

Coulomb Nuclear Interference in elastic polarized proton-ion scattering at RHIC

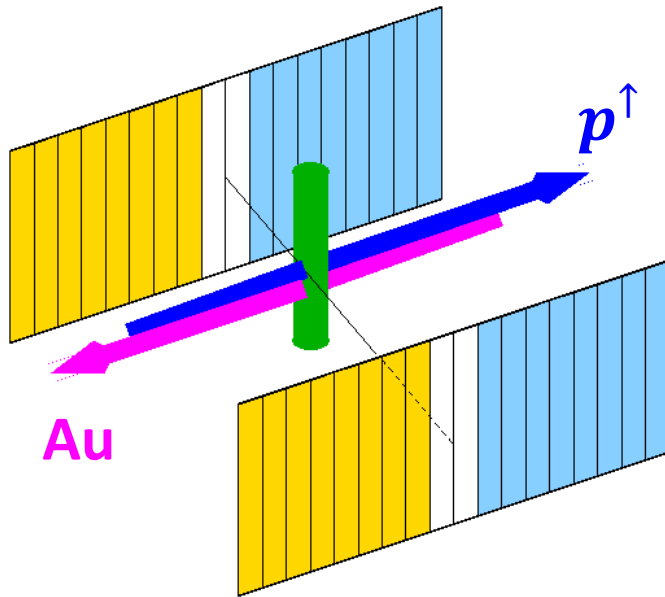
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2015 polarized proton – ion runs



In RHIC Run 2015, polarized proton – nuclear runs were taken for the first time for

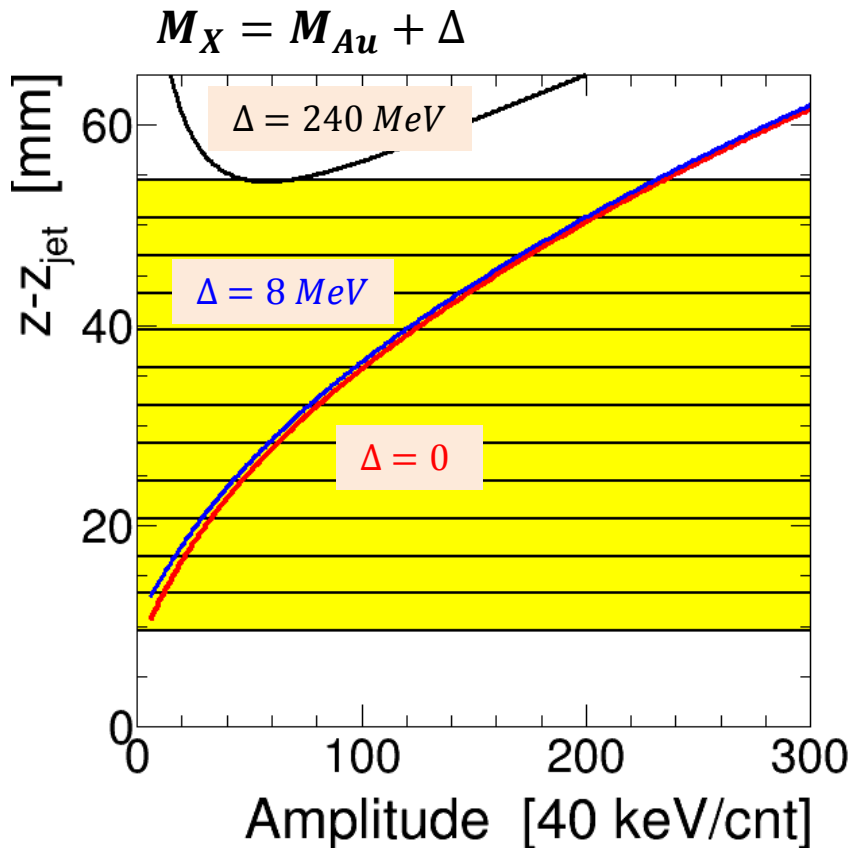
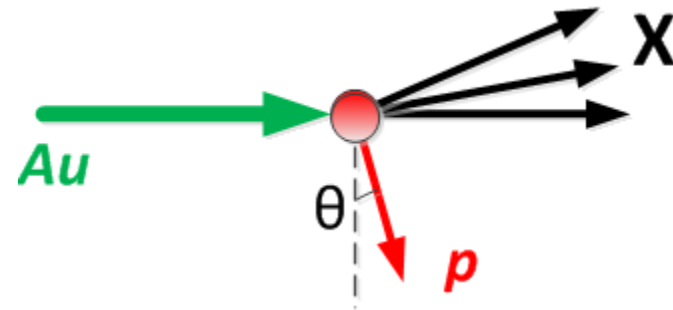
- $p^\uparrow Au$, 100 GeV/nucleon
- $p^\uparrow Al$, 100 GeV/nucleon

