



Early History of RHIC Polarimetry

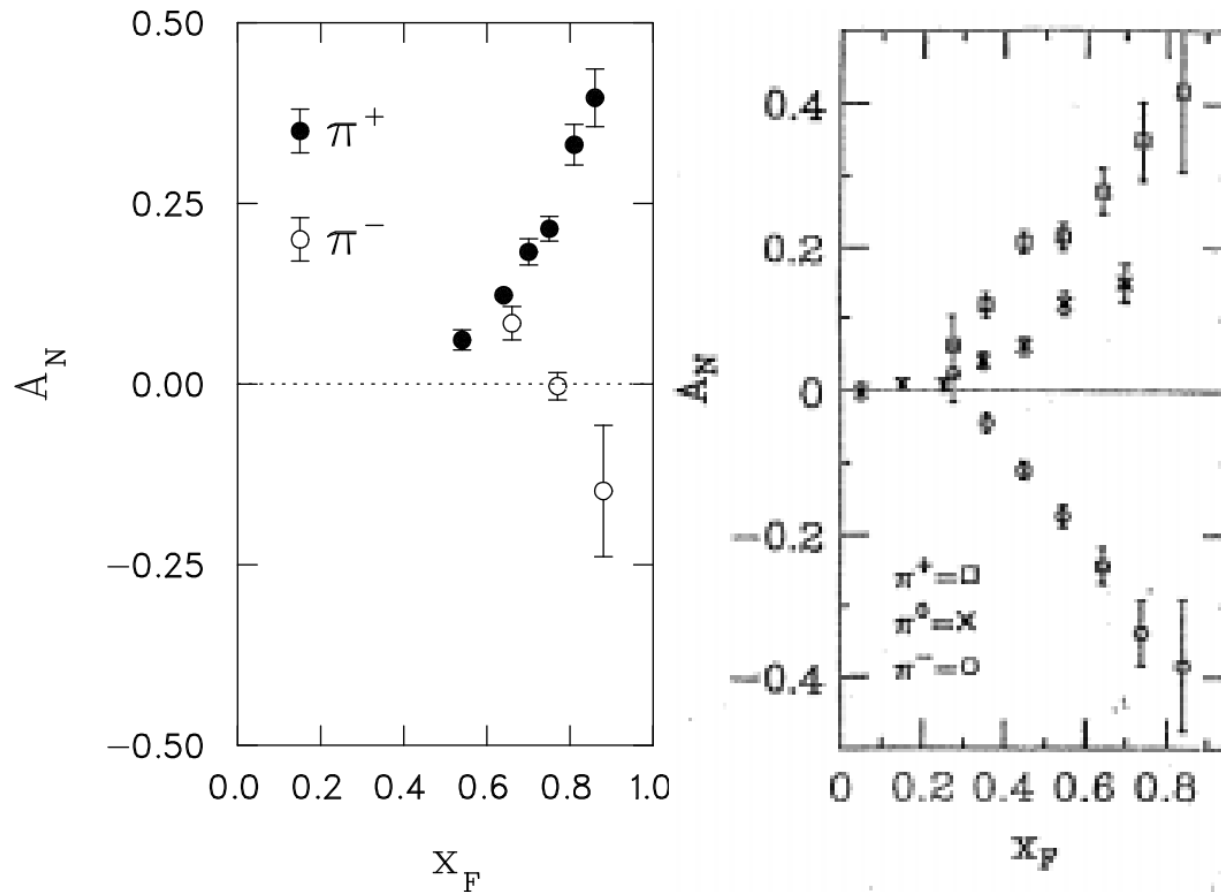
Haixin Huang

July 9-10th, 2026

RHICfest



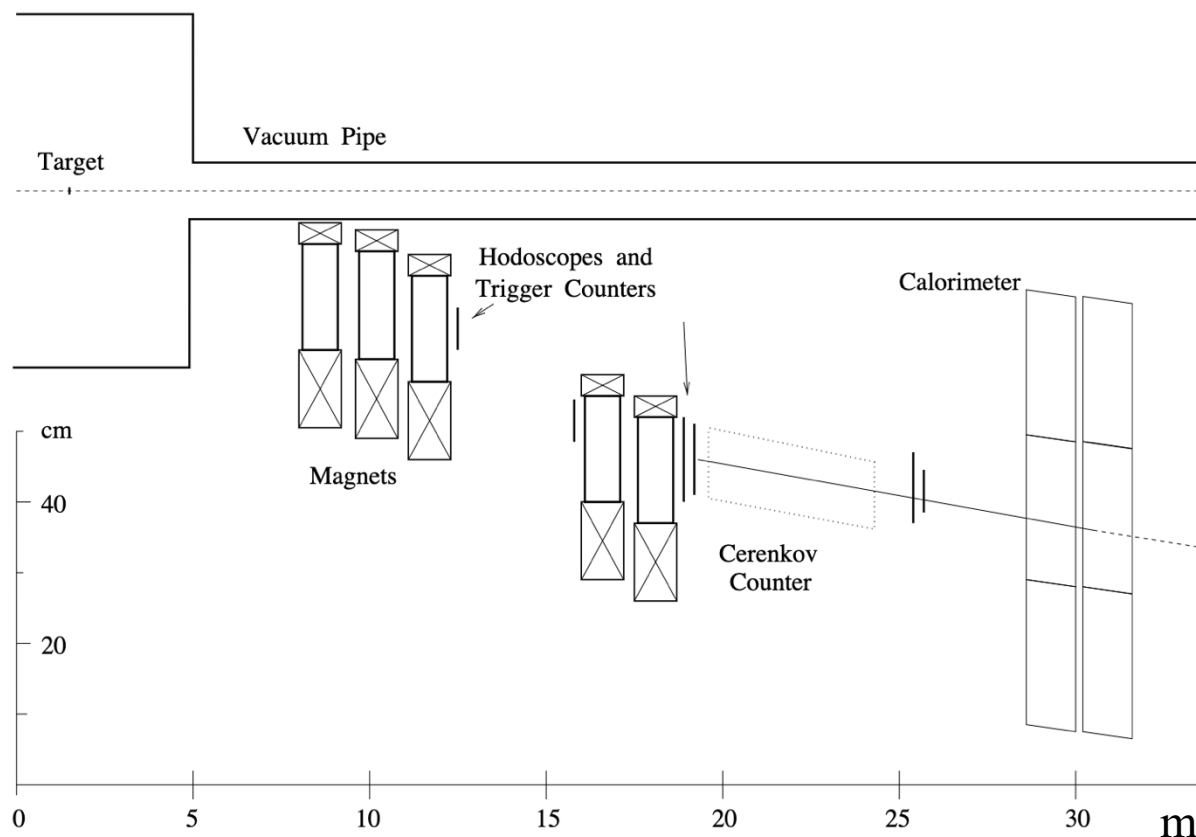
Initial Design: Pion Inclusive Polarimetry



Left: pion asymmetries at ZGS (12 GeV/c); right: pion asymmetry at