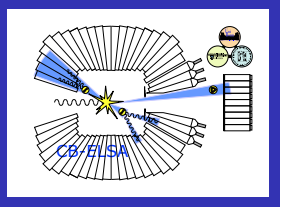
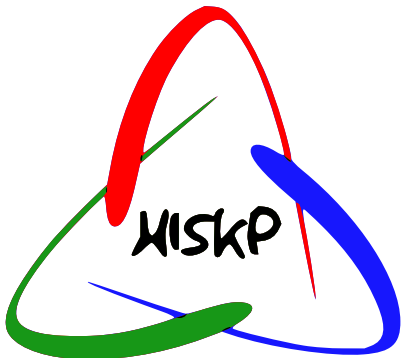


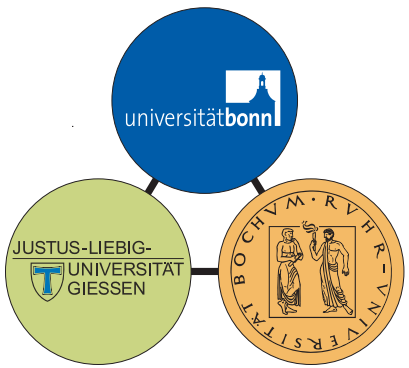
Measurement of the double polarisation observable E in the reactions $\vec{\gamma}\,\vec{p} \to p\eta$ and $\vec{\gamma}\,\vec{p} \to p\pi^0$

Jonas Müller

for the CBELSA/TAPS collaboration



Helmholtz-Institut für Strahlen- und Kernphysik



supported by SFB/TR16

13. June 2011

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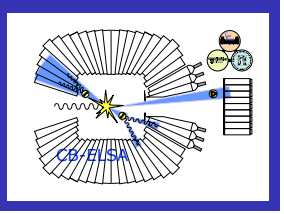
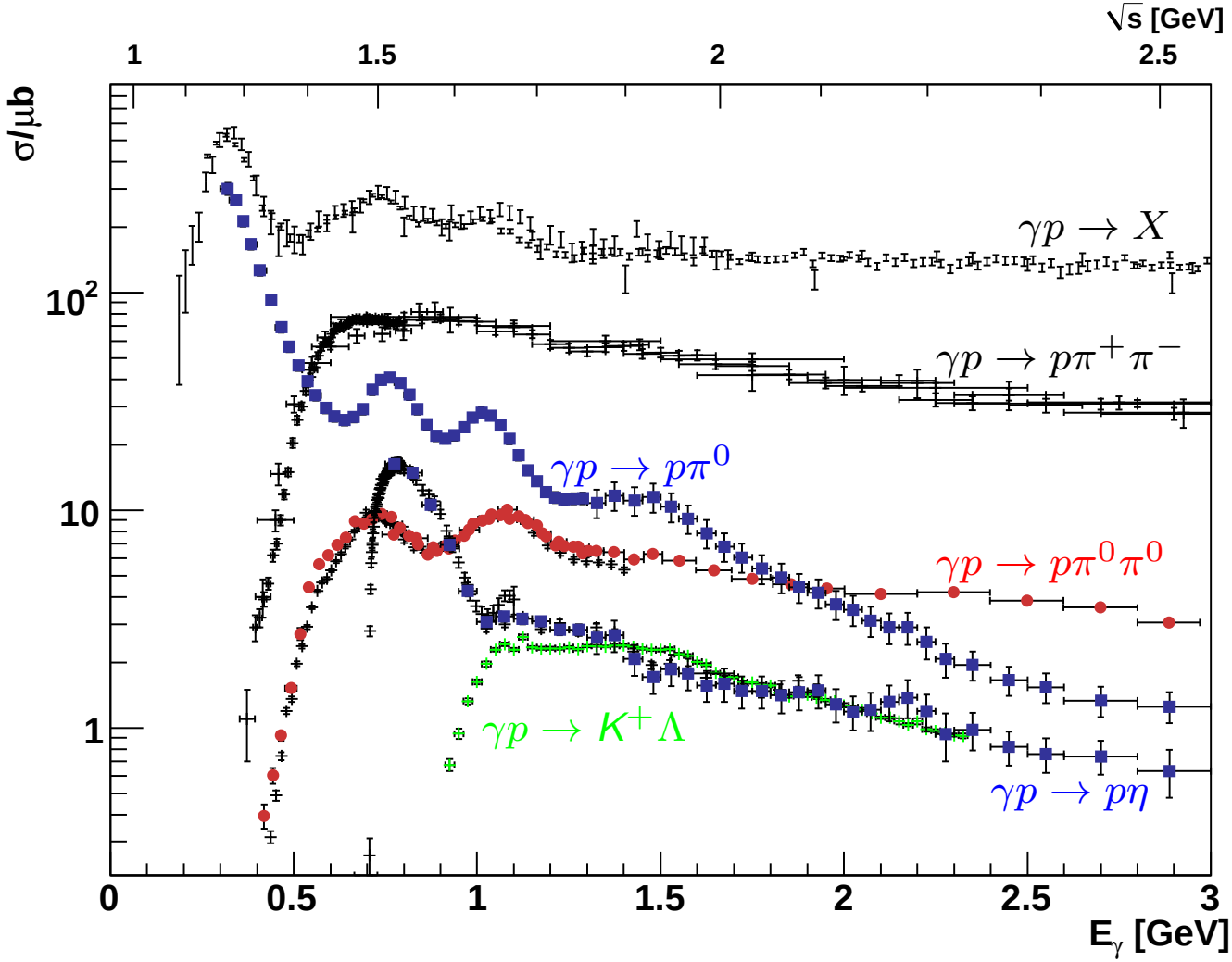
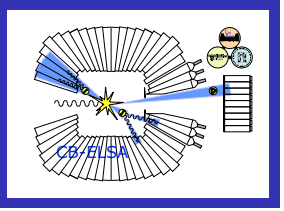


Baryon spectroscopy

With the CBELSA/TAPS experiment we want to understand the spectrum and properties of baryons.