Proton beam polarization was measured by the HJet polarimeter in a regular way. Since the Gold (Aluminum) beam was passed through the Polarized Hydrogen Jet Target we got an opportunity to measure an asymmetry in $p^\uparrow Au$ and $p^\uparrow Al$ elastic scattering.

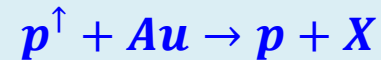
Since the 100 GeV/nucleon Au scattering on proton is, actually, the same as 100 GeV proton scattering on Au, I will always use the term pAu (pAl) scattering.



$$\frac{z - z_{jet}}{L} \approx \frac{E}{\sqrt{E^2 - M^2}} \sqrt{\frac{T}{2m_p}} \left(1 + \frac{M(M_X - M)}{ET} \right)$$



Since we do not control scattered Au,
we measure inclusive reaction

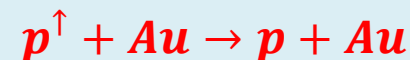


with kinematical constraints

$$-t < 0.025 \text{ GeV}/c^2$$

$$\theta < 70 \text{ mrad}$$

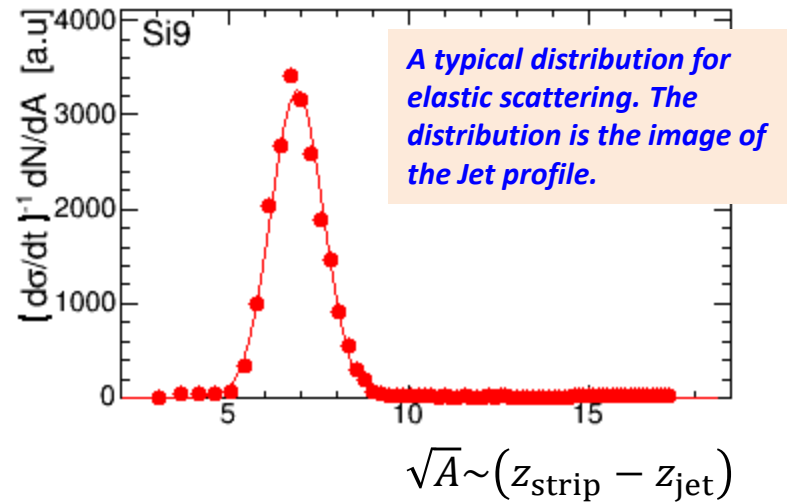
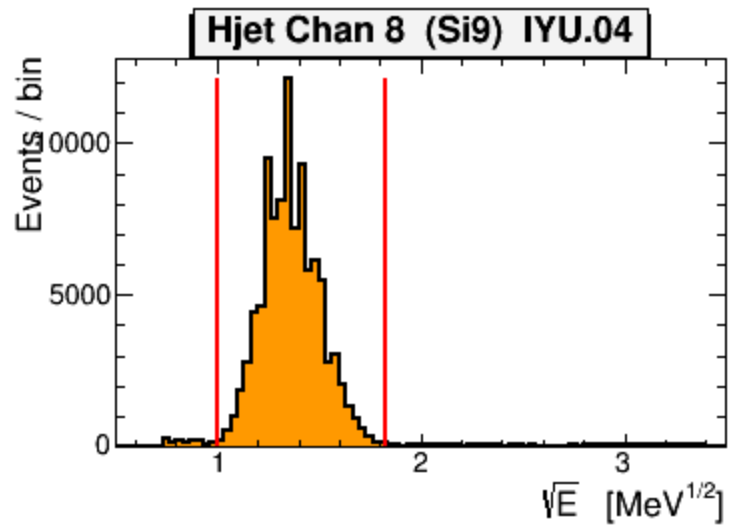
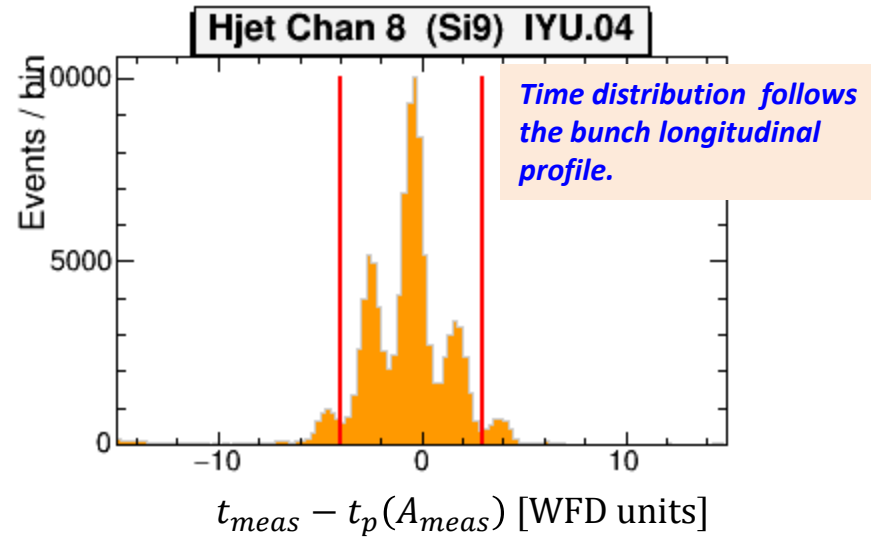
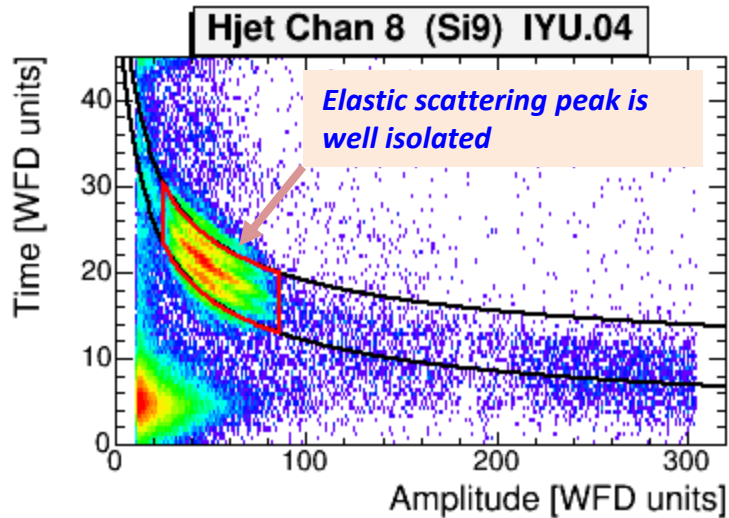
Elastic component



is not well isolated.

Nonetheless, inelastic component is suppressed.

