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**Proton-Proton Streuung:**

**Ergebnisse des**

**EDDA Experiments**

**an COSY**

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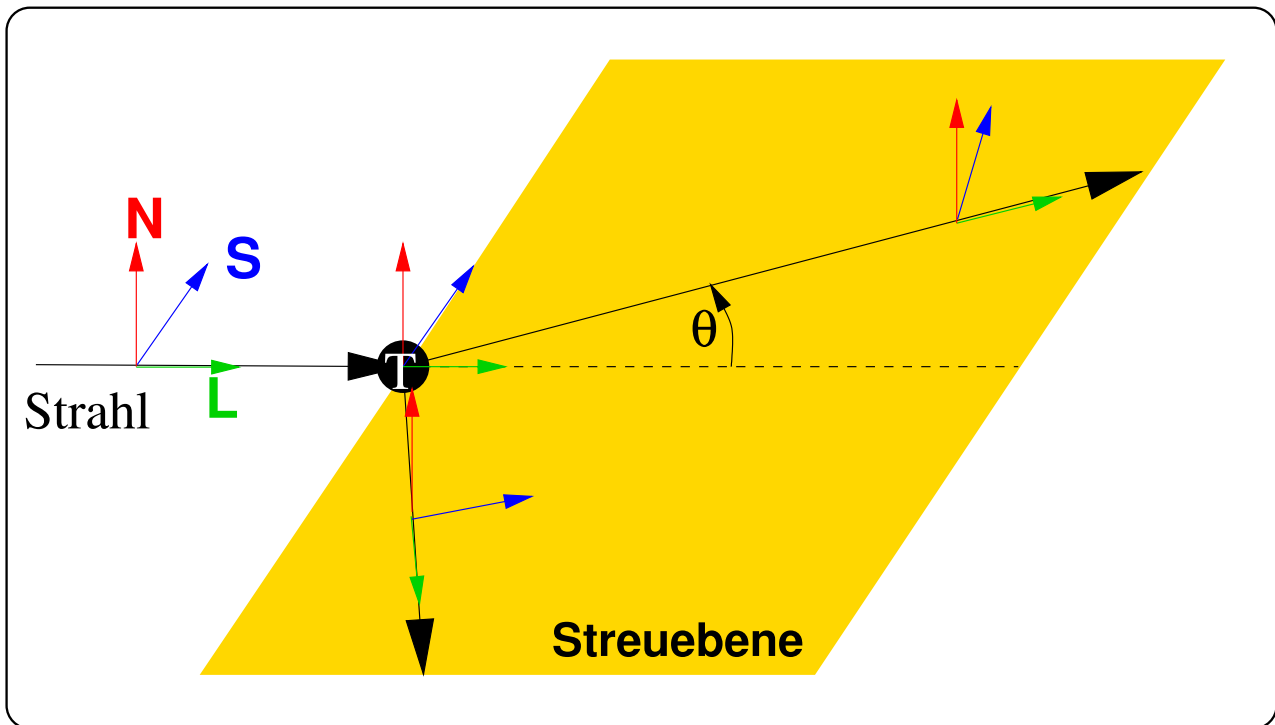
für die EDDA-Kollaboration

(Bonn, Hamburg, Jülich)

$$\vec{p} \vec{p} \rightarrow p p \quad T_p = 0.5 \dots 2.5 \text{ GeV}$$

$$\frac{d\sigma}{d\Omega} \quad A_N$$

$$A_{NN} \quad A_{SS} \quad A_{SL}$$



## Phasenanalyse (PSA)

- Partialwellenzerlegung

$$S_J = e^{2i\delta_J} ; \quad \vec{J} = \vec{L} + \vec{S}$$

- Physikalische Randbedingungen

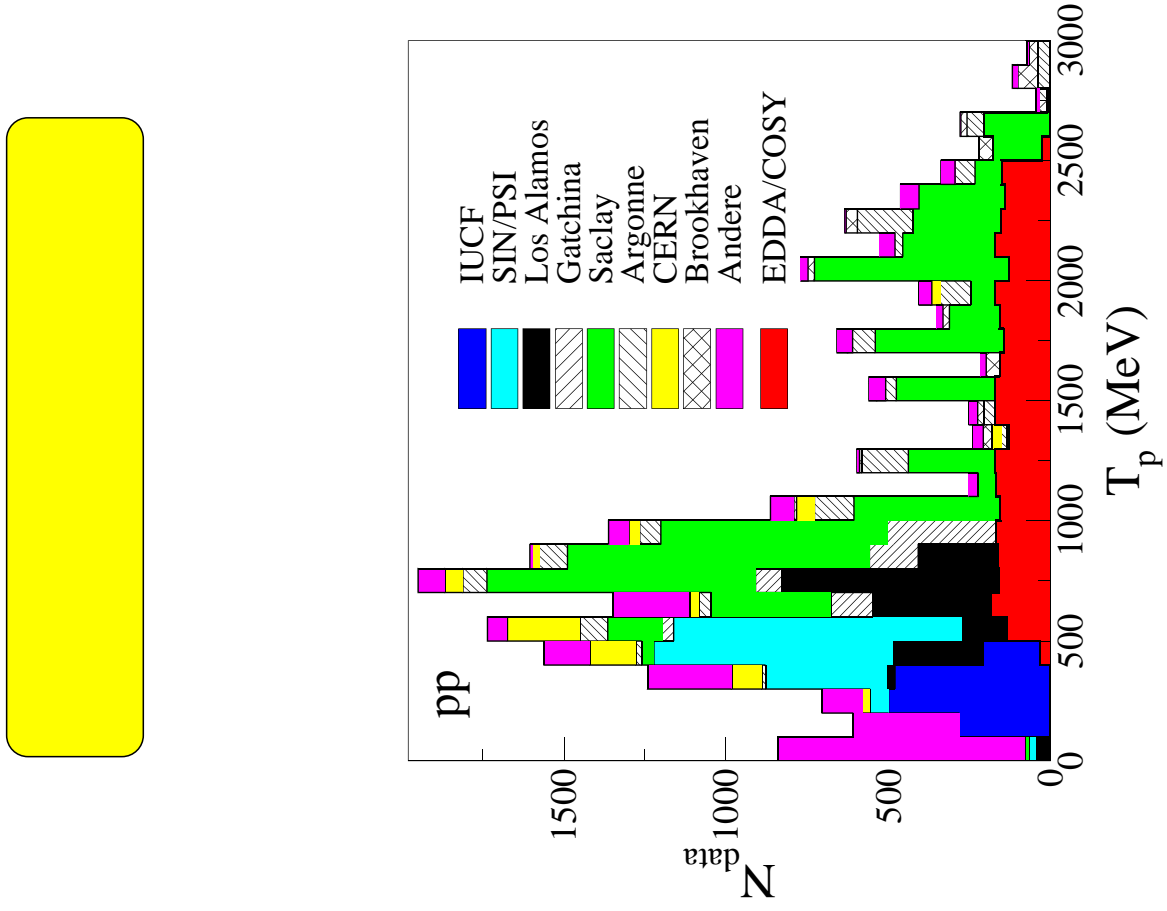
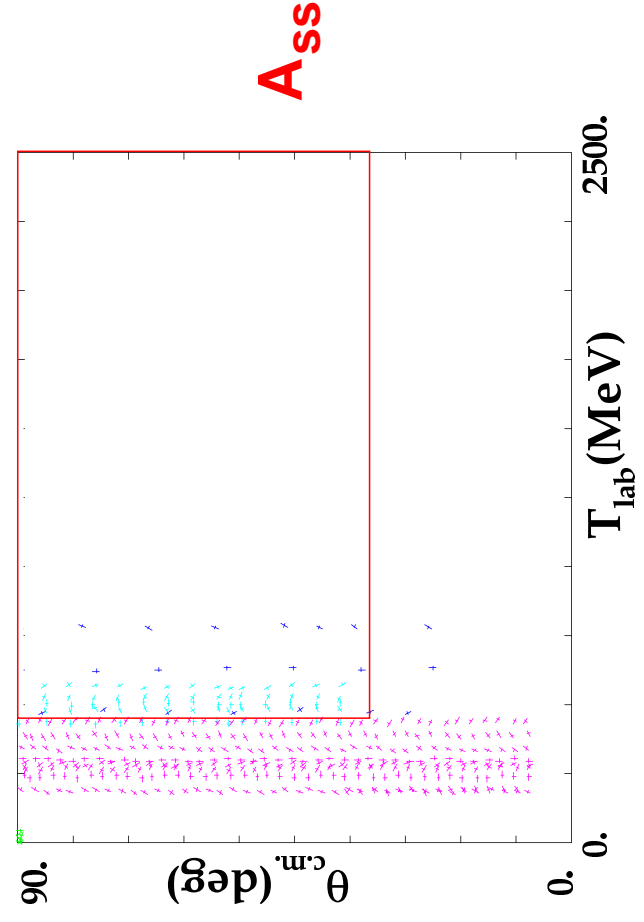
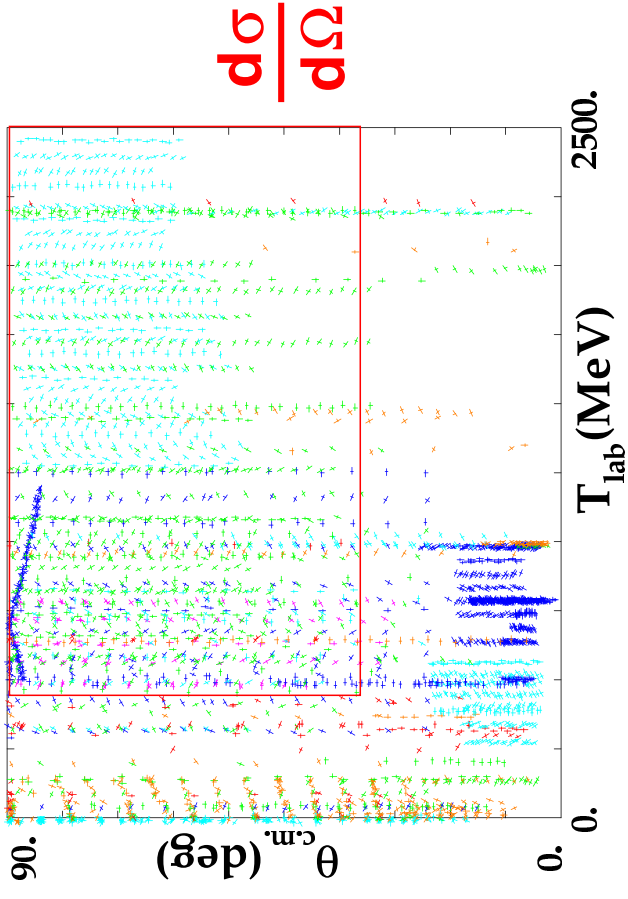
z.B.:  $L > L_{\max}$  : OPE