Fermilab E704 (200 GeV/c). AGS E925 (in 1997) confirmed that a similar asymmetry was observed with a carbon target, indicating little dependence on target nuclei.

Initial design: inclusive pion polarimeter with x_F at 0.8.

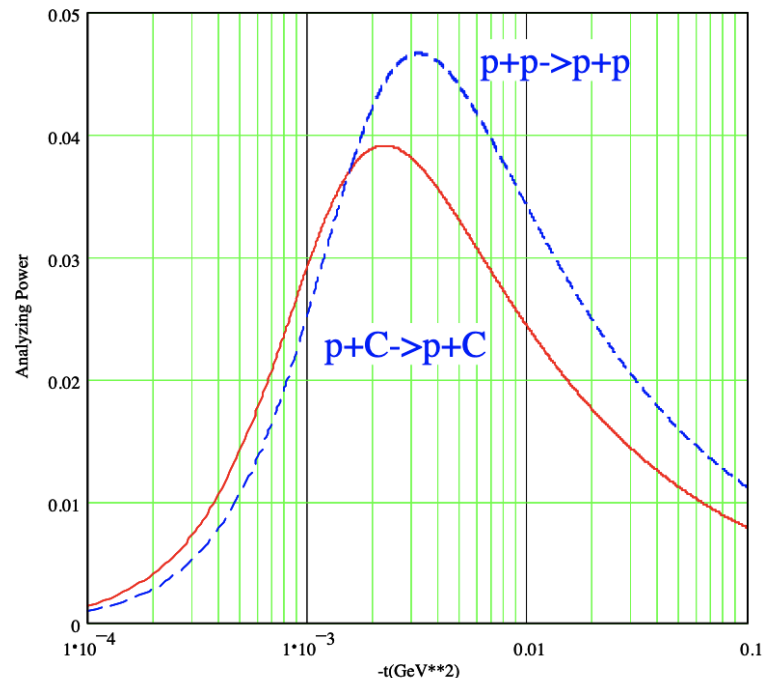
Initial Design (2)



