

# Analysis Update

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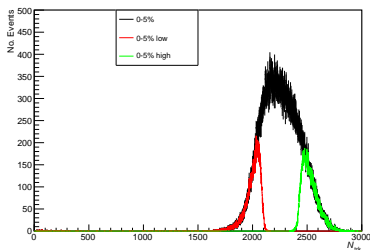
August 13th, 2021

# Outline

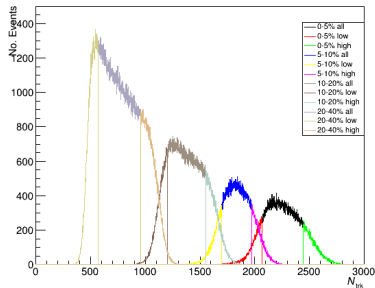
- 1 Errorbars
- 2 Multiplicity Results
- 3 Ratio Results
- 4 Comments/questions

# Changes

- Running the analysis once, obtaining the multiplicities for the whole dataset (no low/high separation), obtaining the means and standard deviations, and then running the analysis again separating low and high.



(a) Before. Notice that the low and high histograms decay smoothly



(b) Now. Notice the sharp decay of the low and high histograms.

# Errorbars

- The errors on the  $p_T$  histograms obtained from the analysis are automatically set to  $\sqrt{\text{number of entries}}$ . This has been manually checked using `GetBinError`. Since we are interested in the quantity

$$R_{lh,i} = \frac{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{low,i}}{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{high,i}}$$

We should check that the errors are well propagated when dividing the whole diagram by a constant ( $N_{ev} \cdot \eta$ ) and when by dividing each bin count by the bin width.

# Errorbars

- This has been manually checked in the original distributions and the low high distributions. Here we include these checks for the 4th bin.

```
oscar@oscarXXX: ~/anaconda3/envs/cern/Summer/FixingErrors
ALL MEANS NOT LOW OR HIGH, ALL
Fourth bin content ALL without doing anything 2.26092e+07
Fourth bin error ALL without doing anything 4754.92
Multiplicity ALL171916
Fourth bin content ALL after dividing by multiplicity 131.513
Fourth bin error after ALL after dividing by multiplicity 0.0276584
Fourth bin width ALL 0.05
Fourth bin content ALL after dividing by bin width2630.26
Fourth bin error ALL after after dividing by bin width 0.553167
LOW
Fourth bin content low without doing anything 2.84965e+06
Fourth bin error low without doing anything 1688.09
Multiplicity low24413
Fourth bin content low after dividing by multiplicity 116.727
Fourth bin error after low after dividing by multiplicity 0.0691472
Fourth bin width low 0.05
Fourth bin content low after dividing by bin width2334.53
Fourth bin error low after after dividing by bin width 1.38294
HIGH
Fourth bin content high without doing anything 4.05574e+06
Fourth bin error high without doing anything 2013.89
Multiplicity high27691
Fourth bin content high after dividing by multiplicity 146.464
Fourth bin error after high after dividing by multiplicity 0.0727271
Fourth bin width high 0.05
Fourth bin content high after dividing by bin width2929.28
Fourth bin error high after after dividing by bin width 1.45454
root [1] █
```

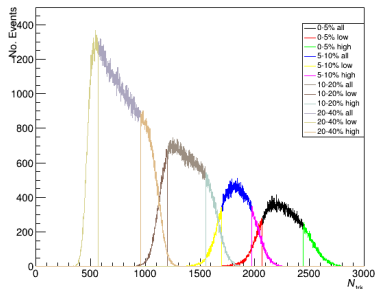
## Comments on errorbars

- All the propagation has been done automatically by calling functions like `->Scale()` and `->Divide`.
- Calling `h->Sumw2()` was setting all the errors equal to 0.

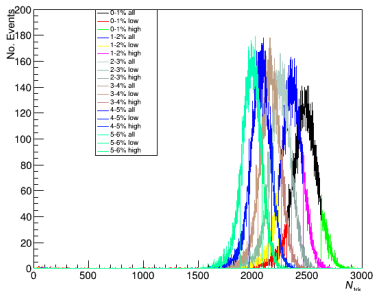
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# Multiplicity plots



(a) Multiplicity plots for the original centralities



(b) Multiplicity plots for 1% centralities.



