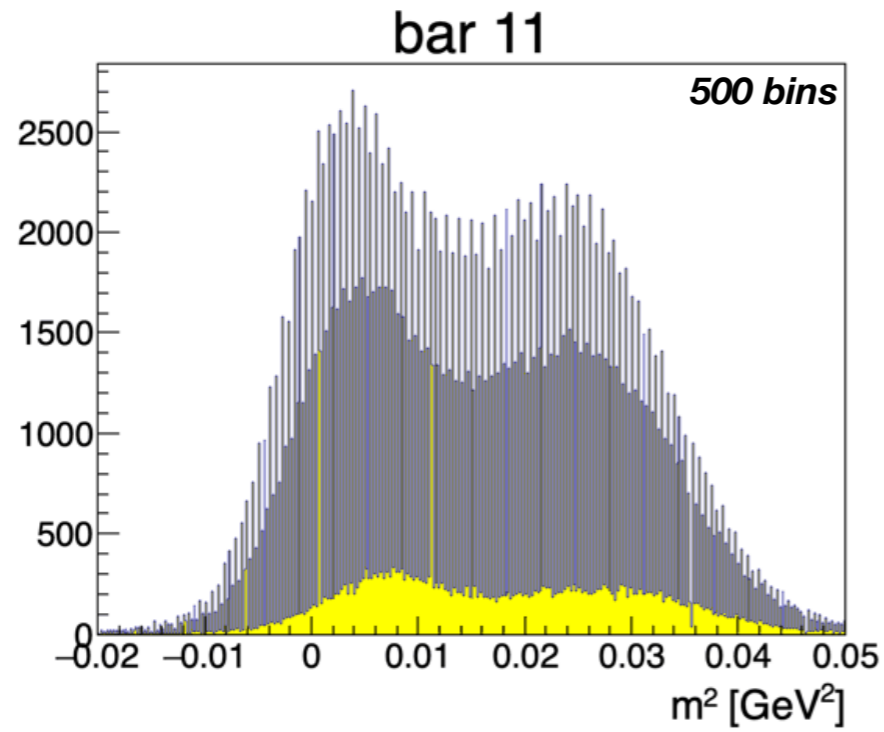
New with respect to the ν_2 production

- All time delays were properly adjusted
- **Time-walk corrections** are implemented
- Amplitude is tuned to simplify the **cut for protons**
 - There was no adjustment of amplitude before the Aug-Sep run: signal saturation depends on channel 300-500 mV
 - Large energy deposition for protons => Amplitude at maximum
 - Maximum value for signals of all channels are adjusted to 400 mV
 - No way to get nice proton signal without the amplitude cut
- **Mass square is added** to the tree
 - Fixed distance is assumed $L=10.9$ m
 - Fixed momentum is assumed: wrong assumption for protons

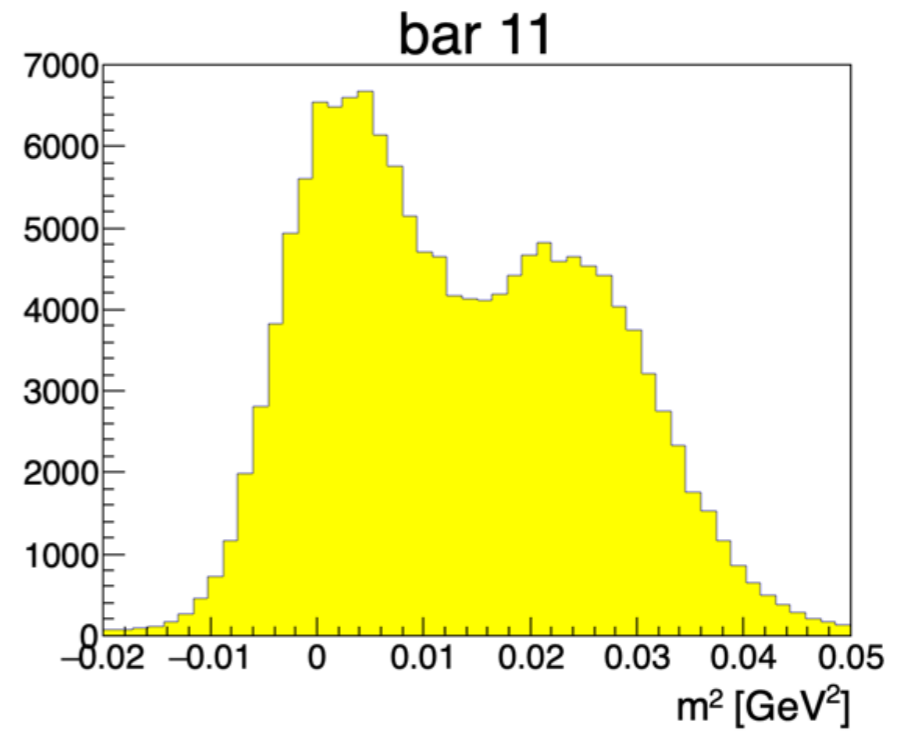
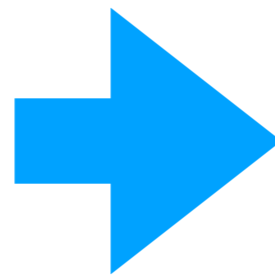
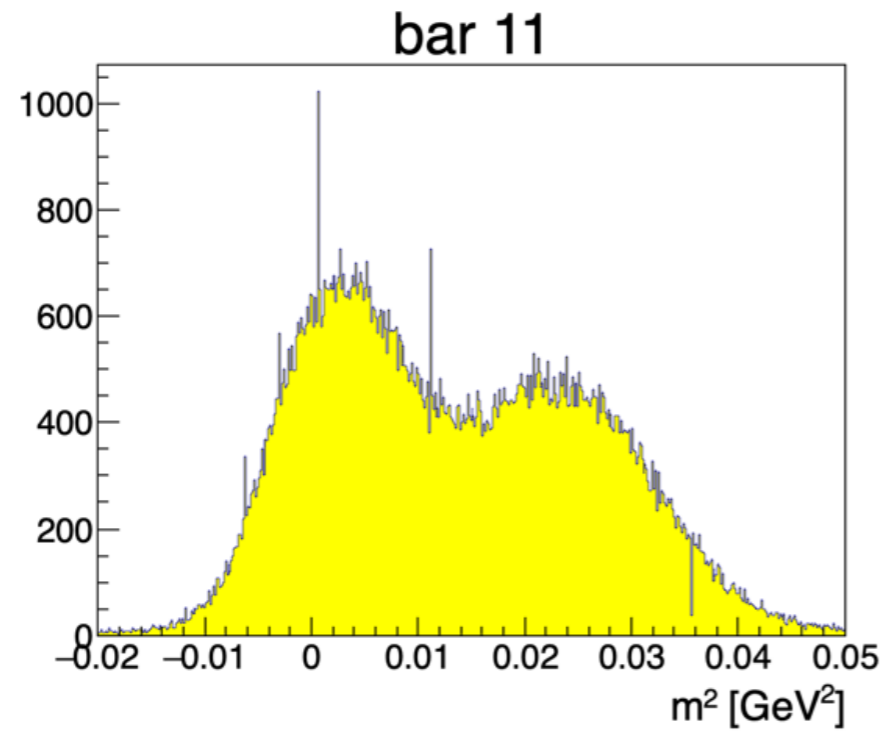


Problem of time recorded (decoded?)