The magnets ($\sim 1\text{T}$) and detectors need to be movable ($\sim 20\text{cm}$) for different energies. Positions shown are for $100\text{GeV}/c$.

Because the detectors are located outside the vacuum chamber, a thin window is required. In 1997, Dr. Marim Fessa left BNL and I took over the RHIC polarimeter design effort.

CNI Polarimetry As an Alternative



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Spin dependence of high energy proton scattering

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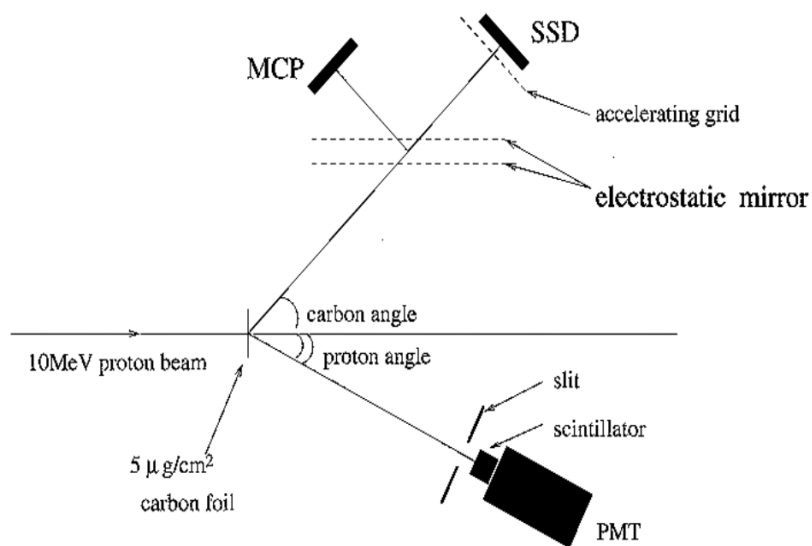
Physics Department, Brookhaven National Laboratory, Upton, New York 11973

(Received 19 January 1999; published 21 April 1999)

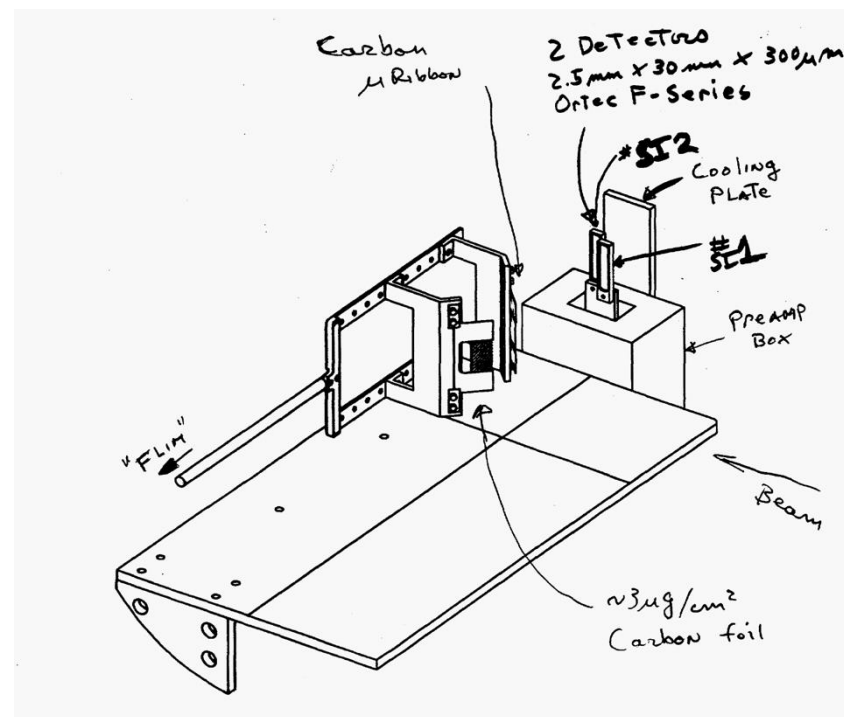
Small-angle elastic scattering of hadrons in the Coulomb-Nuclear Interaction (CNI) region has long been advocated for polarimetry (N. Buttimore in 1974 and B. Kopeliovich in 1978). L. Trueman brought it up again in 1996. N. Buttimore, E. Leader, B. Kopeliovich, J. Soffer, and L. Trueman suggested CNI Polarimetry.