➔ Vorhersagekraft !!

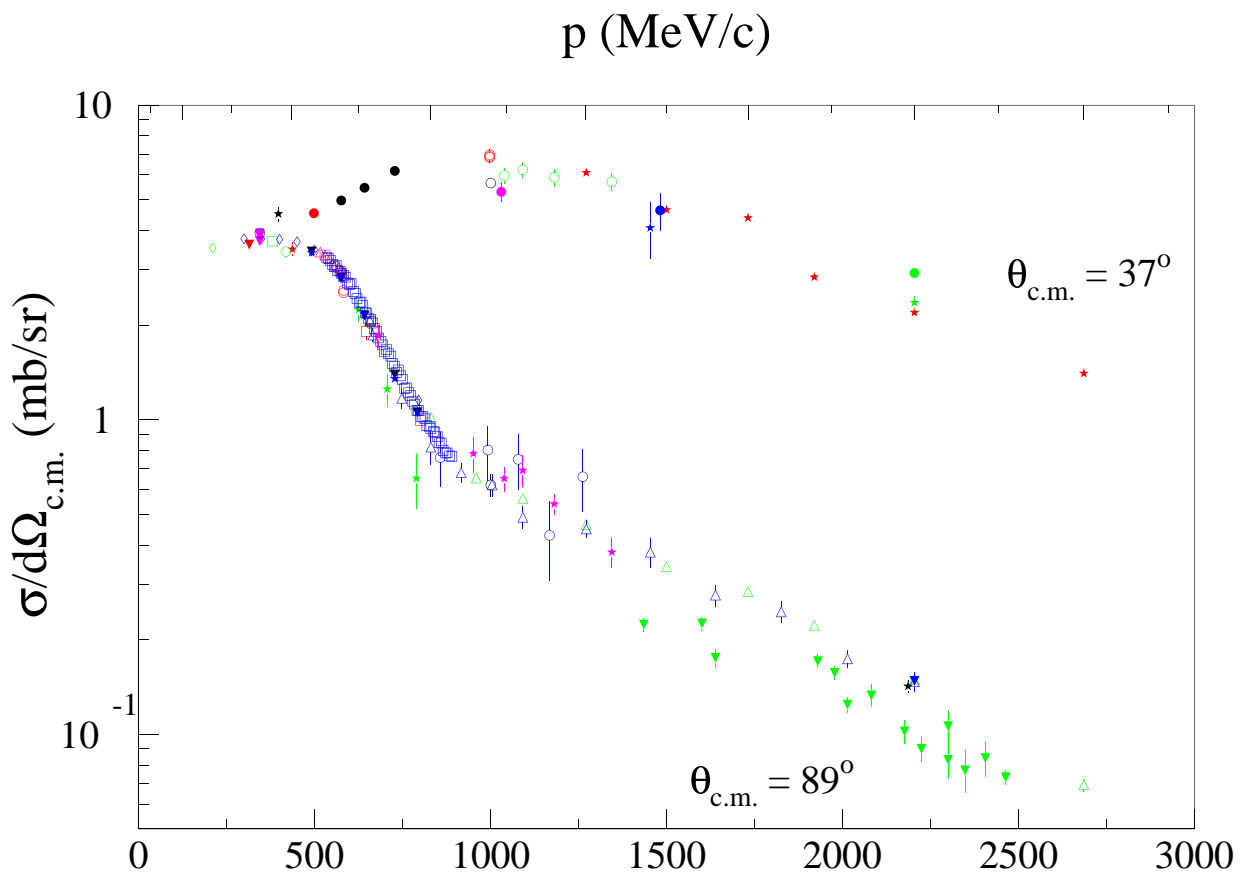
z.B. VPI (SAID) R. Arndt et al.

$T_p \in 0-3 \text{ GeV} :$       23000 / 12000 pp / np Daten

↔ Theorie

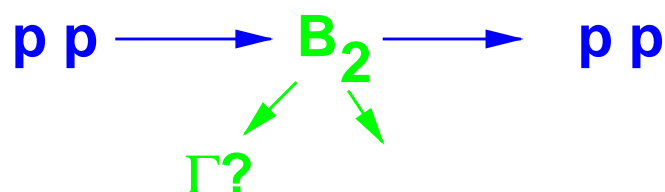


# Motivation



## Anforderungen:

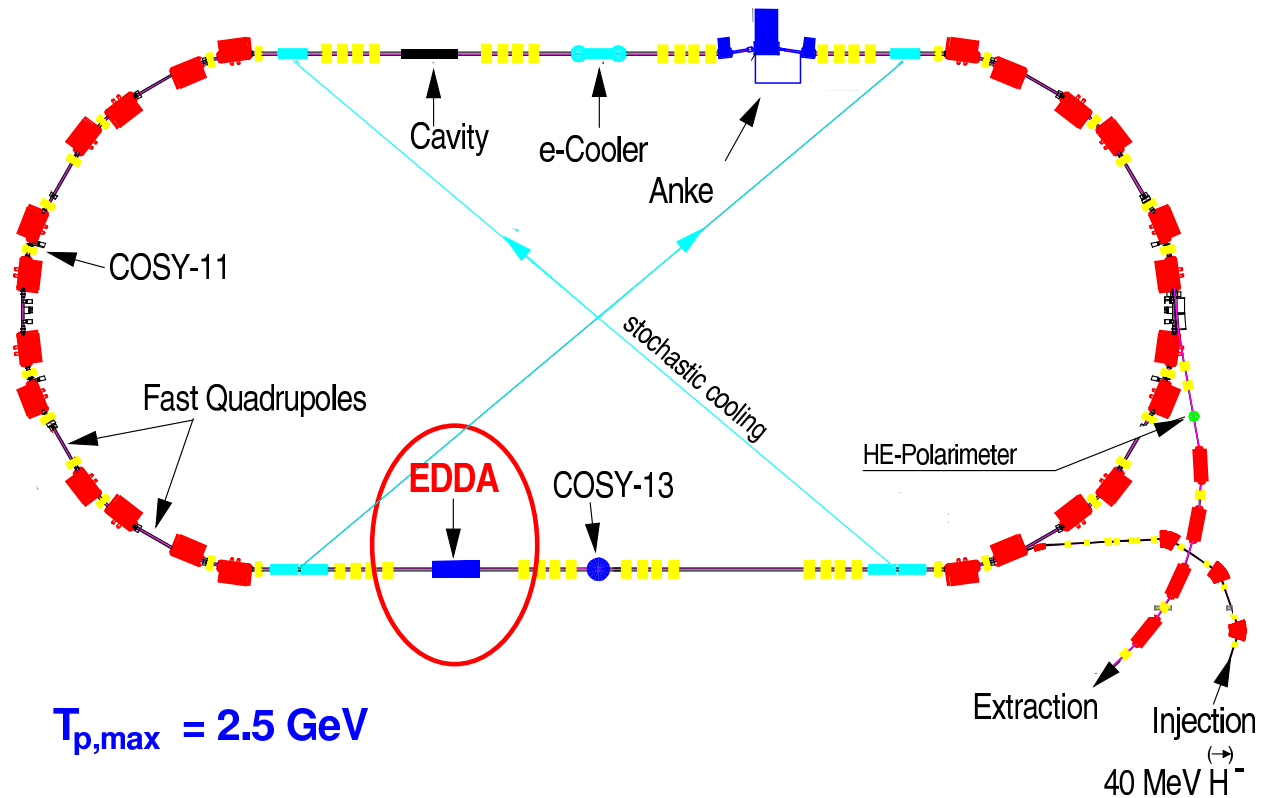
- Statistik
- Konsistenz
- Spin Observablen
- Kleine Energieschritte





