Tagged dA Spectra

Sean Leckey

PHENIX collaboration

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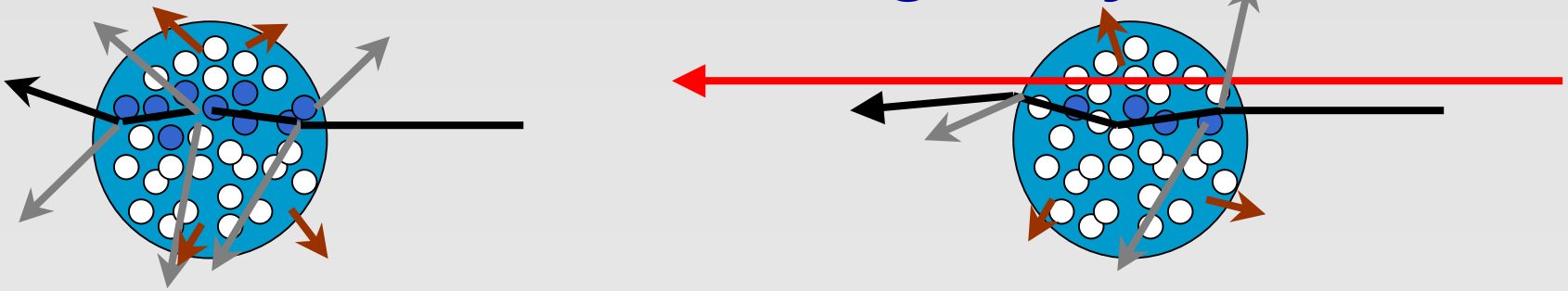
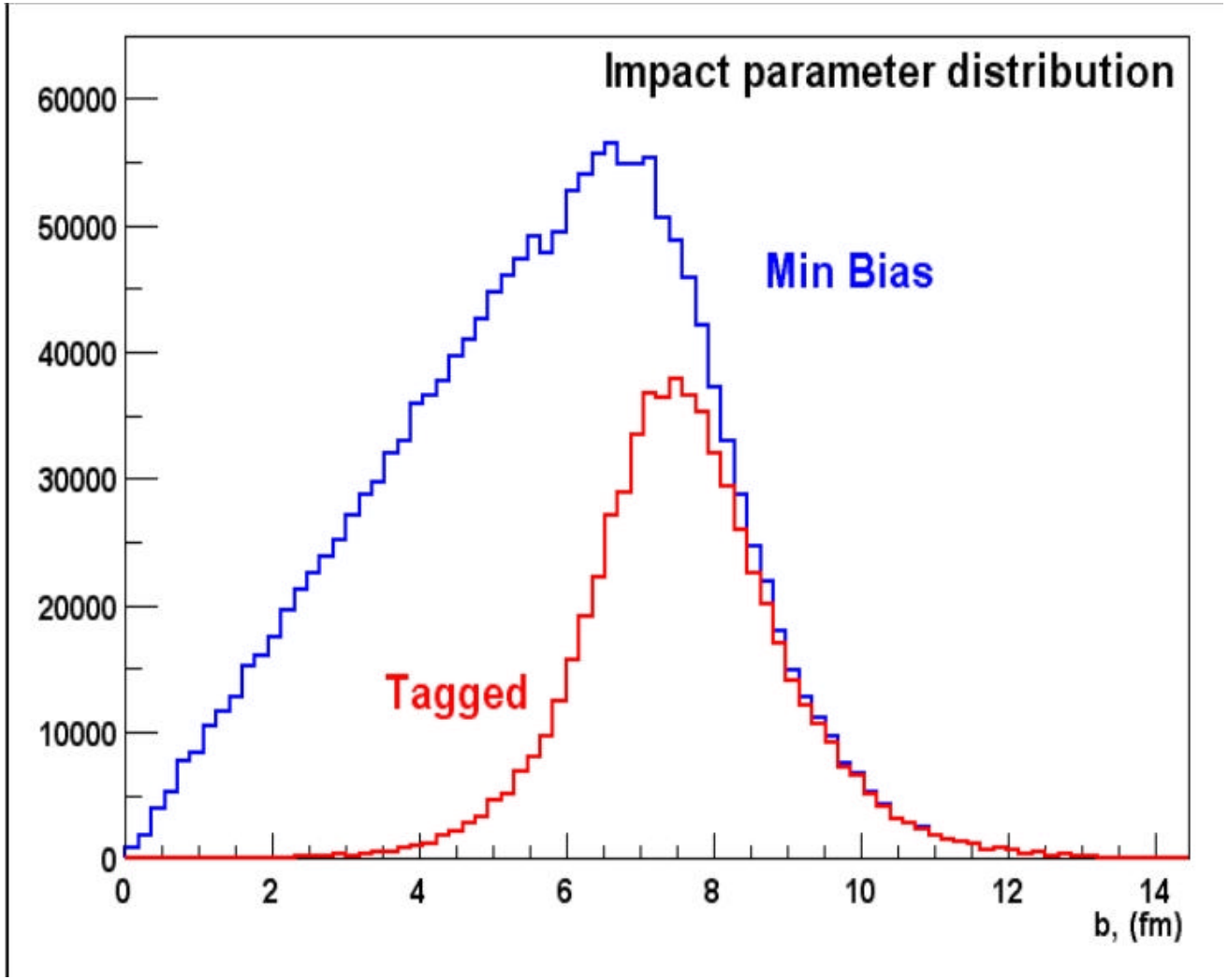


