SPACE-DYNAMIC CORRELATIONS IN QUASI-TWO-PARTICLES π+Xe → π+n INTERACTIONS AT GeV ENERGY REGION

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XXII ISHEPP, Dubna, September 15-20, 2014

OUTLINE

MOTIVATION

ABSTRACT

RESULT OF CALCULATIONS USING JAM CODE

CONCLUSIONS

Motivation

It is commonly known that the impact parameter (IP) is a very important quality determining the initial interaction geometry of hadron-nucleus interactions. But directly measured are momenta and energies of identified secondary particles only. So, the question arises whether and to what extend one can estimate the range of IPs at which a specific channel of the reaction occurred. To clear up this problem it is appropriate to analyze the correlation between some constructions of the measured features and IP using reliably established modeling codes.

Abstract

Earlier [1] we investigated the correlation between multiplicity, rapidity and IP (b) of charged pions, protons and neutrons produced in π+Xe interactions at intermediate energies by means of a JAM modeling code and found that there exists some meaningful correlation between IP and both the average multiplicity and average rapidity of produced particles and it is possible in principle to infer more than simply qualitatively about the initial interaction geometry on the basis of available observables.

[1] B.Słowiński, R.Korzeniowski, R.Sobczak. Multiplicity-rapidity-impact parameter correlation in pion-xenon interactions at intermediate energies. NIM A, 2012.

In our work we study the correlation between the rapidity, transverse momentum and b in quasi-two-particles π+Xe interactions at GeV energy region in order to clarify the possibility of plausible estimation of IP interval where these reactions occur. The work has been performed using the JAM simulation code. For each energy region 10 million π+Xe interactions have been modelled.

Literature

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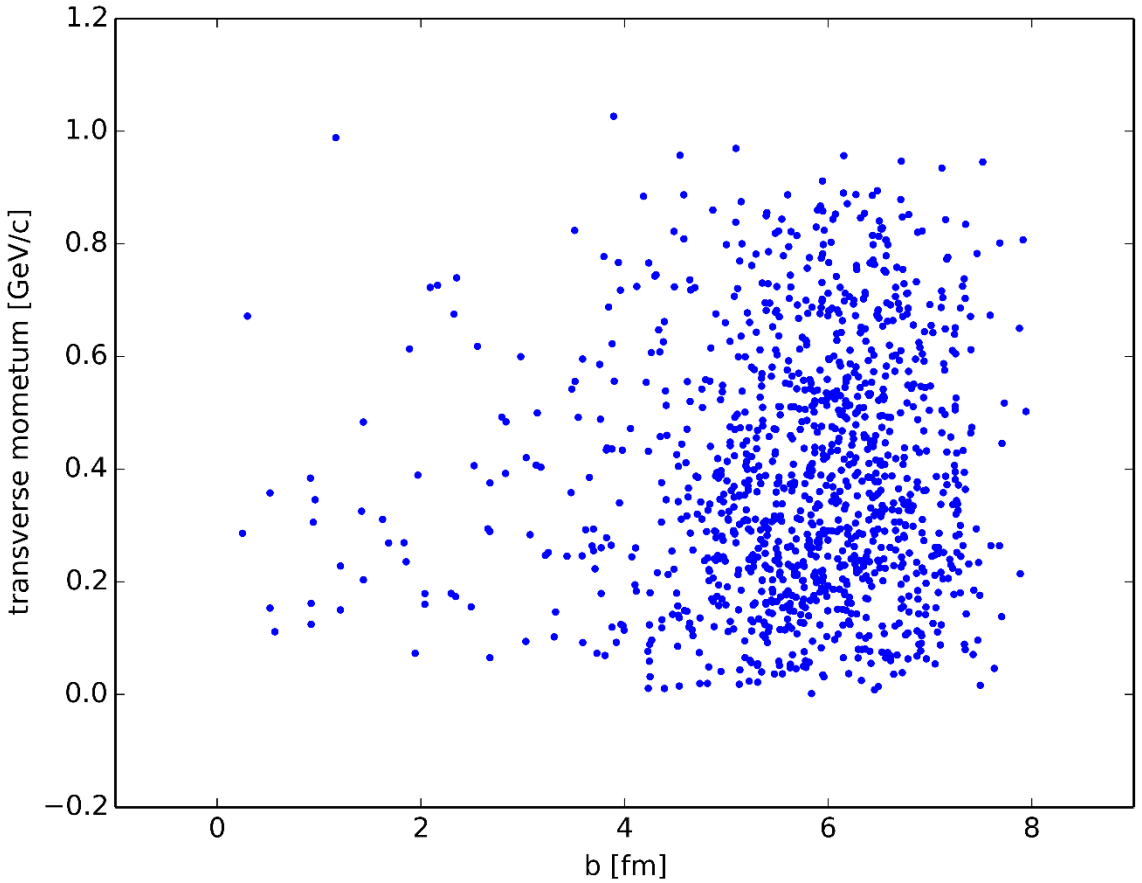
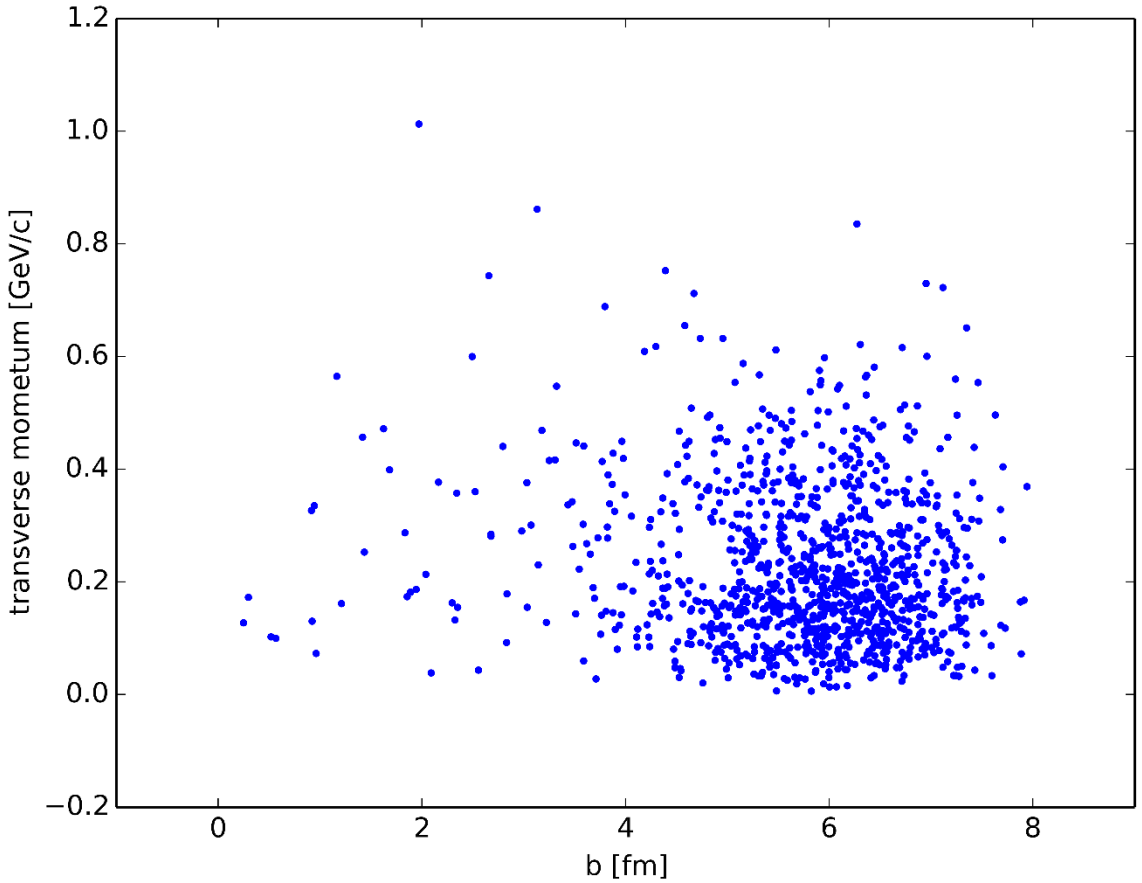
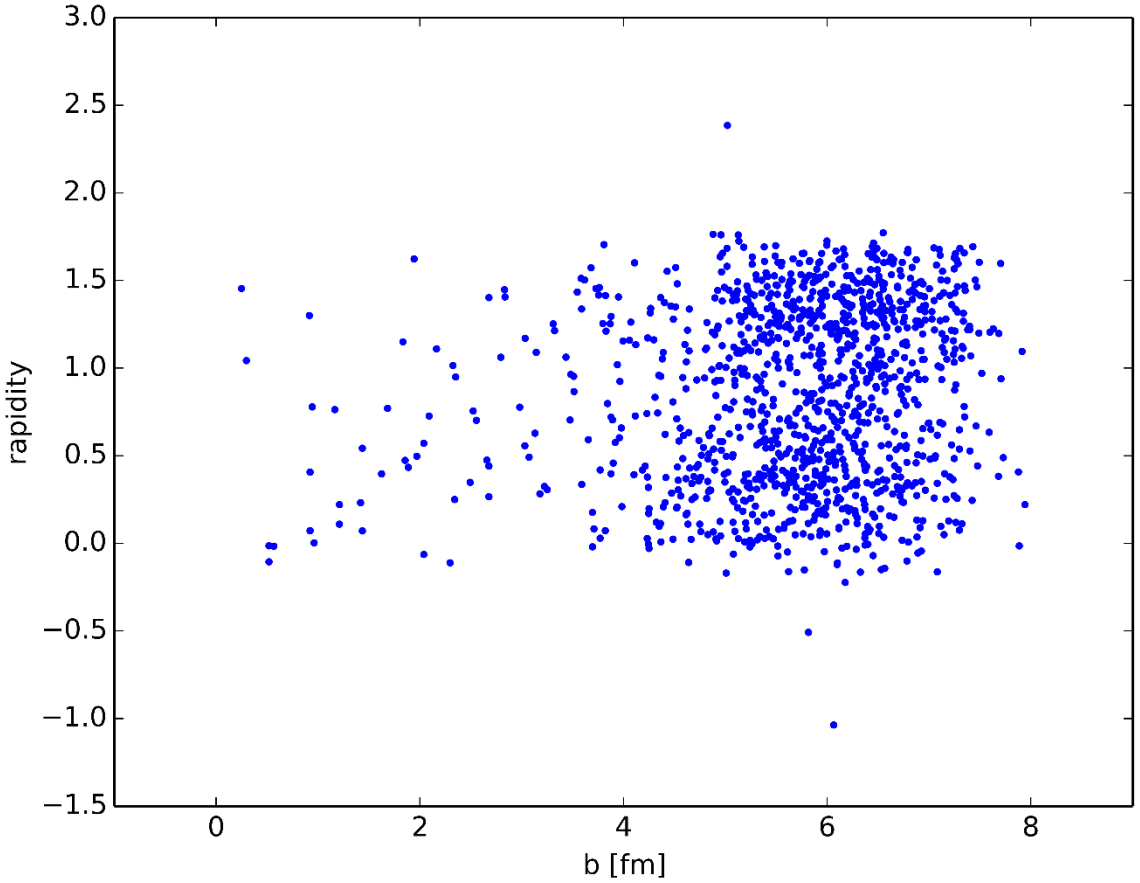
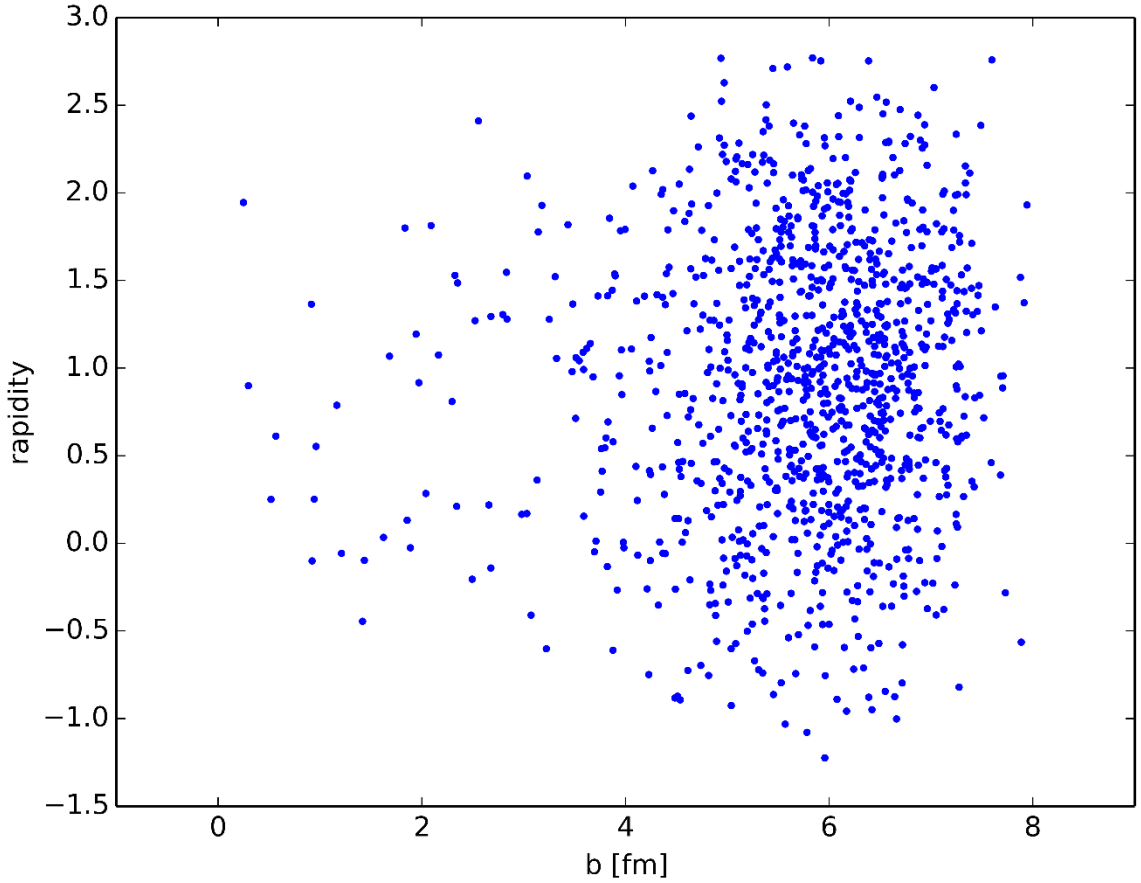
Scatter plot of transverse momentum vs impact parameter for $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c (left - for protons, right - for π^0).