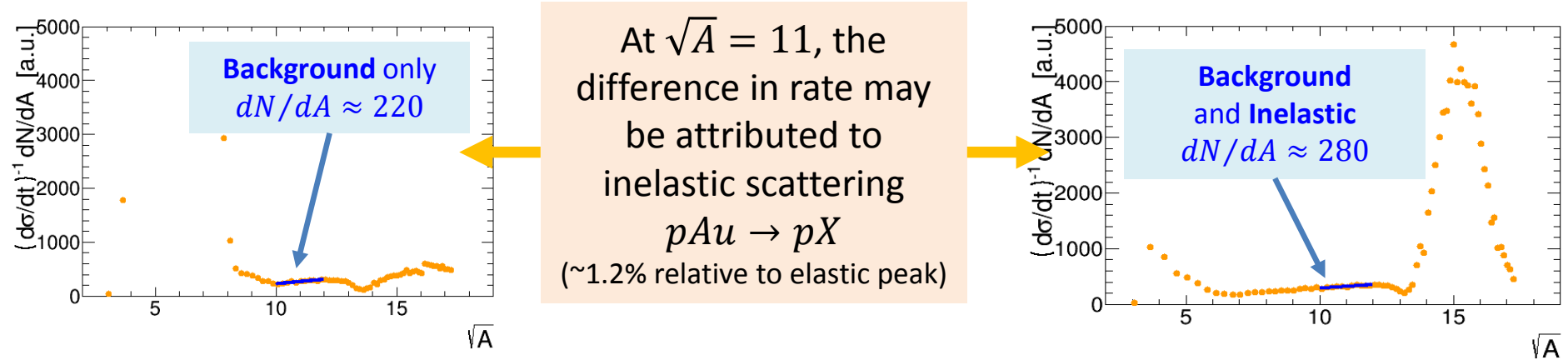
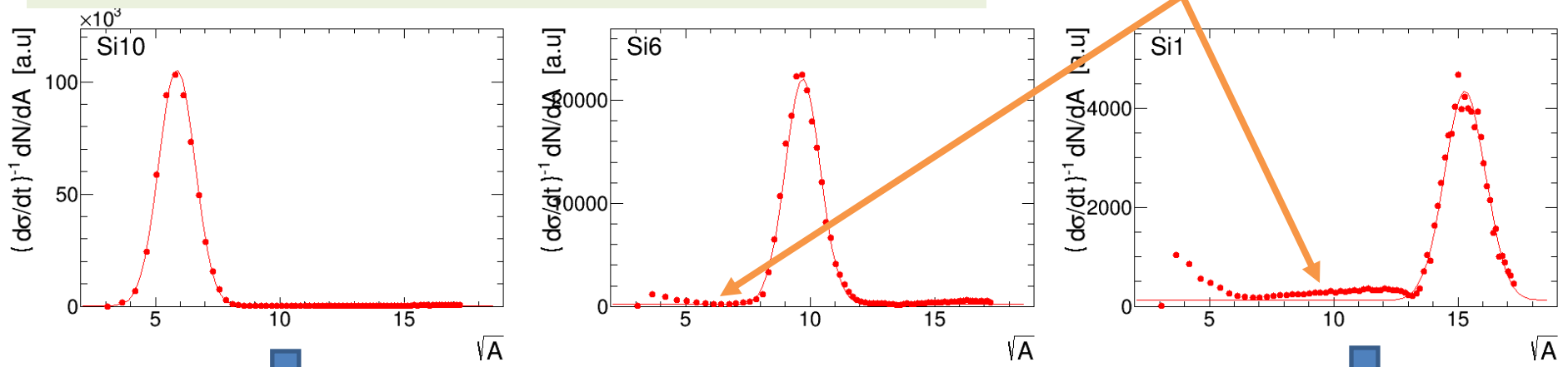
Signal distributions for yellow (Gold) beam