Introduction

- R_{da} provides a probe to study the Cronin effect and Color Glass Condensate. Both the Cronin effect and CGC have a strong Centrality (impact parameter and N_{coll}) dependence.
- Centrality Selection in dA experiments is always difficult. PHENIX has several handles on centrality, including a new forward calorimeter. As we study the response of these detectors we utilize a convenient method of defining a centrality bin.
- A sub-sample of Minimum bias data in dA has a spectator on the deuteron side. This sample contains very peripheral events with a much smaller $<N_{coll}>$ than the Minimum Bias sample. The tagged neutron method provide a clean sample with simple systematics to select a peripheral events.

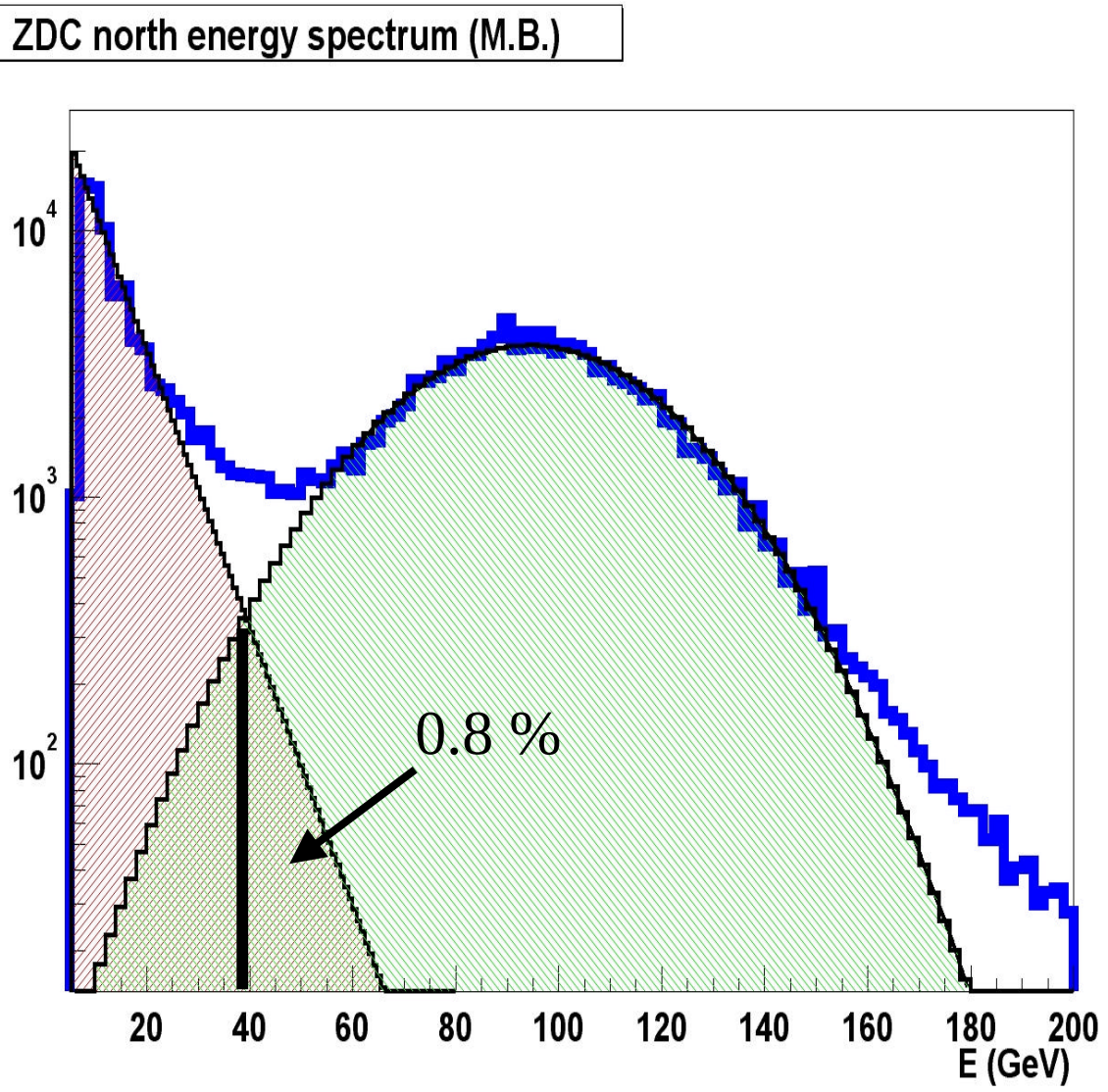
Species Tagged Study

- The distribution of impact parameters in the Glauber model is shown. The Tagged distribution represents only one nucleon of the deuteron interacting.
- One can see that the tagged sample corresponds to very peripheral events and constitutes approzimately 40% of our Min Bias sample.



