Bonn-Gatchina PWA of photoproduction data on the neutron

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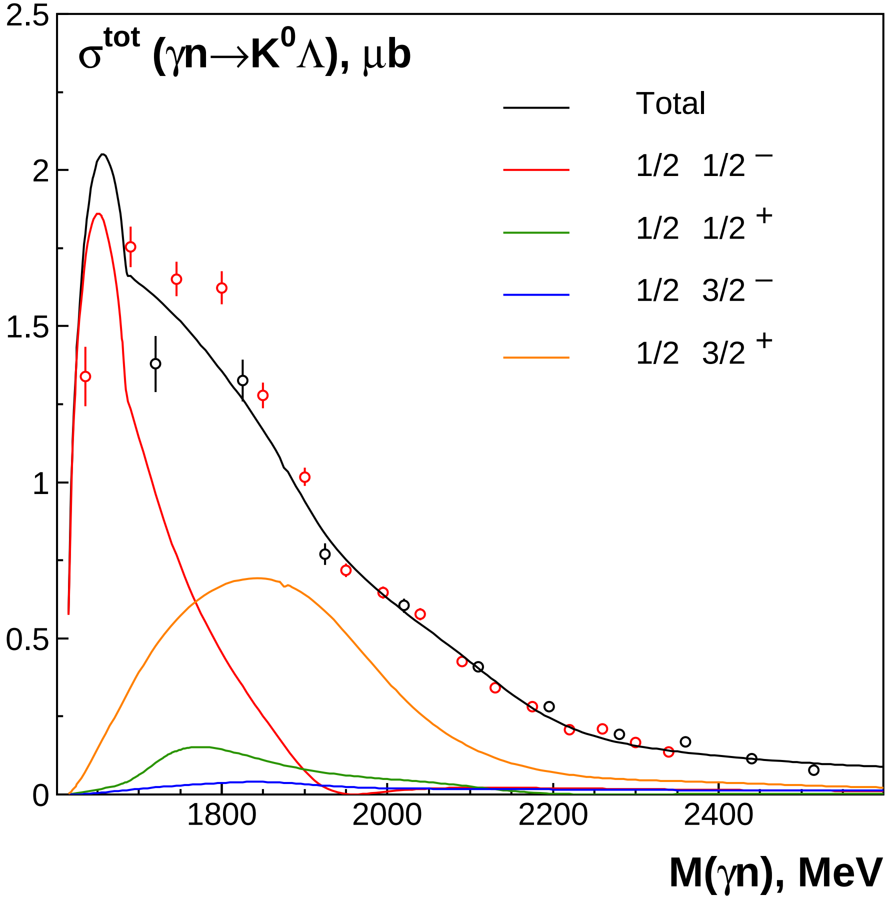
Data base updated

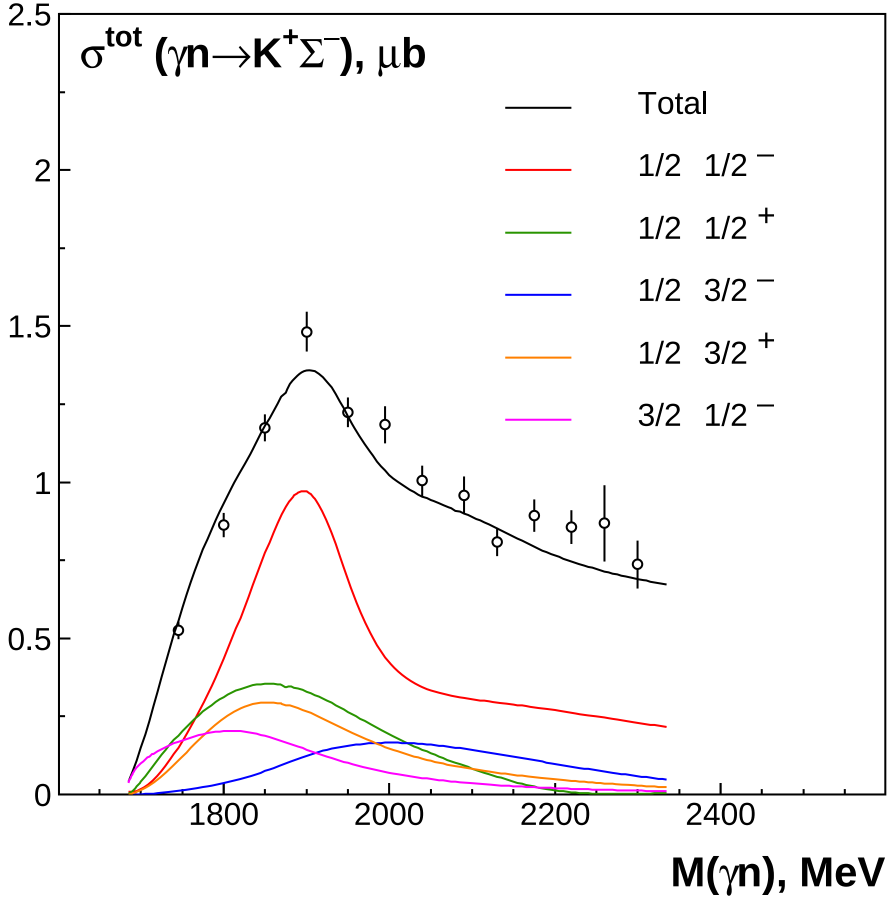
Reaction	BG2011-2014	added in BG2015-2016
$\gamma n \to \pi^0 n$	$\frac{d\sigma}{d\Omega}, \Sigma$	
$\gamma n \to \pi^- p$	$\frac{d\sigma}{d\Omega}, \Sigma, T, P$	
$\gamma n \to \Lambda K^0, \Sigma^- K^+$	—	$\frac{d\sigma}{d\Omega}$ **(CLAS)**
$\gamma n \to \eta n$	$\frac{d\sigma}{d\Omega}, \Sigma$	$\frac{d\sigma^{1/2}}{d\Omega}$, $\frac{d\sigma^{3/2}}{d\Omega}$ **(MAMI)**