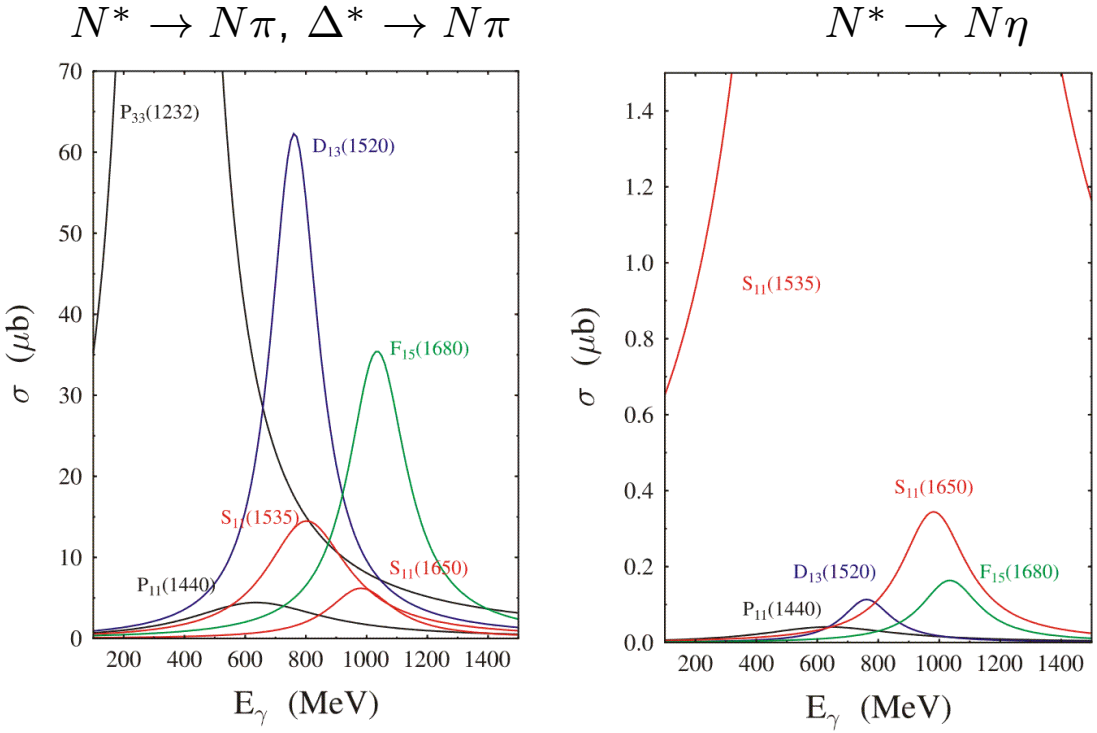




Baryon spectroscopy

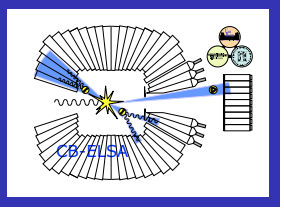
Experimentally:

Broad, overlapping resonances



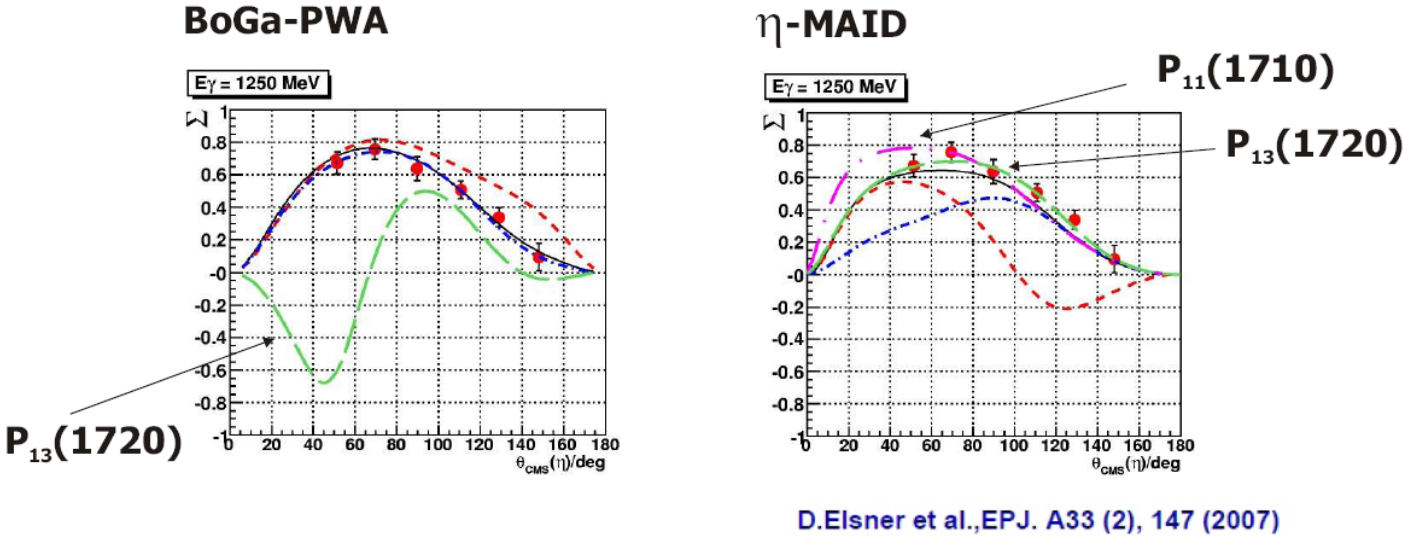
Important:

- Measurement of different final states
- Measurement of polarisation observables (unambigious PWA)



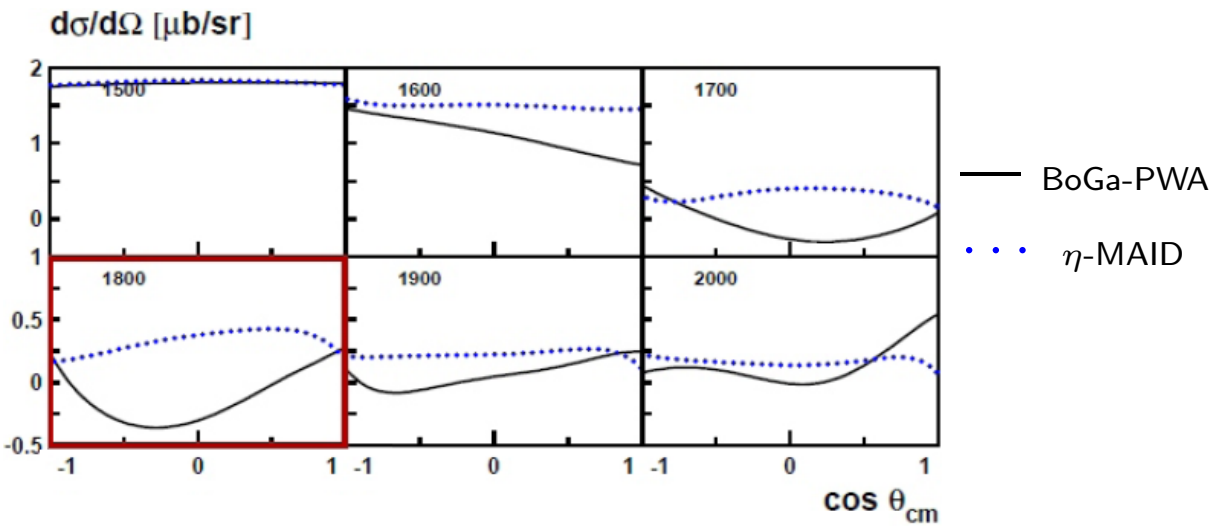
Polarisation observables

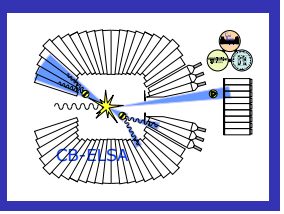
Beam asymmetry Σ in $\gamma p \to p\eta$



