Update on Fluctuations Analyses

Zachary Sweger
5/12/22

Status of FXT Data

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Fixed-target data sets:

3.0 GeV (2021)
- Waiting on production

3.2 GeV (2019)
- I presented preliminary cumulants to this group in February.
- Now waiting on embedding

3.5 GeV (2020)
- I have plots and preliminary cumulants today

3.9 GeV (2020)
- I have plots today

4.5 GeV (2020)
- I have plots today

5.2 GeV (2020)
- I have plots today

6.2 GeV (2020)
- I have plots today

7.2 GeV (2020)
- Waiting on production

7.7 GeV (2020)
- I have plots today

For all FXT produced data:
- Issues identified with $n\sigma_p$ which need to be investigated
- ETOF needs to be recalibrated for all > 3.2 GeV

Recap: February 3.2 GeV Preliminary Cumulants Results

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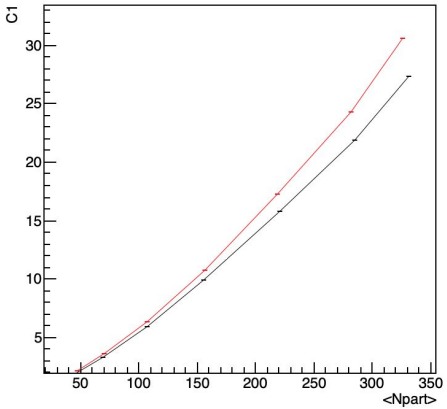
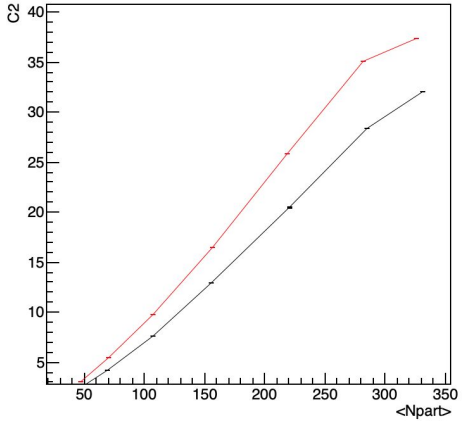
Preliminary 3.2 GeV cumulants before corrections roughly consistent with 3.0 GeV uncorrected results