The complete list of the data used in the combined analysis is now on the peb page

http://pwa.hiskp.uni-bonn.de/baryon_x.htm

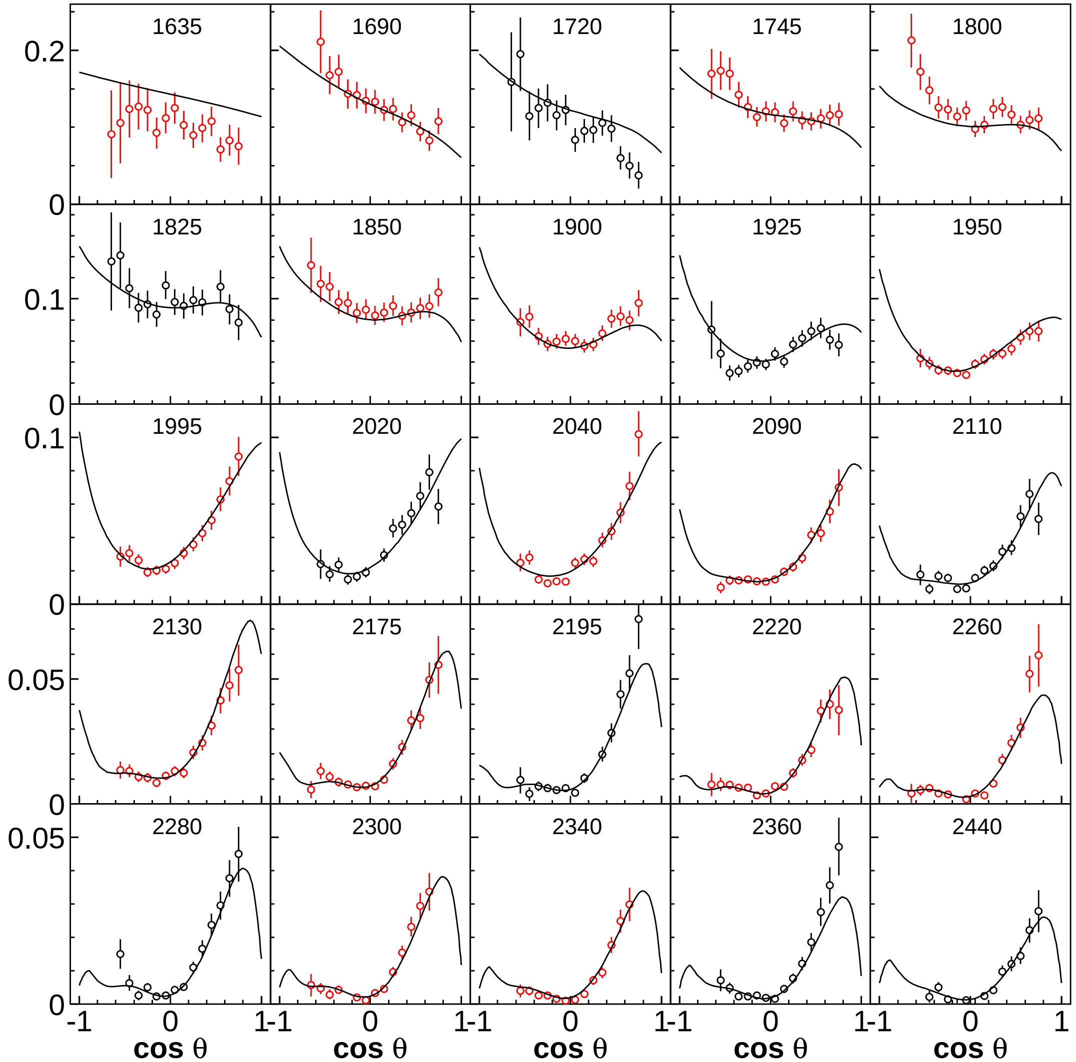
Preliminary CLAS data, total cross sections.