# Multiplicity plots

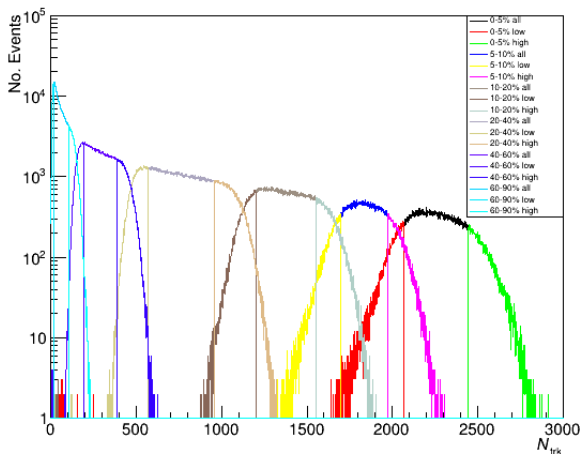


Figure 3: Peripheral collisions have a lot of events!

# Outline

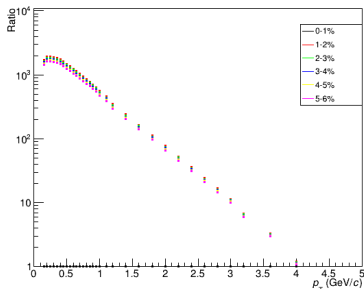
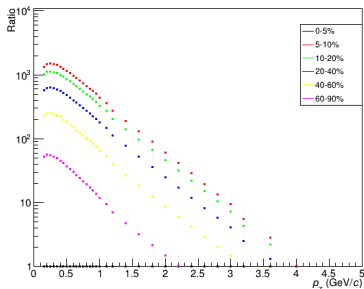
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## Ratio definitions, $R_{aa}^{ij}$

- Let  $i$  and  $j$  be indices that run over the centrality classes. For example  $i = 0 \rightarrow 0 - 5\%$ ,  $i = 1 \rightarrow 5 - 10\%$ ... if we have 6 centrality classes or  $i = 0 \rightarrow 0 - 1\%$ ,  $i = 1 \rightarrow 1 - 2\%$  if we have 100 centrality classes.
- First we will study the ratio  $R_{aa}^{ij}$ , where the subindices stand for all/all, we are not separating low and high here.

$$R_{aa}^{ij} = \frac{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_i}{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_j}$$

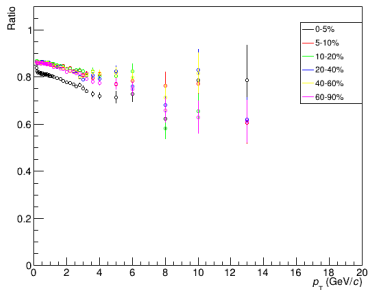
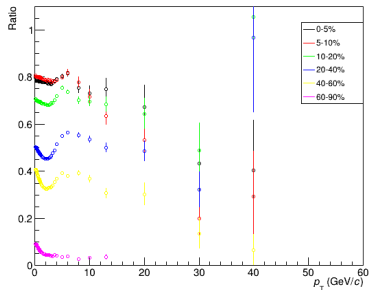
- We will study  $R_{aa}^{i0}$ , what means that we put the most central collision on the denominator, 0 – 5% in one case, and 0 – 1% in the other case.  $R_{aa}^{00} = 1$ , as it should be.



## Ratio definitions, $R_{lh}$

- Now we study the quantity  $R_{lh}$  for each centrality class, where  $l$  means low multiplicity part and  $h$  means high multiplicity part.

$$R_{lh} = \frac{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{low}}{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{high}}$$



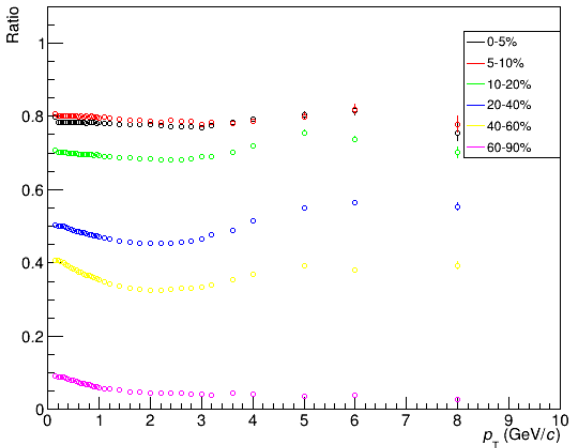
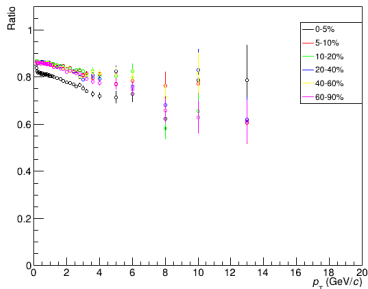
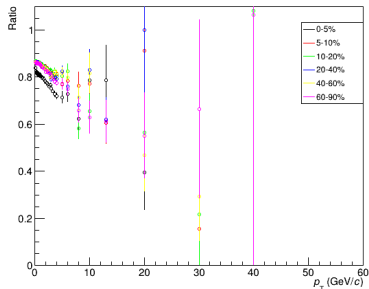