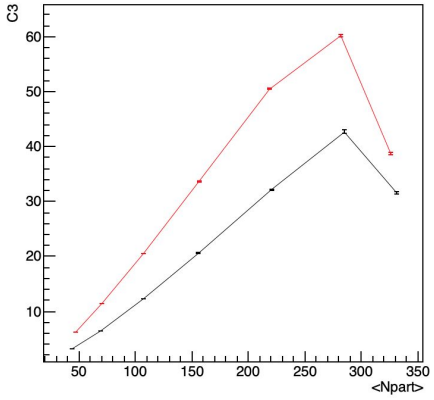
C1



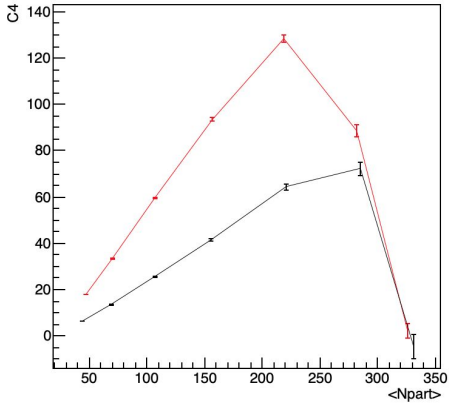
C2



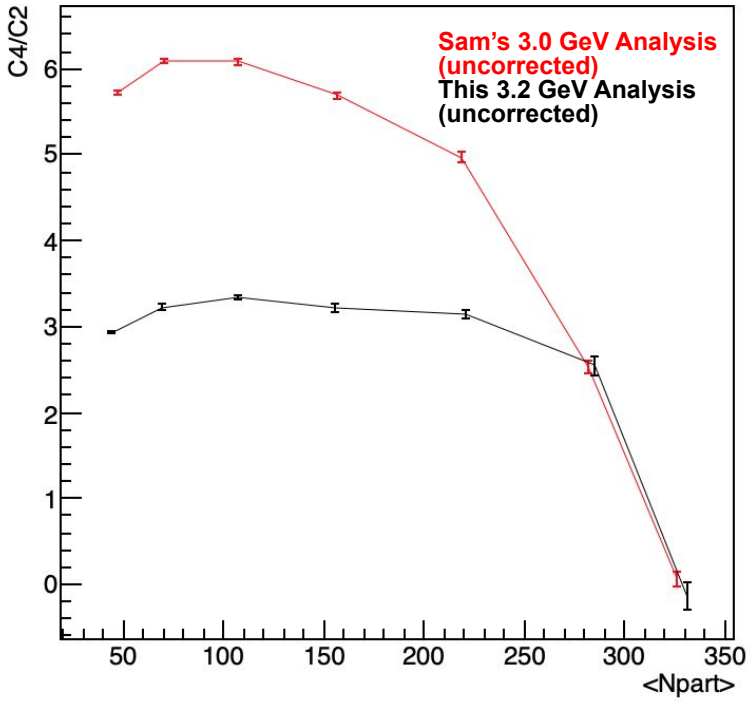
C3



C4



C4/C2



The Data

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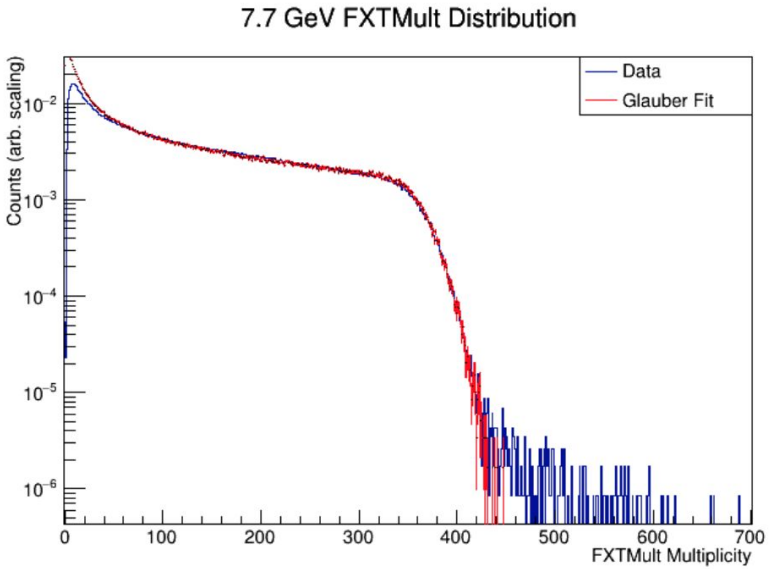
√s (GeV)	Year	Production Tag	Trigger IDs	Bad runs used
3.2	2019	production_4p59GeV_fixedTarget_2019	680001	20180005, 20180006
3.5	2020	production_5p75GeV_fixedTarget_2020	720000	None yet
3.9	2020	production_7p3GeV_fixedTarget_2020	730000	None yet
4.5	2020	production_9p8GeV_fixedTarget_2020	740000, 740010	None yet
5.2	2020	production_13p5GeV_fixedTarget_2020	750000	None yet
6.2	2020	production_19p5GeV_fixedTarget_2020	760000	None yet