Data_2018_9_12_b1.root



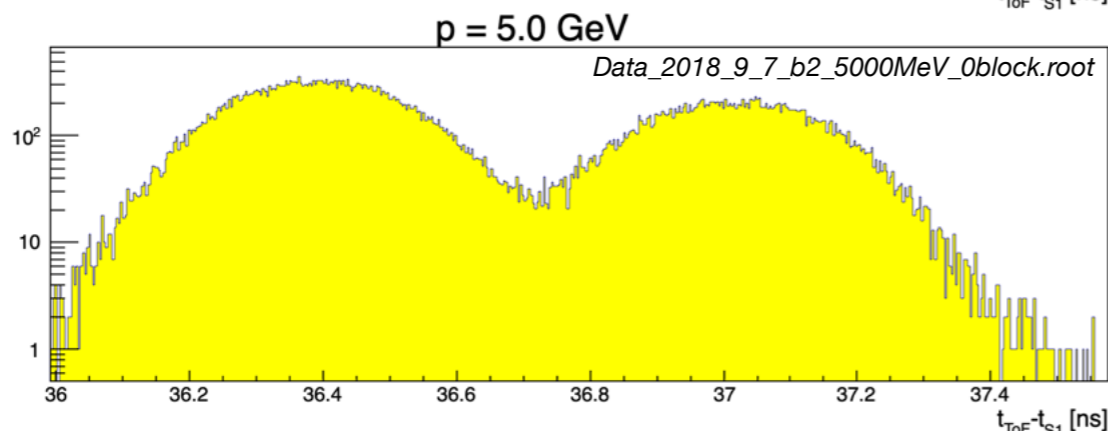
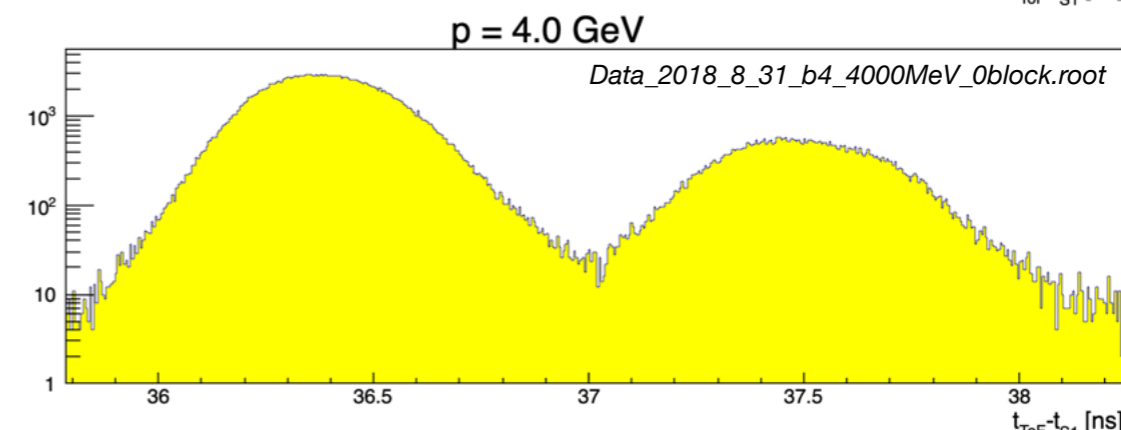
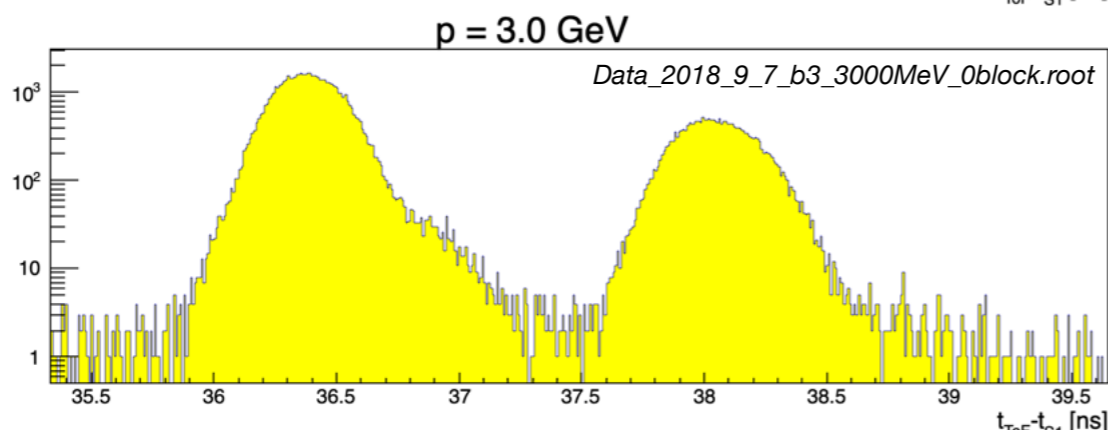
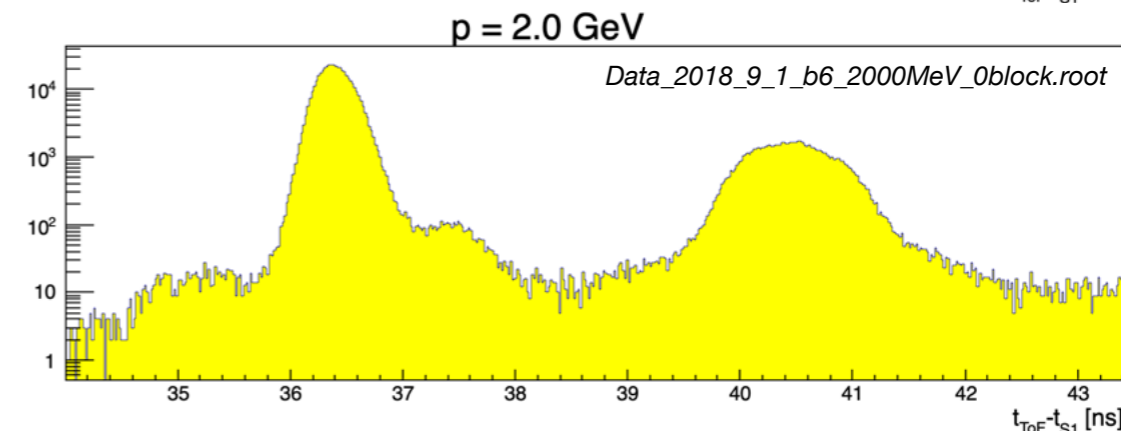
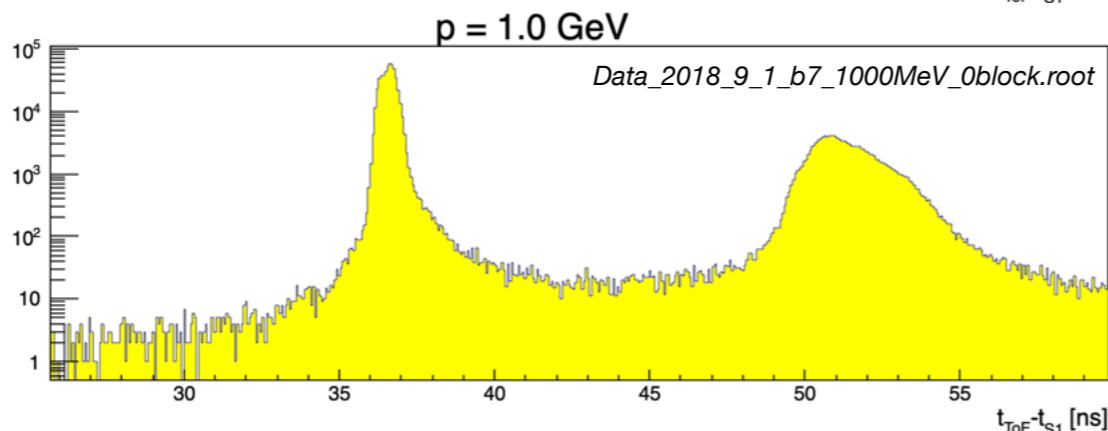
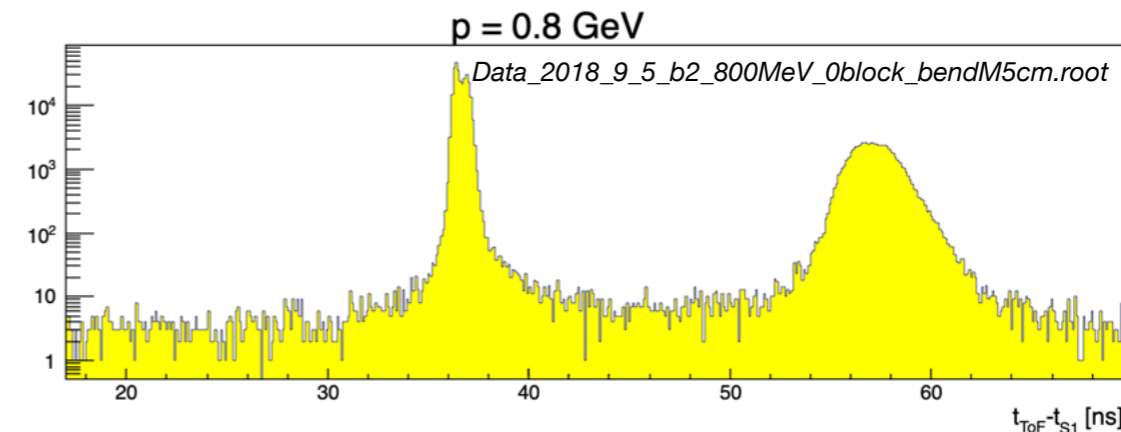
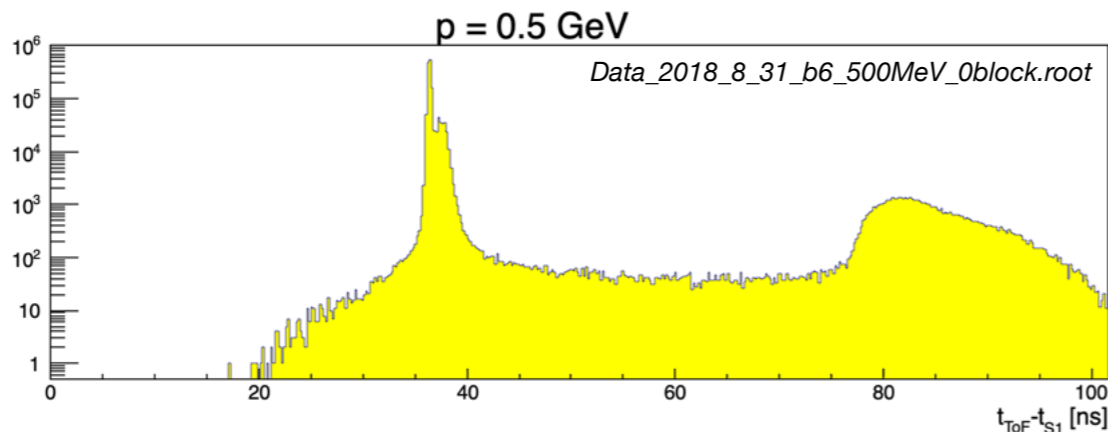
Data_2018_9_10_b1.root



Do not use fine binning!