# Experimentelle Technik

## ● COSY@JÜLICH



## ● Internes Experiment

$p + CH_2$ Fädchen	→	$\frac{d\sigma}{d\Omega}$	✓
$p + \vec{p}$ Atomstrahl	→	$A_N$	✓
$\vec{p} + \vec{p}$ Atomstrahl	→	$A_{NN}$ $A_{SS}$ $A_{SL}$ (✓)	

## ● Anregungsfunktionen

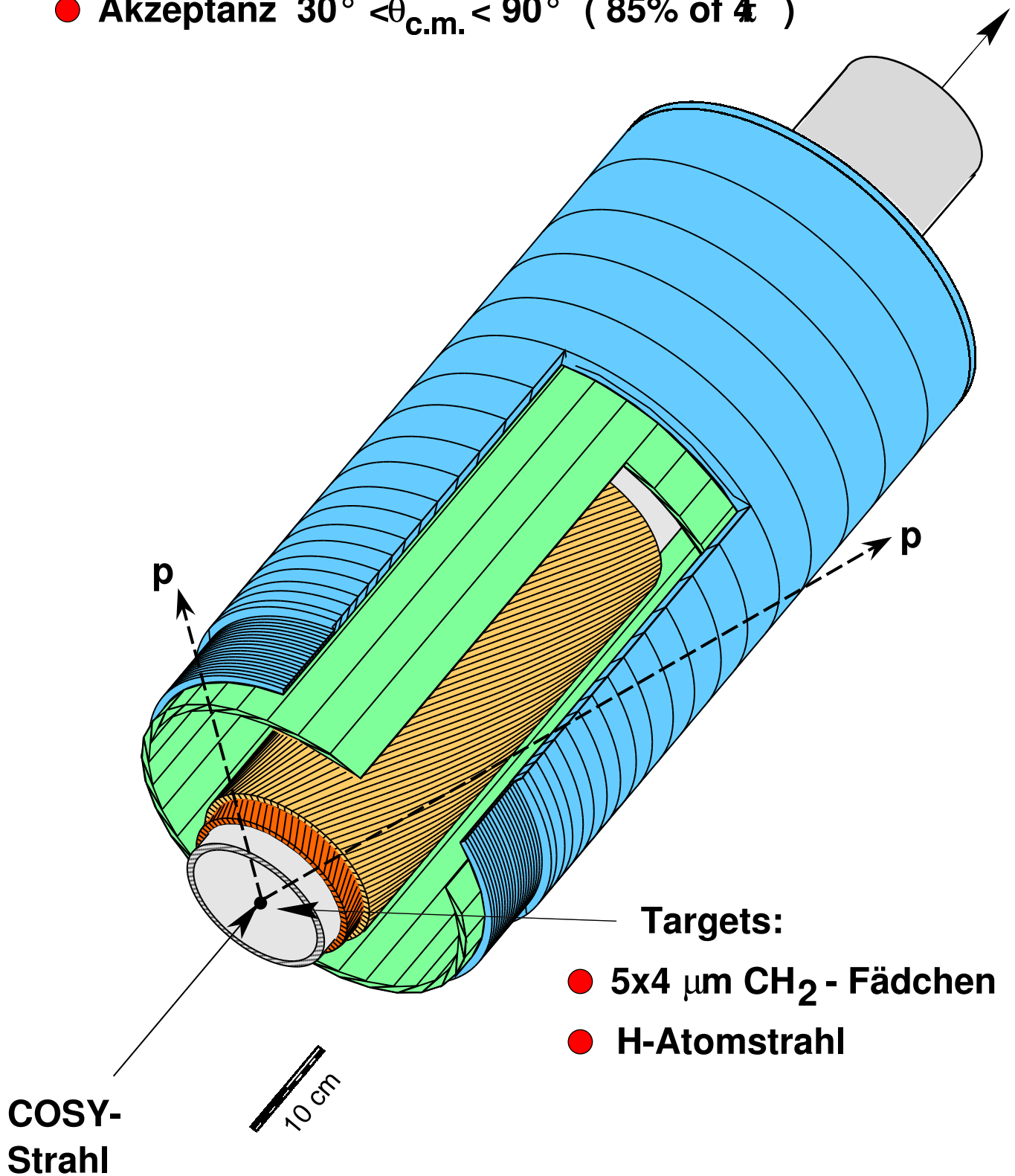
DAQ während Beschleunigung / ( Abbremsen )

$T_p = 300 \dots 2500 \text{ MeV}$  in 2 s

# EDDA@COSY: Detector

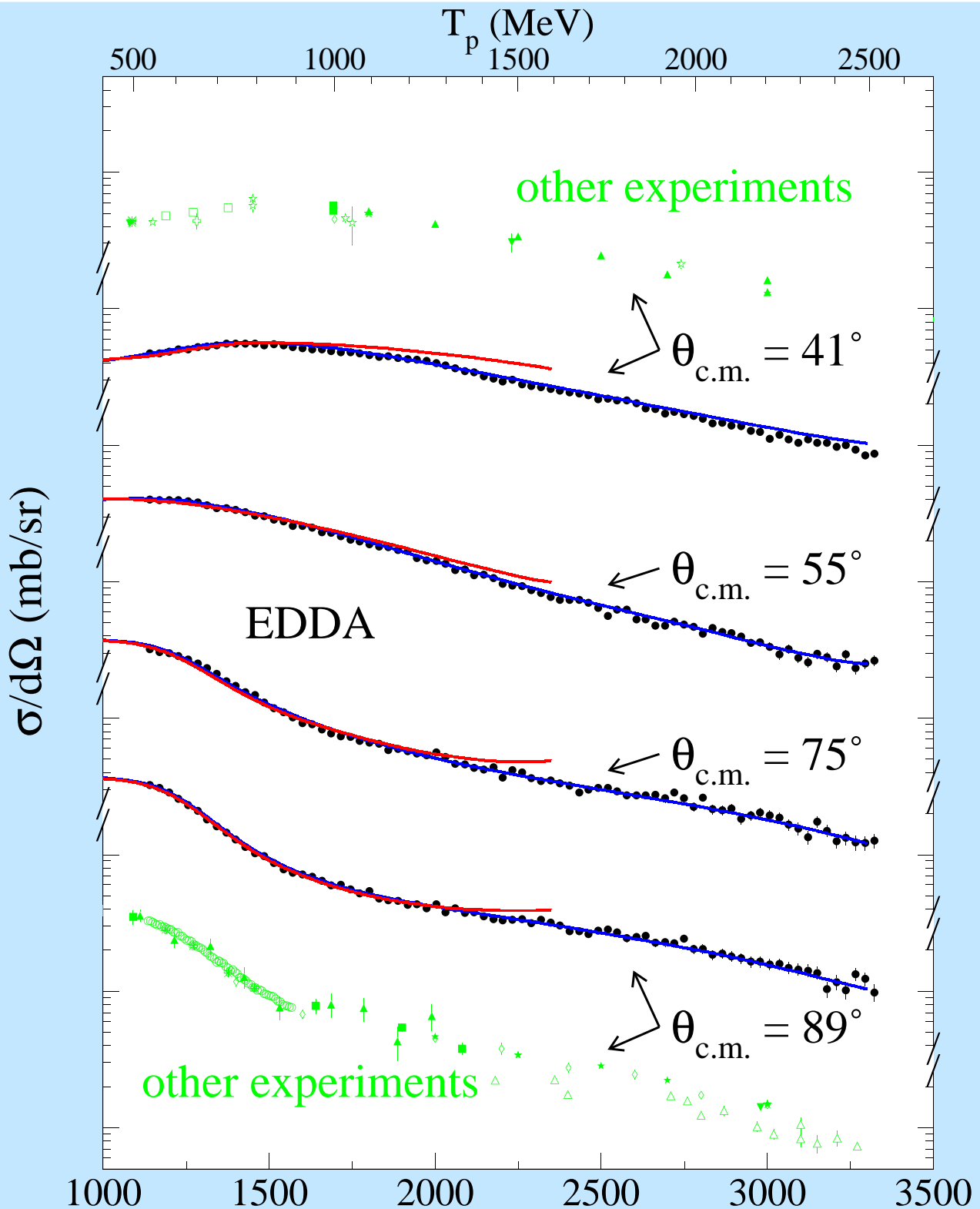
Bonn, Hamburg, Jülich

- Akzeptanz  $30^\circ < \theta_{\text{c.m.}} < 90^\circ$  ( 85% of  $4\pi$  )



