

Study of the eta meson production with the polarized proton beam

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Motivation

- Dynamics of the eta meson production in $\vec{p}\vec{p} \rightarrow pp\eta$ reaction.
- Interaction of the η meson with nucleons.
- Mechanism production of η meson.

For the studies, a precise knowledge about contributions from different partial waves is required.
We would like to learn about it from the Analyzing power (A_y) measurement.

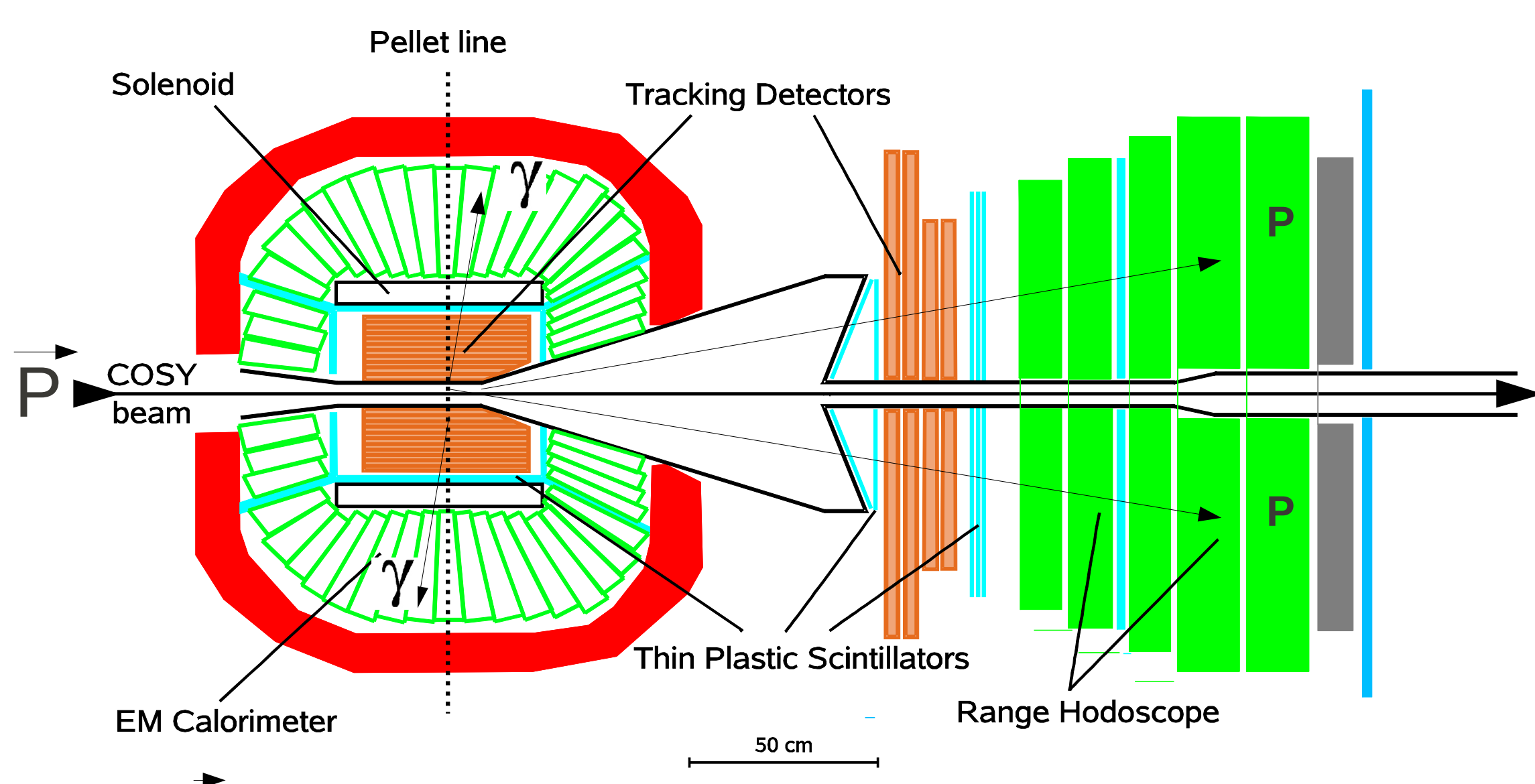
Analyzing power

- Vector of A_y may be understood as a measure of the relative deviation between the differential cross section for the experiment with and without polarized beam.
- Differential cross section with polarization.