Different beam momenta, without moderator

$$t = L/c \sqrt{\frac{m^2}{p^2} + 1}$$

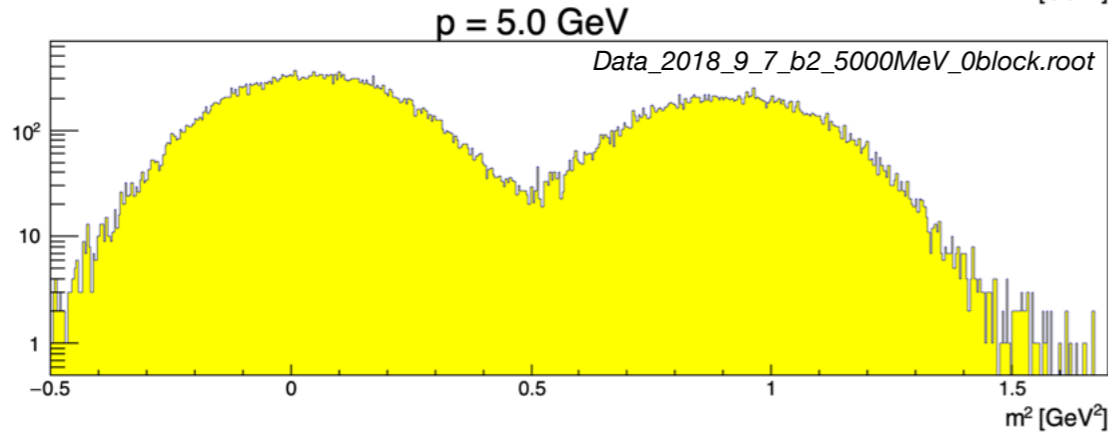
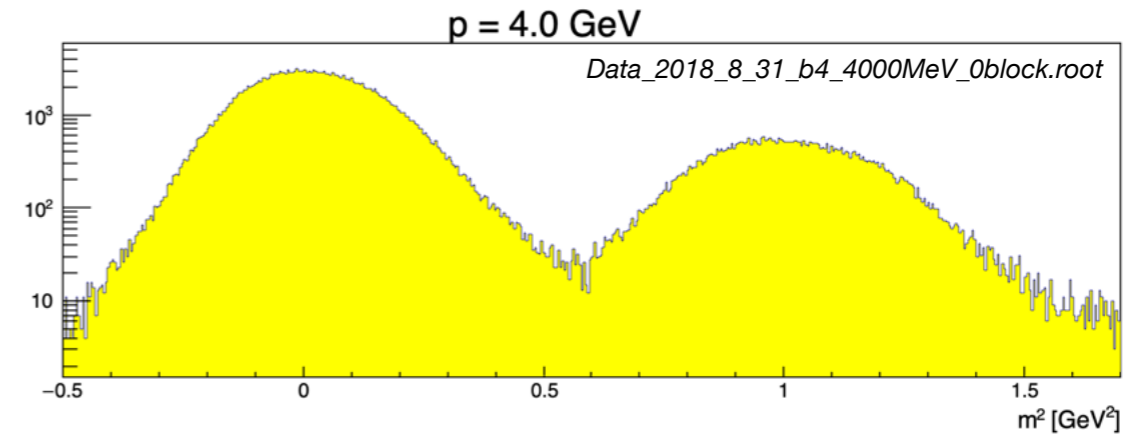
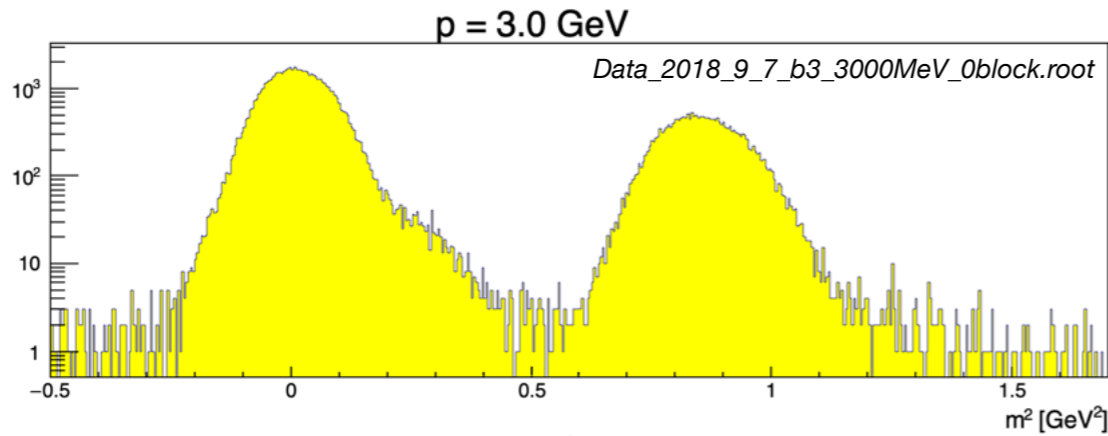
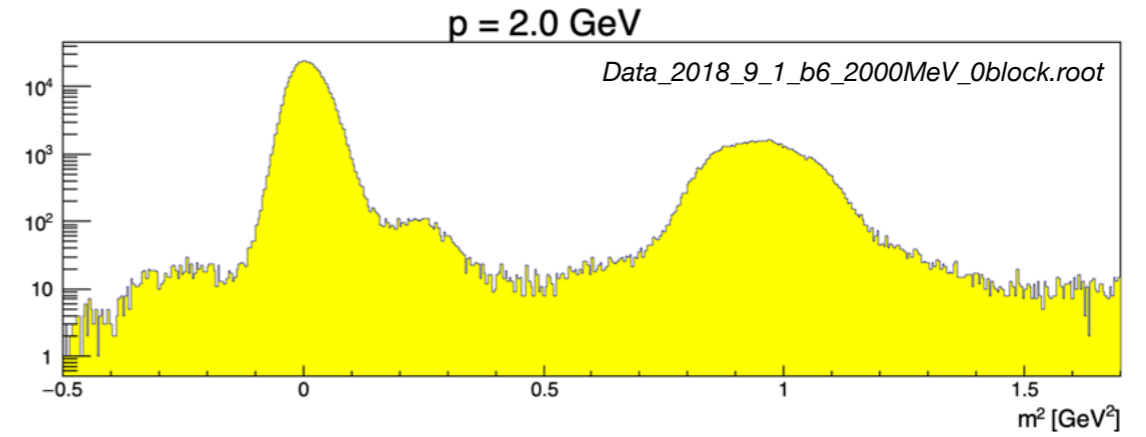
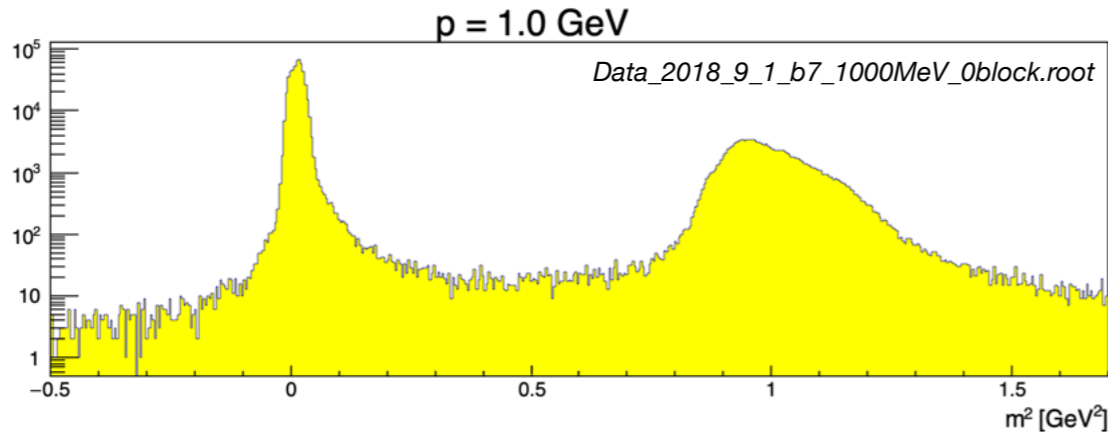
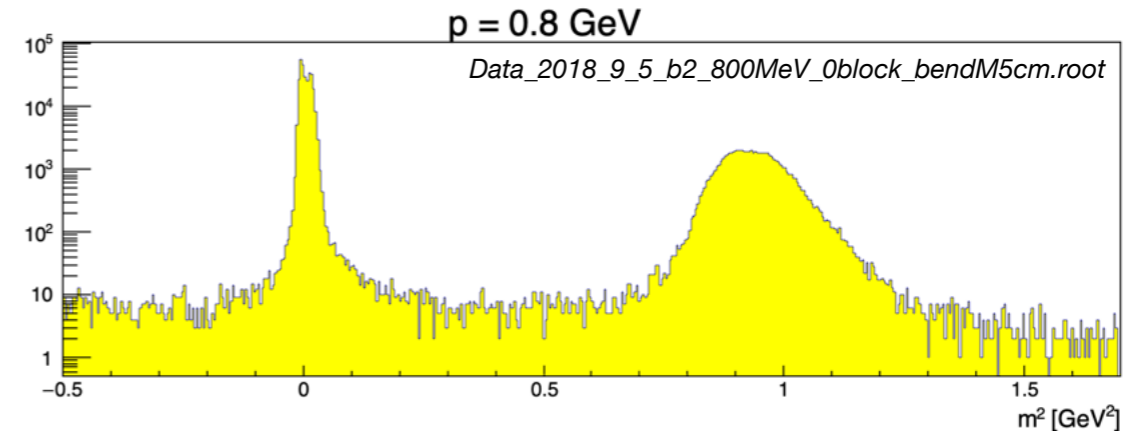
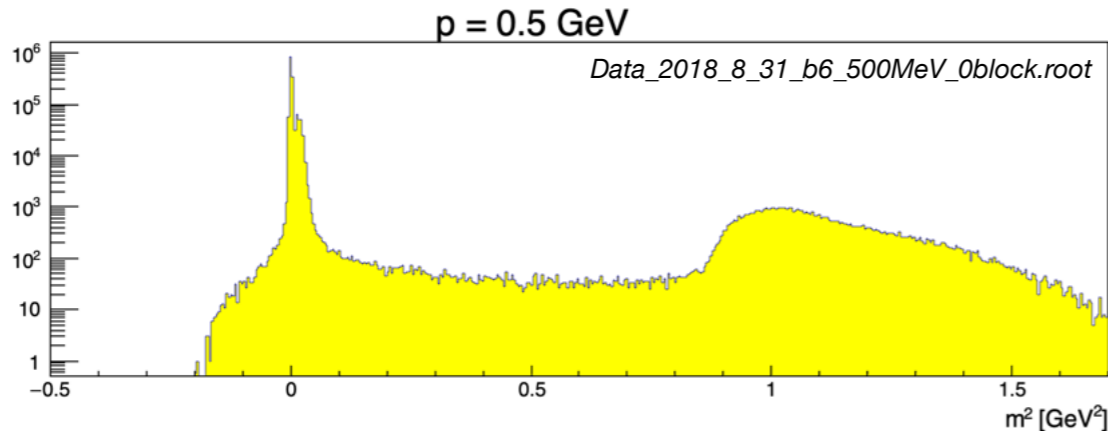


Calculation for $L = 10.9 \text{ m} = 36.4 \text{ ns}$

	0.5GeV	0.8GeV	1GeV	2GeV	3GeV	4GeV	5GeV
$t_{\mu} - t_e$	0.8 ns	0.3 ns	0.2 ns	0.1 ns	0.0 ns	0.0 ns	0.0 ns
$t_{\pi} - t_e$	1.4 ns	0.5 ns	0.4 ns	0.1 ns	0.0 ns	0.0 ns	0.0 ns
$t_K - t_e$	14.7 ns	6.4 ns	4.2 ns	1.1 ns	0.5 ns	0.3 ns	0.2 ns
$t_p - t_e$	41.0 ns	19.7 ns	13.5 ns	3.8 ns	1.7 ns	1.0 ns	0.6 ns
$t_D - t_e$	171. ns	56.3 ns	40.9 ns	13.5 ns	6.5 ns	3.8 ns	2.5 ns