# EDDA Results: $\frac{d\sigma}{d\Omega}$

D.Albers et al. *Phys. Rev. Lett.* **78**, 1652 (1997)



**SAID PSA: SM94, SM97**

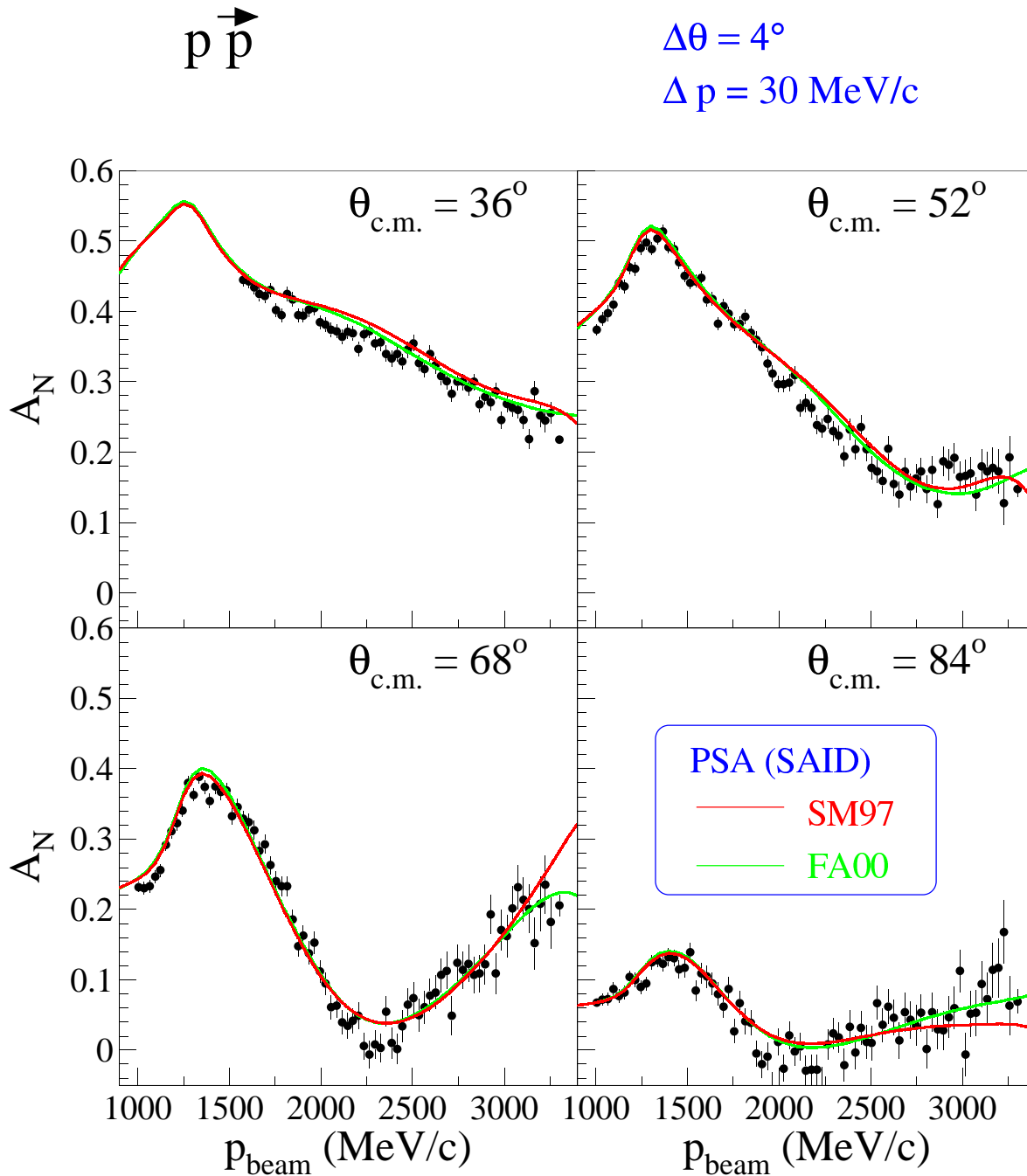
# Results: Analyzing Power

M. Altmeier et al. *Phys. Rev. Lett.* **85**, 1819 (2000)

$25 \times 10^6$  Events

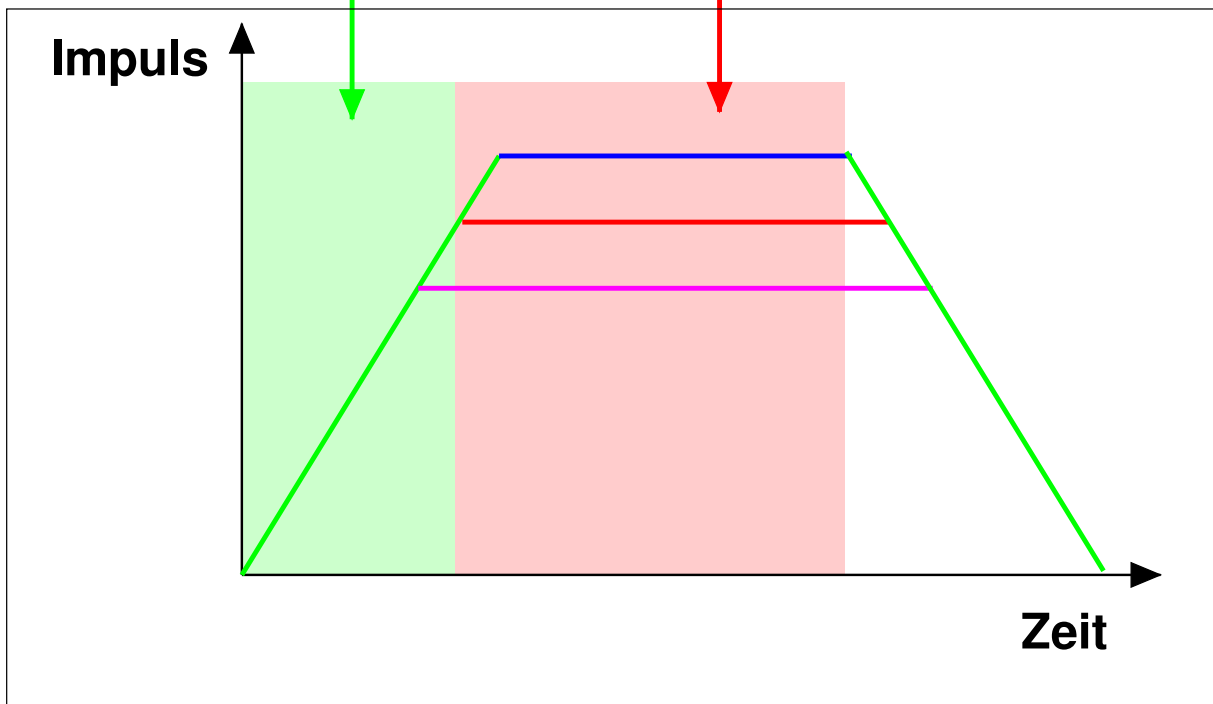
$\Delta\theta = 4^\circ$

$\Delta p = 30$  MeV/c



## Messungen mit $\vec{p}$ $\vec{p}$

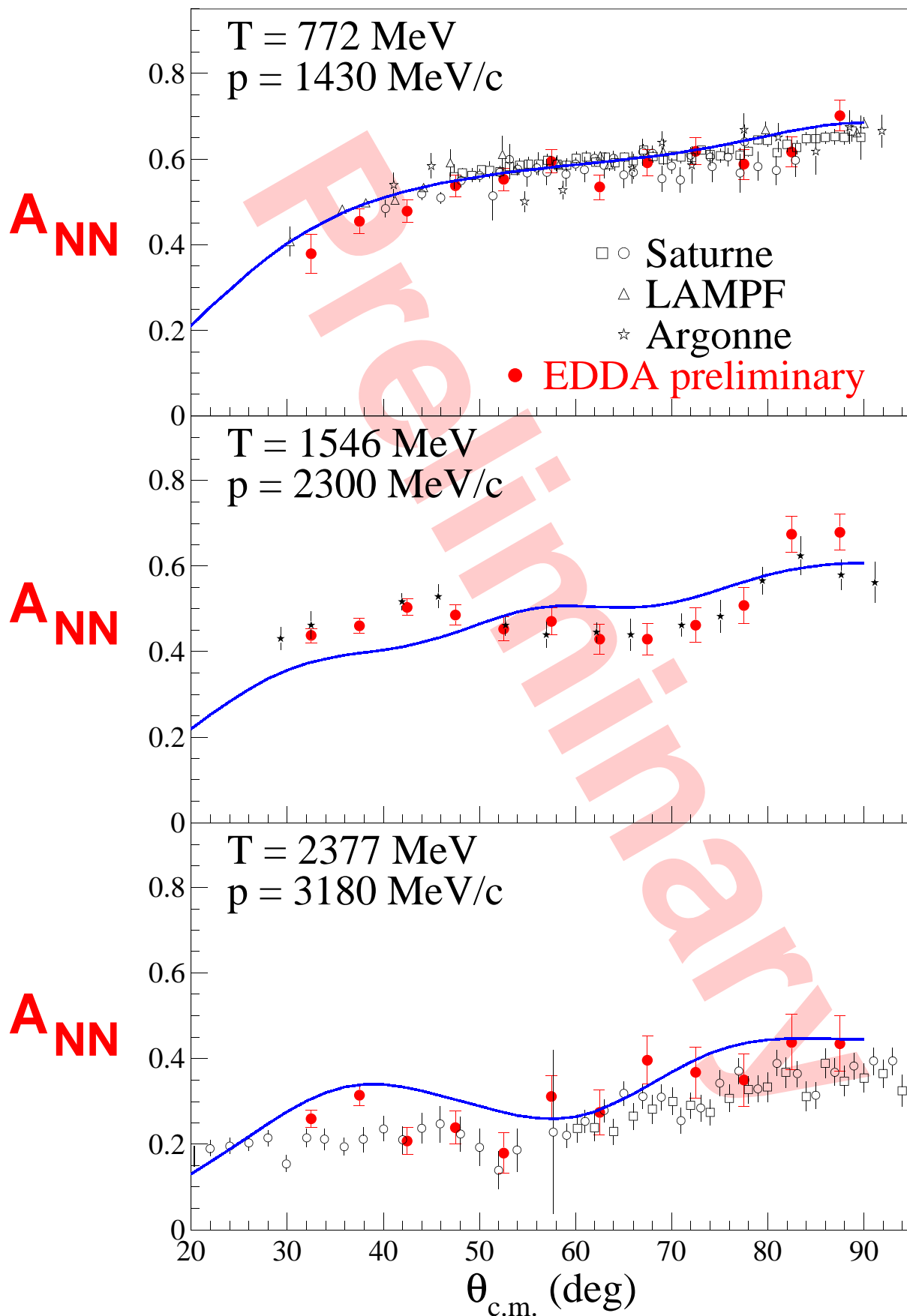