Contribution of Inelastic $p Au \rightarrow p X$ scattering

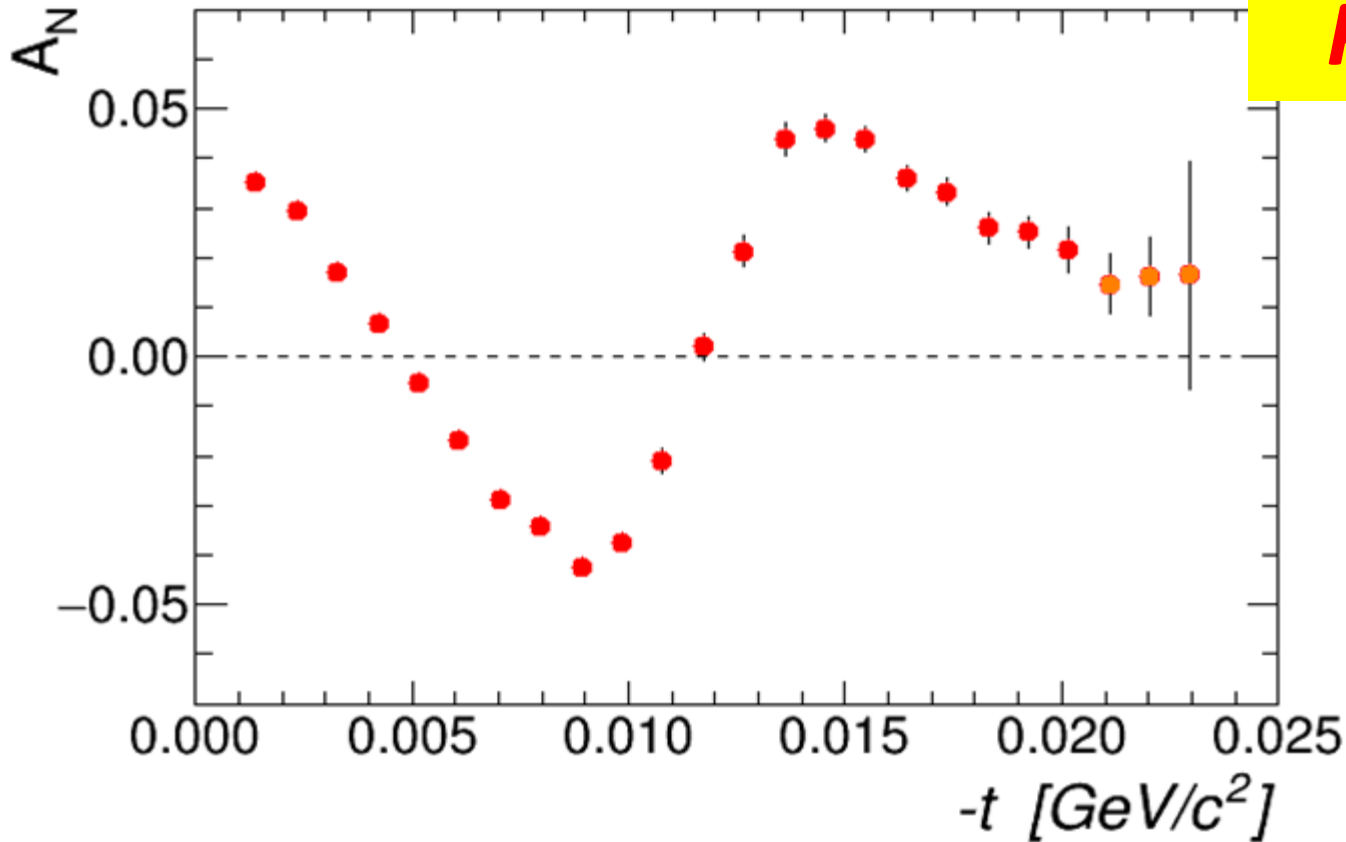
The \sqrt{A} distributions are typical for elastic scattering:

