Corrections to pp cross sections due to trigger counter acceptance

F. Videbæk
Brookhaven National Laboratory, Upton, New York , USA
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There has again been discussion about how to correct the raw invariant rapidity densities $d^2n/2\pi p_t dp_t dy$ for the losses in both min bias trigger and when requiring the vertex information for the tracks in the spectrometer. The way we usual state how the pp reference spectra are produced is to have the normalization done relative to the total inelastic cross section. The main reason is of course that in the Glauber model the number of collsiions are calculated using this same inelastic cross section, not the NSD cross section. This was e.g. stated in [1] as

> A useful way to compare the spectra from nucleus-nucleus collisions to those from nucleon-nucleon collisions is to scale the normalized $p+p$ spectrum (assuming $\sigma^{pp}_{inel} = 42 \pm 1mb$) by the number of binary collisions (N_{bin}) corresponding to the centrality cuts applied to the nucleus-nucleus spectra and construct the ratio.

In the R_{dA} forward rapidity dependent paper we explicitely stated that the measured yields have been corrected for effect of the experimental trigger with a correction that was estimated using the PYTHIA model and found to be $13 \pm 5\%$, approximately independent on p_T and η. To illustrate how this can be done from experimental data lets us look at the basic premise for measuring the proper invariant yields.

The measured number of counts in a (y, p_t) bin in the spectrometer is given by

$$N(y, p_t) = L\sigma_{y,p_t} Accp P_{tr,cc}, \tag{1}$$

where L is the luminosity, σ_{y,p_t} the cross section, Accp the acceptcance, effeciencies etc and $P_{tr,cc}$ the probability that the event has a CC vertex associated with the track. This later condition can be in hardware or on software. The measured number of counts in the vertex is given by

$$N_{cc} = L\sigma_{Inel}P_{cc}, \tag{2}$$

where σ_{Inel} is the inelastic cross section and P_{cc} the probablity that for a given interaction a valid cc hit/event is recorded. The product of these two variables is of course the σ_{cc}. Thus what we are after is the invariant yield normalized to the inelastic cross sections $\sigma_{y,p_t}/\sigma_{Inel}$, which can be extratced from the equations above yielding

$$\sigma_{y,p_t}/\sigma_{Inel} = (N(y,p_t)/N_{cc})(P_{cc}/(AccpP_{tr,cc}) \tag{3}$$

Thus, the final correction to the invariant yields usually calculated in the banapp, spectrumobject package or whatever is given by

$$C = P_{cc}/P_{tr,cc} \tag{4}$$

1 Simulation Evaluation

The next question is how these numbers are determined. For the 200 GeV pp it was estimated from the Pythia simulations that the counters see 70% of the σ_{Inel}. The $P_{tr,cc}$ was estimated from the data, as described in my note to be 80%. Thus the overall correction factor is 0.87, thus reducing the yields.

[simulation tables for Pythia and geanthits in CC]

	Left	Right	Left and Right
Ring1	0.67	0.43	
Ring2	0.23	0.22	
Ring 1 or 2	0.75	0.57	0.43

2 Experimental Evaluation

For the 200 GeV pp data we showed by comparing data with and without CC vertex requirement, that for the high rapidity data there is no dependence within the range of measurements. [Add a plot or two to show this]

For 62 GeV pp we had actual Vernier scan runs. For the two runs in questions I extracted a σ_{cc} of 12.5, and 11.6 mb. The inelastic cross section was estimated from Pythia to be 36 mb i.e. $C = 12./36 = 0.33$, with $\approx 8\%$ estimated error. The $P_{tr,cc}$ is 40% at mid-rapidity, and we see momentum and specie dependent at forward rapidities, but in the order of 40% too. This is for $p_T \approx 1$ GeV/c dropping to $\approx 25 - 30\%$ at 1.5 GeV/c. Thus the correction C is ≈ 0.82. [add plots...]

References

[1] I. Arsene *et al.*, BRAHMS Collaboration, Phys. Rev. Lett. **91**, 072305