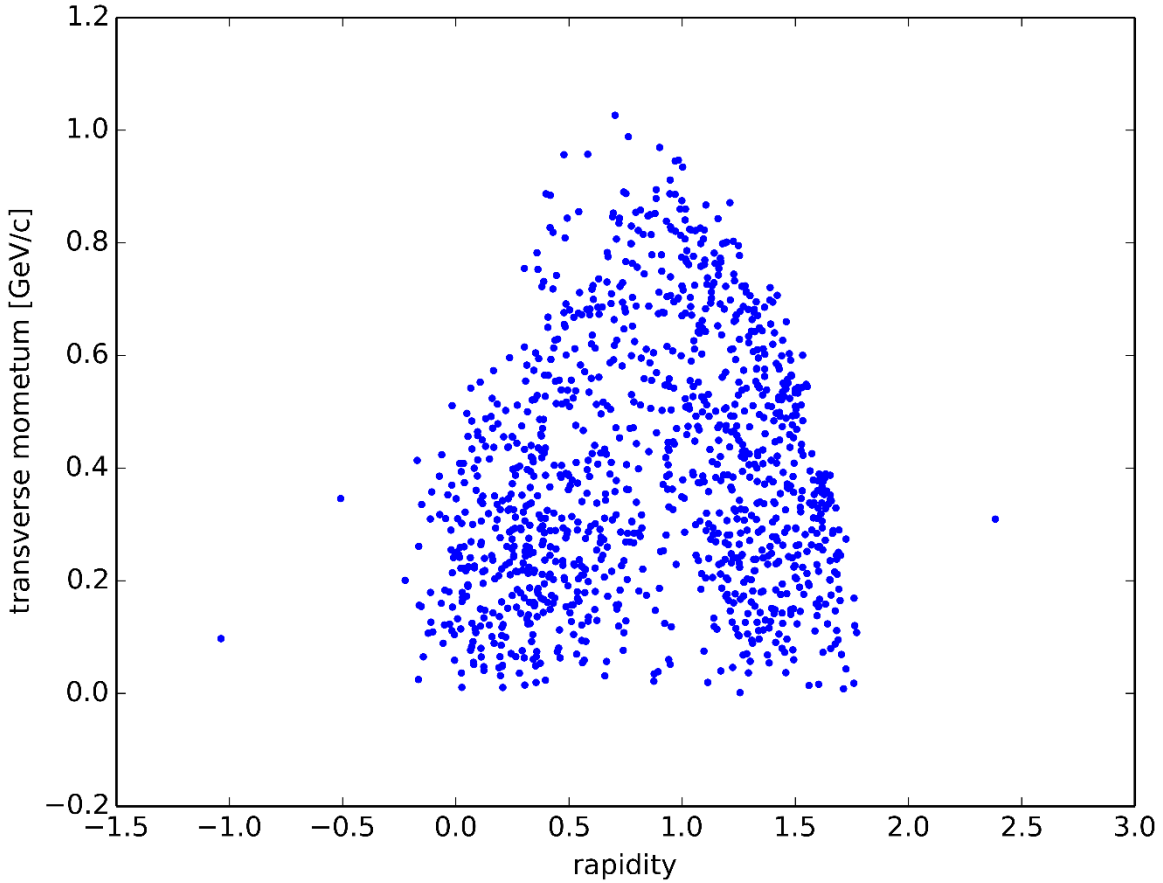


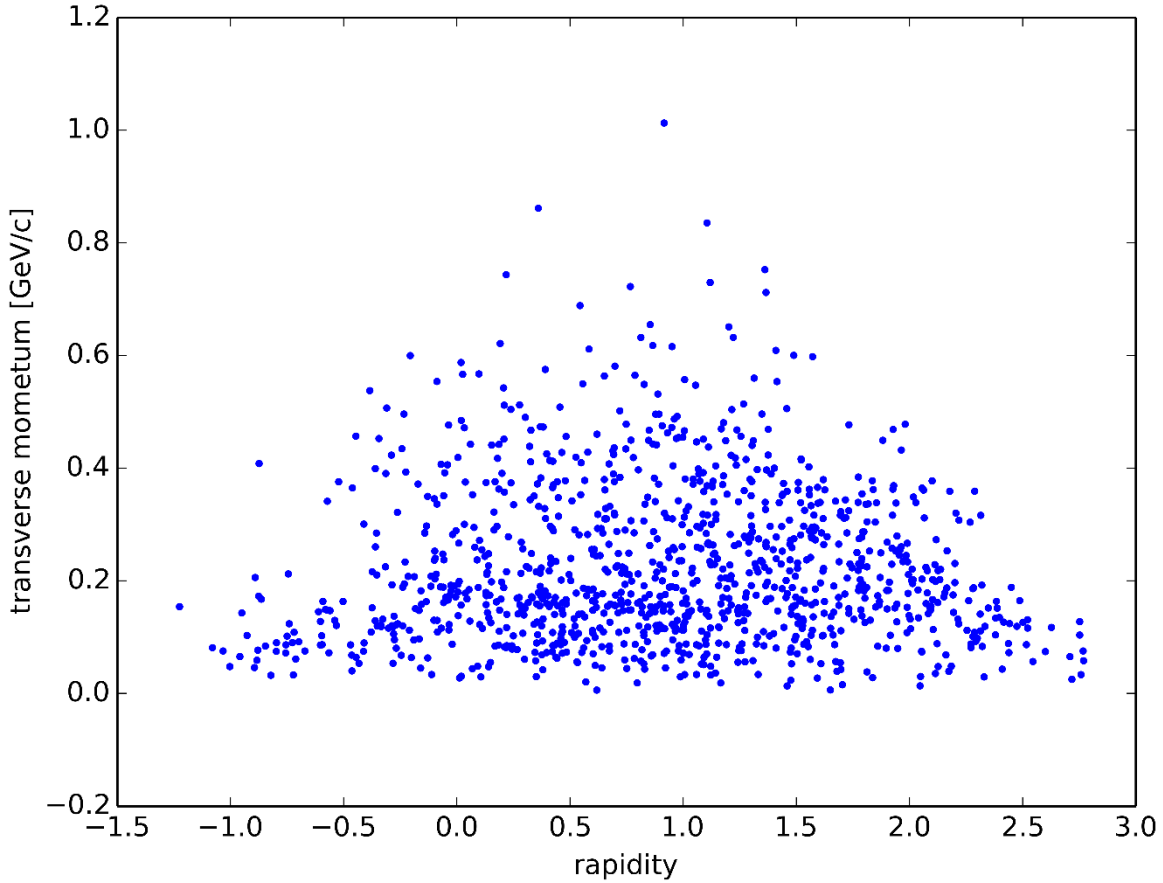
Scatter plot of rapidity vs impact parameter for $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c (left - for protons, right - for π^0).