Figure 6: Same plot as before until 10 GeV

# $R_{lh}$ for 1% centrality classes

- We plot exactly the same but for 1% centrality classes.

$$R_{lh} = \frac{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{low}}{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{high}}$$



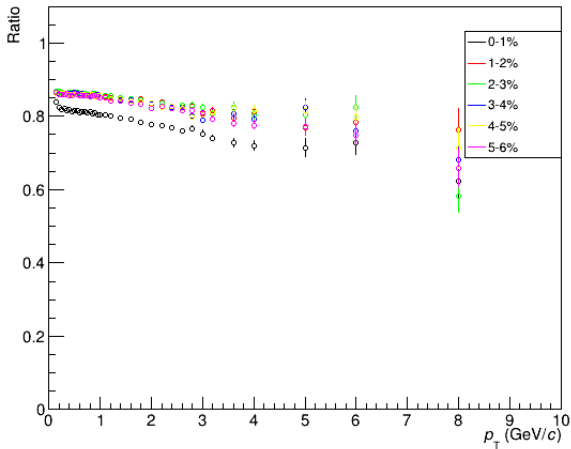


Figure 8: Same plot as before until 10 GeV



## Ratio definitions, $R_{hh}^{ij}$

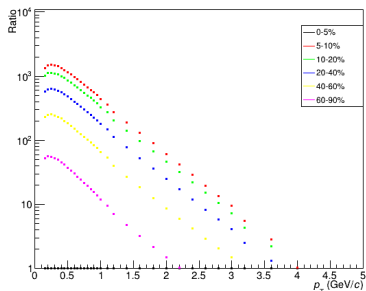
- As suggested by Guy, we also study the quantity  $R_{hh}^{ij}$ , where  $i$  and  $j$  are indices that refer to the centrality class as before and  $hh$  means high/high

$$R_{hh}^{ij} = \frac{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{i,high}}{\left( \frac{1}{N_{ev}} \frac{d^2N}{dp_T d\eta} \right)_{j,high}}$$

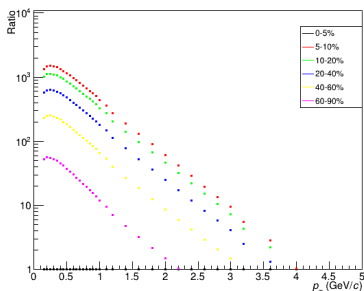
- As before, we will be putting the most central collision in the denominator, therefore we will study  $R_{hh}^{i0}$

# $R_{hh}^{i0}$ for the original centrality classes

- The plot on the left corresponds to  $R_{\alpha\alpha}^{i0}$ , it was shown in previous slides but it's also displayed here to do the comparison.



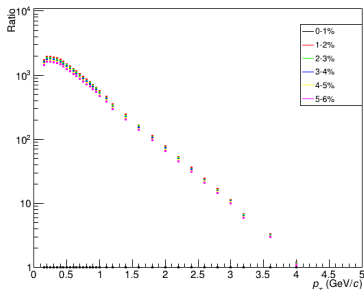
(a)  $R_{\alpha\alpha}^{i0}$ , meaning that we don't separate high and low multiplicity parts, we keep all the centrality class.



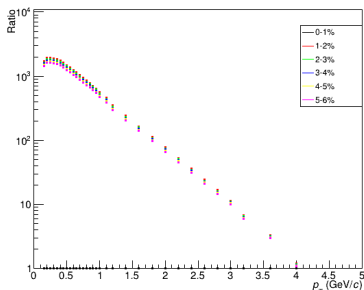
(b) Same plot as in the left, but only keeping the high centrality parts of the centrality class.

# $R_{hh}^{i0}$ for 1% classes

- The plot on the left corresponds to  $R_{\alpha\alpha}^{i0}$ , it was shown in previous slides but it's also displayed here to do the comparison.



(a)  $R_{\alpha\alpha}^{i0}$ , meaning that we don't separate high and low multiplicity parts, we keep all the centrality class.



(b) Same plot as in the left, but only keeping the high centrality parts of the centrality class.

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# Comments/questions

- I'm not getting a lot of information from the 1% plots, how could we extract things from there?
- I want to write my report this weekend, do you have suggestions for the structure?