$$\sigma(\zeta, P) = A_y(\xi) * P * \sigma_0(\xi) + \sigma_0(\xi)$$

$\vec{p} + \vec{p} \rightarrow p + p + \eta$ COSY-PAC38 Proposal 209

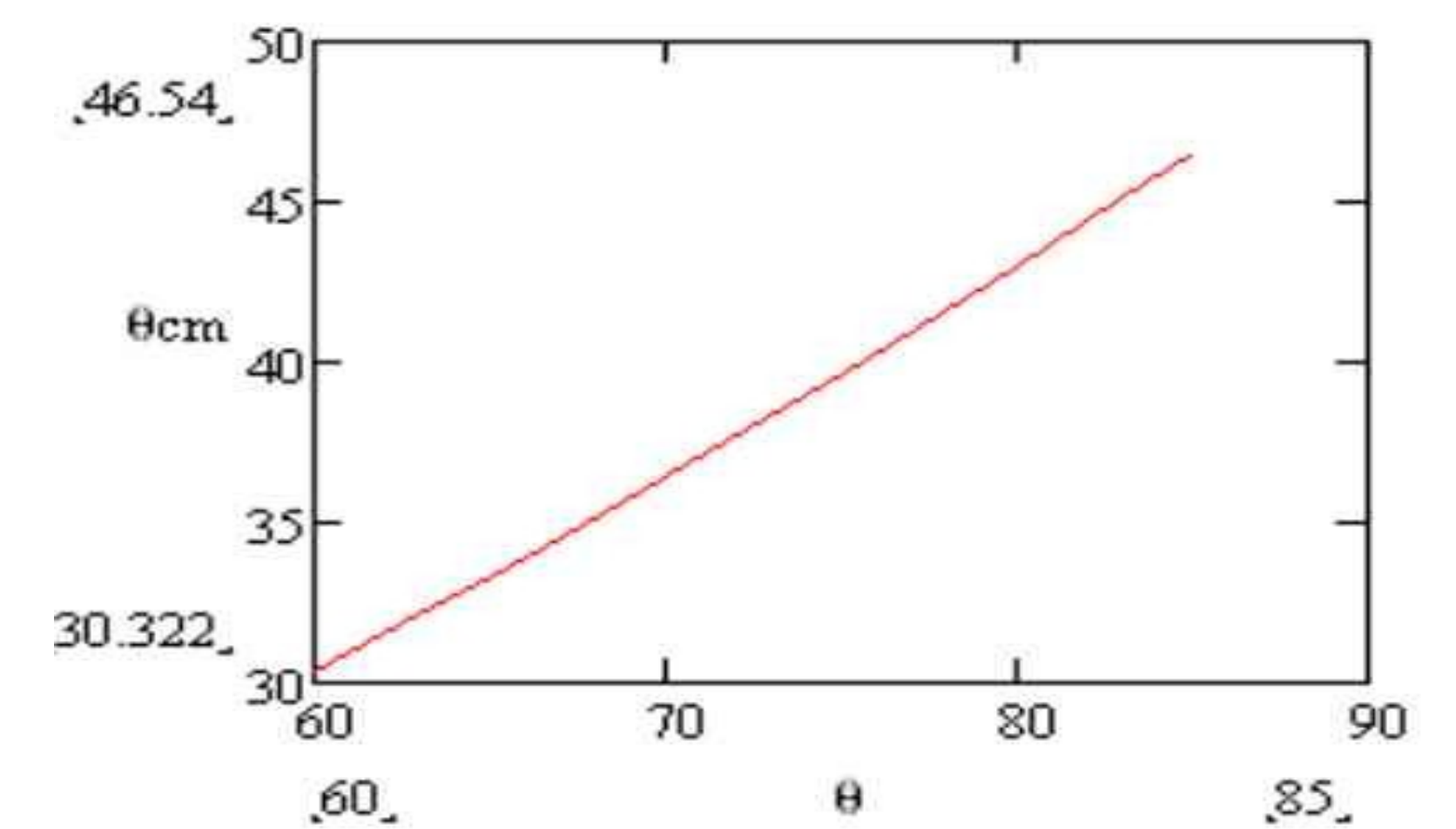
WASA-at-COSY Detector



• Protons from $pp \rightarrow pp\eta$ reaction are registered in Forward Detector and gamma quanta from η meson decay are detected in the electromagnetic calorimeter.

- WASA detector covers following angular ranges:
 - For Forward Detector [3°, 18°];
 - For Central Detector [60°, 84°].

Corresponding Range of Theta from elastic scattering for the Center Mass system.



Method to extract A_y for experiment.