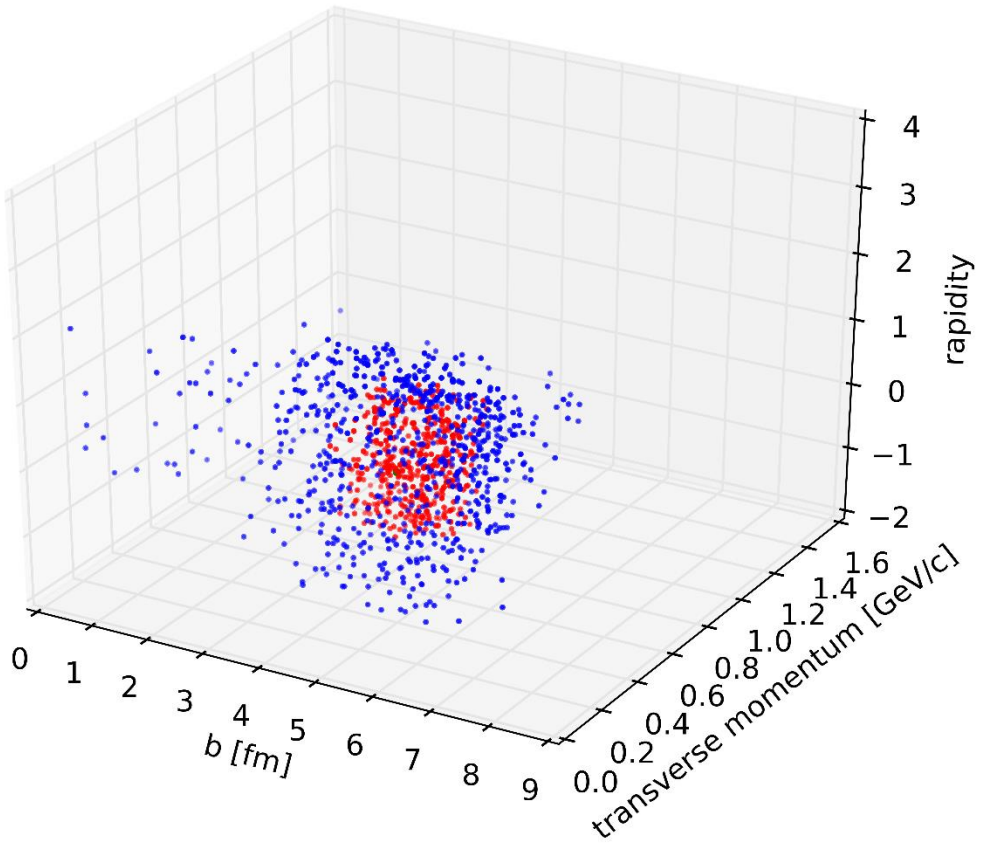
Scatter plot of transverse momentum vs rapidity for $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c (left - for protons, right - for π^0).



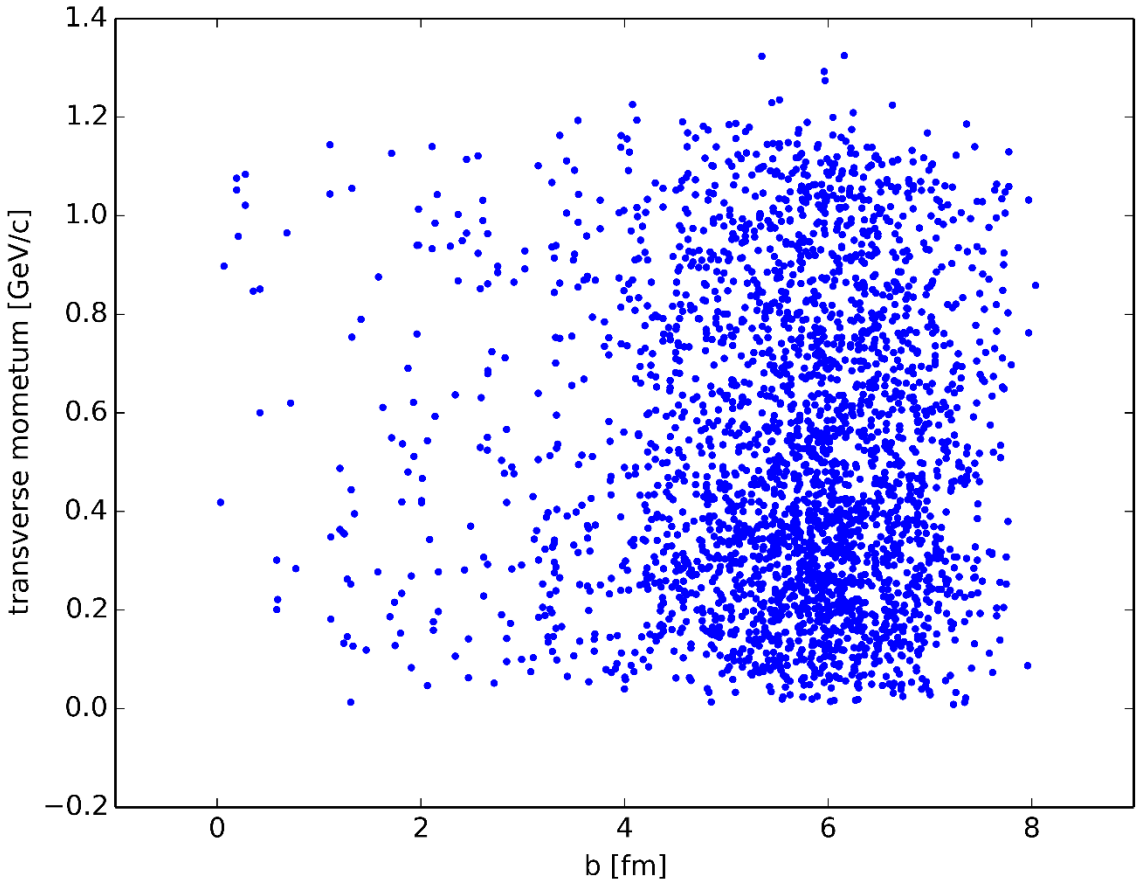


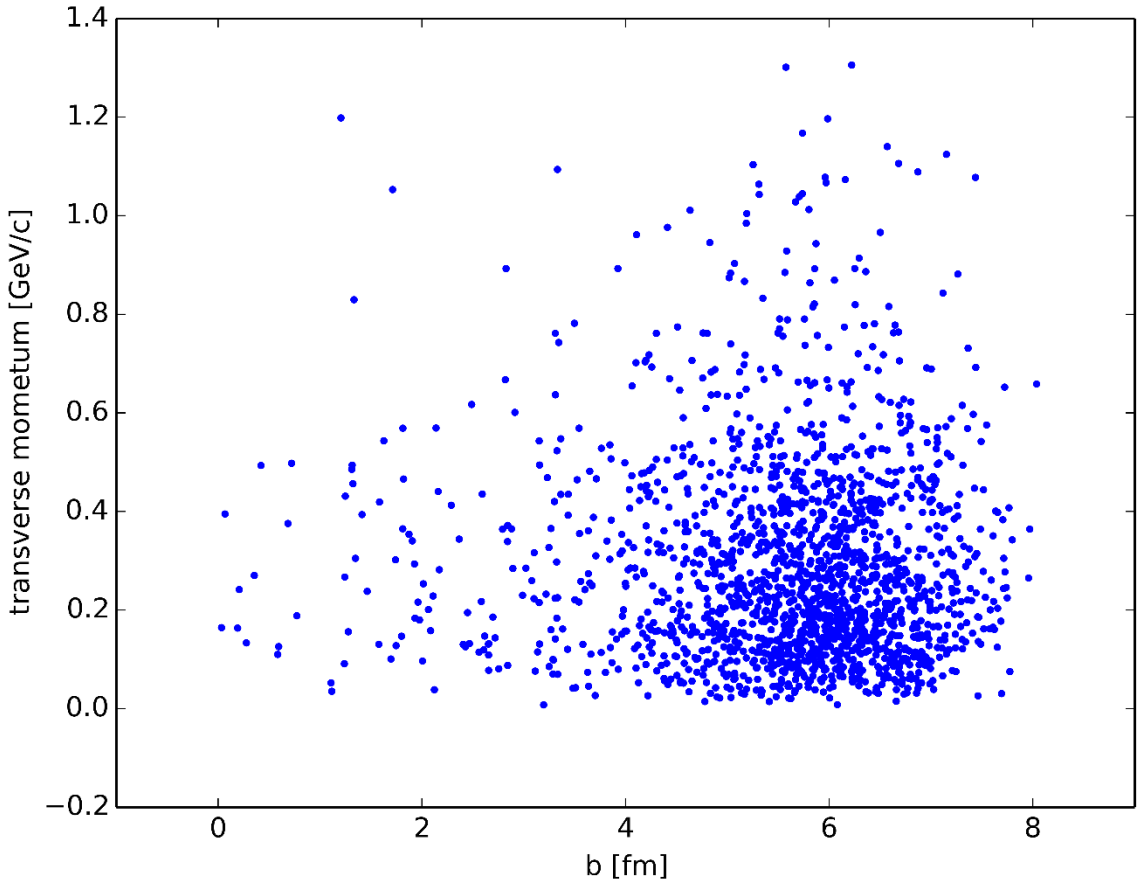
3D scatter plot of transverse momentum vs rapidity vs impact parameter for π^0 from $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c

Red dots represent values that occur within a 50% probability window near the mean value.
Blue dots represent the rest of values.



Scatter plot of transverse momentum vs impact parameter for $\pi^- + Xe \rightarrow \pi^0 + n + (p/n/\pi^{\pm}) + A$ at 3.5 GeV/c (left - for neutrons, right - for π^0).