Different beam momenta, without moderator

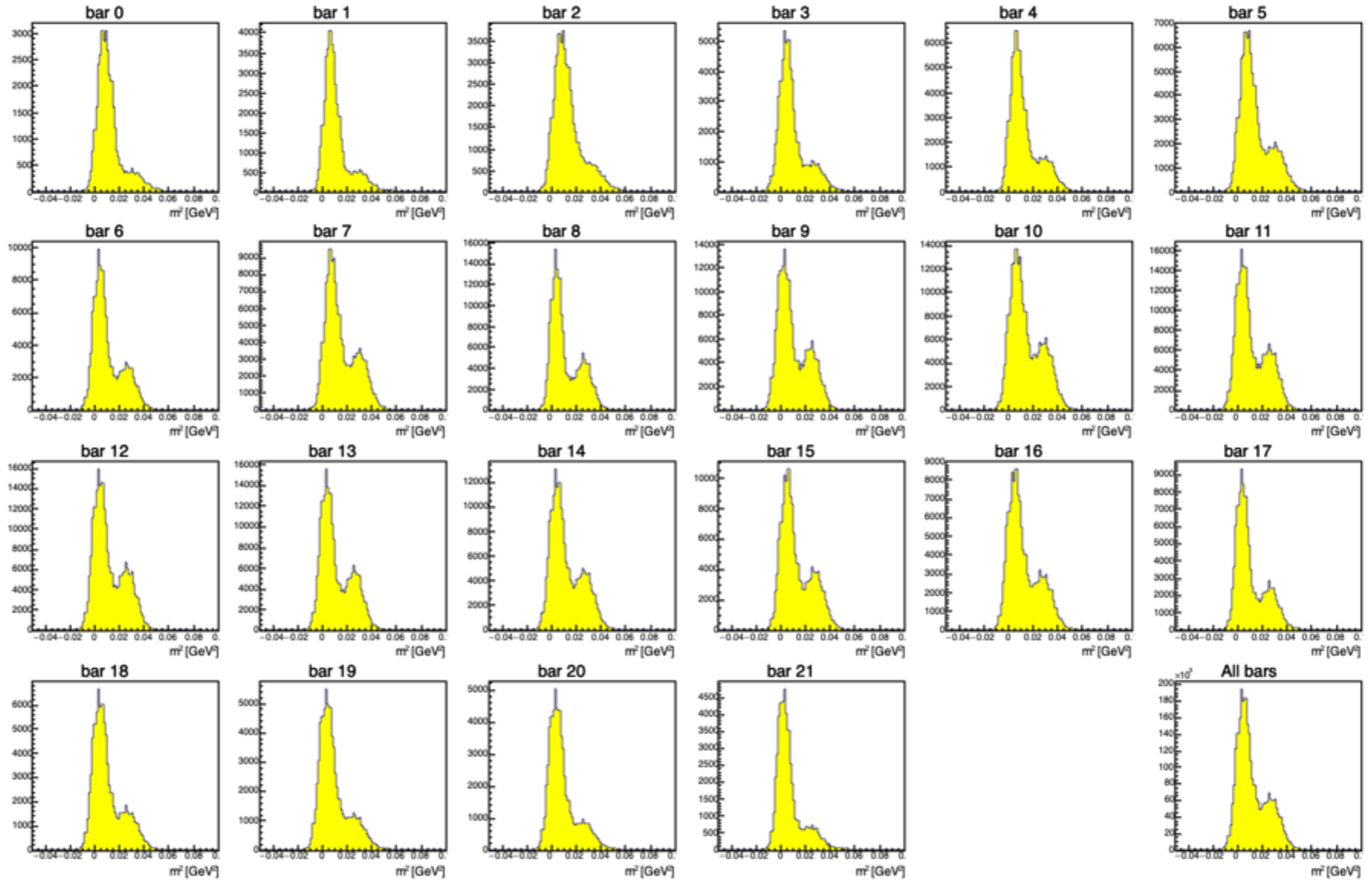
$$m^2 = p^2 \left(\frac{t^2}{(L/c)^2} - 1 \right)$$



	e	μ	π	K	p	D
m	0.5 MeV	0.11 GeV	0.14 GeV	0.49 GeV	0.94 GeV	1.88 GeV
m²	0.00 GeV ²	0.01 GeV ²	0.02 GeV ²	0.24 GeV ²	0.88 GeV ²	3.52 GeV ²

800 GeV beam with 4 moderator blocks / e, μ, π peaks

Beam +4cm

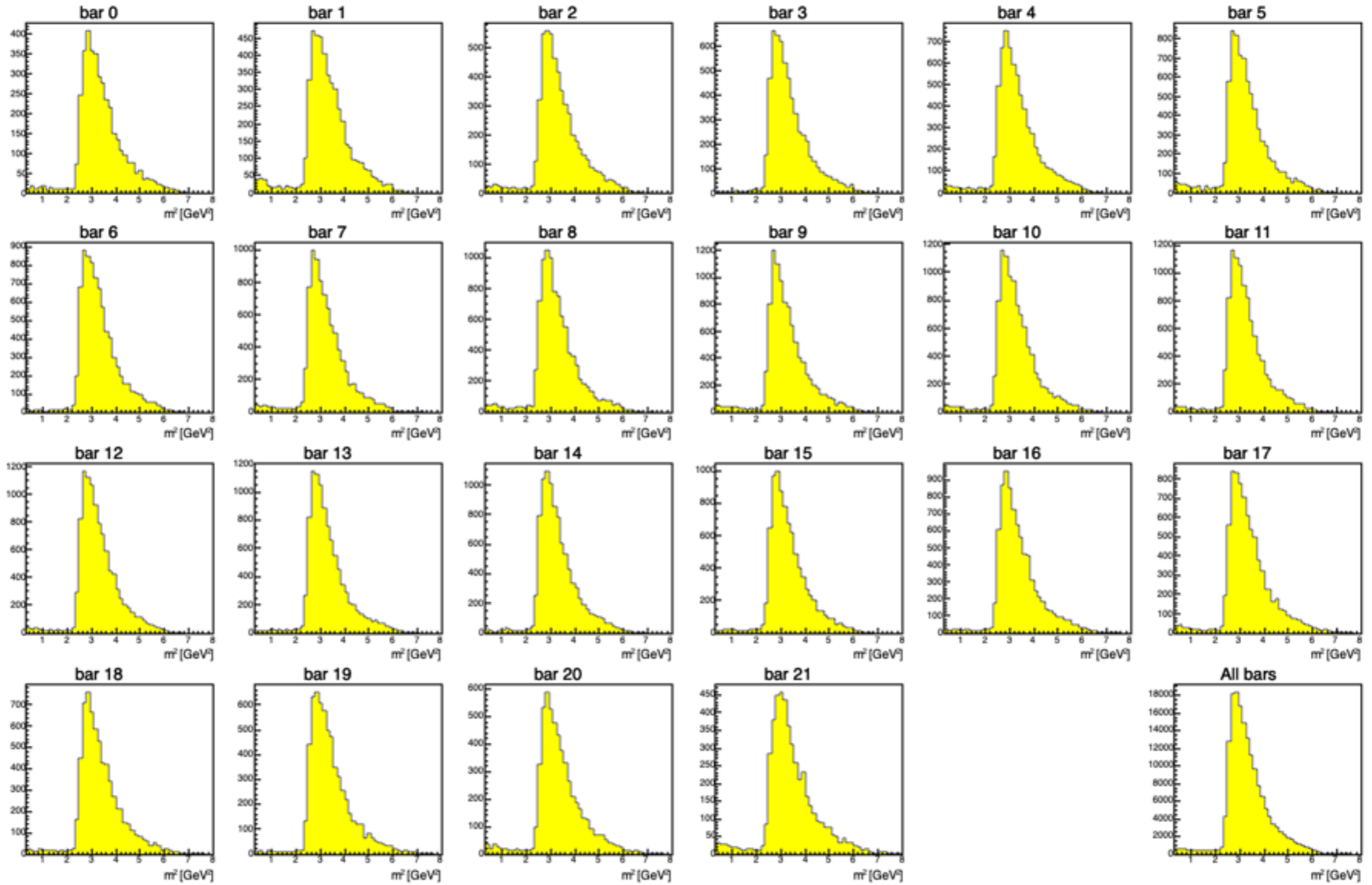


Data_2018_9_4_b2_800MeV_4block.root

● fraction of pions is larger in the centre

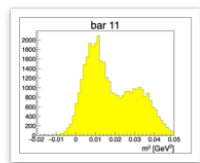
800 GeV beam with 4 moderator blocks / proton peaks

Beam +4cm

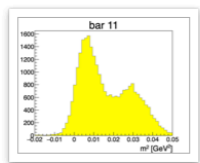


Data_2018_9_4_b2_800MeV_4block.root

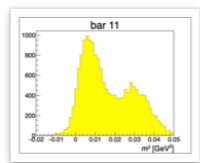
800 GeV beam with moderator blocks / e, μ, π peaks



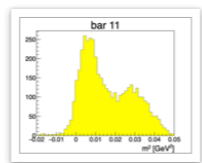
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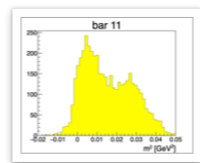
Data_2018_8_28_b5_e.g if



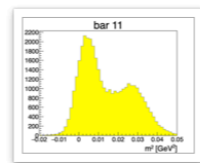
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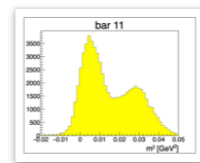
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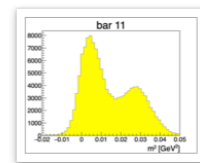
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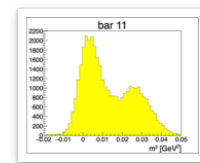
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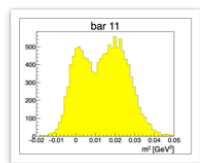
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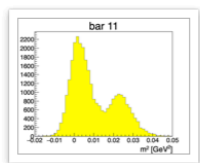
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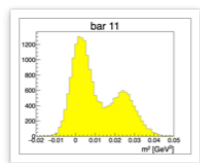
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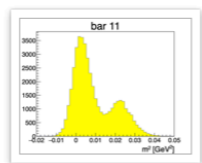
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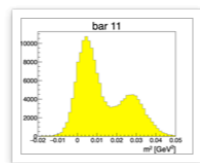
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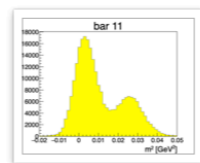
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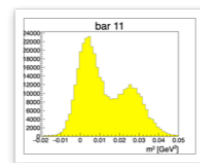
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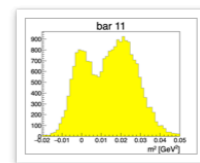
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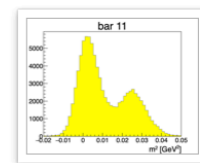
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Data_2018_9_2_b1_800 MeV_4block...tr70ns_e.gif