während der Beschleunigung  
und im Flattop



Spineinstellungen: Strahl (p) + Target(q)

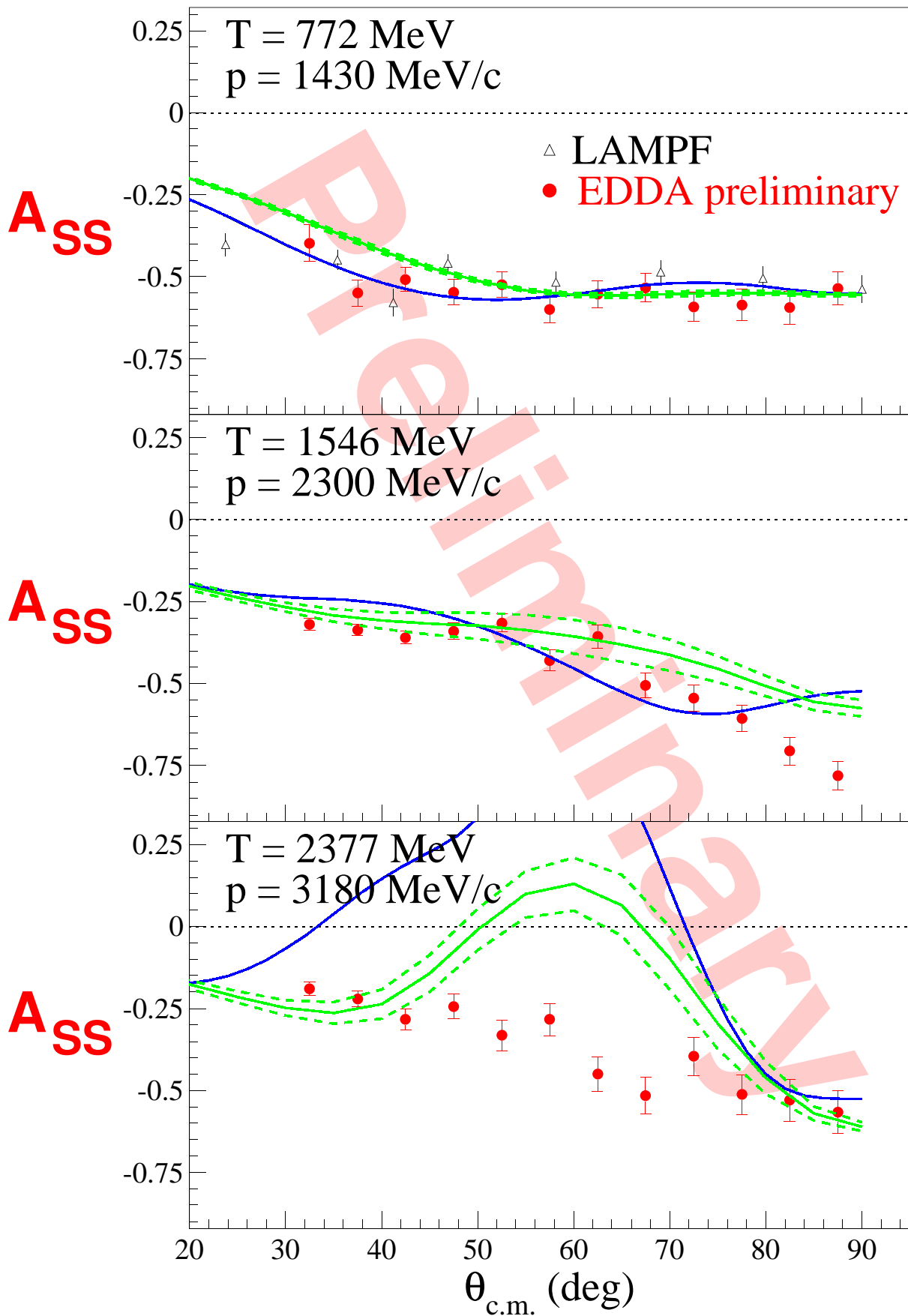
$$\begin{aligned} \frac{\sigma}{\sigma_0}(\phi) = & 1 + A_N \{ (p_y + q_y) \cos \phi + q_x \sin \phi \} \\ & + A_{NN} \{ p_y q_y \cos^2 \phi - q_x p_y \sin \phi \cos \phi \} \\ & + A_{SS} \{ p_y q_y \sin^2 \phi + q_x p_y \sin \phi \cos \phi \} \\ & + A_{SL} p_y q_z \cos \phi \end{aligned}$$