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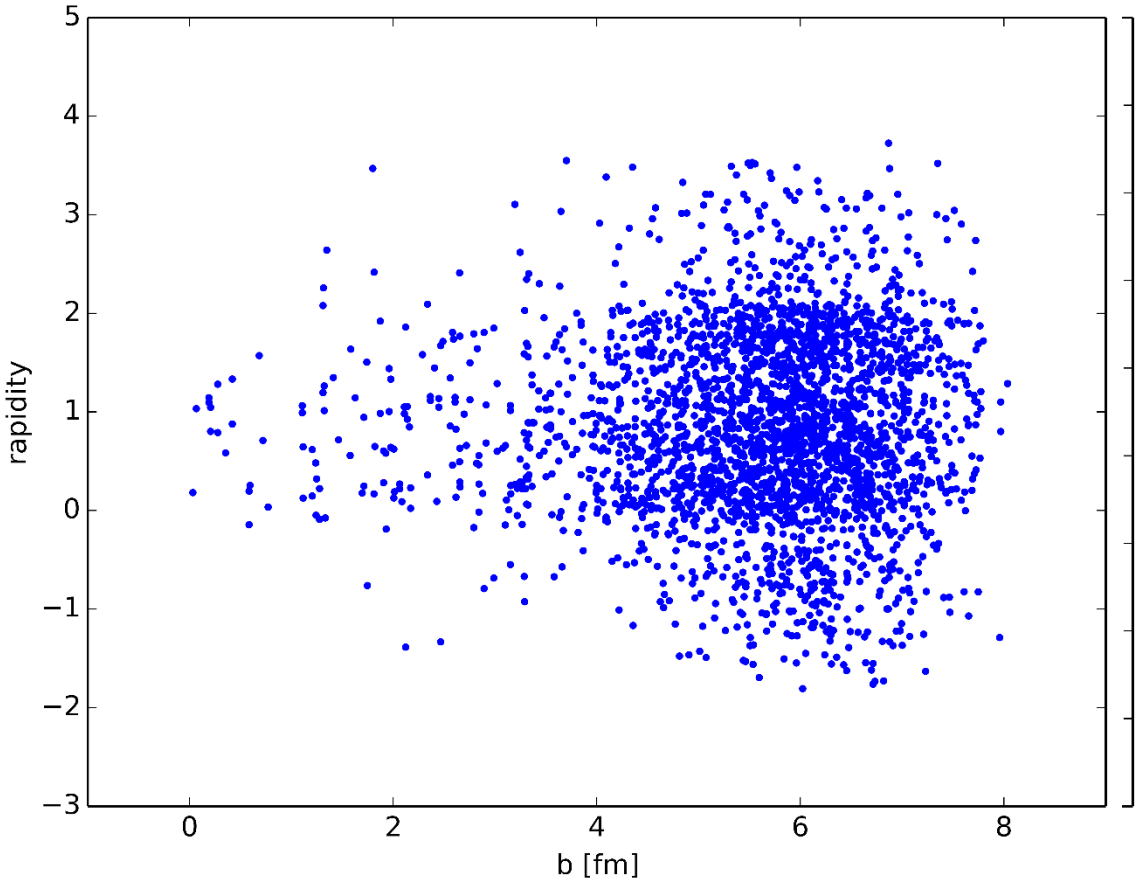
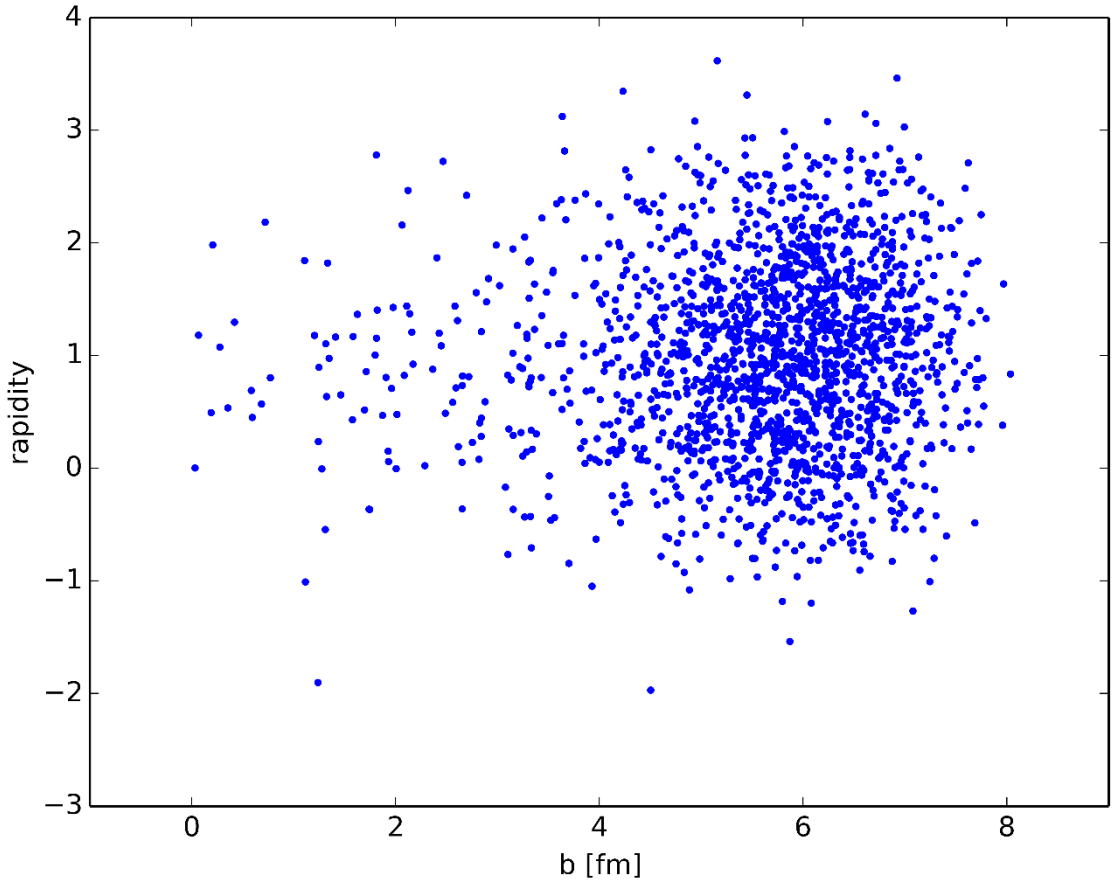
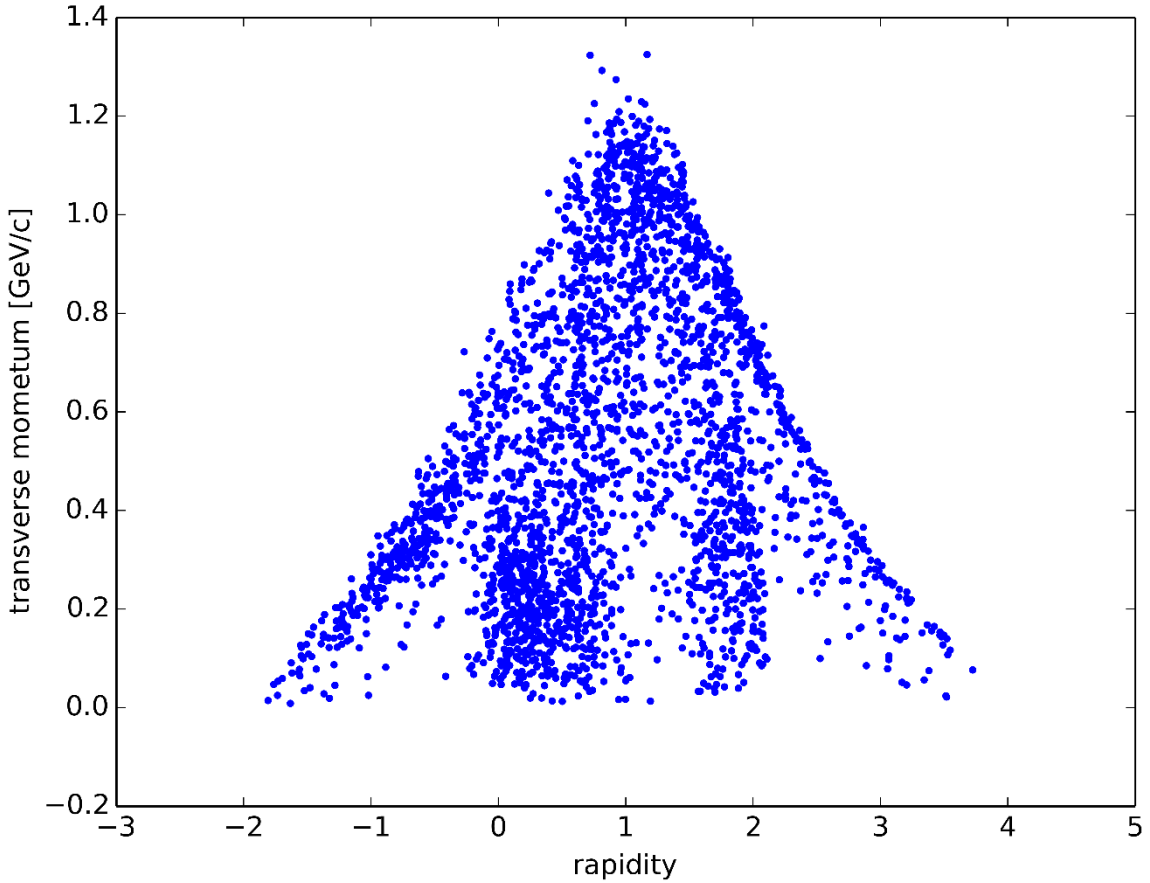
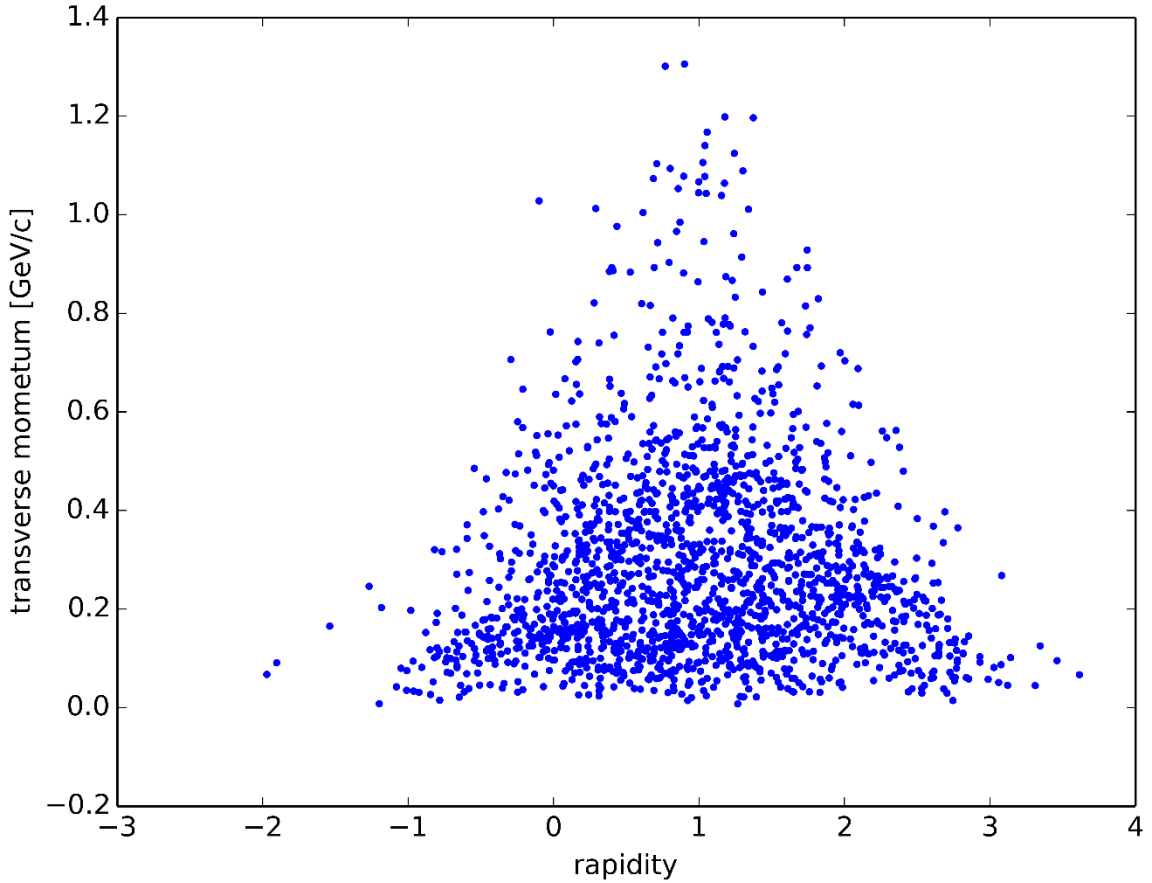




Scatter plot of transverse momentum vs rapidity for $\pi^- + Xe \rightarrow \pi^0 + n + (p/n/\pi^{\pm}) + A$ at 3.5 GeV/c (left - for neutrons, right - for π^0).