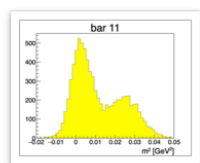


Data_2018_9_3_b1_800 MeV_4block...Obend_e.gif

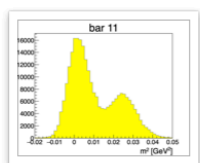


Data_2018_9_3_b2_800 MeV_4block...d4cm_e.gif

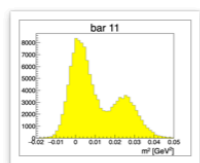
Beam +4cm



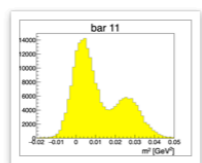
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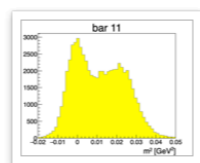
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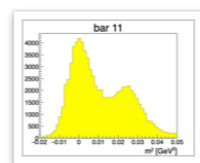
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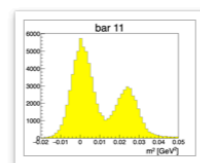
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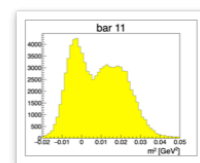
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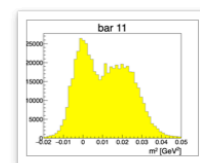
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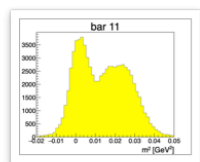


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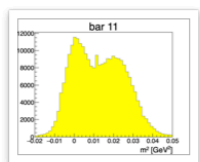


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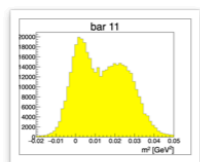
Beam -5cm



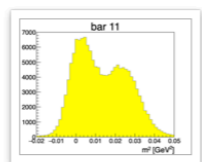
Data_2018_9_8_b1_e.g if



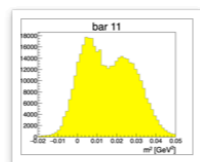
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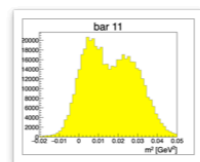
Data_2018_9_9_b3_800 MeV_4block...M5cm_e.gif



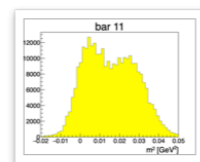
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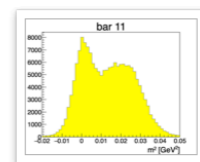
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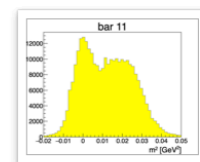
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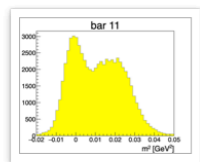
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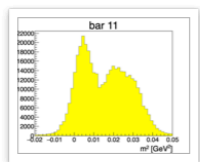
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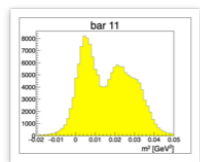
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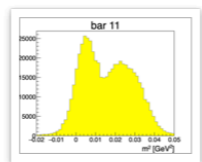
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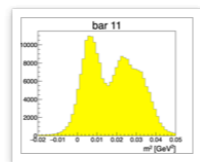
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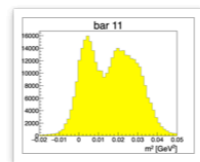
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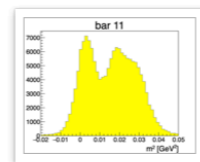
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Data_2018_9_16_b1_e.g if



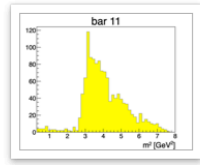
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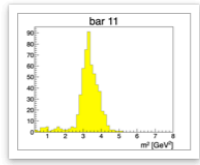
Data_2018_9_17_b1_e.g if

$e/(\mu+\pi)$ ratio is changed with the beam position

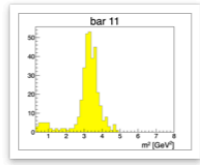
800 GeV beam with moderator blocks / proton peaks



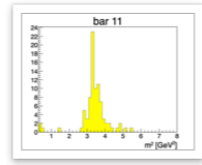
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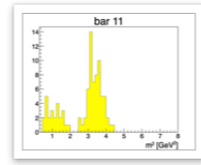
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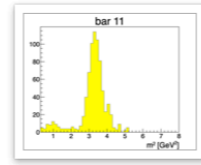
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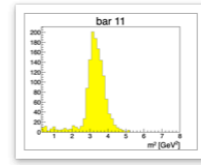
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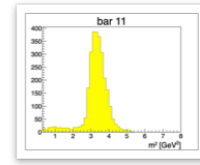
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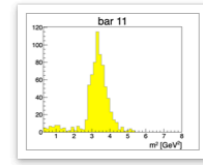
Data_2018_8_29_b1_p.gif



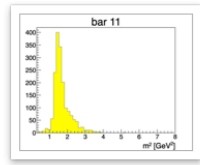
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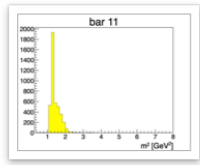
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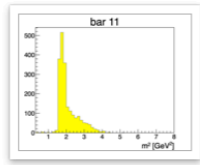
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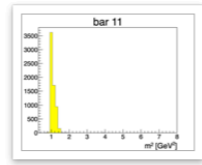
Data_2018_9_1_b1_800MeV_2block_p.gif



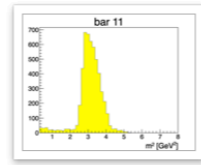
Data_2018_9_1_b2_800MeV_2block...d4cm_p.gif



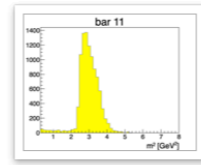
Data_2018_9_1_b3_800MeV_3block...d4cm_p.gif



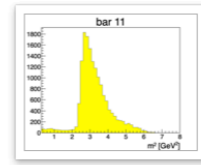
Data_2018_9_1_b4_800MeV_1block...d4cm_p.gif



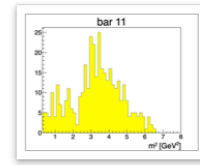
Data_2018_9_1_b5_800MeV_4block_p.gif



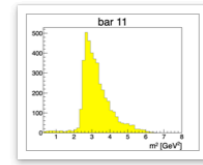
Data_2018_9_1_b8_800MeV_4block...d4cm_p.gif



Data_2018_9_2_b1_800MeV_4block...r70ns_p.gif

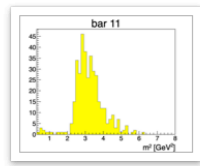


Data_2018_9_3_b1_800MeV_4block...bend_p.gif

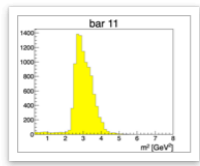


Data_2018_9_3_b2_800MeV_4block...d4cm_p.gif

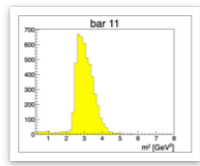
Beam +4cm



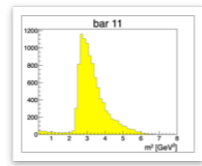
Data_2018_9_3_b3_800MeV_4block_p.gif



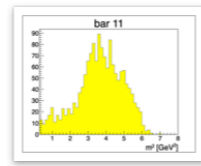
Data_2018_9_3_b4_800MeV_4block...mUSB_p.gif



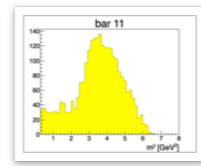
Data_2018_9_4_b1_800MeV_4block_p.gif



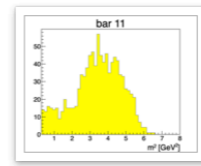
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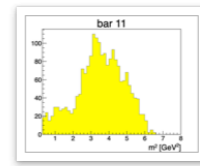
Data_2018_9_5_b3_800MeV_4block...M5cm_p.gif



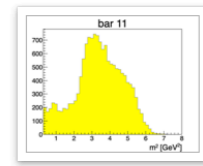
Data_2018_9_5_b5_800MeV_4block...M5cm_p.gif



Data_2018_9_6_b1_800MeV_4block_p.gif

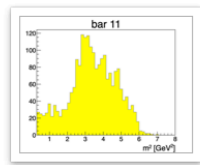


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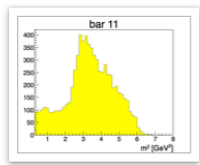


Data_2018_9_7_b4_800MeV_4block...M5cm_p.gif

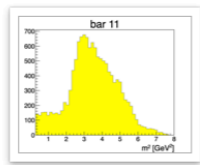
Beam -5cm



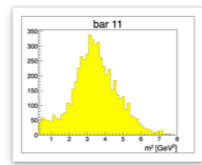
Data_2018_9_8_b1_p.gif



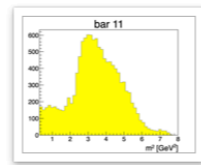
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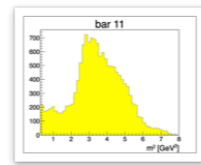
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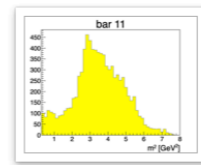
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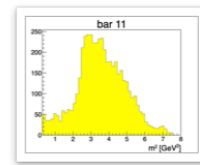
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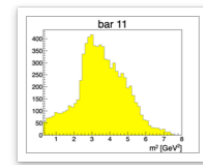
Data_2018_9_11_b1_800MeV_4block...5mm_p.gif