D.Elsner et al.,EPJ. A33 (2), 147 (2007)

Predictions for E in $\vec{\gamma}\,\vec{p} \to p\eta$



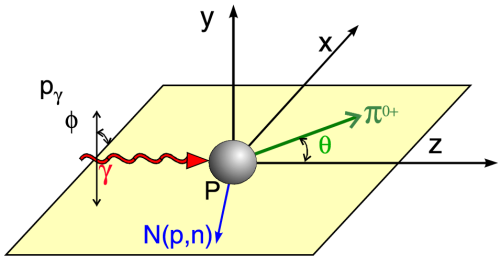


Polarisation observables

Single pseudoscalar meson photoproduction

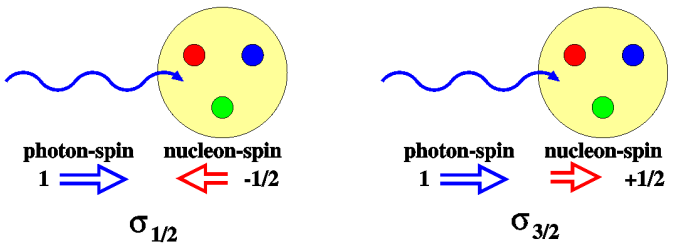
Complete experiment: 8 well chosen observables out of 16

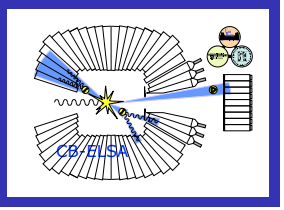
$$\frac{d\sigma}{d\Omega}(\theta,\phi) = \frac{d\sigma}{d\Omega}(\theta)\cdot\left[1 - p_\gamma^{lin}\,\Sigma(\theta)\cos(2\phi)\right.$$
$$+ p_x\cdot\left(-p_\gamma^{lin}\,H(\theta)\sin(2\phi) + p_\gamma^{circ}\,F(\theta)\right)$$
$$- p_y\cdot\left(+p_\gamma^{lin}\,P(\theta)\cos(2\phi) - T(\theta)\right)$$
$$\left. - p_z\cdot\left(-p_\gamma^{lin}\,G(\theta)\sin(2\phi) + p_\gamma^{circ}\,E(\theta)\right)\right]$$



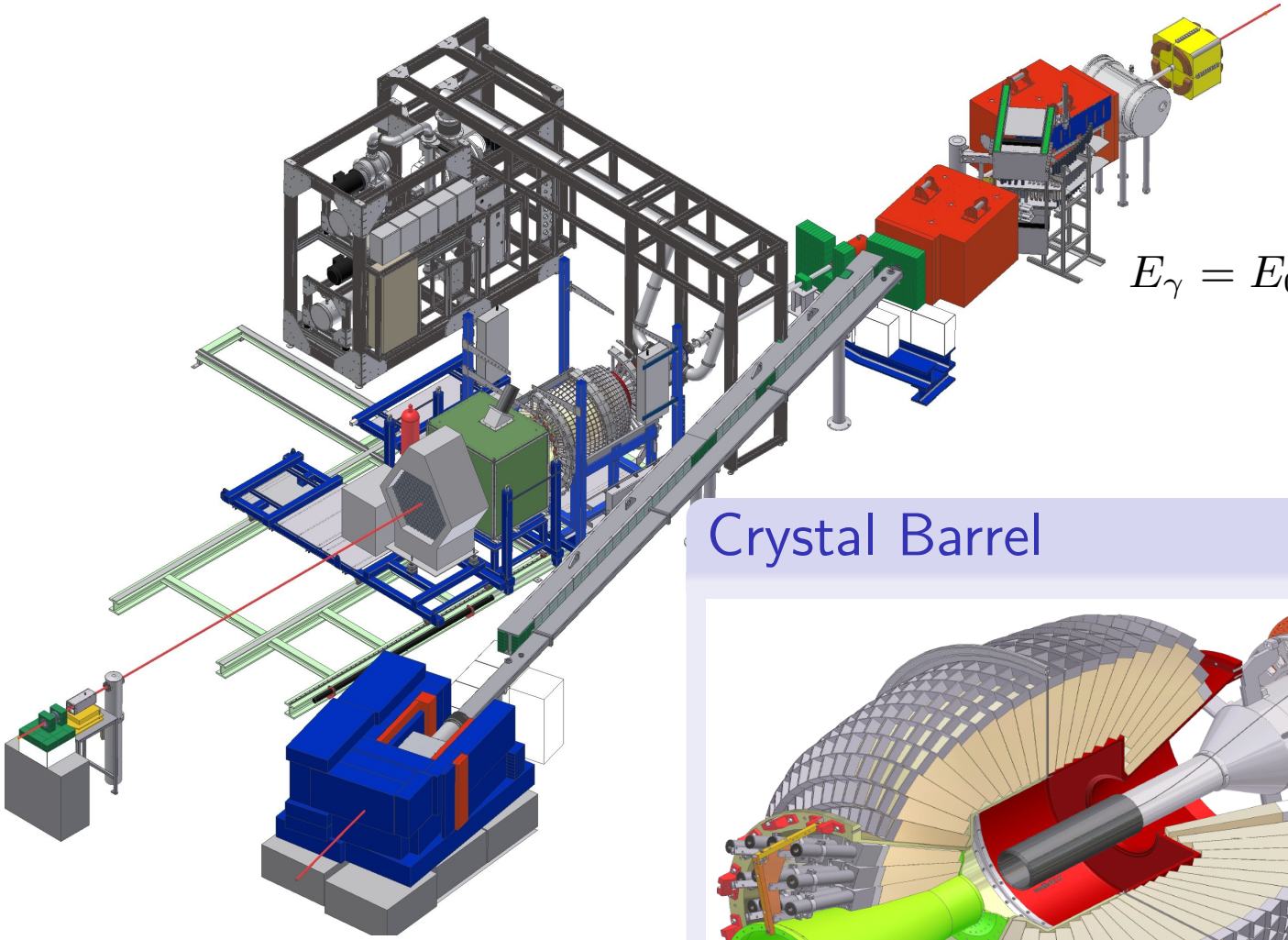
Photon pol.		Target pol. axis		
		x	y	z
unpolarised	σ	-	T	-
linearly	$-\Sigma$	H	$-P$	$-G$
circularly	-	F	-	$-E$

$$E = \frac{\sigma_{1/2} - \sigma_{3/2}}{\sigma_{1/2} + \sigma_{3/2}} = \frac{1}{P_\gamma \cdot P_z}\cdot\frac{1}{f_{dil}}\cdot\frac{N_{1/2} - N_{3/2}}{N_{1/2} + N_{3/2}}$$