3D scatter plot of transverse momentum vs rapidity vs impact parameter for π^0 from $\pi^- + Xe \rightarrow \pi^0 + n + (p/n/\pi^{\pm}) + A$ at 3.5 GeV/c

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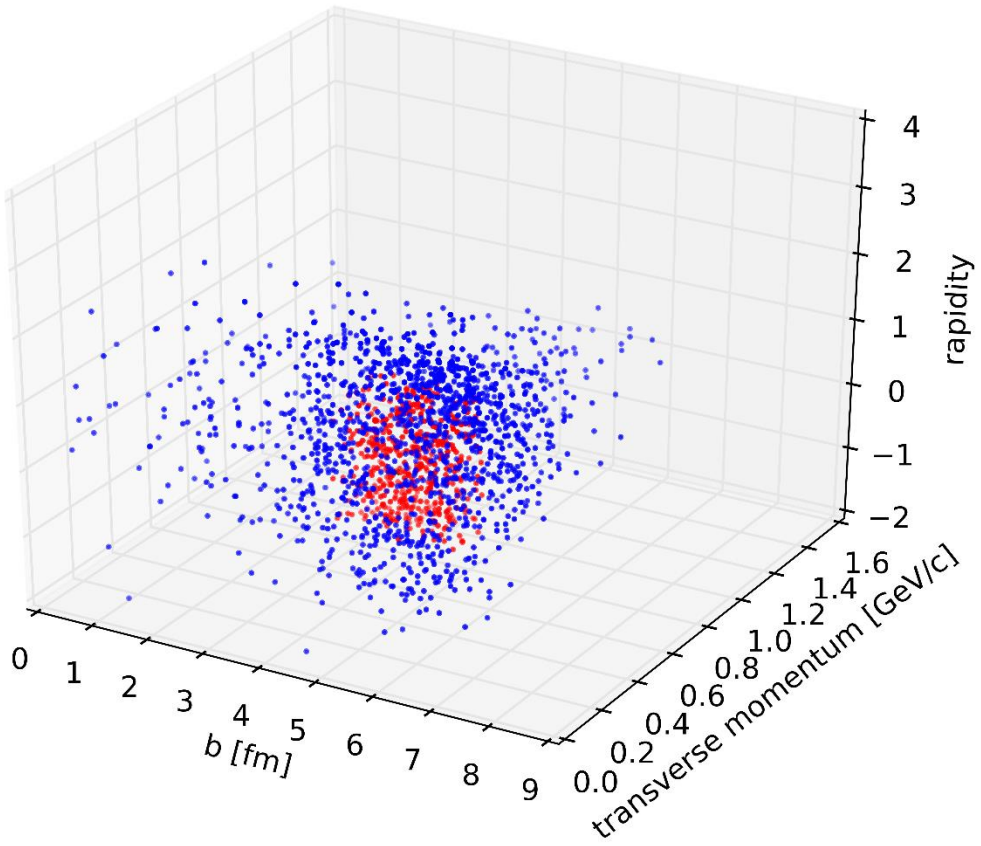
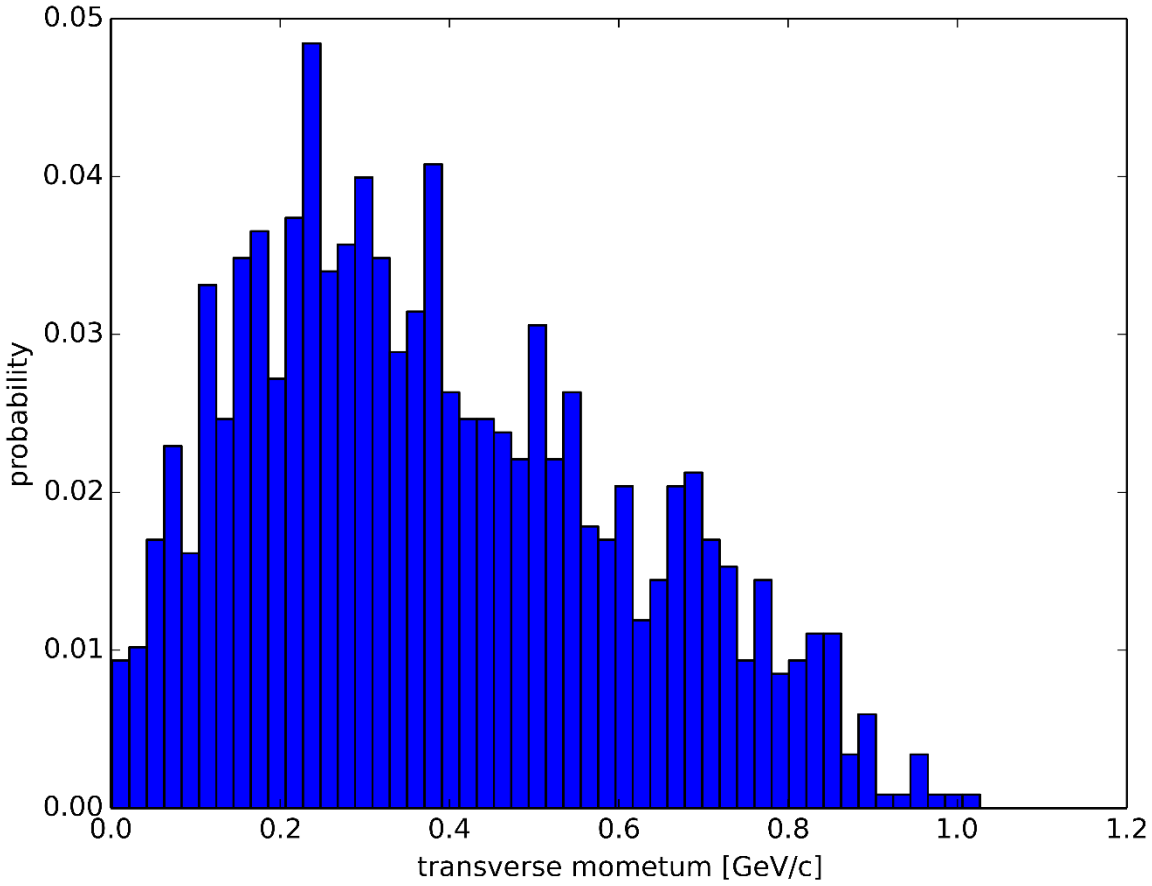
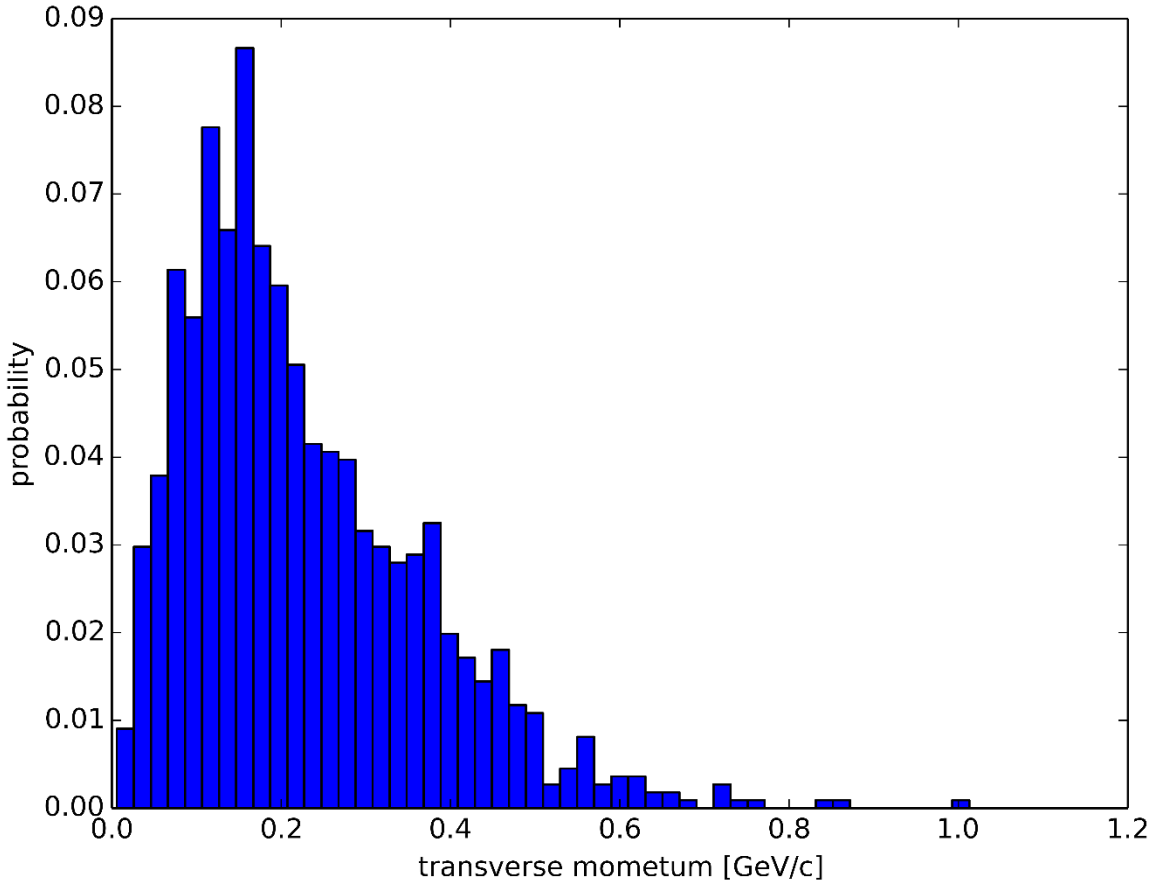
Blue dots represent the rest of values.