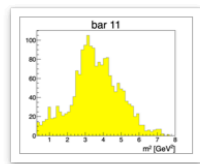
Data_2018_9_12_b1_p.gif



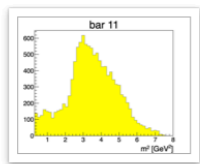
Data_2018_9_13_b1_p.gif



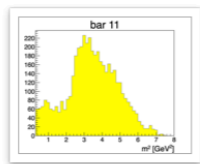
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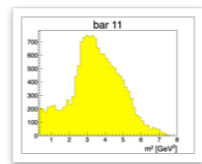
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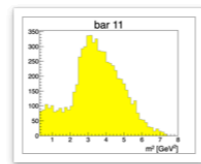
Data_2018_9_14_b2_800MeV_4block_Trig_p.gif



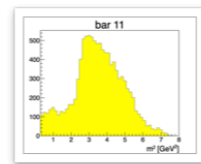
Data_2018_9_15_b1_p.gif



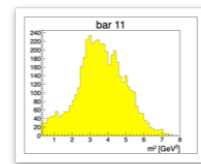
Data_2018_9_15_b2_p.gif



Data_2018_9_16_b1_p.gif



Data_2018_9_16_b2_p.gif

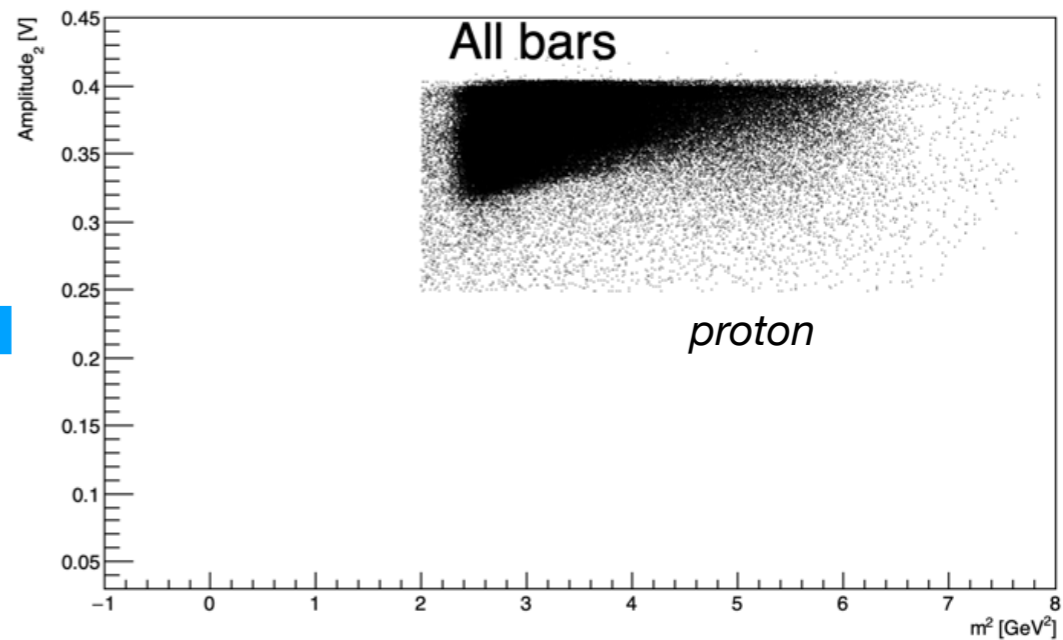
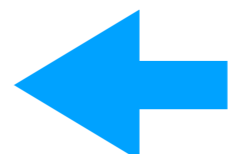
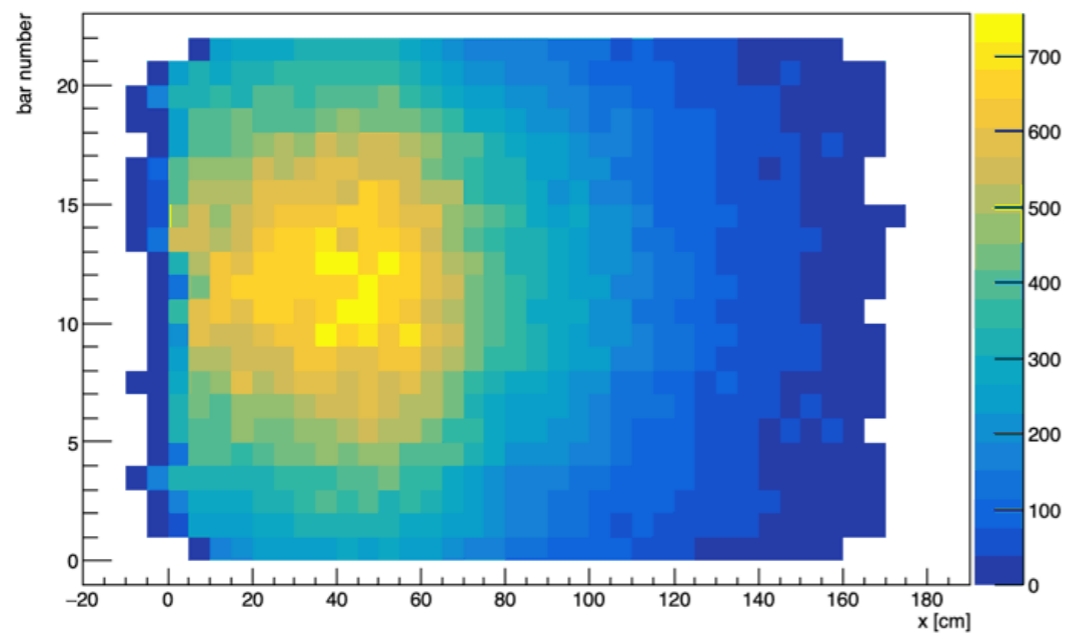
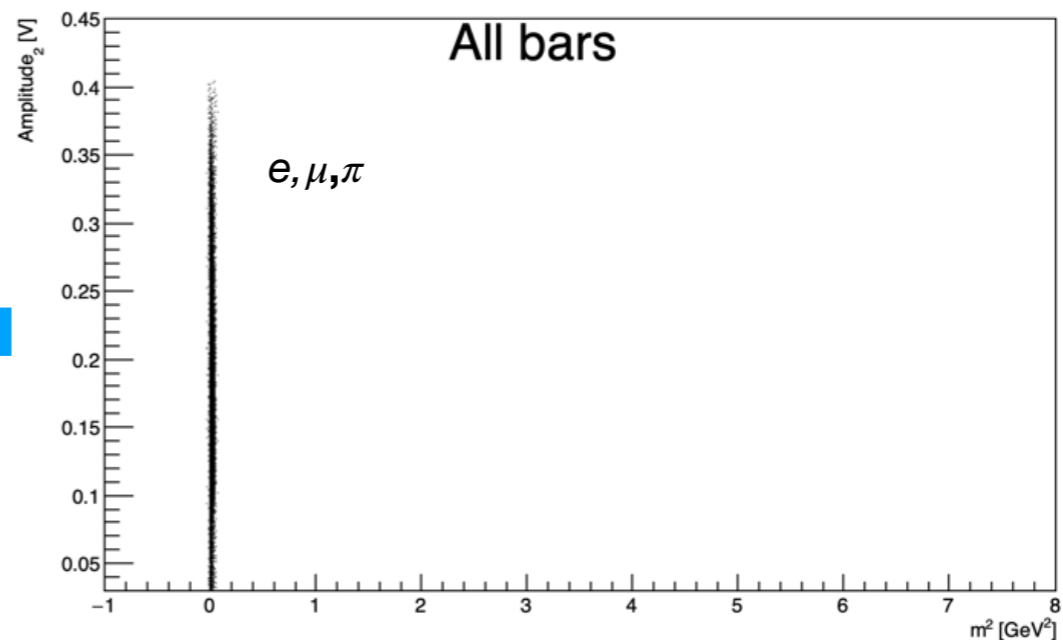
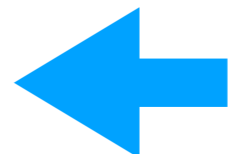
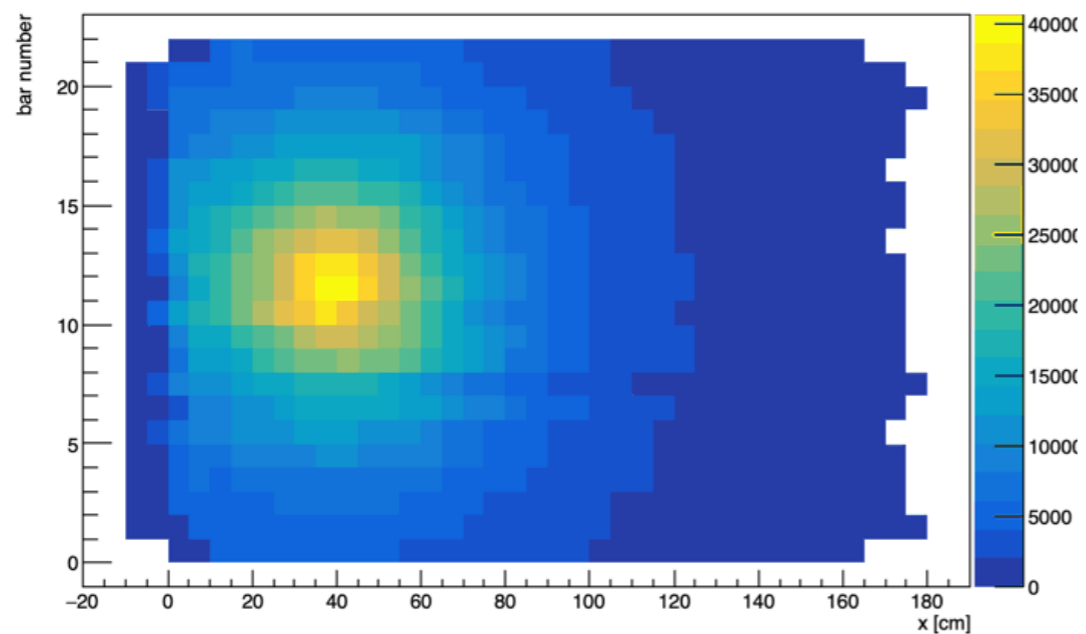