7.2	2020	None yet	790010	None yet
7.7	2020	production_31p2GeV_fixedTarget_2020	770000	None yet

Centrality

- I’ve been looking into centrality for the Fixed-Target program since 2020 and had defined preliminary centrality cuts based on fastoffline data for each FXT energy
- Centrality for FXT data is unique because the traditional Glauber largely over-estimates the contribution of peripheral events
- As I presented at April Meeting 2021, this over-estimation can be minimized with the inclusion of a multiplicity-dependent inefficiency that is larger than is typically used in collider centrality



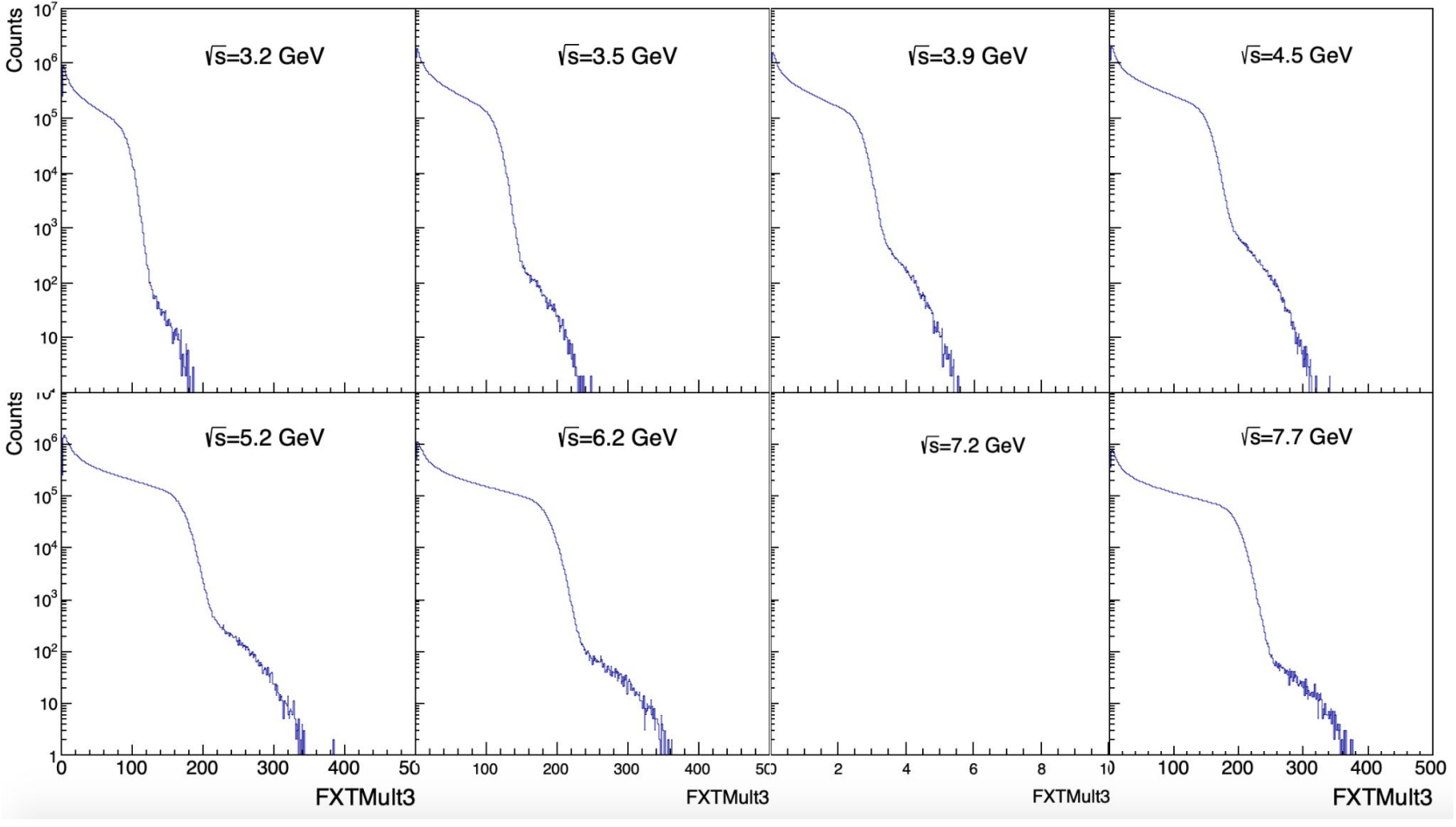
Parameters
x = 0.073%
μ = 2.35333
k = 2.77215
TE=10%