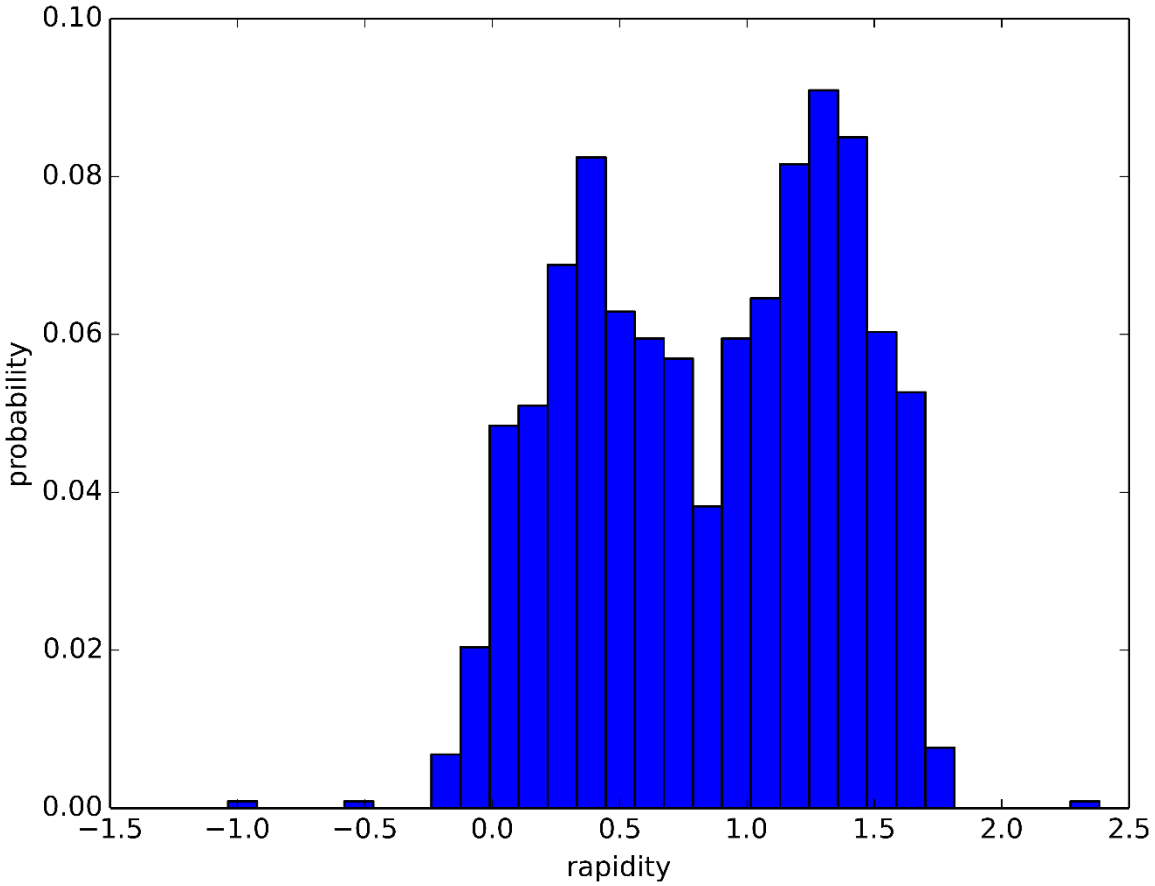


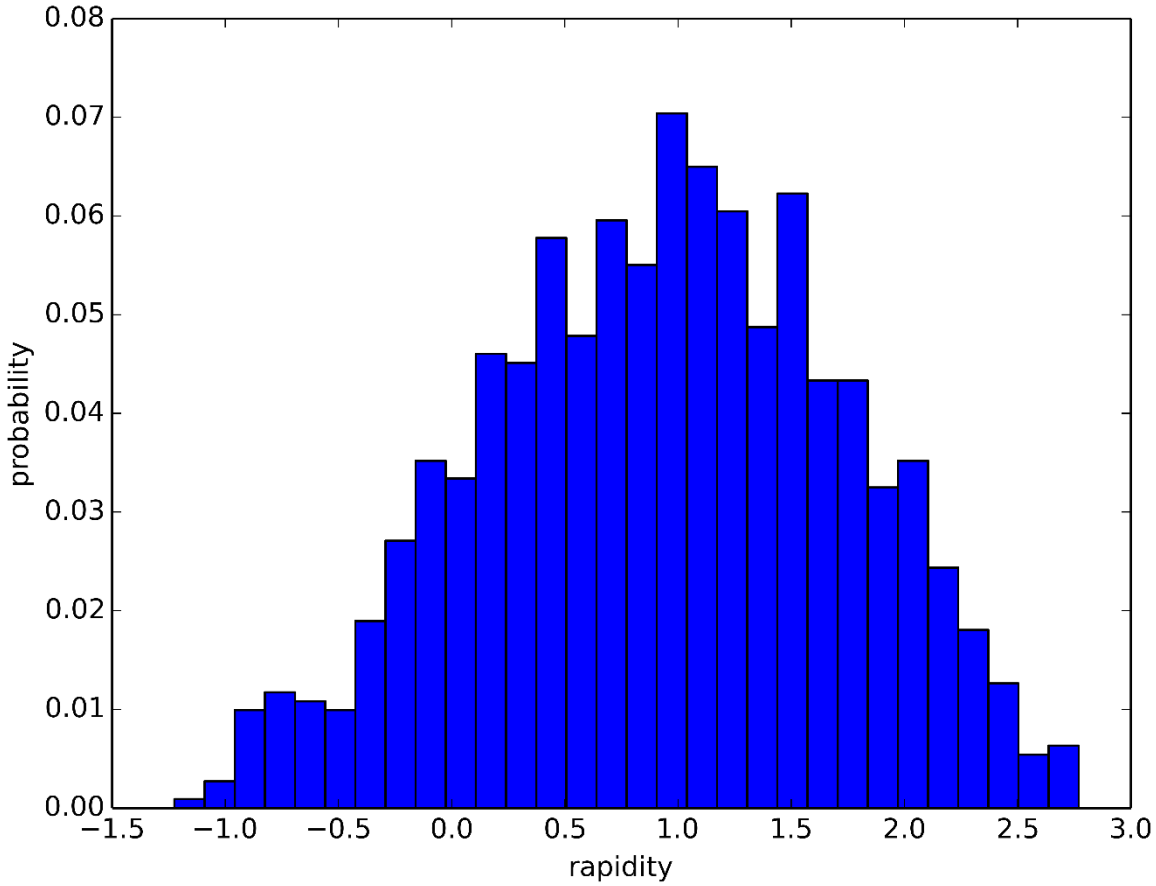
Distribution of transverse momentum for $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c (left - for protons, right - for π^0).



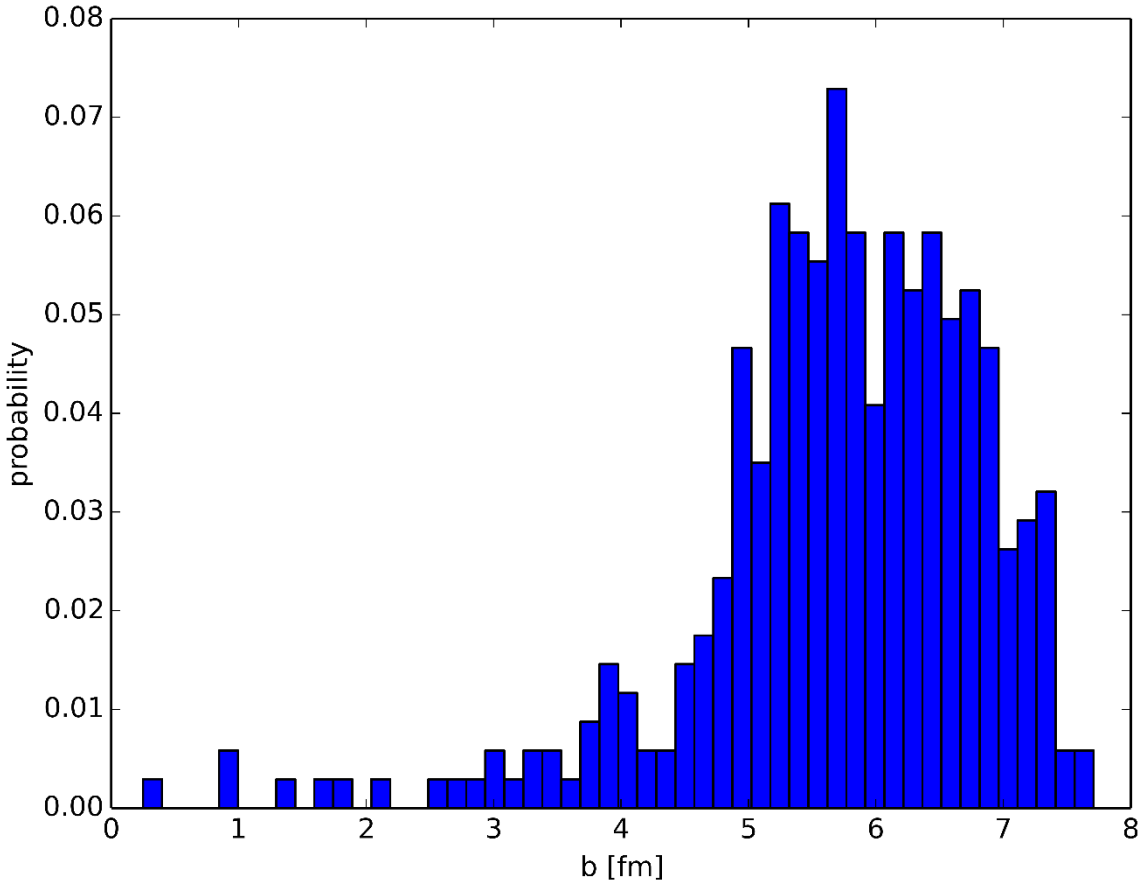


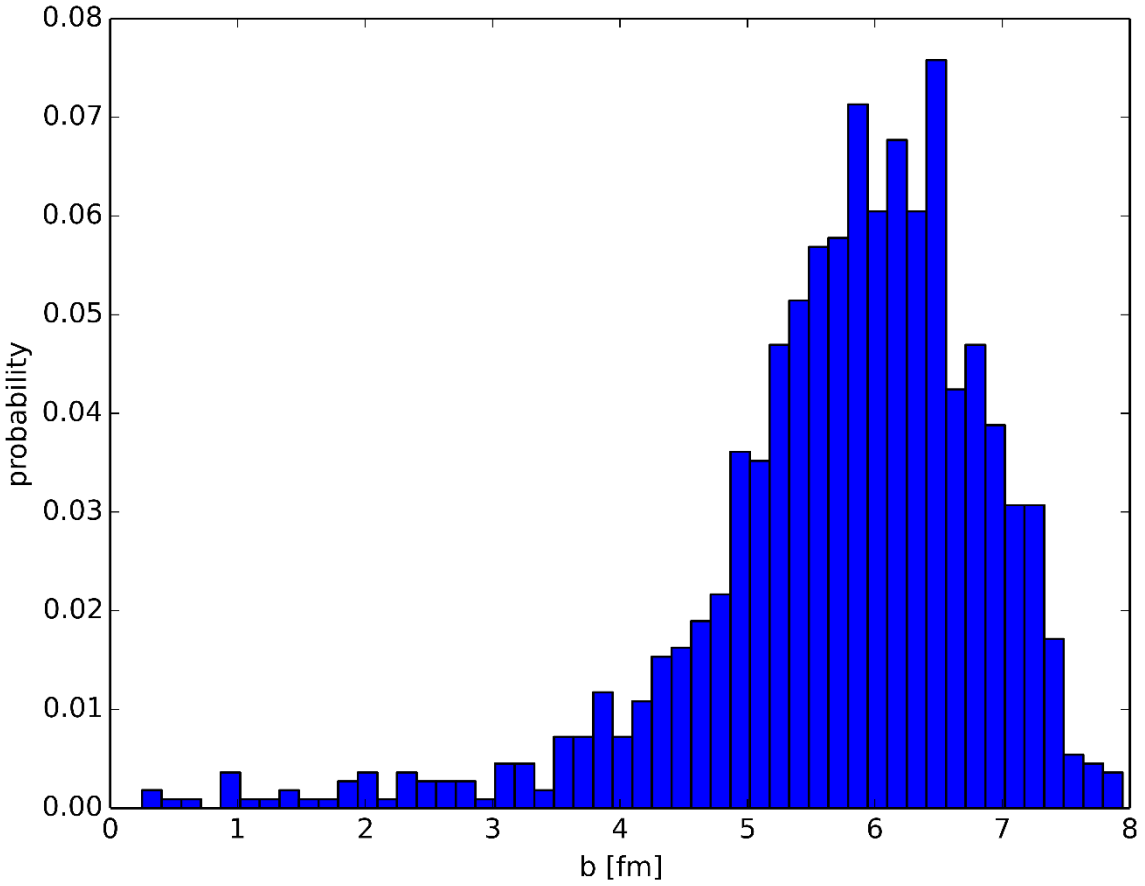
Distribution of rapidity for $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c (left - protons, right - π^0).