Approximately 4% analyzing power but with high statistics

CNI Process Tests at Low Energies



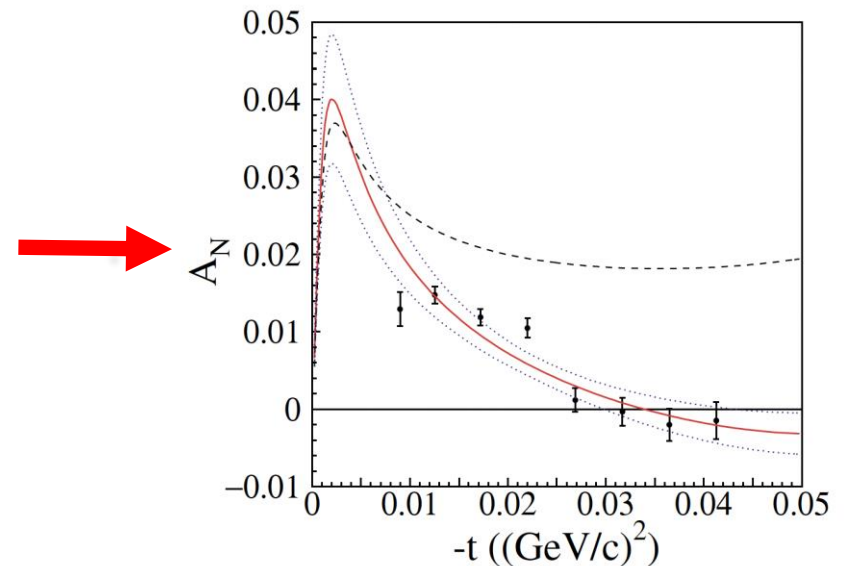
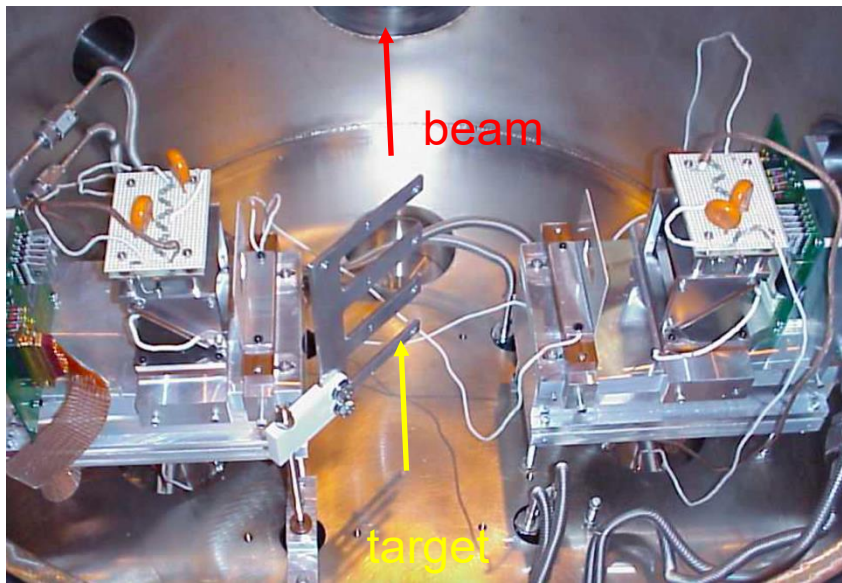
10 MeV (proton-Carbon) test at Kyoto Univ. Van de Graaff led by Prof. Ken Imai