Inelastic events may contribute here



Inelastic contribution to the measured $p Au \rightarrow p Au$ is about *few %*

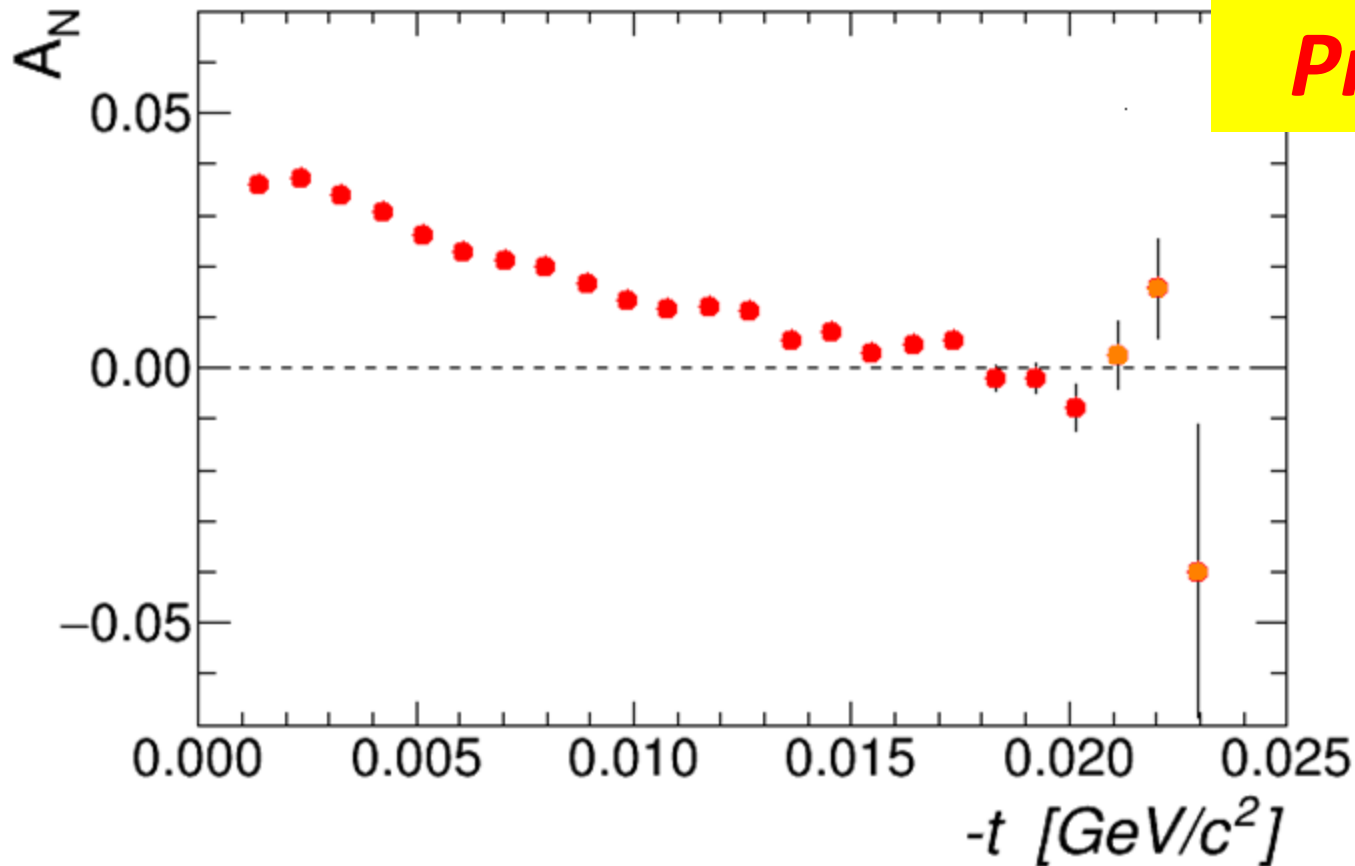
Analyzing power for p^\uparrow Au scattering at 100 GeV