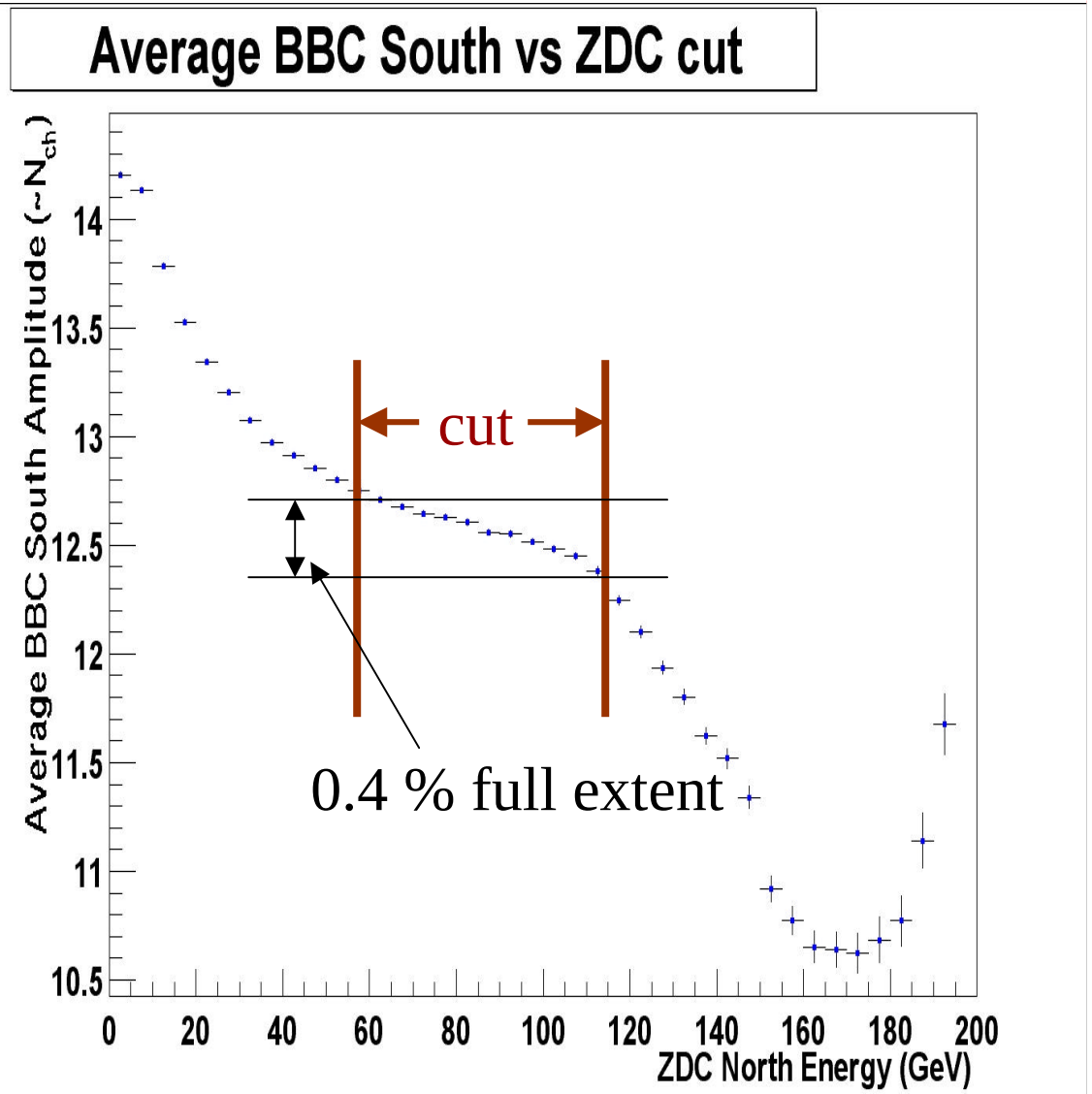
Selecting Neutron Tagged Sample

- To select Neutron Tagged events, we use the Zero Degree Calorimeter.
- We show the ZDC energy distribution on the deuteron side.
- We can see a distinct peak at ~100 GeV corresponding to the deposited neutron energy.
- The contribution from the tail on the left side is restricted with a ~40 GeV cut.
- Our currently analyzed Min Bias sample has 12 million events. The Tagged Neutron sample corresponds to 16.3+-0.8% of the Minimum Bias sample.