200 MeV proton-Carbon test at IUCF, lead by Dr. Doug Fields

In 1997, the CNI process came into consideration. The asymmetry is not as high as pion inclusive process, but the detector system is relatively simple.

Polarimetry Test in AGS –E950 (1999)

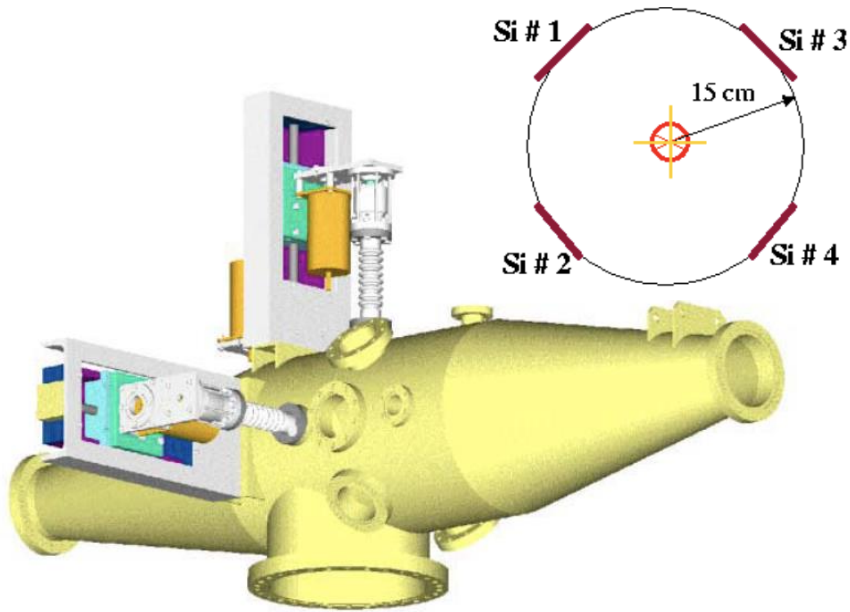


A new collaboration was formed to carry out a CNI test in the AGS. Yale group (A. Deshpande, et al.) provided the chamber and Kyoto Univ. group provided detectors (Si and MCP). I. Alekseev and D. Svirida (IHEP) provided DAQ system. G. Bunce, H. Huang, K. Kurita, Y. Makdisi, T. Roser from BNL worked on this experiment. Challenges include: 1. synchronizing bunch passage with detected carbon events, 2. suppress significant beam and RF noise.

It took us three weeks of fights to solve the problem and successfully begin data taking.

Measurement of Analyzing Power for Proton-Carbon Elastic Scattering in the Coulomb-Nuclear Interference Region with a 22-GeV/c Polarized Proton Beam,
J. Tojo *et al.* Phys. Rev. Lett. **89**, 052302 (2002)

RHIC Polarimeter Design (1999-2000)



- The successful A_N measurement provided the basis for RHIC polarization measurement during the first few year's operation, until H-jet came online in 2005.
- The next step is to design the RHIC CNI polarimeter:
 - chamber design with impedance considerations;
 - detector design to suppress noise;
 - electronics capable fully digitizing the signal.

A thin window was carved on the chamber; in case conversion to a pion polarimeter became necessary.