Preliminary

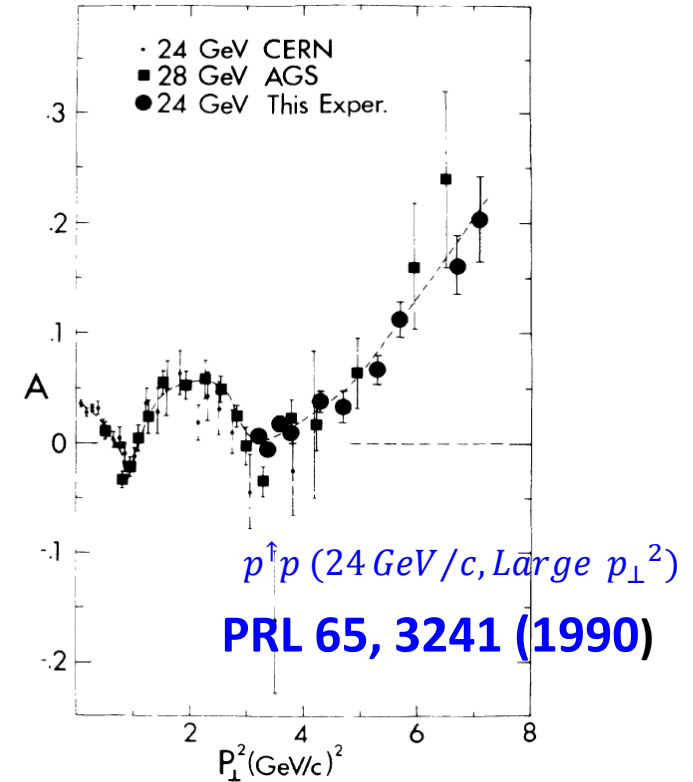
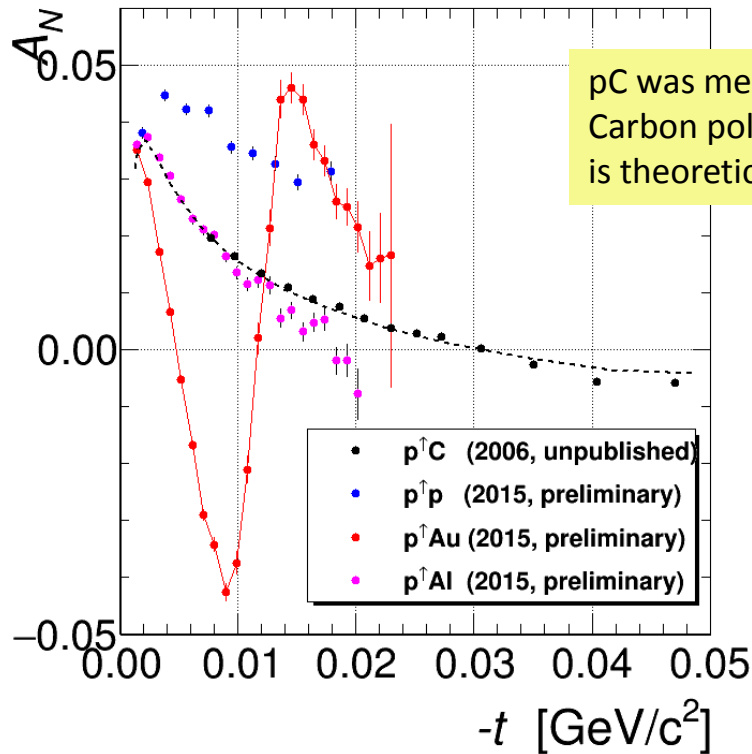
- *RHIC Fills 19093-19100 (About 10% of total statistics)*
- *More work is needed for calibrations, alignments, cuts optimization.*
- *Background was not subtracted.*
- *Systematic errors may be significant for $-t > 0.02 \text{ GeV}/c^2$*

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Analyzing Power for 100 GeV protons