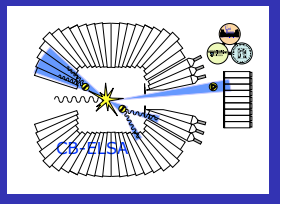


Crystal Barrel/TAPS @ ELSA



$E_\gamma = E_0 - E_{e^-}$

Crystal Barrel

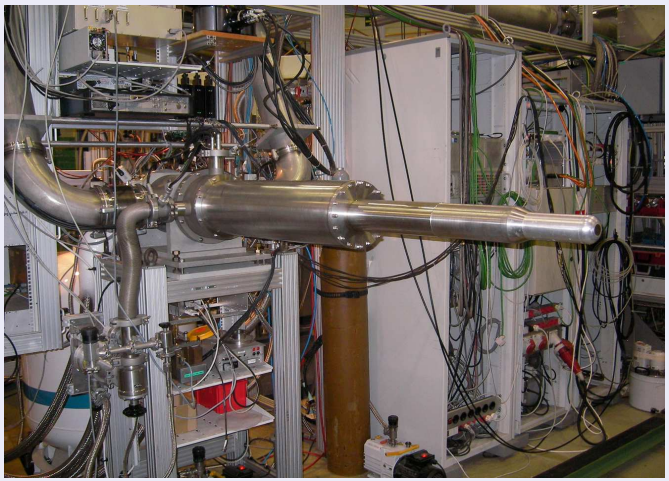


Polarised target and beam

Frozen spin butanol target

longitudinally polarised protons within butanol

mean polarisation $\approx 70\%$



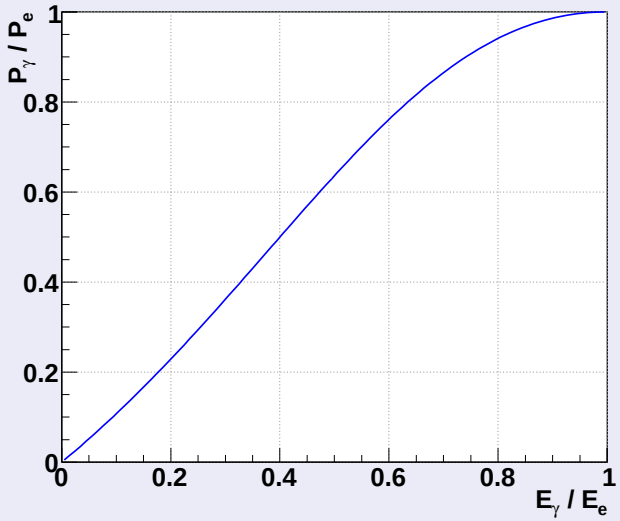
Bradtke et. al

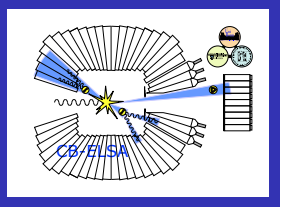
Beam polarisation

circularly polarised photons via bremsstrahlung of long. pol. e^-

mean e^- pol. $\approx 65\%$ at $2.4GeV$

Helicity transfer





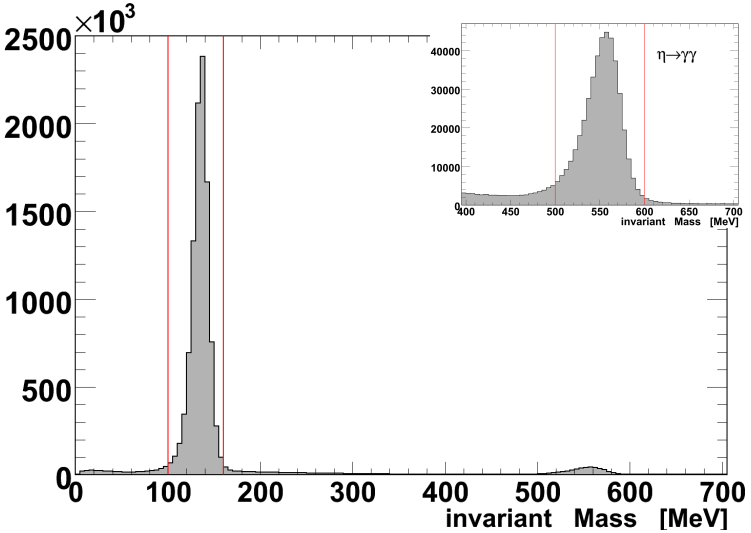
Data selection

$\vec{\gamma}\vec{p} \to p\pi^0/p\eta$

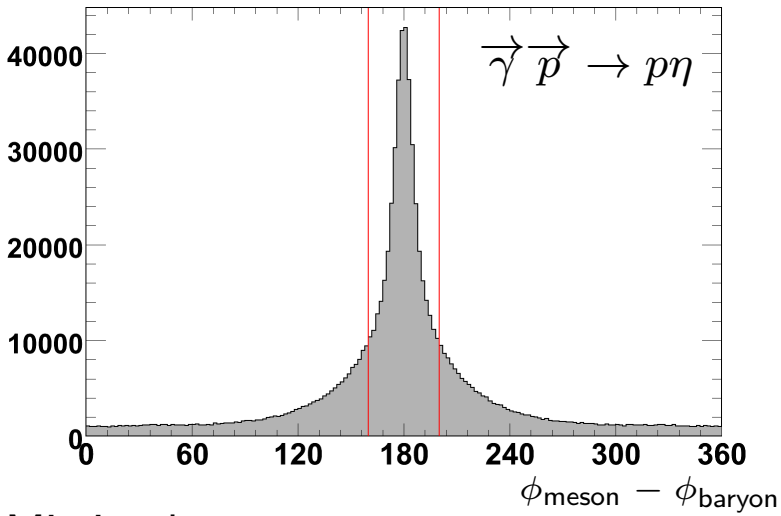
Final states:

- $\vec{\gamma}\vec{p} \to p\gamma\gamma$

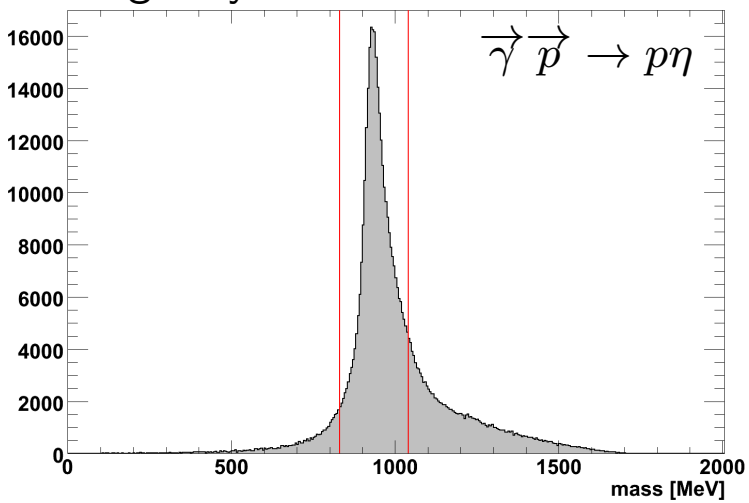
Invariant meson mass spectrum



Coplanarity between meson and baryon

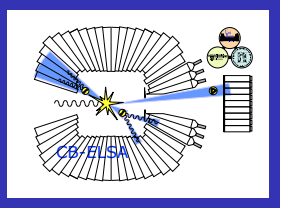


Missing baryon mass



Applied cuts:

