

Photoproduction Data

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Observables in meson photoproduction

- single polarization: σ_0, Σ, T, P
- beam-target: H, G, F, E
- beam-recoil: O_x, O_z, C_x, C_z

beam		Target			Recoil		
		x	y	z	x'	y'	z'
unpolarized	σ_0	-	T	-	-	P	-
linear	Σ	H	$-P$	G	O_x	$-T$	O_z
circular	-	F	-	E	C_x	-	C_z

Figure of Merit :

$$FoM \sim \frac{1}{T_{meas}}$$

Hierarchy of precision - Figure of Merit

- For cross section σ_0 :

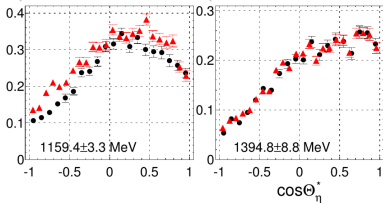
$$FoM = N_0 = \sigma_0 \cdot l_\gamma \cdot n_T \cdot \epsilon$$

Hierarchy of precision - Figure of Merit

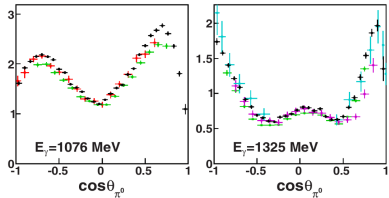
- For cross section σ_0 :

$$FoM = N_0 = \sigma_0 \cdot I_\gamma \cdot n_T \cdot \epsilon$$

$\gamma p \rightarrow \eta p$

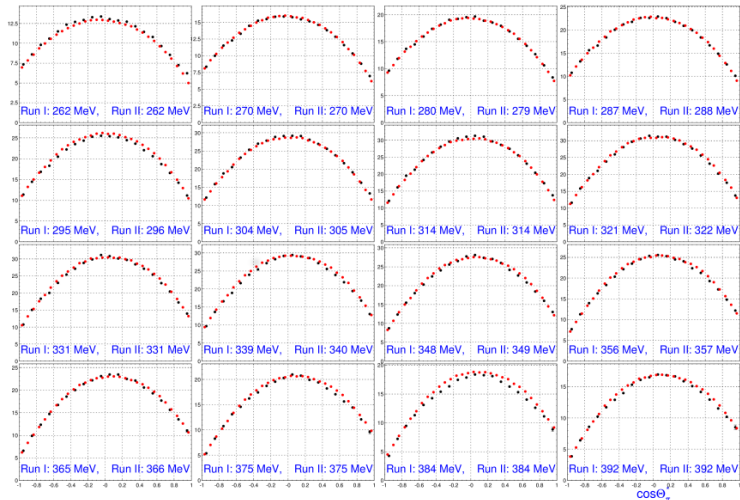


$\gamma p \rightarrow \pi^0 p$



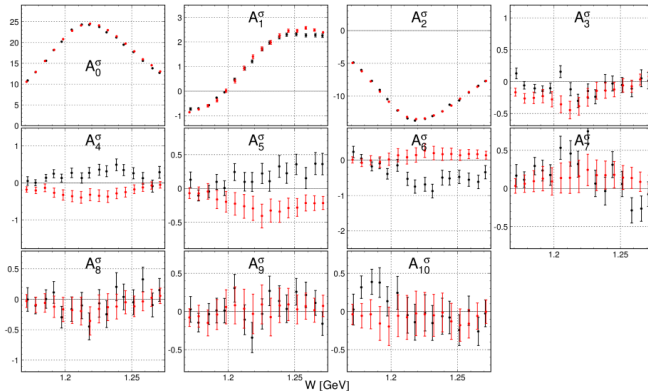
Systematics

$\gamma\rho \rightarrow \pi^0\rho$: cross section



Systematics

$\gamma\rho \rightarrow \pi^0\rho$: Legendre Coefficients



Hierarchy of precision - Figure of Merit

- For cross section σ_0 :

$$FoM = N_0 = \sigma_0 \cdot l_\gamma \cdot n_T \cdot \epsilon$$

- For asymmetries or polarization measurements

$$FoM = N_0 \cdot A^2 \cdot P^2 \cdot P_\gamma^2 \cdot \epsilon_A$$

A: physics asymmetry

$P \sim 0.6(0.2)$: target polarization (analyzing power)

$P_\gamma \sim 0.8 - 0.2$: beam polarization

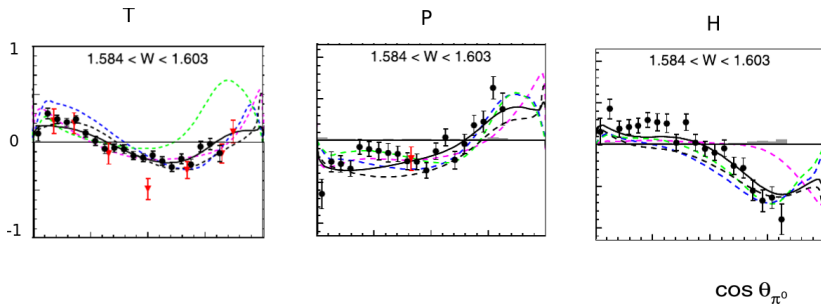
$\epsilon_A \sim 0.6 - 0.2$: additional effort (systematics, background, energy range)

Figures of Merit

	$P \cdot P_\gamma$	ϵ_A	FoM
σ_0			1
T	0.6	0.5	0.2
F, E	$0.6 \cdot 0.8 -$ $0.6 \cdot 0.2$	0.6	0.12 - 0.015
P (as BT) G, H	$0.6 \cdot 0.5$	$0.6 \cdot 0.3$	0.015
P	0.2	0.05	0.002
C_x, C_z	$0.2 \cdot 0.8$	0.05	<0.001