χ^2/DOF= 2.38

Centrality

- I’ve defined preliminary centrality cuts from my analysis of the fastoffline FXTMult.
- The cuts have been scaled down to be used for centrality with FXTMult3
- These cuts will be used as a first pass, but the next step will be to determine centrality from the produced data

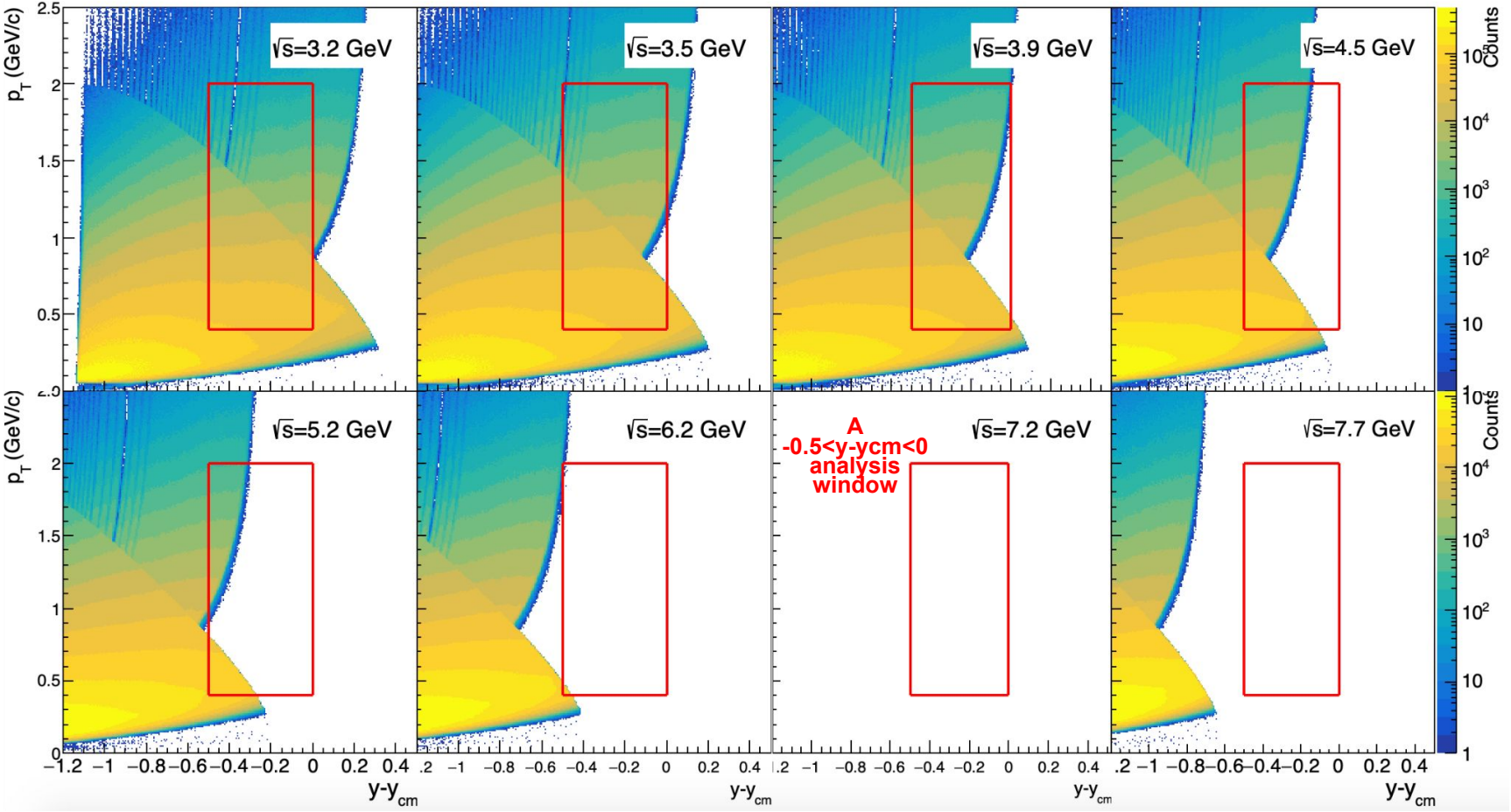
FXTMult3 Distributions



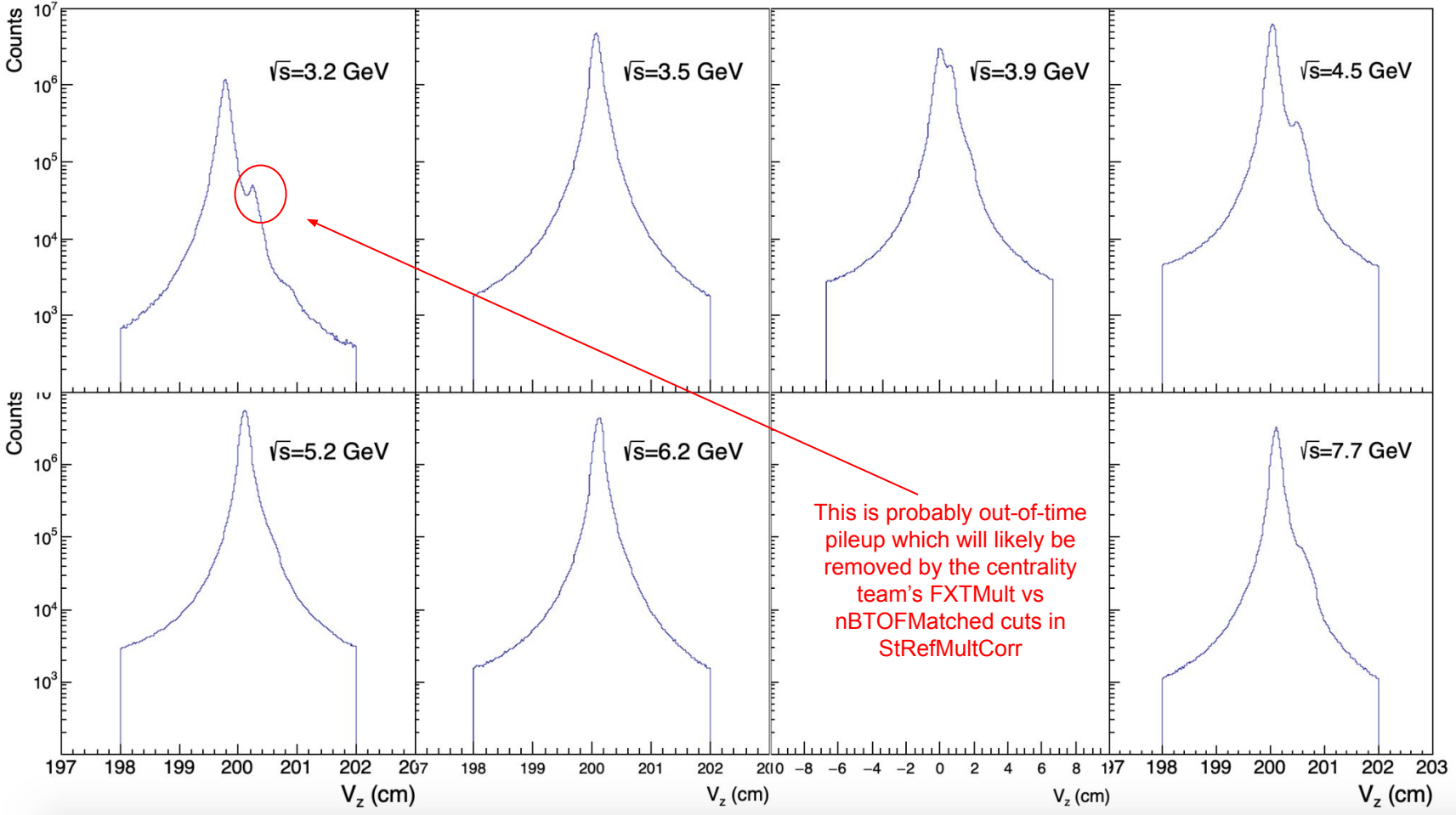
Preliminary Lower-Edge Centrality Cuts in FXTMult3

√s (GeV)	0-5%	5-10%	10-20%	20-30%	30-40%	40-50%	50-60%
3.2	75	61	41	27	17	10	6
3.5	100	82	55	36	24	14	8
3.9	126	106	75	52	35	22	14
4.5	140	114	76	50	31	19	11
5.2	155	126	84	55	34	20	11
6.2	177	148	104	72	48	31	18
7.7	199	172	127	91	62	40	25