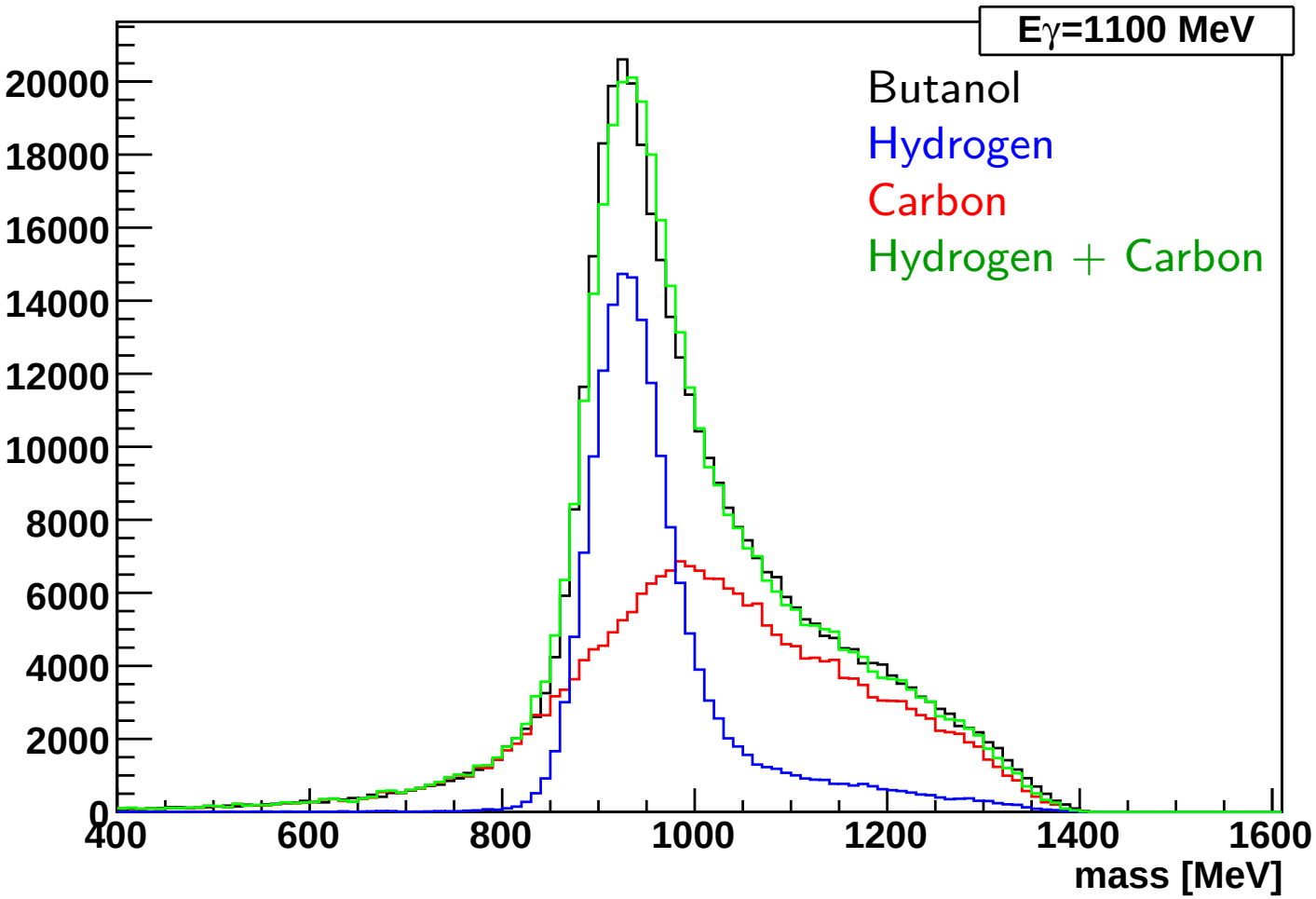
- charge
- coplanarity
- calculated proton mass
- meson mass
- time background subtraction

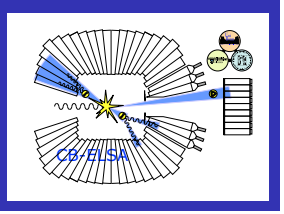


Dilution factor determination

Effective dilution factor:

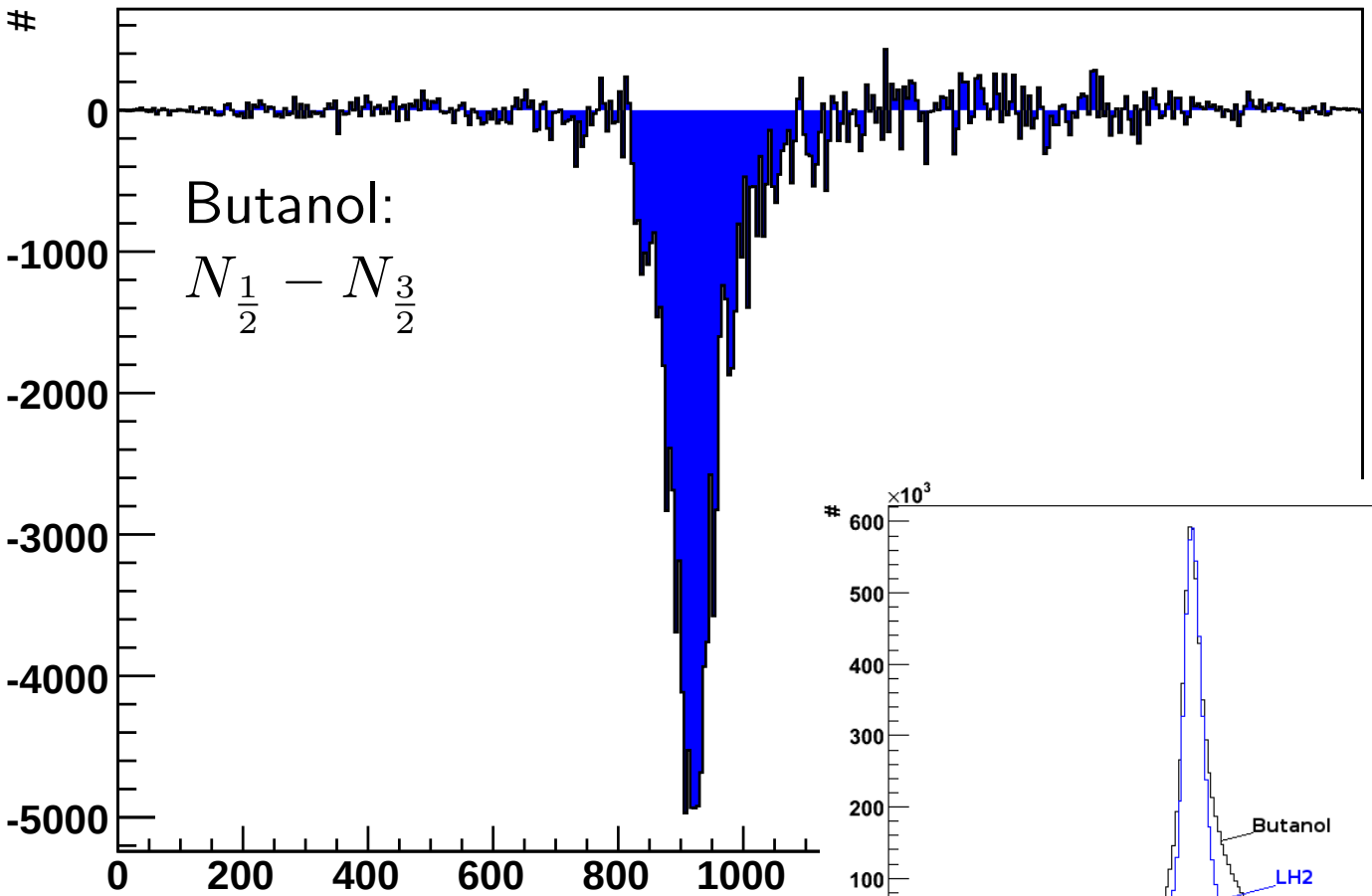
$$f_{\text{dil}} = \frac{N_{\text{butanol}} - N_{\text{carbon}}}{N_{\text{butanol}}}$$