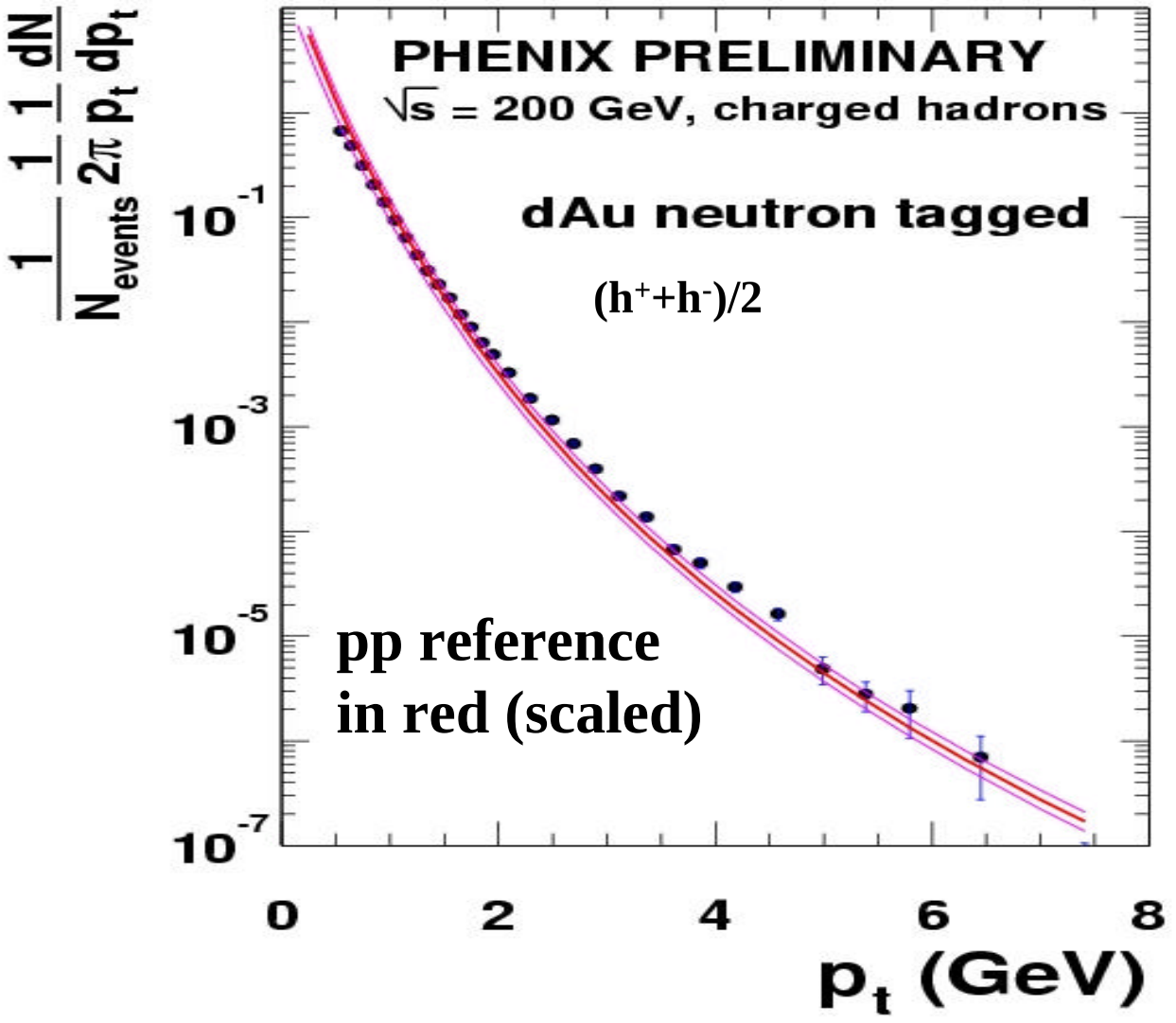
Integrity of Tagged Neutron Sample

- To insure the integrity of the Tagged Neutron sample, given the “tail” contamination, we plot the Beam Beam Counter (BBC) south amplitude for different restrictions on the ZDC energy range.
- Assuming that BBC south amplitude is roughly proportional to N_{part} (~N_{coll}) a tainted sample will change the amplitude.
- One can see from the figure that, in the range of our cut, the BBC amplitude suffers only a slight decrease of 0.4%.



Tagged Neutron charged pt Spectrum

- Shown is the pt spectrum for the neutron tagged sample. In this plot only statistical errors are shown.
- In red is the pp reference spectrum. The bands give the uncertainty on the reference spectrum. It is scaled up by the number of binary nucleon nucleon collisions for the neutron tagged sample, $<N_{coll}>=3.6+-0.4$.