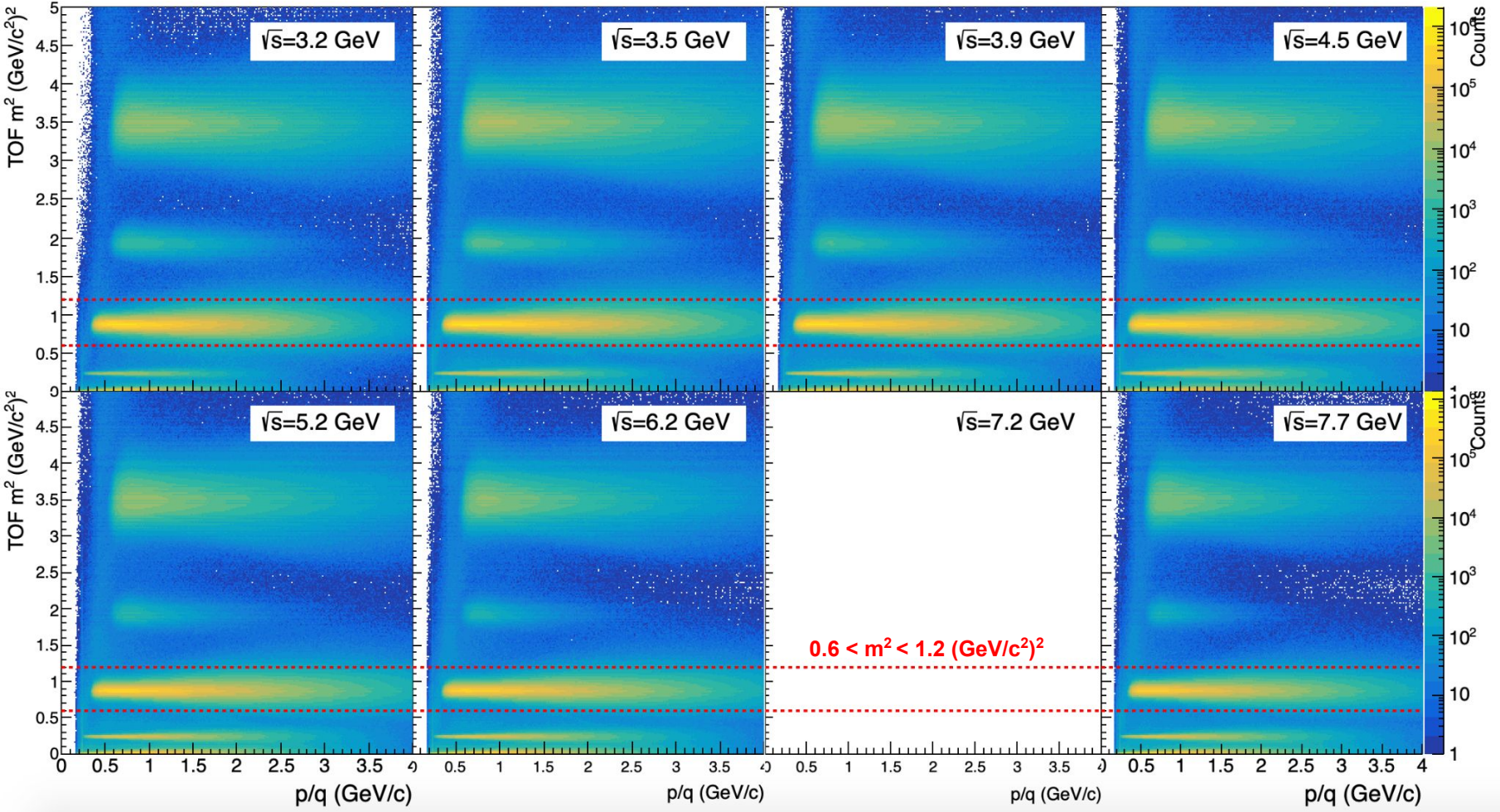
Acceptance without ETOF



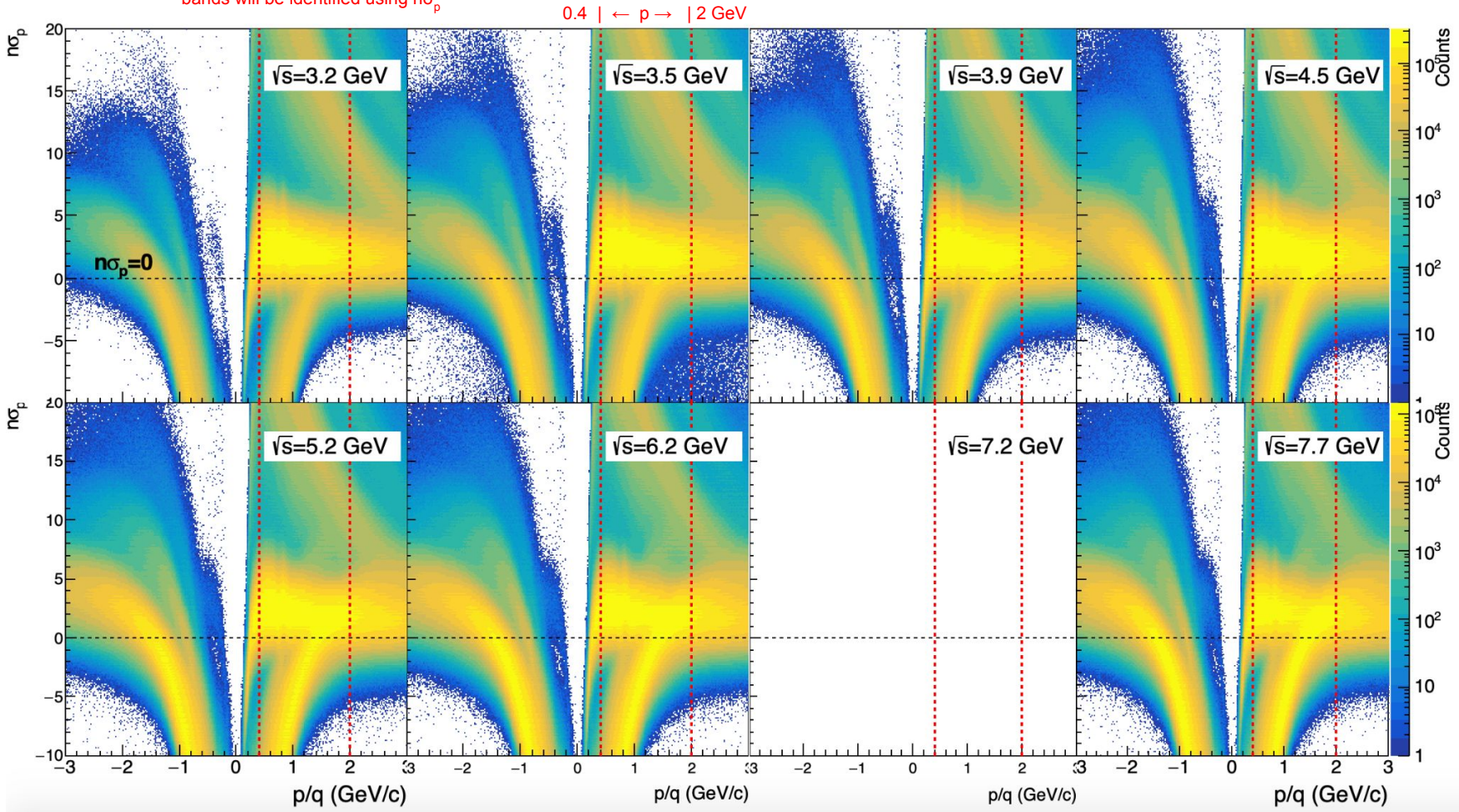
Vz Distributions