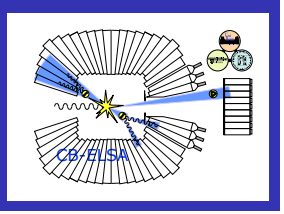




Polarised events

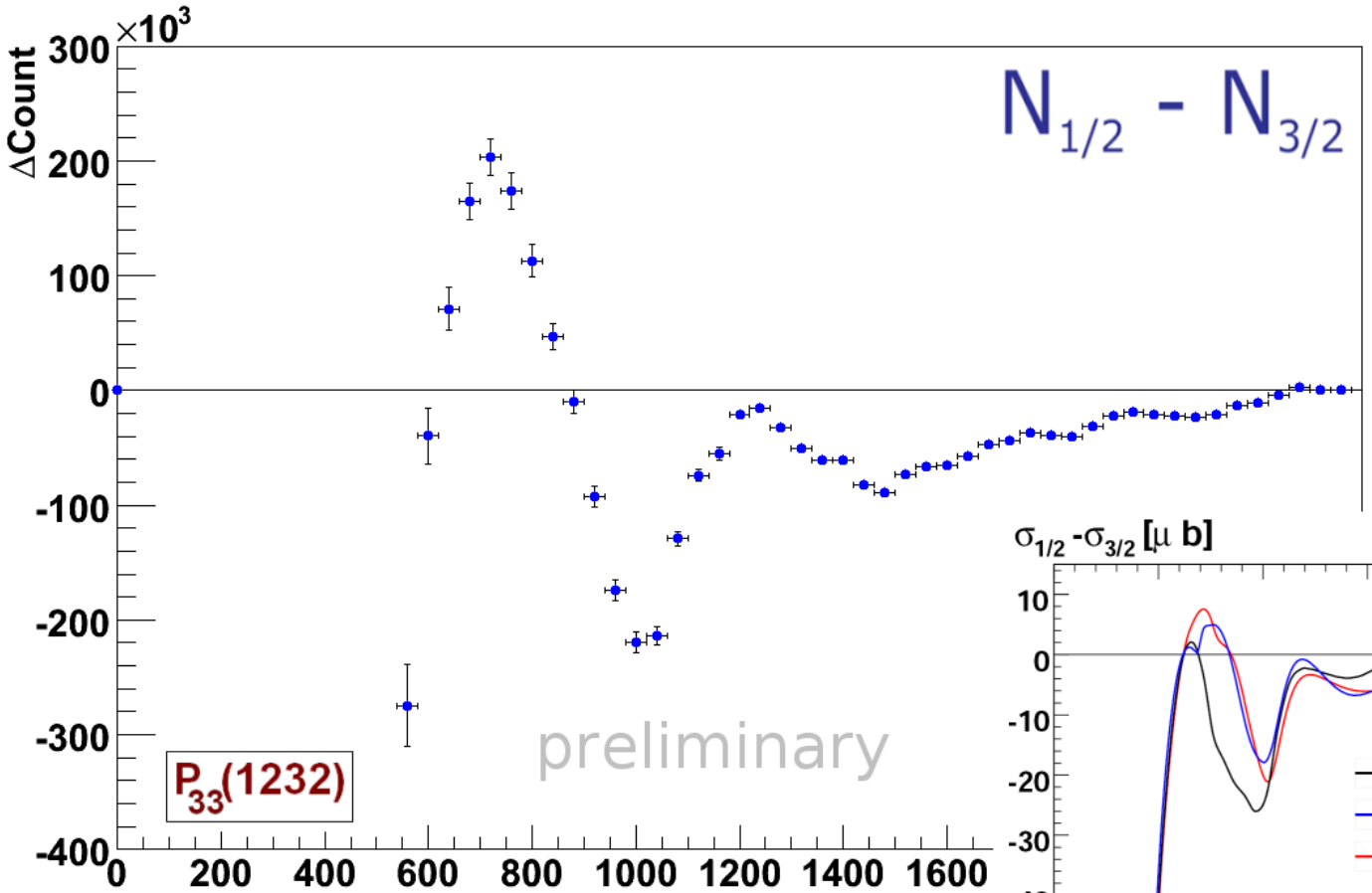
Helicity difference in calculated missing baryon mass for π^0 events