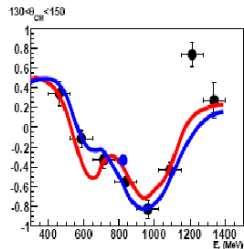
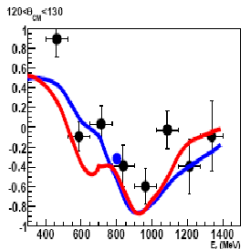
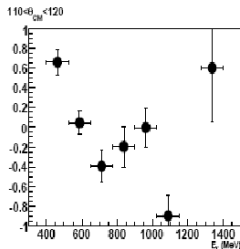
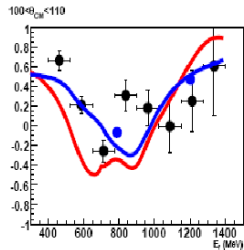
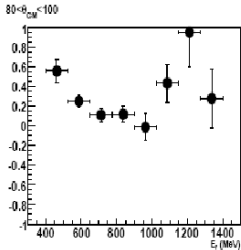
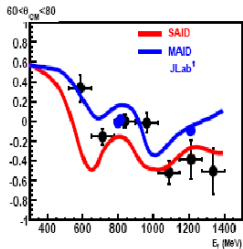
Target and beam-target asymmetries

$\gamma\rho \rightarrow \pi^0\rho$: CB-ELSA, J. Hartmann et al.



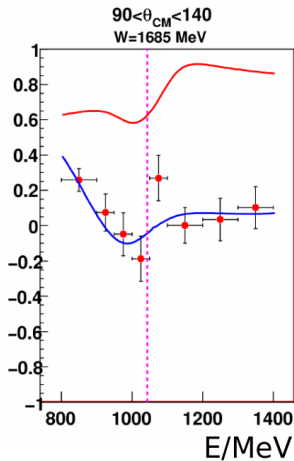
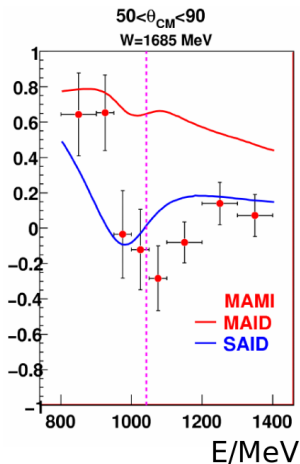
Beam-Recoil Polarization

$\gamma p \rightarrow \pi^0 p$: C_x from MAMI



Beam-Recoil Polarization

$\gamma p \rightarrow \eta p$: C_x from MAMI



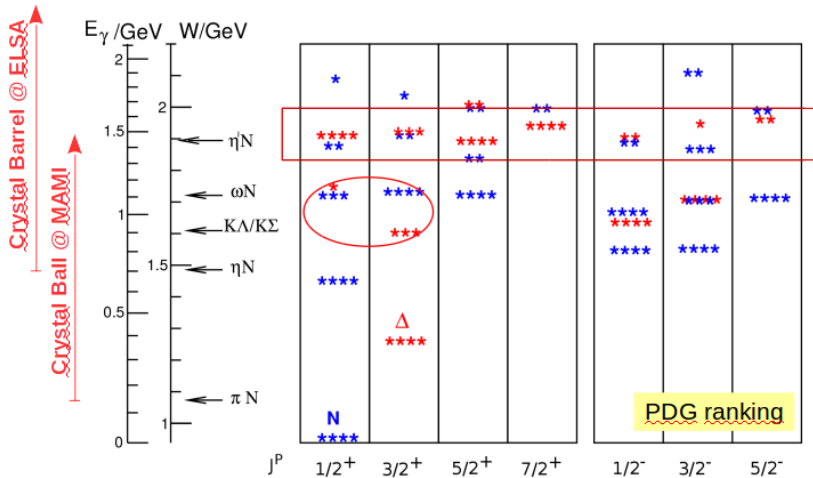
What next?

- **Proton:**

	$P \cdot P_\gamma$	ϵ_A	FoM
σ_0			1 (~ 400h)
T	0.6	0.5	0.2
F, E	$0.6 \cdot 0.8 - 0.6 \cdot 0.2$	0.6	0.12 - 0.015
C_x, C_z	$0.2 \cdot 0.8$	0.05	<0.001

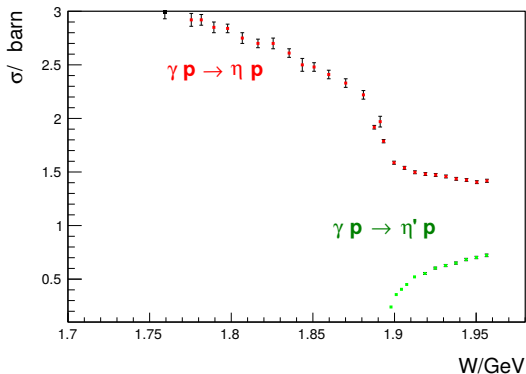
- **Neutron (Deuteron):** Another factor of ~ 0.2

Resonances



η and η' total cross sections

Total cross section from new MAMI data (2014):



What next?

Expected beamtime in 2016-2019:

3000 h @ ELSA

3000 h @ MAMI

- Scenario 1:
Re-measure all observables (p and n) and improve statistics by $\sim \sqrt{2} - 2$
- Scenario 2:
Concentrate on ~ 2 observable (e.g. T and F) and measure to the limit given by systematics.