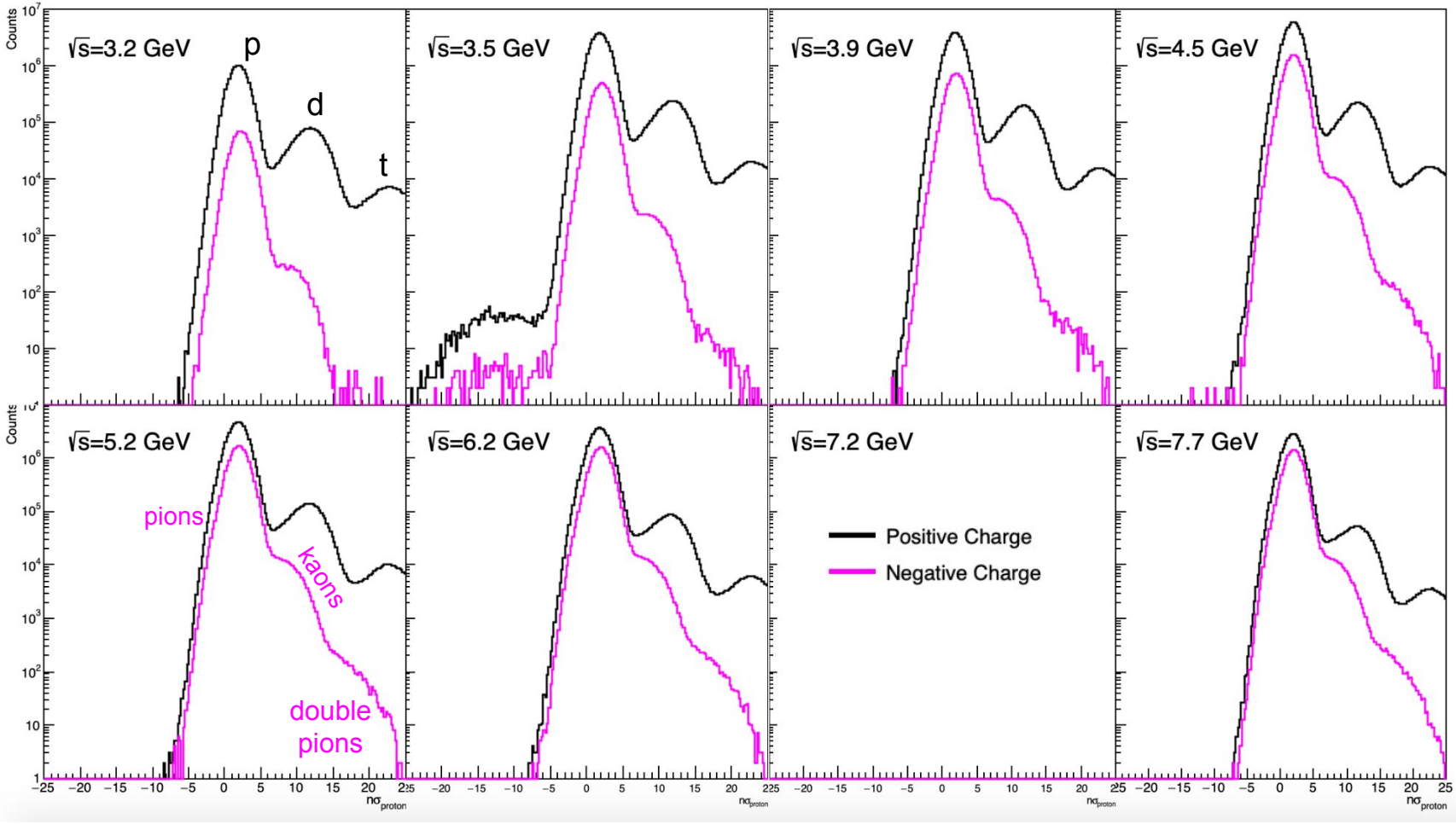
TOF Particle ID



TPC Particle ID



TPC PID Proton Purity at 1.8<p<1.9 GeV



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