RHIC Polarimeter Installed in the Tunnel



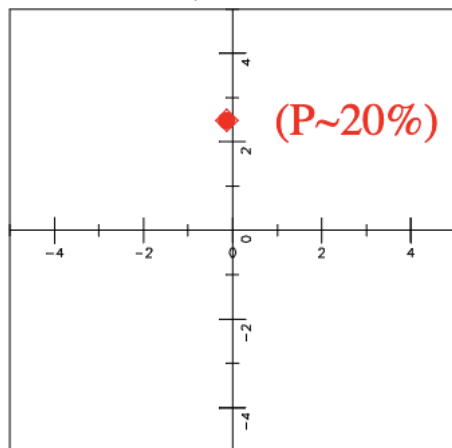
Some of the contributors to the RHIC polarimeter project are shown in this photo taken in 2006: R. Davis, J. Scaduto, *H. Huang*, *D. Svirida*, *O. Jinochi*, *H. Spinka*, C. Delapara, *A. Deshpande*, G. Mahler, *Y. Makdisi*, B. Duffin, *G. Bunce*, *A. Bravar*, *D. Underwood*, *D. Fields* and *N. Saito*.

First Sets of RHIC Polarization Measurements in 2000

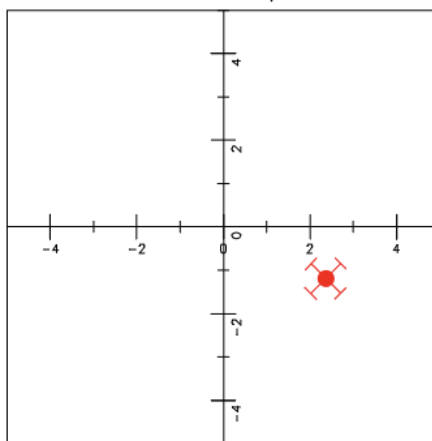
In 2000, only one Siberian snake was installed in the Blue Ring. The snake had to be turned off to inject a vertically polarized beam. The measurements confirmed that both the polarimeter and Siberian snake performed as expected.

Inject, snake off

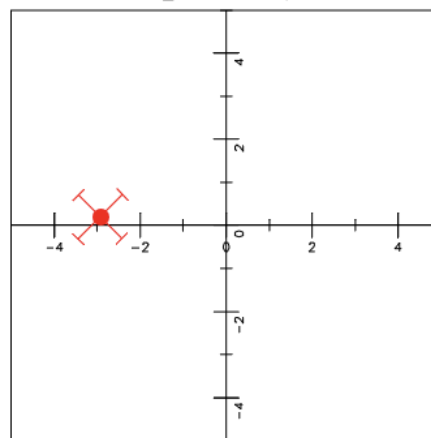
$G\gamma = 46.5$



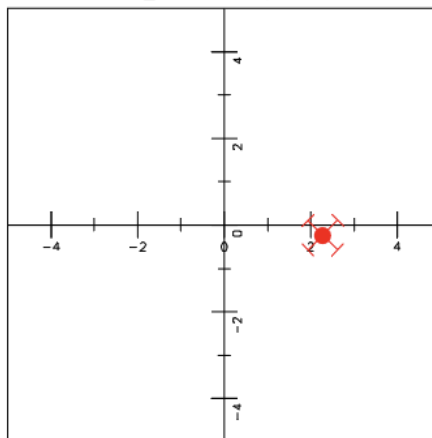
Snake on $G\gamma = 46.5$



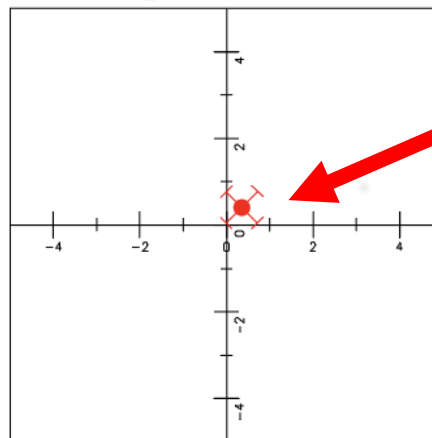
Ramp to $G\gamma = 48$



Ramp to $G\gamma = 55.7$



Ramp to $G\gamma = 60.3$



Polarization loss due to large orbit error and betatron tune variation

CNI Polarimetry Works!

- The CNI polarimetry is a compact polarimeter and served RHIC spin program successfully.
- In 2006 it won Faraday Cup Award in Beam Instrumentation Workshop.
- It continued to evolve through several upgrades and successfully supported the RHIC spin program until Feb. 2026.