# Spinkorrelationsparameter

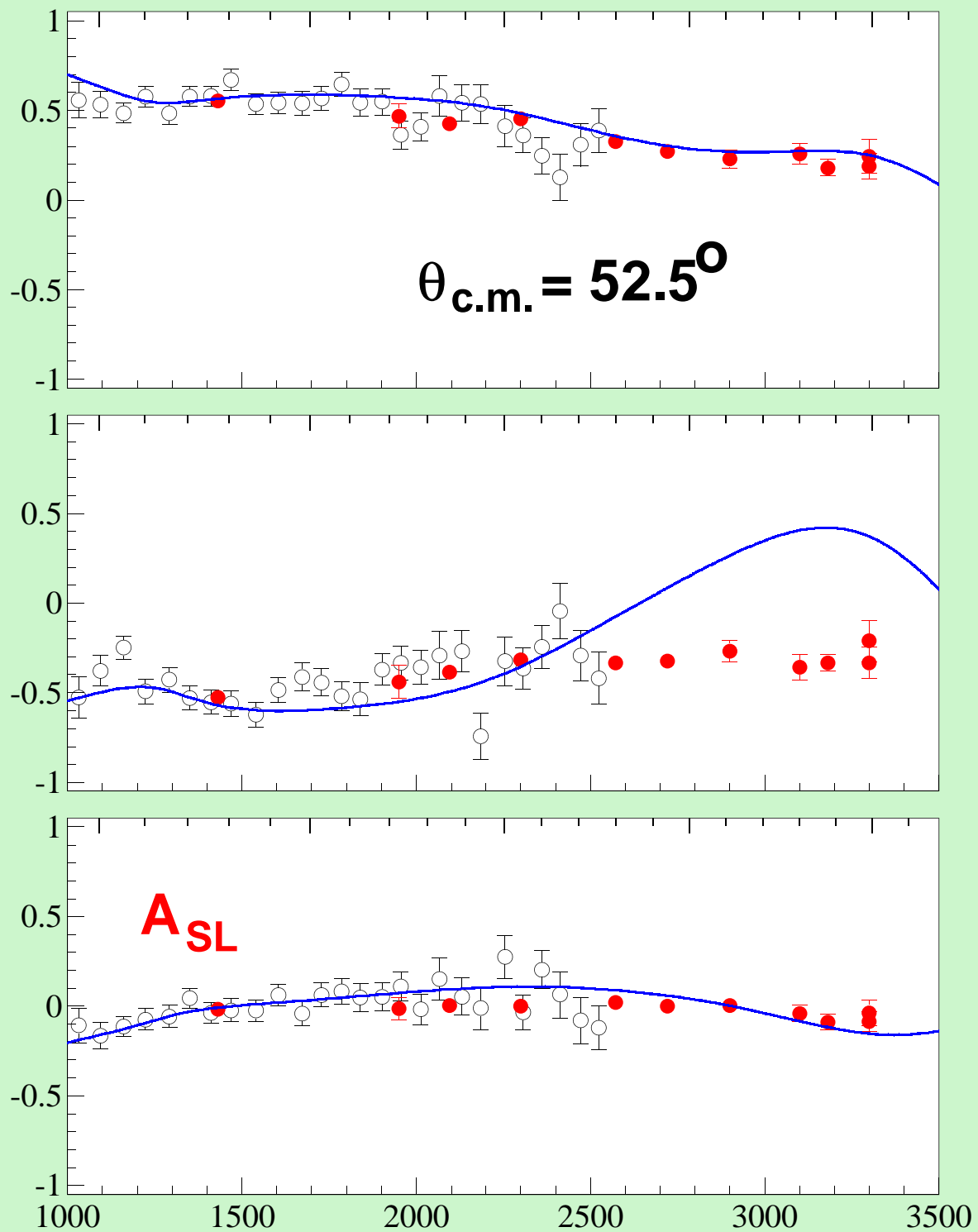


PSA: SAID(SM00)

# Spinkorrelationsparameter



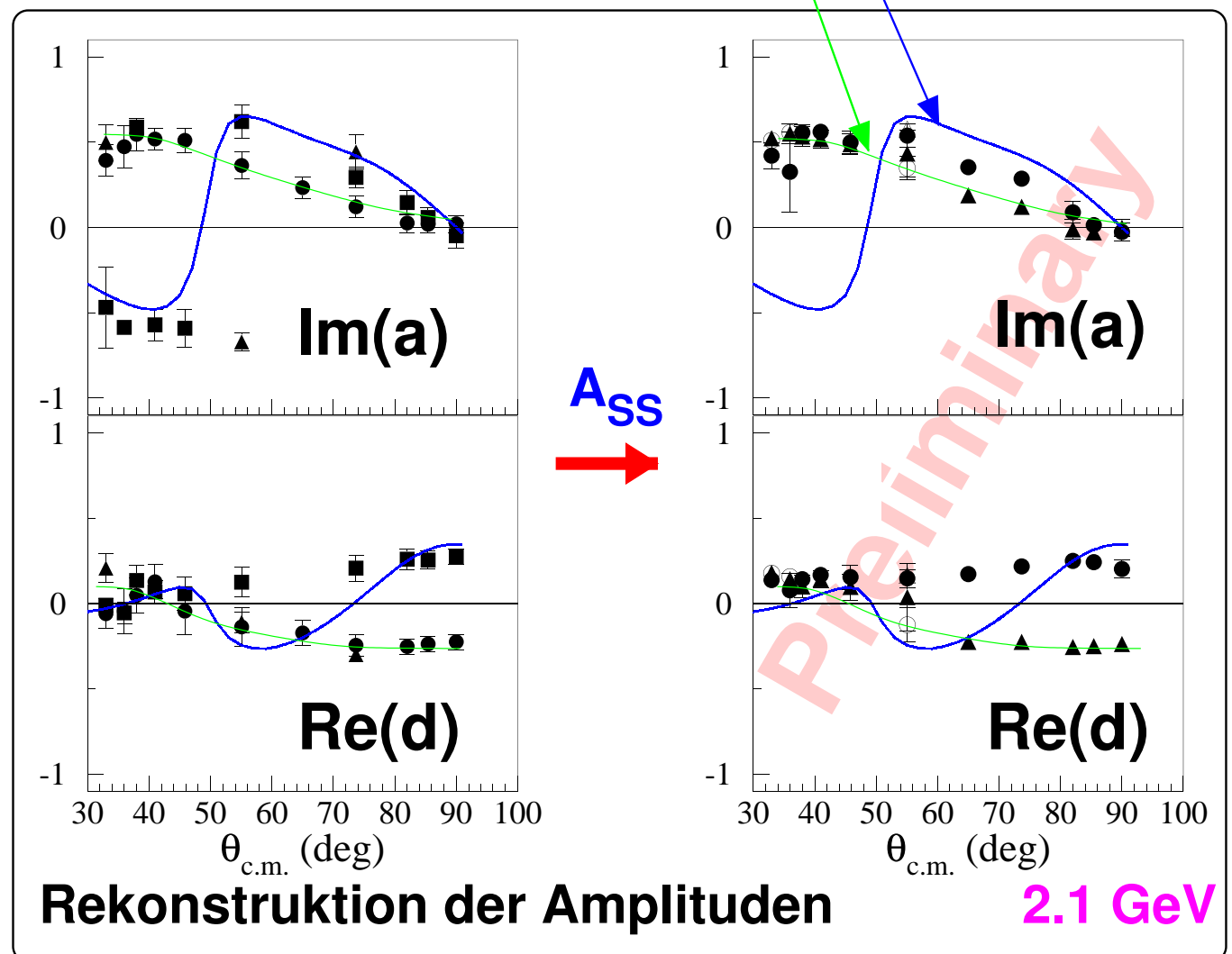
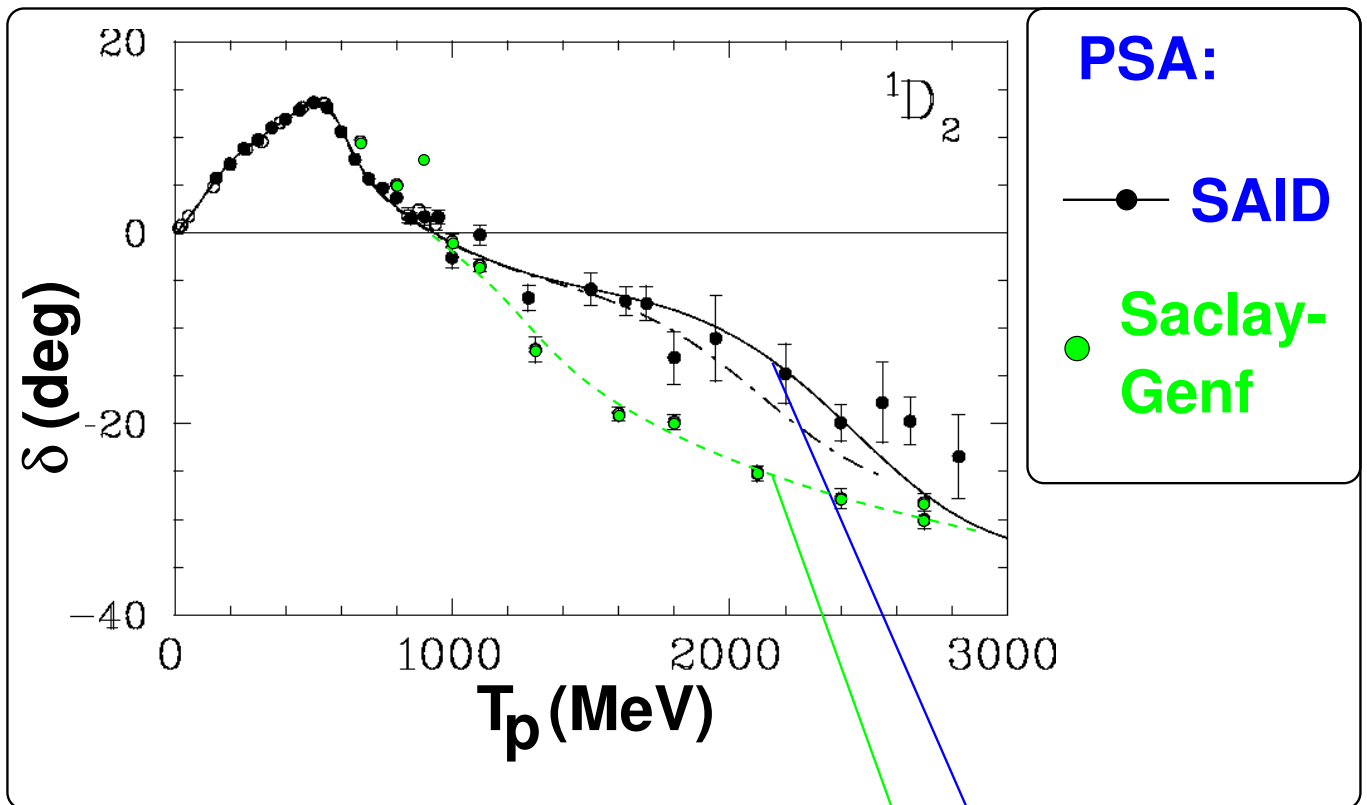
PSA: **SAID(SM00)** **Saclay-Genf**