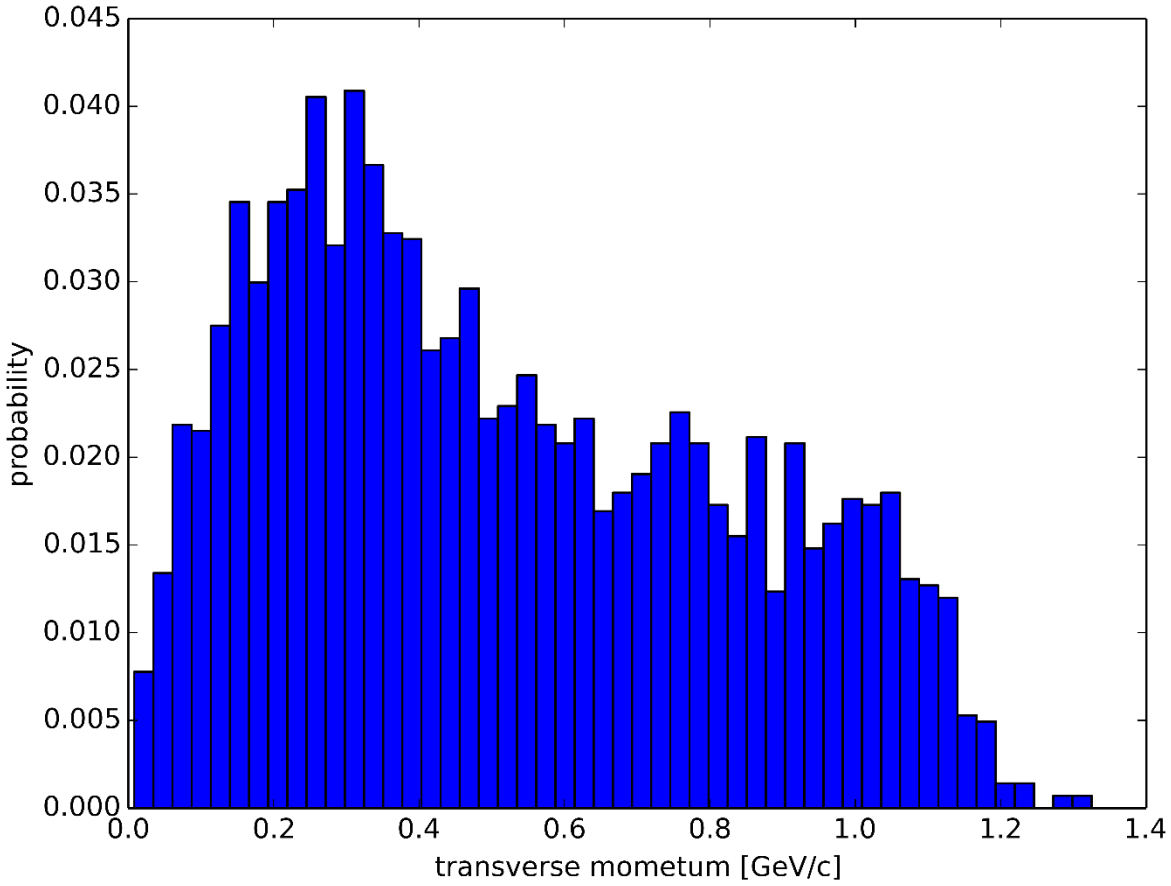


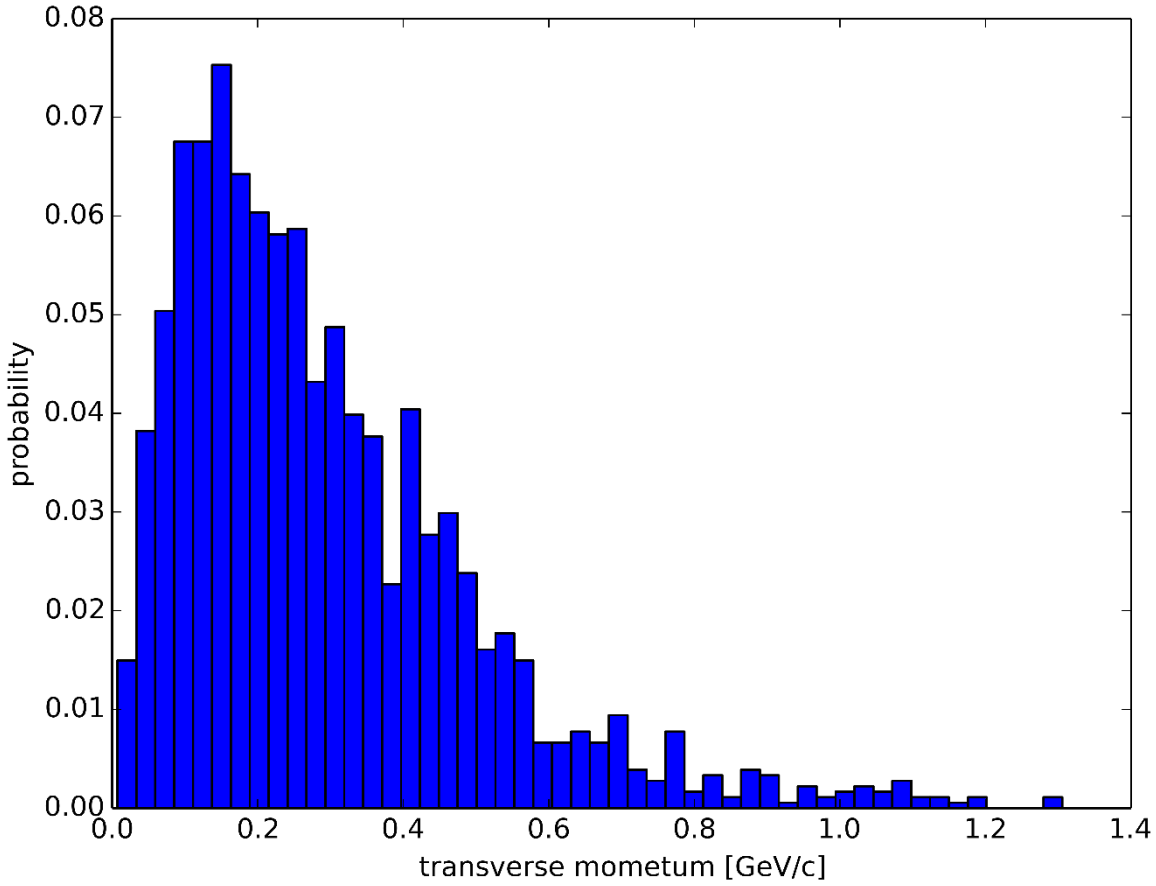
Distribution of impact parameter for $\pi^+ + Xe \rightarrow \pi^0 + p + (p/n/\pi^{\pm}) + A$ at 2.34 GeV/c (left - for protons, right - for π^0).





Distribution of transverse momentum for $\pi^- + Xe \rightarrow \pi^0 + n + (p/n/\pi^{\pm}) + A$ at 3.5 GeV/c (left - for neutrons, right - for π^0).





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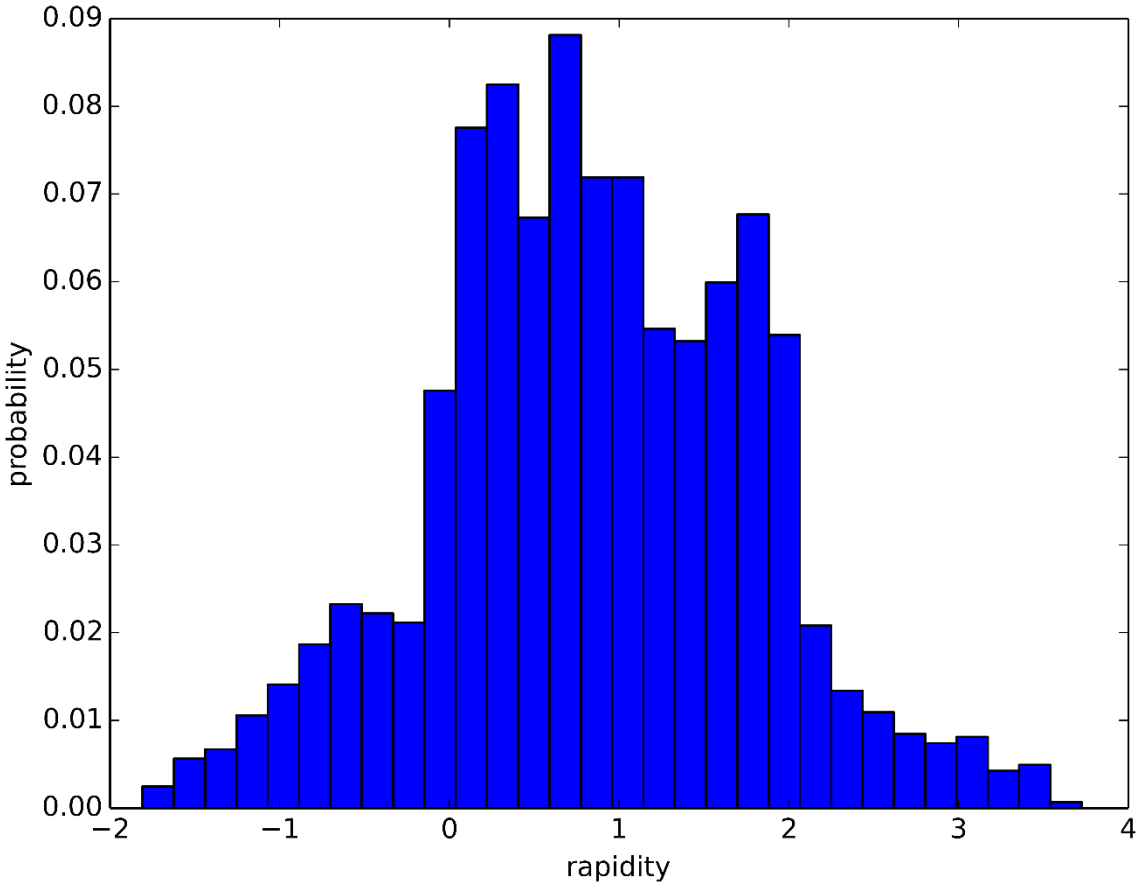