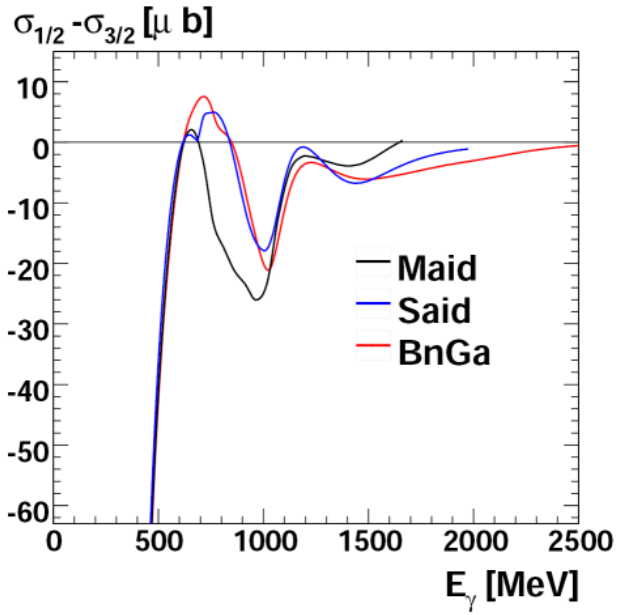


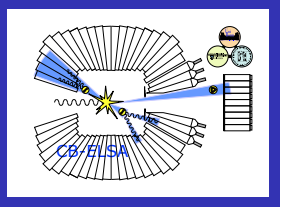


$\vec{\gamma}\vec{p} \to p\pi^0$

π^0 count rate difference

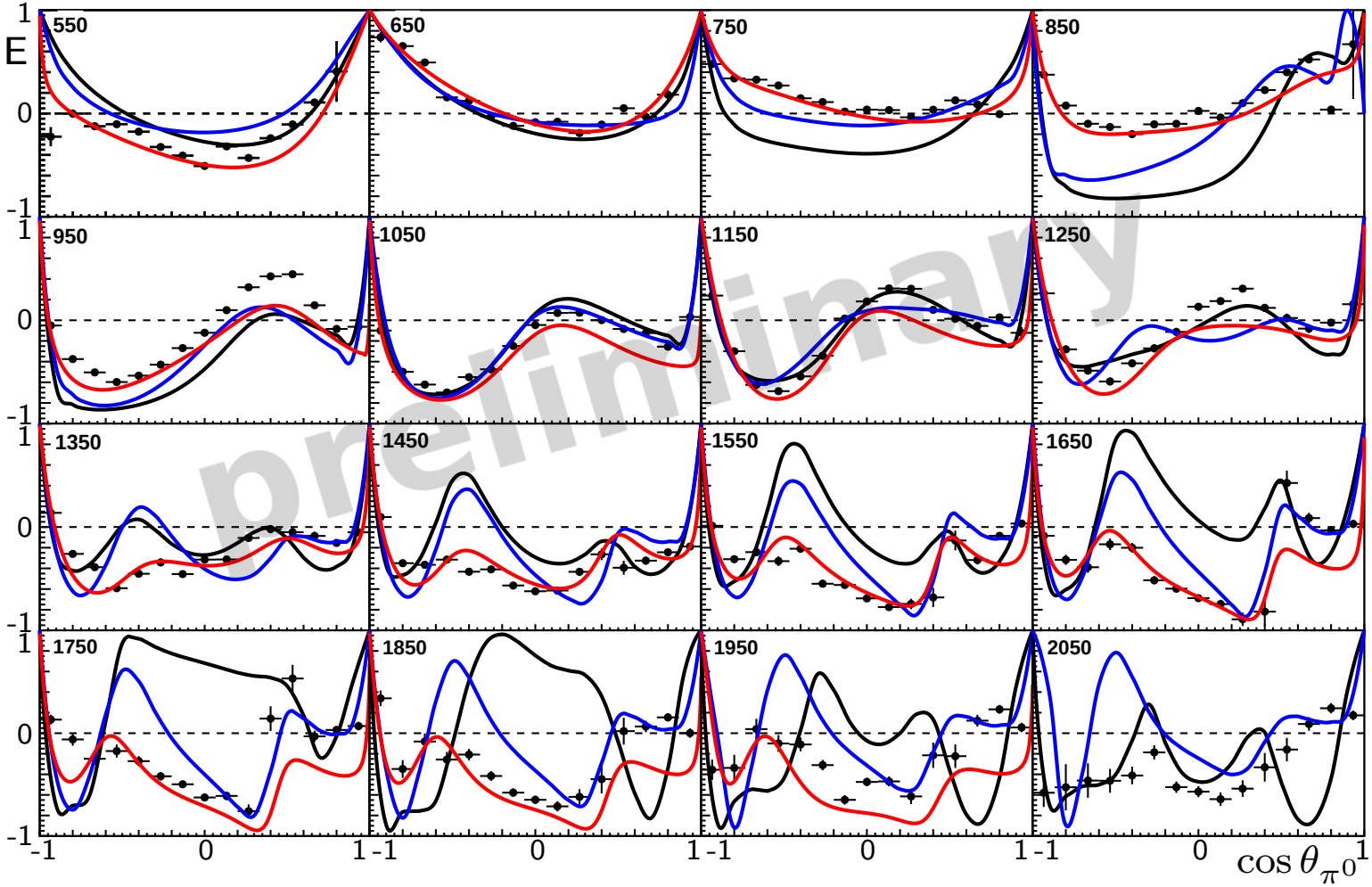






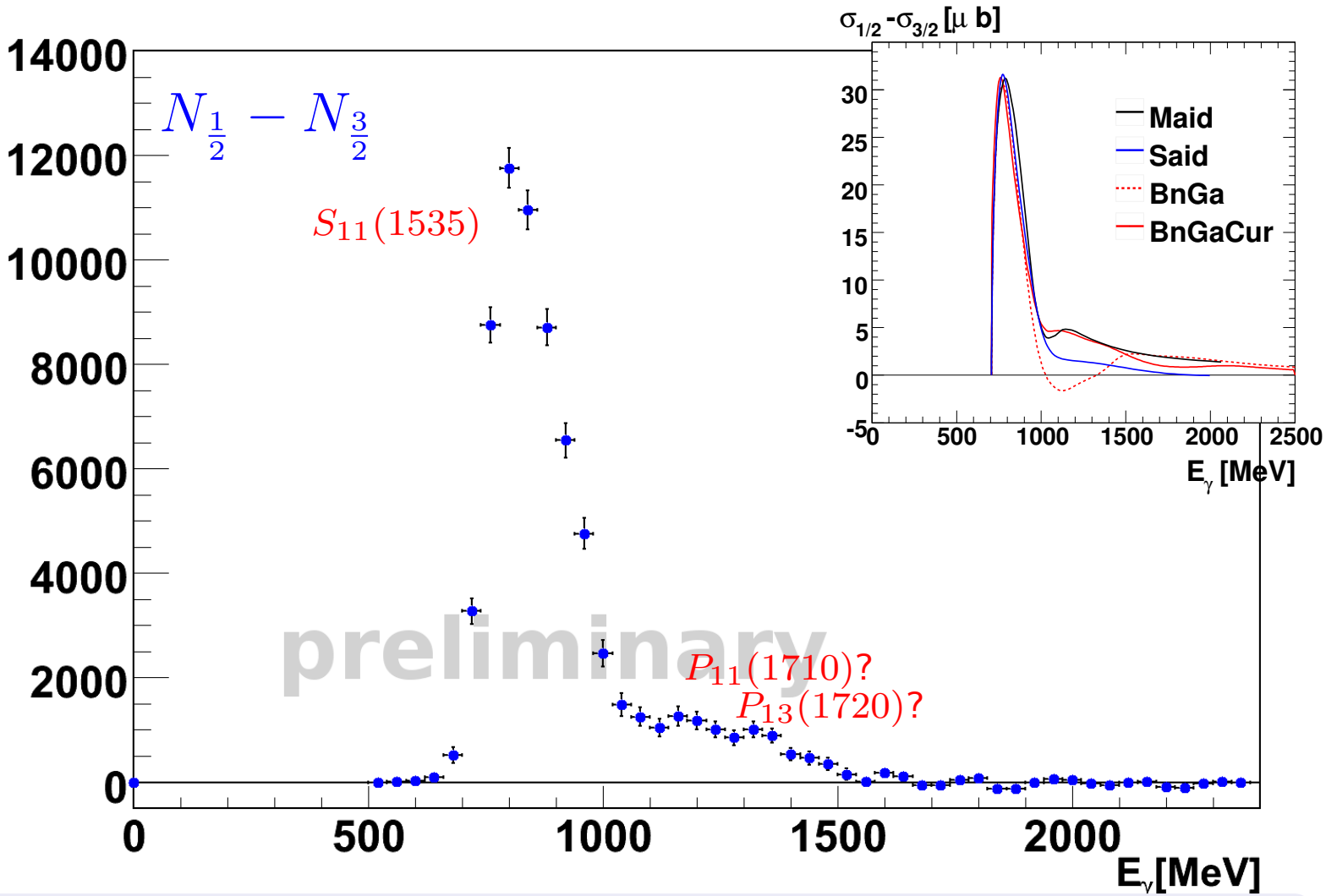
E for $\vec{\gamma}\,\vec{p} \to p\pi^0$