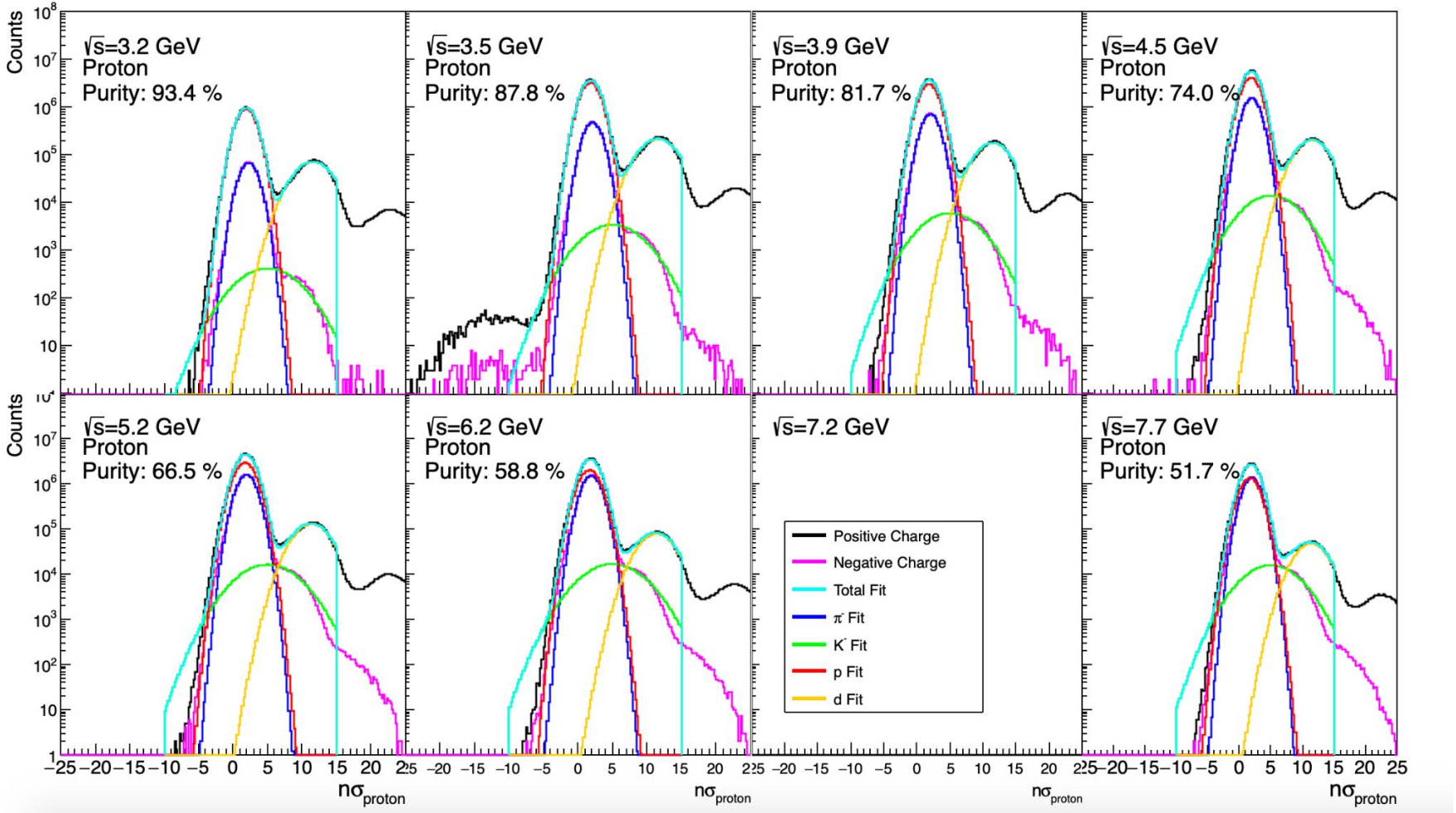
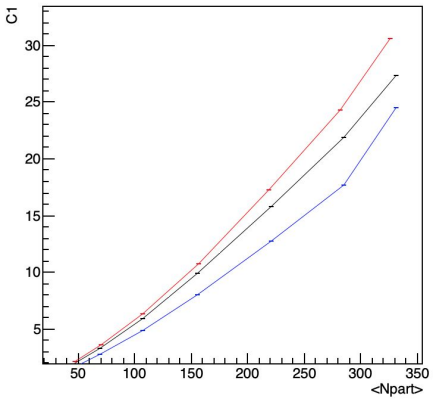
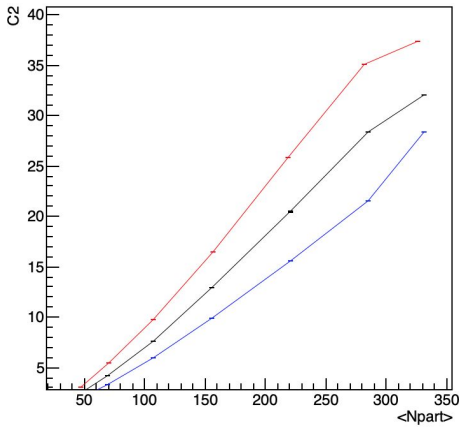