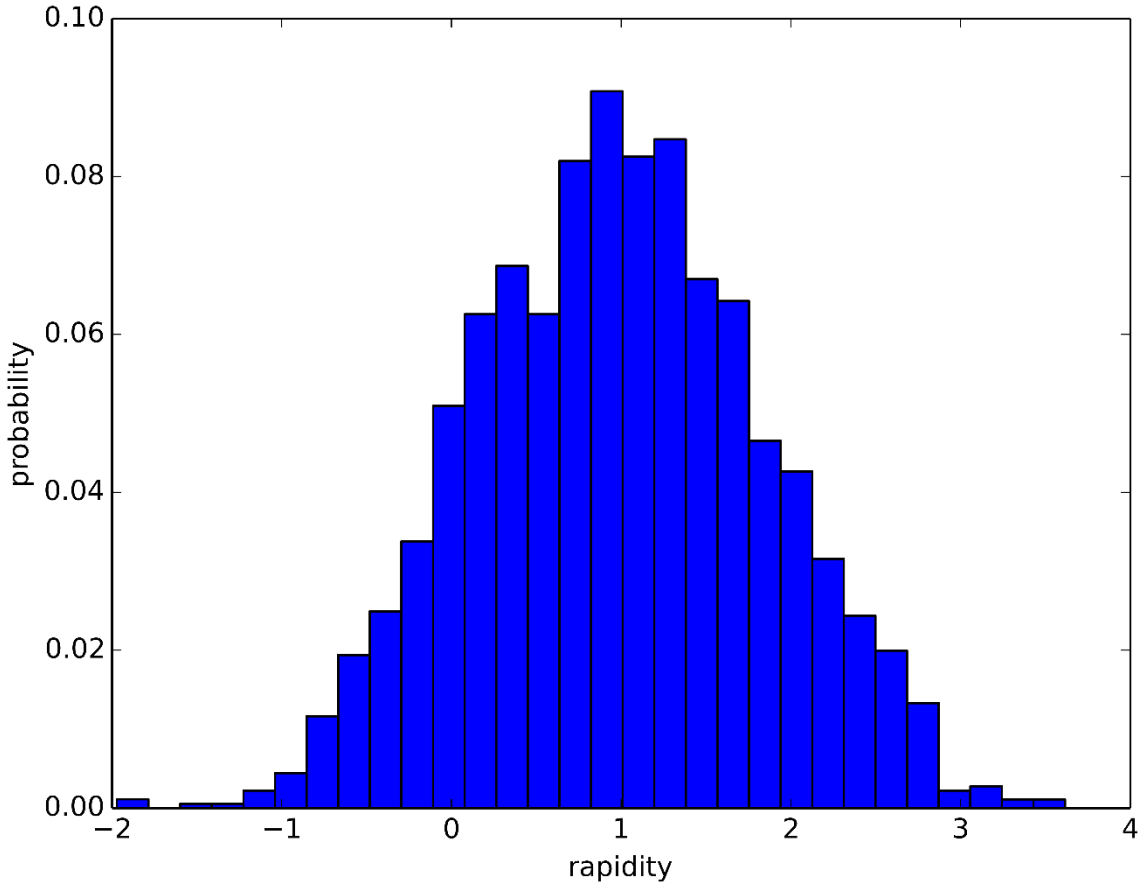

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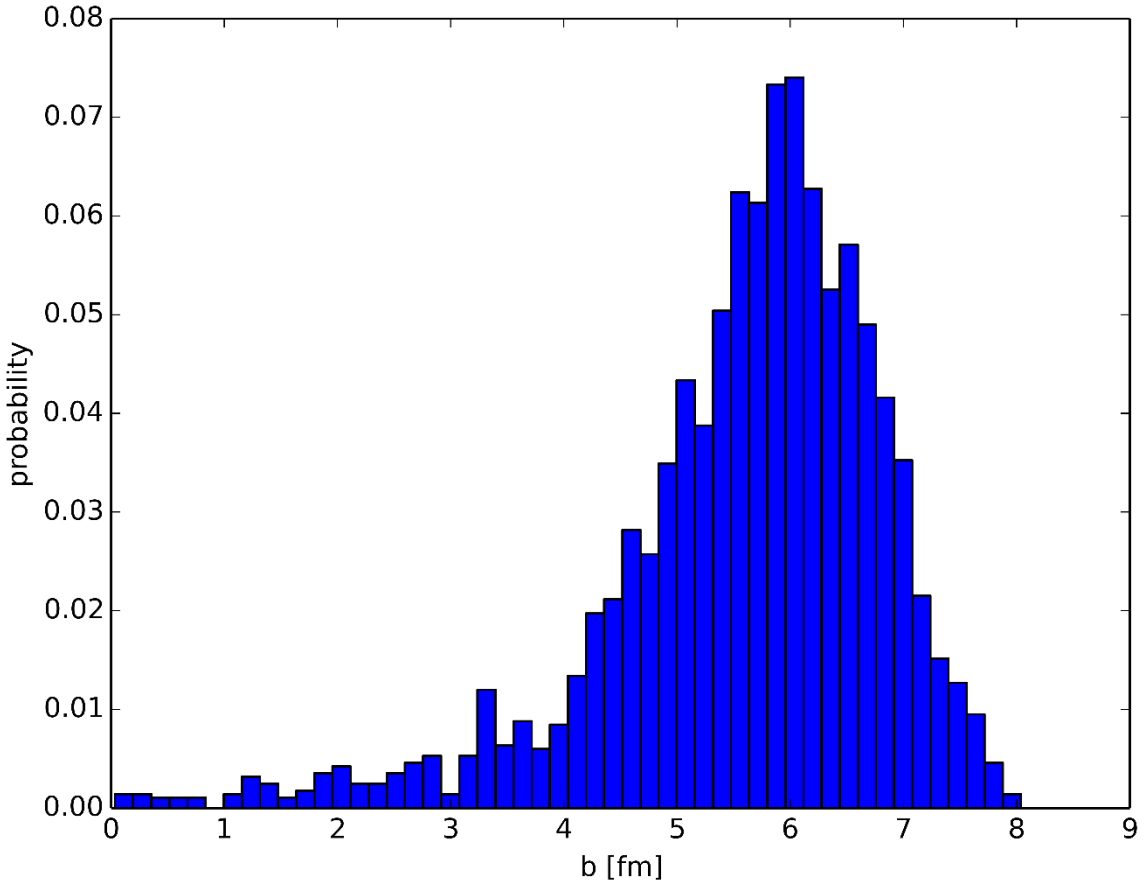

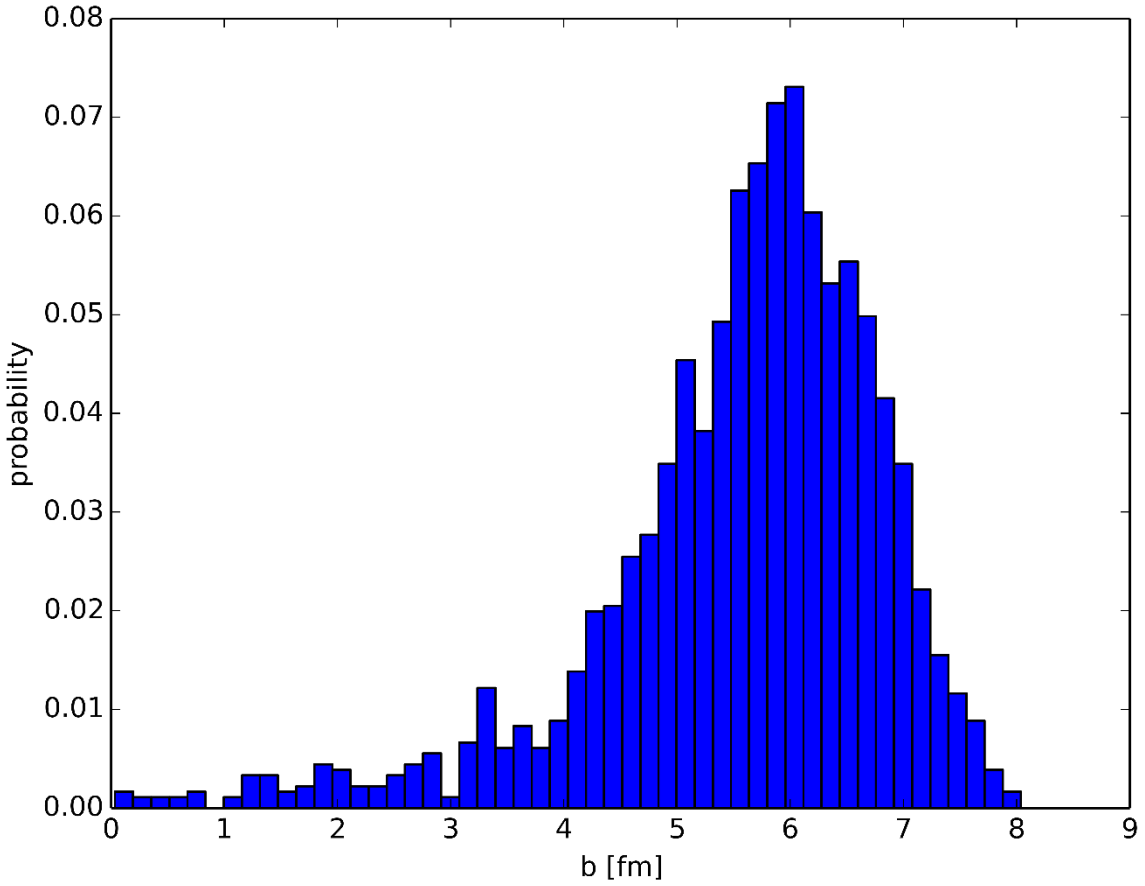

Summary and conclusion

Extensive analysis of the correlation between multiplicity, rapidity and impact parameter has been done using JAM code by the example of the quasi-two-particle reaction π + Xe at 2.34 and 3.5 GeV/c.

For π^0 from π + Xe at 2.34 reaction if transverse momentum is within 0.1-0.5 GeV/c and rapidity between 0.5-1.3 then we can say with ~70% probability that the impact parameter was within range of 5-7 fm. Similarly for protons, if transverse momentum is within 0.1-0.3 and rapidity between 0.2-1.8 then we can say with ~70% probability that the impact parameter was within range of 5-7 fm as well.

The obtained results point out that there exists the possibility to derive information about the impact parameter on the basis of the measured multiplicity of different kinds of emitted particles and their rapidity even at such moderate energies.

The above mentioned task may be solved more successfully if other scaling variables are used, too.

Thank you for attention