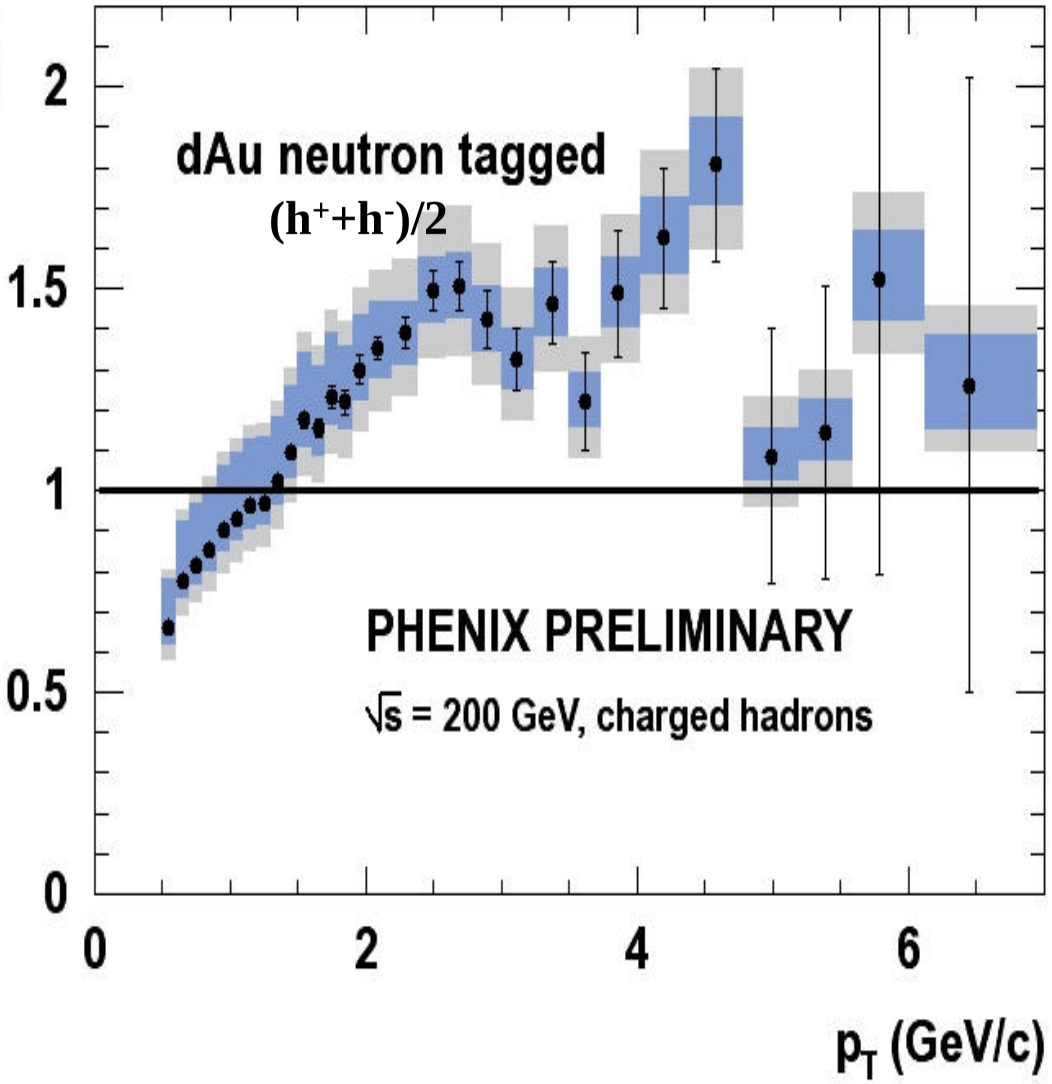
R_{da} for Neutron Tagged Spectra

$$R_{AA}(p_T) = \frac{d^2N^{AA}/dp_T d\eta}{T_{AA} d^2\sigma^{NN}/dp_T d\eta}$$

R_{dA}

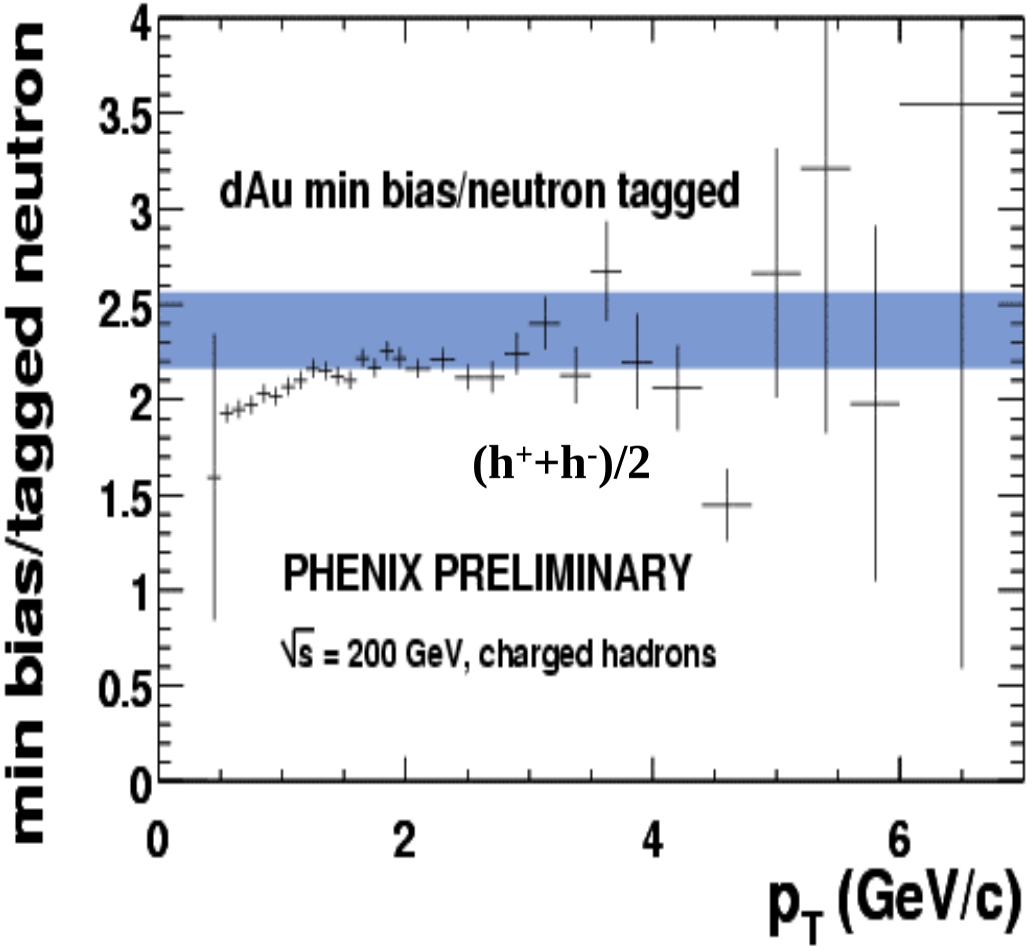
$<N_{binary}>/\sigma_{inel}^{p+p}$

- Plotted is Rda for the the Neutron Tagged sample. Error bars are statistical. Blue shades are pt dependent systematic error bars, Grey shades are pt independent and pt dependent error bars added in quadrature.



Ratio Minbias to Tagged Spectra

- Plotted is the ratio of the Min. Bias charged pt spectra to the Neutron Tagged spectra. See Anne Sickles' Poster Presentation for more on PHENIX's Min. Bias spectra.
- In the ratio, many systematic errors cancel out. In particular, for Min Bias we have $\langle N_{coll} \rangle = 8.5 \pm 0.7$, and $\langle N_{coll} \rangle_{MB} / \langle Ncoll \rangle_{NT}$ is estimated to be 2.35+-0.2. This ratio is shown as a solid blue band.



Proton Tagged Sample (work in progress)

- Using the newly installed Forward Calorimeter (FCAL) one can tag events wherein only the neutron undergoes the collision with gold.
- Shown is a scatter plot of the events in the North FCAL and ZDC.
- In the lower left corner we have the so-called “Untagged sample.”
- In the lower right and upper left we have the Neutron Tagged and Proton Tagged samples respectively. Note that both have approximately the same statistics.
- In the upper right we have the small fraction of events which have a large response in both detectors (in the ellipse). It is expected that these correspond to the disassociation of the deuteron.
- Further Study looks promising.