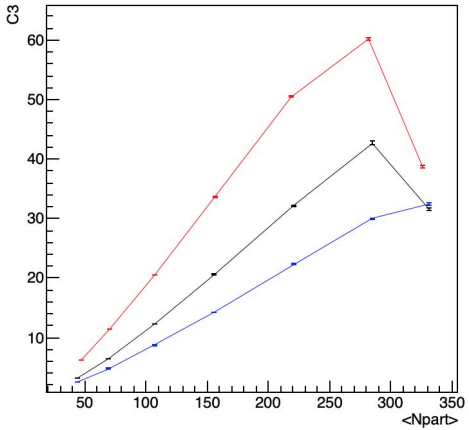
Very Preliminary Cumulants

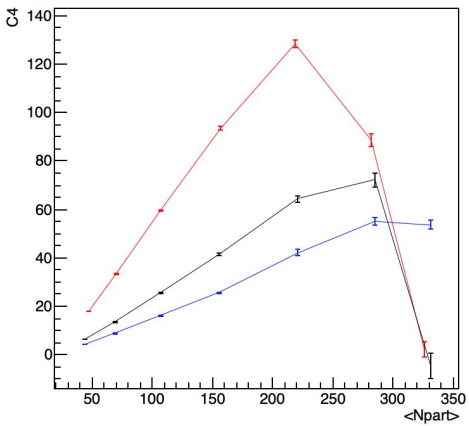
The plots below are preliminary results for the first four cumulants before bin-width and pileup corrections
At this stage the efficiencies from 2018 3.0 GeV are being used which will not be close to the actual efficiencies, so this is mostly just to get the wheels turning on this analysis

3.0 GeV 2018 before corrections
3.2 GeV 2020 before corrections
3.5 GeV 2020 before corrections

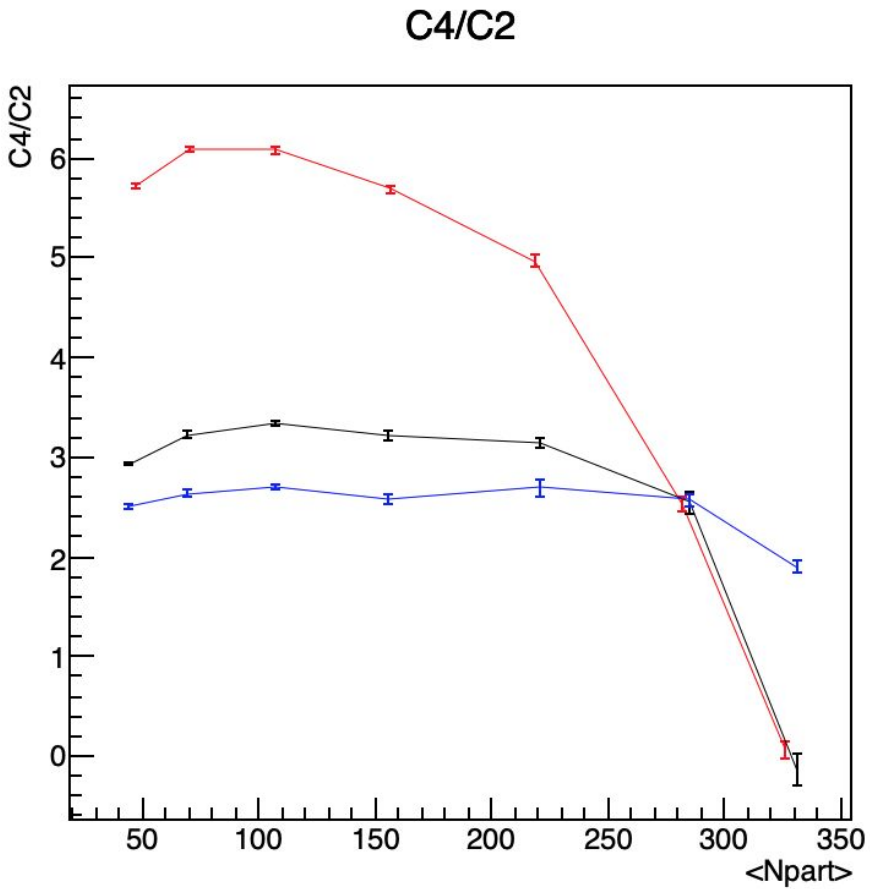








Very Preliminary Cumulant Ratios



3.0 GeV 2018 before corrections
3.2 GeV 2020 before corrections
3.5 GeV 2020 before corrections

Next Steps for FXT Cumulants

<u>To do</u>

- Plot acceptance including ETOF, consider analysis window
- Run pileup correction code for each energy
- Parameterize $n\sigma_p$ shift as a function of momentum
- Calculate preliminary cumulants for 3.9, 4.5, 5.2, 6.2, 7.2, and 7.7 GeV

<u>Waiting on</u>

- 3.2 GeV embedding
- Official QA for all FXT data
- $n\sigma_p$ recalibration?
- ETOF recalibration