- 1 step: $\vec{p} + \vec{p} \rightarrow p + p$ we know from EDDA experiment A_y Polarization P

- 2 step: $\vec{p} + \vec{p} \rightarrow p + p + \eta$ we calculate $N_- = \sqrt{\frac{N_R^+ N_L^-}{\epsilon_R L^+ \epsilon_L L^-}}$ and $N_+ = \sqrt{\frac{N_L^+ N_R^-}{\epsilon_L L^+ \epsilon_R L^-}}$ we know Polarization P

- 3 step: So, we calculate A_y for $\vec{p} + \vec{p} \rightarrow p + p + \eta$ reaction.

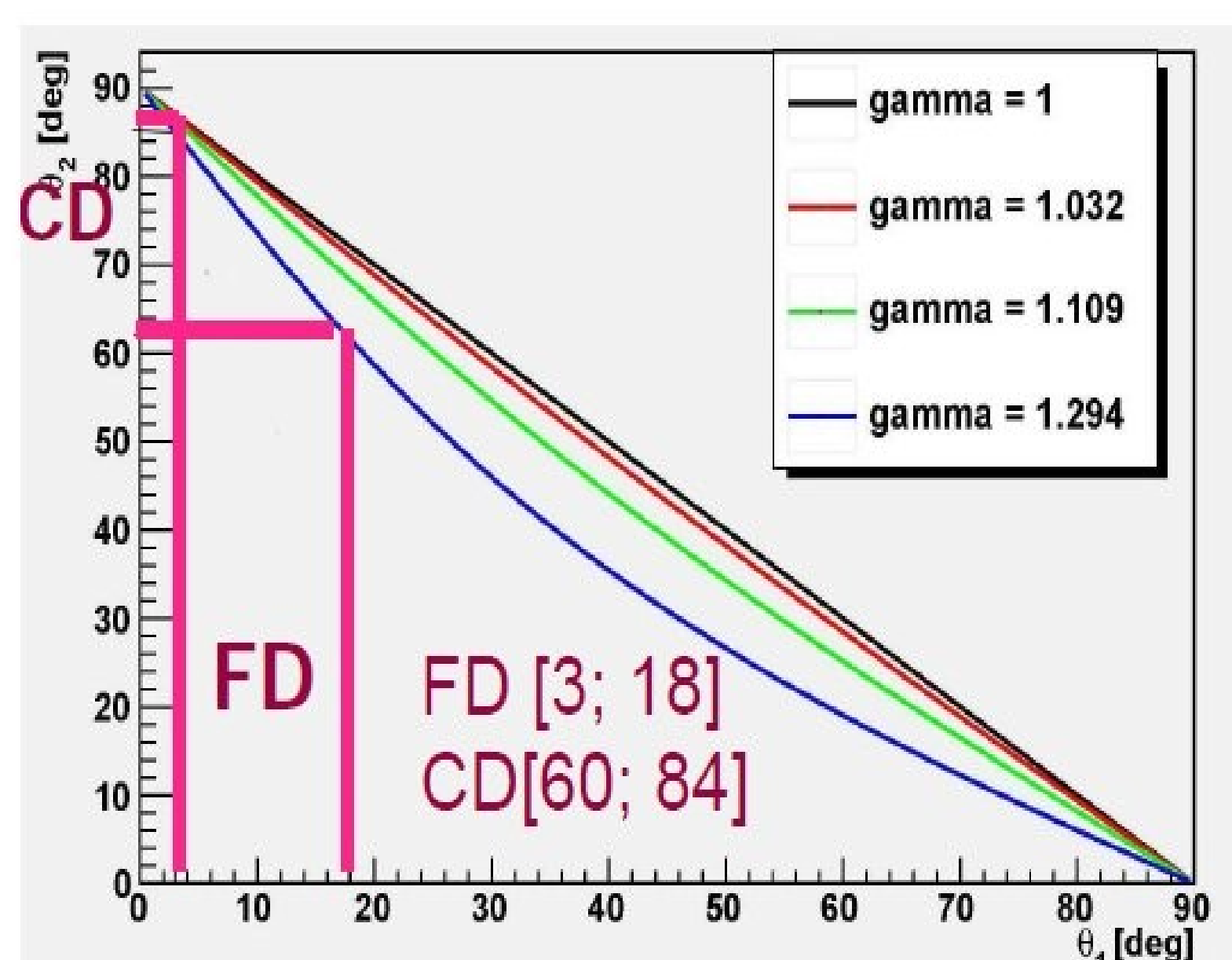
$$A_y(\theta) = \frac{1}{P \cos \varphi} \frac{N_+(\theta, \varphi) - N_-(\theta, \varphi)}{N_+(\theta, \varphi) + N_-(\theta, \varphi)}$$