— PSA (SAID SM00)



# Ambiguitäten in Streuphasen



# Dibaryonen

- farbneutrale Zustände:

	Baryonen	Mesonen	
Warum nur	$q q q$	$q \bar{q}$	beobachtet
und nicht	$q q q q \bar{q}$ $q q q q q q$	$q q \bar{q} \bar{q}$	??

- Viele theoretische Vorhersagen !  
für  $l=1$  ,  $S=0$  :  $W_R \approx 2.1 \dots 2.7 \text{ GeV}$   
 $\Gamma = 10 \dots 150 \text{ MeV}$

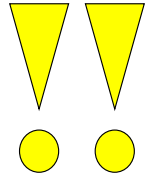
keine experimentelle Evidenz !

- bekannte Strukturen:

$$\begin{array}{lcl}
 {}^1D_2(2170) & \Gamma \approx 80 \text{ MeV} & \\
 {}^3F_3(2250) & \Gamma \approx 150 \text{ MeV} & \\
 \end{array}
 \left. \vphantom{\begin{array}{l} {}^1D_2(2170) \\ {}^3F_3(2250) \end{array}} \right\} N\Delta \text{ Schwelle/Resonanz}
 \begin{array}{l}
 {}^5S_2 \\
 {}^5P_3
 \end{array}$$

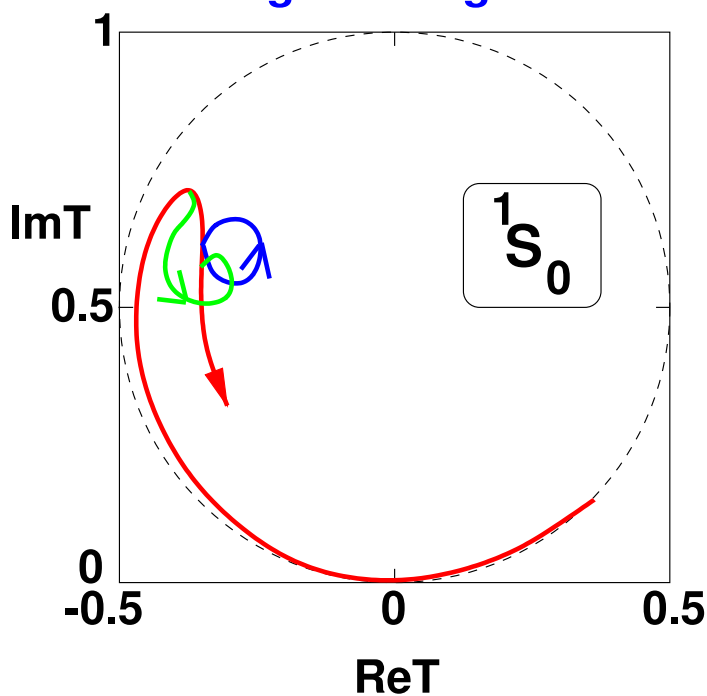
# Dibaryonen?

## ● KEINE EVIDENZ

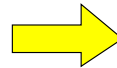


## ● OBERE GRENZEN ?

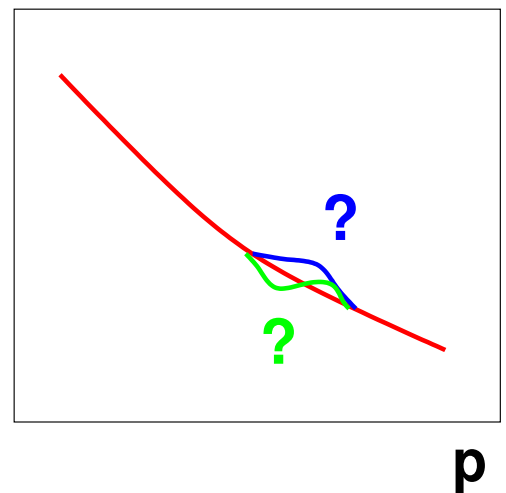
Argand-Diagramm



$$\frac{d\sigma}{d\Omega}$$



Observable



$$S_{LJ} = \eta'_{LJ} e^{2i\delta'_{LJ}} = e^{2i\delta_{LJ}} \left( \eta_{LJ} - \frac{i \Gamma \eta_{el} e^{2i\phi}}{W - W_R + i \Gamma/2} \right)$$

Ziel: für jedes ( $W_R, \Gamma$ ), finde obere Grenze für

$$\eta_{el} = \Gamma_{el} / \Gamma$$

# Obere Grenzen für $\Gamma_{\text{el}} / \Gamma_{\text{tot}}$

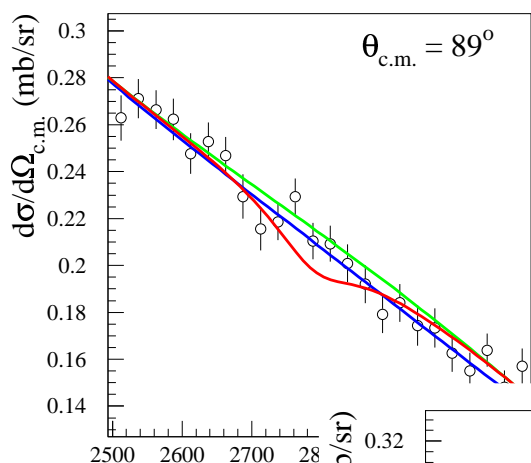
Beispiel:

$^1S_0$

$W_R = 2700 \text{ MeV}$

$\Gamma_{\text{tot}} = 50 \text{ MeV}$

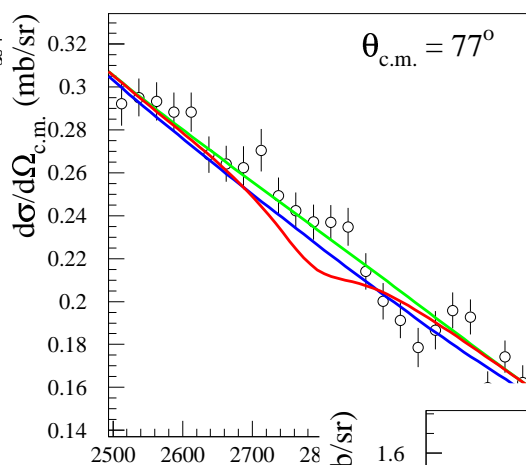
$\phi = -60^\circ$



— PSA

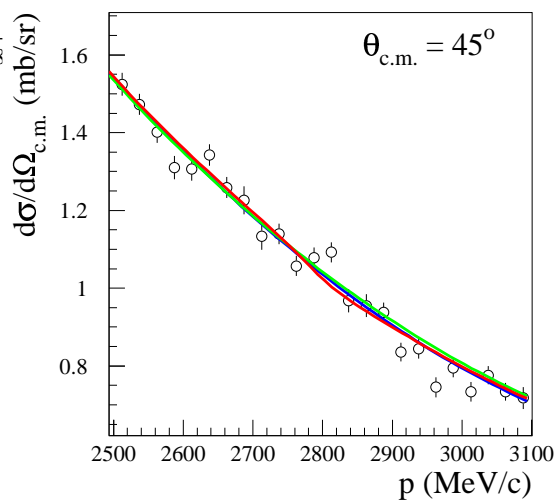
— PSA' + Resonanz

— PSA'