$$E = \frac{1}{P_\gamma \cdot P_z} \cdot \frac{1}{f_{dil}} \cdot \frac{N_{1/2} - N_{3/2}}{N_{1/2} + N_{3/2}}$$

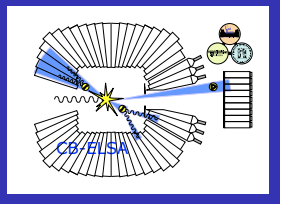


$\vec{\gamma}\,\vec{p} \to p\eta$

η count rate difference

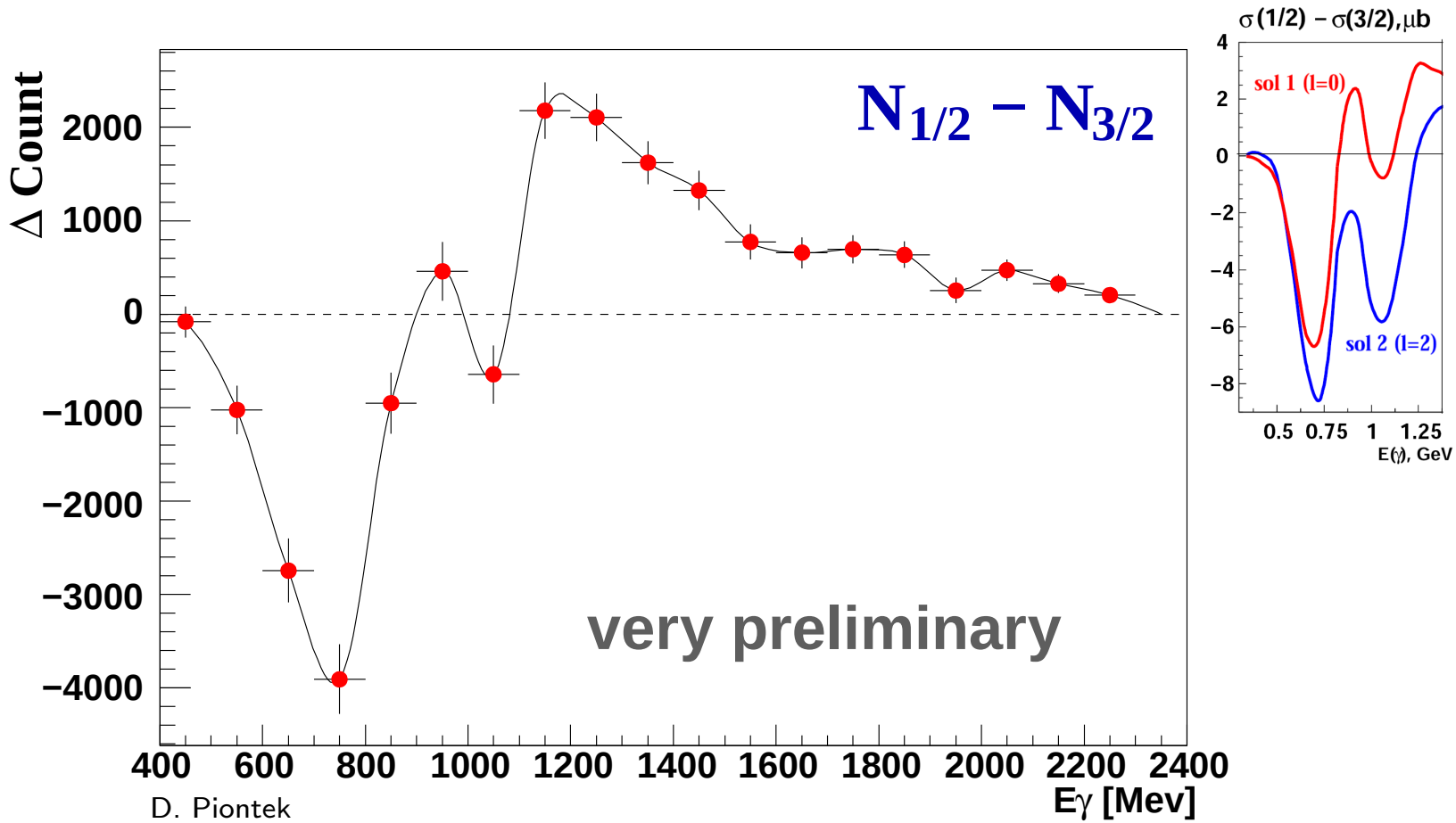


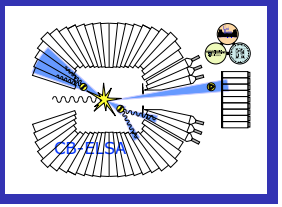
Important information for partial wave analyses



$\vec{\gamma}\,\vec{p} \to p\pi^0\pi^0$

Count rate difference in $\pi^0\pi^0$ photoproduction



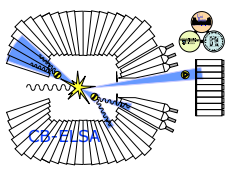


Summary

Double polarisation data have been taken with the Crystal Barrel/TAPS experiment:

- Polarisation observable E currently analysed for different channels
- Measurements for different polarisation observables are ongoing
- Preliminary results show clear deviation from current PWA analyses

The results will be important input for PWA and lead us one step closer to the complete experiment.



funded within SFB/TR16