Data_2018_9_17_b1_p.gif

proton peak is changed with the beam position

800 GeV beam with 4 moderator blocks, beam +4cm

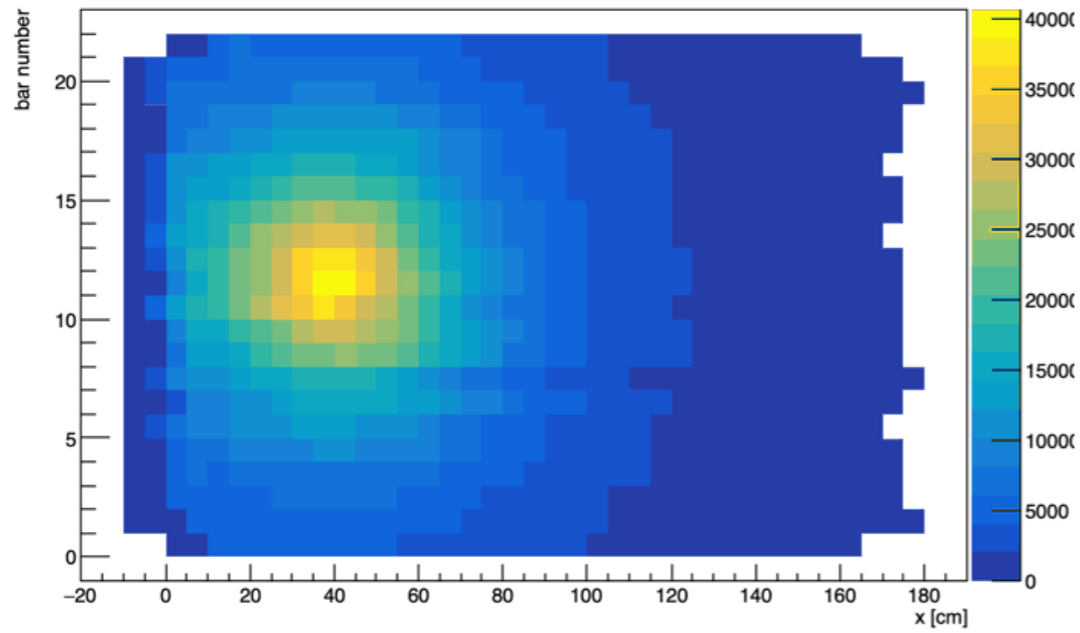
Data_2018_9_4_b2_800MeV_4block.root



800 GeV beam with 4 moderator blocks

Beam +4cm

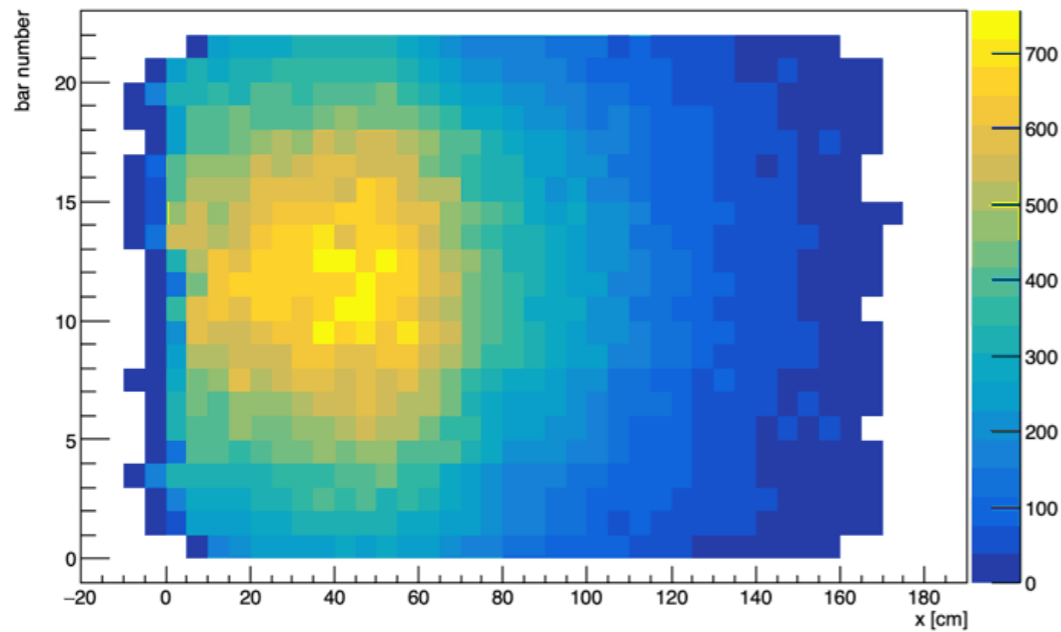
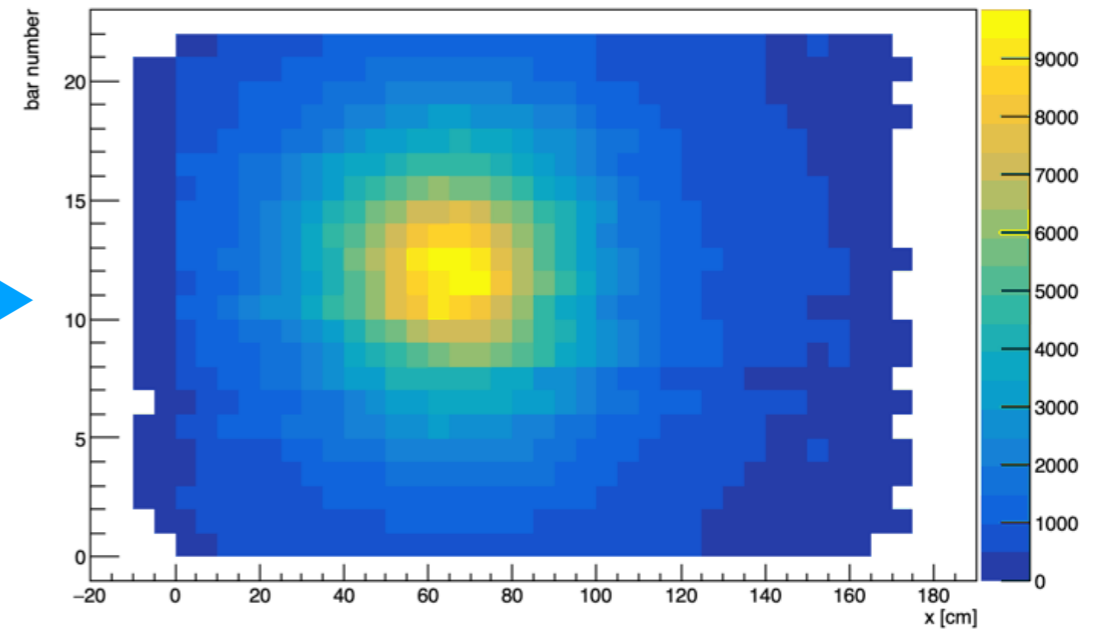
Data_2018_9_4_b2_800MeV_4block.root