$\frac{d\sigma}{d\Omega}$

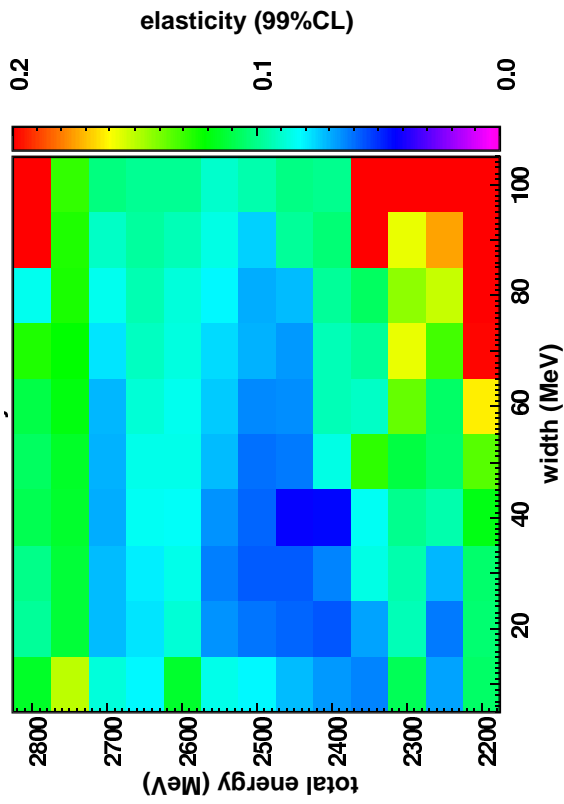
Impuls



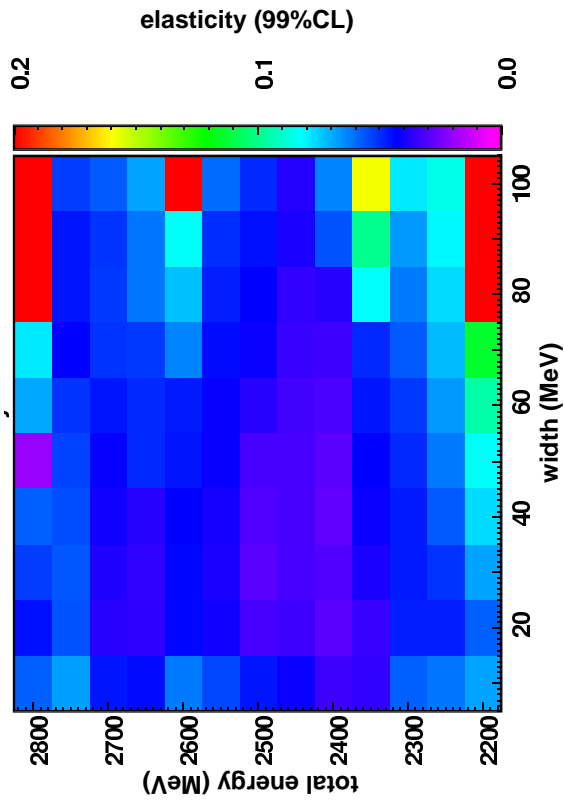
➡  $\eta_{\text{el}} = \Gamma_{\text{el}} / \Gamma_{\text{tot}} < 0.07 ; \quad 99\% \text{ CL}$

UPPER LIMITS  $\eta = \Gamma_{\text{el}} / \Gamma_{\text{tot}}$

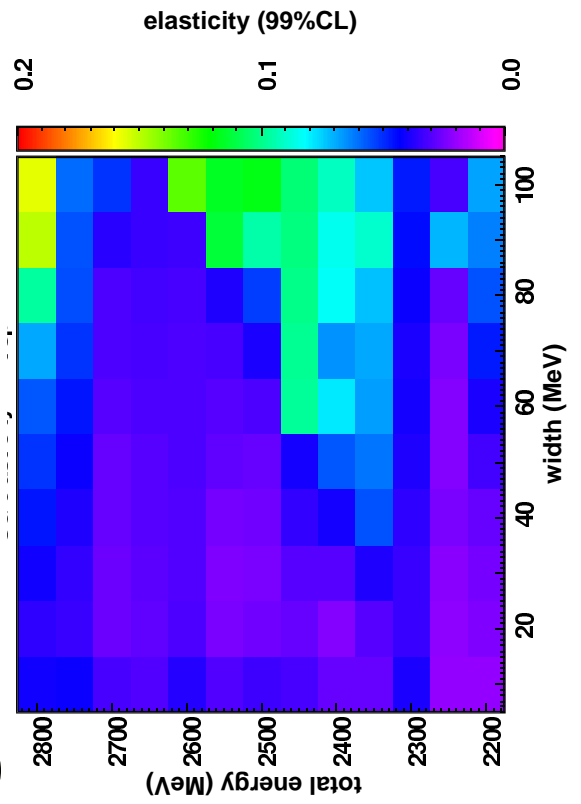
$1S_0$



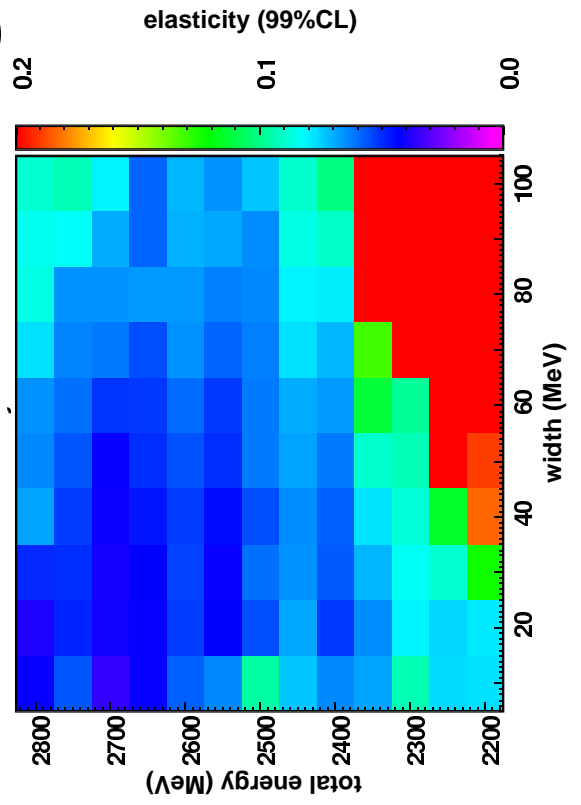
$1D_2$



$3P_1$



$3F_3$



**obere Grenzen für  $\eta_{\text{el}} = \Gamma_{\text{el}} / \Gamma_{\text{tot}}$  ( 99% CL )**

$$W_R = 2.2 \dots 2.8 \text{ GeV}$$

$$\Gamma = 10 \dots 100 \text{ MeV}$$

$$\eta_{\text{el}} > 0.09 \quad ({}^1S_0)$$

$$0.05 \quad ({}^1D_2)$$

$$0.10 \quad ({}^3P_0)$$

$$0.03 \quad ({}^3P_1)$$

$$0.06 \quad ({}^3F_3)$$

**mit 99%**

**Wahrscheinlichkeit  
ausgeschlossen**

# Zusammenfassung

- Anregungsfunktionen  $\frac{d\sigma}{d\Omega}$ ,  $A_N$

➡ PSA

➡ Test auf resonante Beiträge

$$W_R = 2.2 \dots 2.8 \text{ GeV}, \Gamma = 10 \dots 100 \text{ MeV}$$

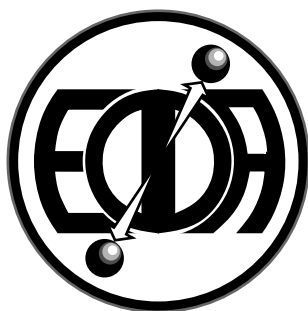
$\eta_{el} > 3..10\%$  ausgeschlossen

- Spinkorrelationsparameter

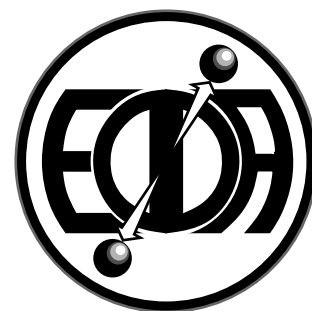
$$A_{NN} \quad \underline{A_{SS}} \quad A_{SL}$$

➡ Verringerung von Ambiguitäten

➡ PSA ?



# The EDDA Collaboration



Spokesmen: J. Bisplinghoff, F. Hinterberger and W. Scobel,

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