Beam parameter and expected number of events for each excess energy

Q [MeV/c]	P _{beam} [MeV/c]	P	Luminosity cm ⁻² s ⁻¹	Acceptance	σ_{tot} [mb]	$N_{\eta \rightarrow \gamma\gamma}$	$N_{\eta \rightarrow 3\pi^0}$
15	2026	70.00%	$1.7 \cdot 10^{30}$	0.55	10^3	99708	81661
72	2188	60.00%	$2.3 \cdot 10^{30}$	0.63	$5 \cdot 10^3$	447789	375558

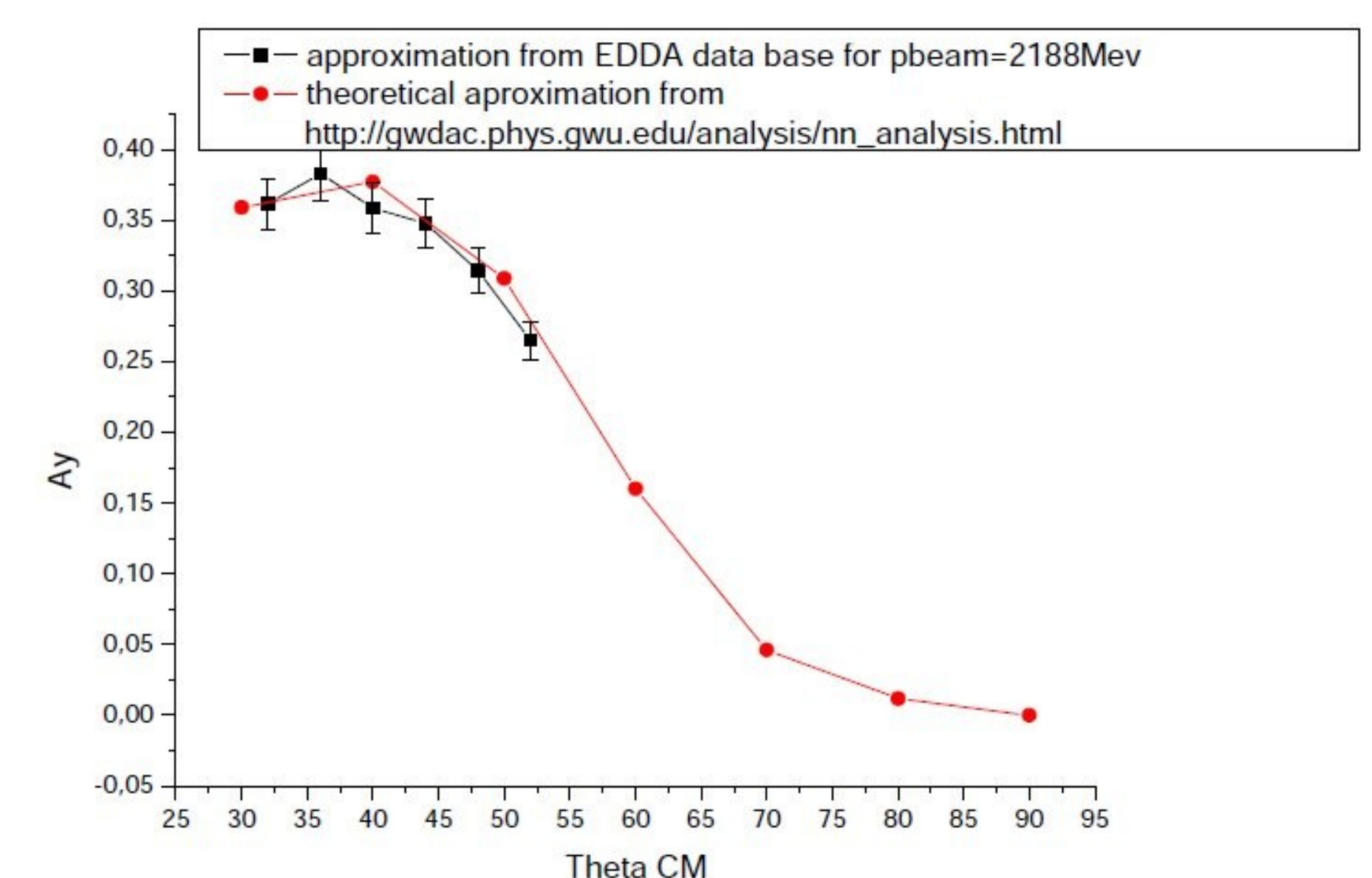
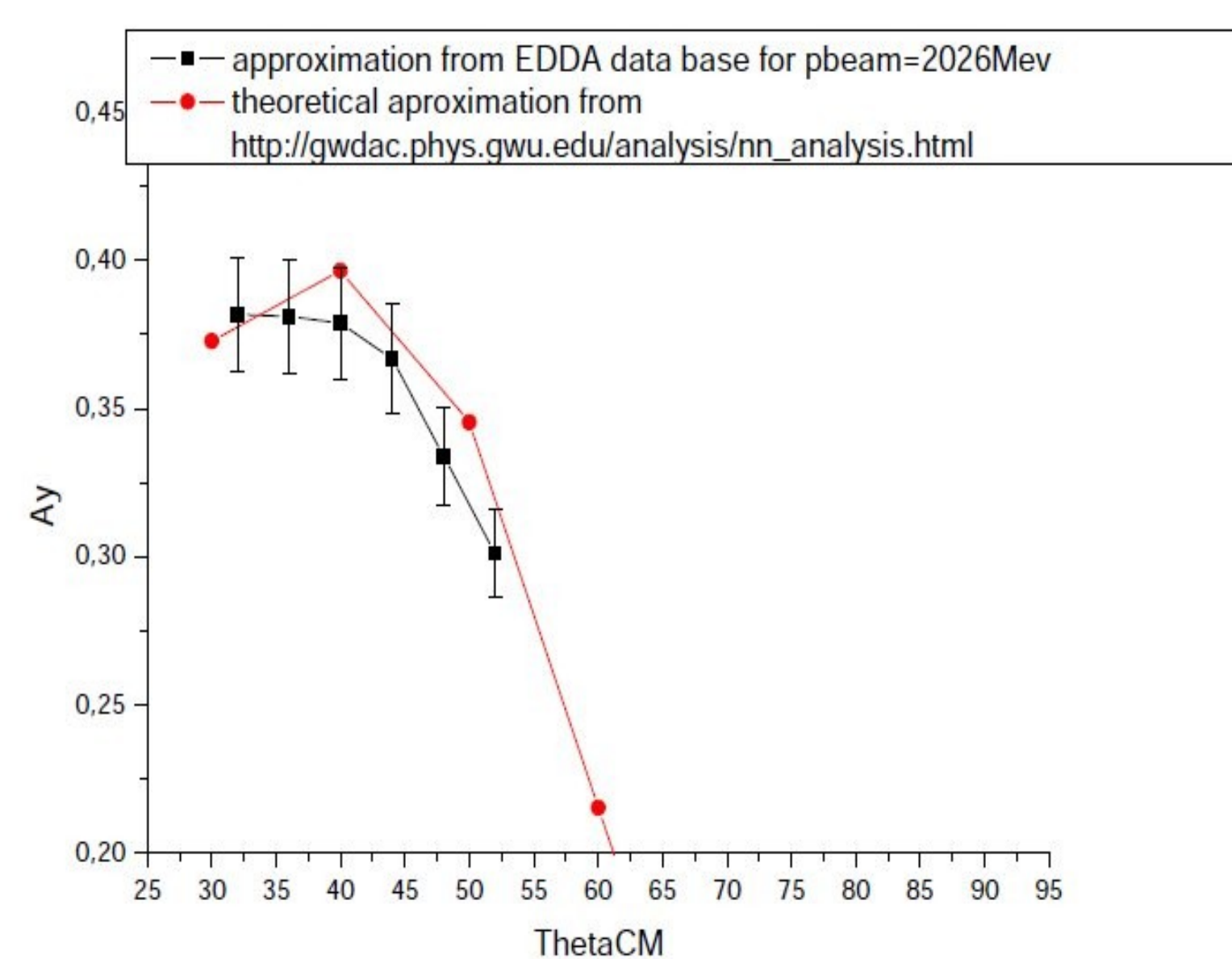
Proton-proton elastic scattering

Correlation between proton angle in Elastic scattering for different p_{beam}



theta₁ - angle for 1 proton
theta₂ - angle for 2 proton

Range of Analyzing Power



In this range, analyzing power for Q=15 MeV and Q=72 MeV was [0.32 - 0.38]

Outlook

- analysis of November 2010 data
- extract A_y for $\vec{p}\vec{p} \rightarrow pp\eta$ experiment
- comparison of result with present available data