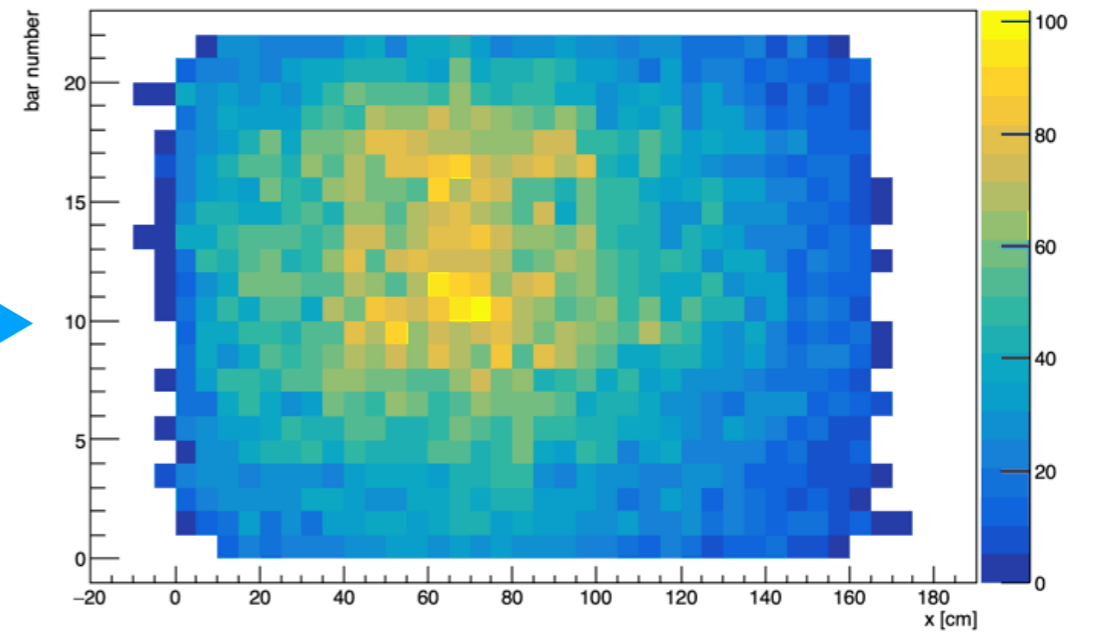
e, μ, π

Beam -5cm

Data_2018_9_5_b3_800MeV_4block_bendM5cm.root



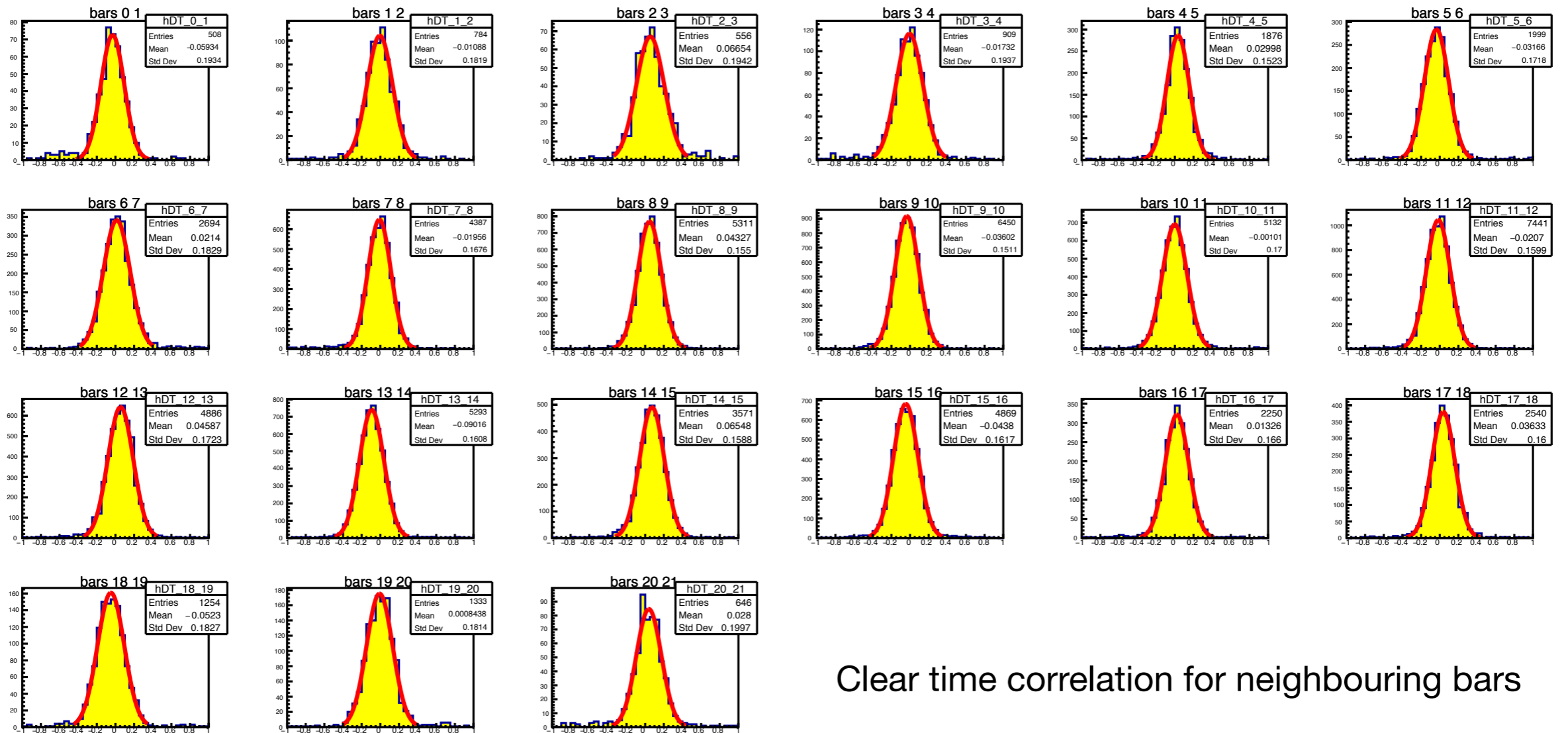
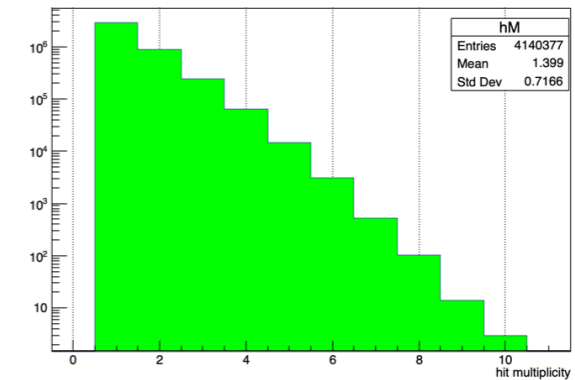
proton



Moderator blocks were not symmetric with respect to the beam line

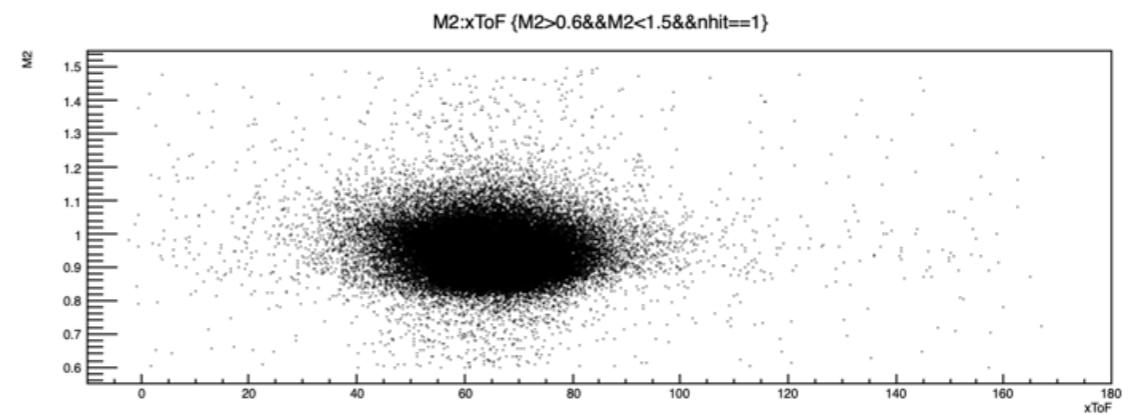
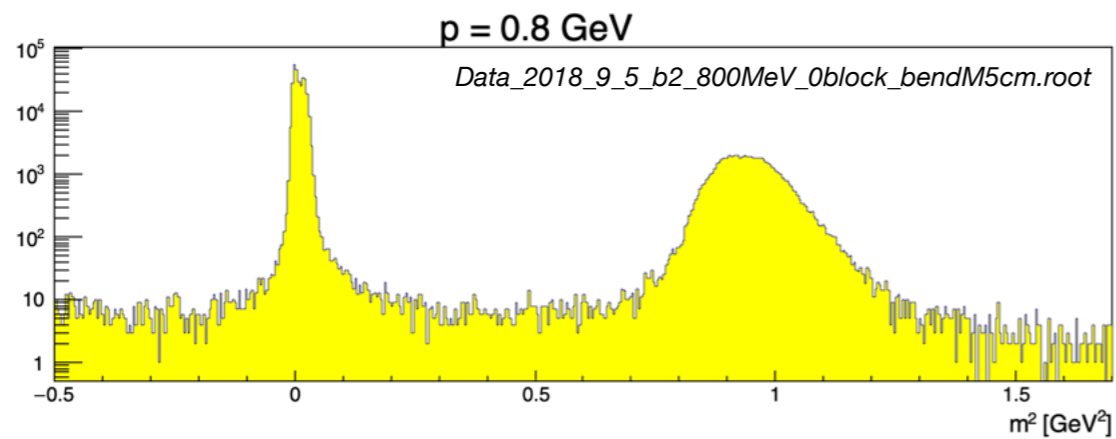
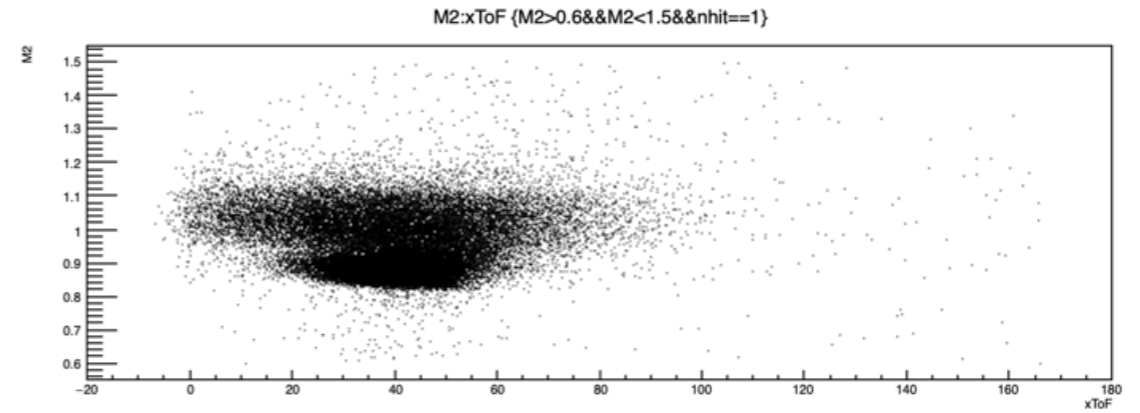
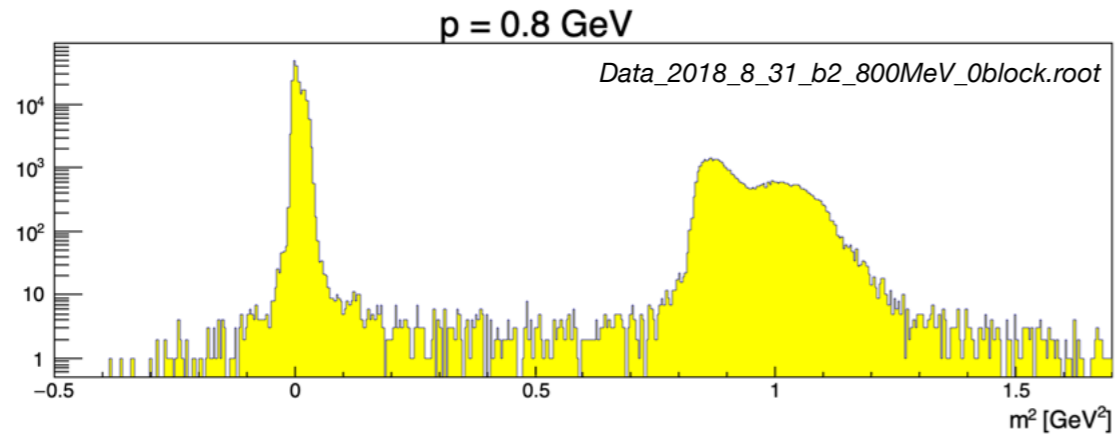
Hit multiplicity

- For all plots shown so far the uToF hit multiplicity =1 have been required
- Larger number of hits can mean an interaction in moderator => strong change in the momentum value => difficult to assign to known mass
- Two hit can also be a consequence of bar overlaps (5mm): should be smaller than $10\text{mm}/60\text{mm}=16\%$



Clear time correlation for neighbouring bars

Puzzle of double proton peak (0 blocks)



- No dependence on x_{ToF} (or any other variable) found
- Dependence on the beam position?

Conclusions

- New production v3 is ready. Copy from lxplus:
 - */eos/home-k/korzenev/Data_root_v3_wo_walk_corr/*
- Mass squared is included to the tree
 - Calculated assuming fixed value of momentum and distance
- Data can be useful to plan further testbeams
- For the uToF reference:
 - A.Korzenev et al., Plastic scintillator detector with the readout based on an array of large-area SiPMs for the ND280/T2K upgrade and SHiP experiments, arXiv:1901.07785
 - <https://arxiv.org/abs/1901.07785>