A_N arises mainly from interference between *EM spin-flip amplitude* and *hadronic non spin-flip amplitude* (Coulomb – Nuclear Interference)

A_N is also sensitive probe to *hadronic spin flip amplitude* (Regge poles/Pomeron Exchange)

For the first crossing zero, $A_N(t_{node}) = 0$, one expects $t_{node} \sim A^{-2/3}$ (diffraction minimum)

	C	Al	Au
$-t_{node}$	0.031	0.017	0.0045
$-t_{node}A^{2/3}$	0.162	0.153	0.152

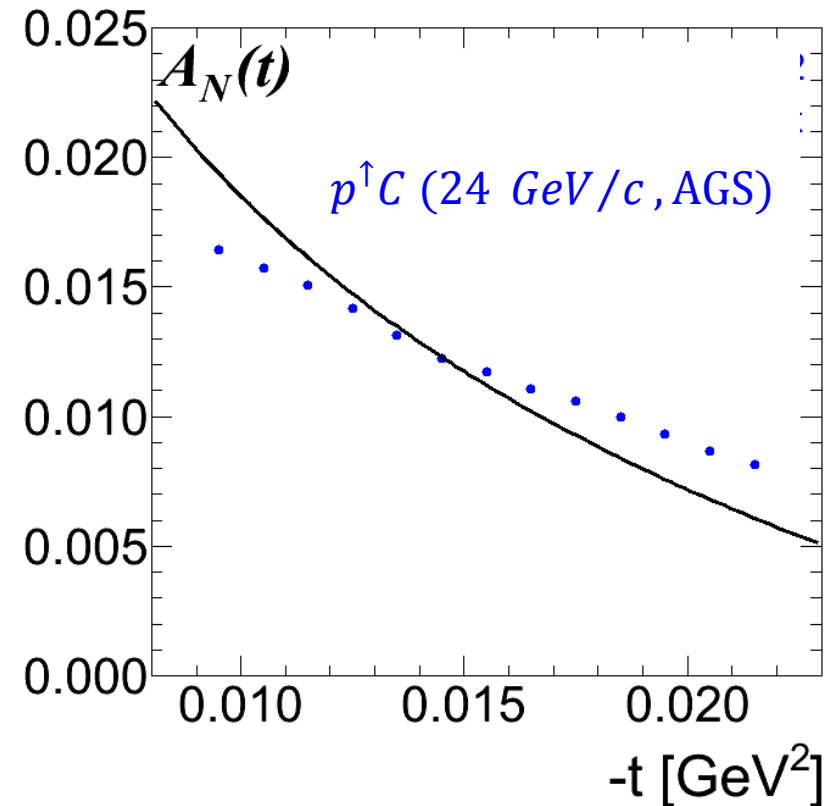
Analyzing Power for p-Carbon Polarimeters

5 CNI pCarbon polarimeters are employed at AGS/RHIC.

At AGS we use analyzing power theoretically derived from BNL E950 data.

There is poor consistency between experimentally measured analyzing power (up to an arbitrary scaling factor) and the theoretical one. Independent measurement of the A_N would be very helpful for better performance of the AGS polarimeter.

HJET can make such measurements at 24 GeV (injection) with sufficient accuracy if RHIC will be filled with Carbon beams. Such measurements (including 100 GeV) would be also helpful for RHIC p-Carbon polarimeters



We are considering a possibility to measure pC analyzing power at HJET, but it requires a dedicated time at RHIC (Carbon beam run, ~ 1 day) and such a proposal does not have high priority for the RHIC Program.

Summary

- Analyzing power for 100 GeV polarized proton elastic scattering on Gold and Aluminum were measured in RHIC Run 15.
- Preliminary results were presented.
- In the 2016 Gold-Gold run at RHIC we plan to measure p^\uparrow Au analyzing power for 100, 30, 15, and 10 GeV (a good measure of the hadronic spin flip amplitude).
- A possibility of measuring of p^\uparrow C in a special short run is discussed.