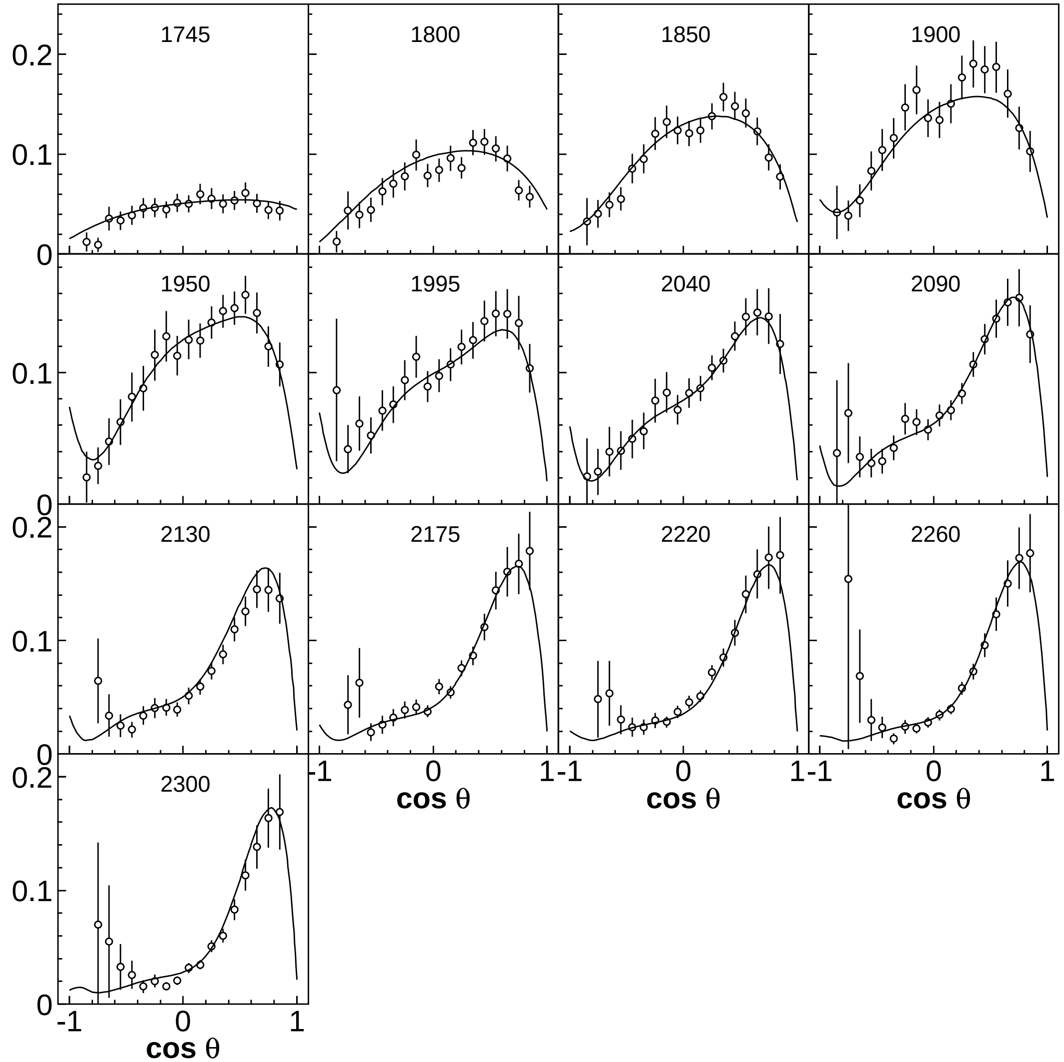




$\gamma n \to K^+\Sigma^-$ **data are fitted without new independent parameters:** t**- and** u**-exchanges parameters are related with** γp **channels by Klebsch-Gordan coefficients.** $\gamma n \to K^0\Lambda$ **has neutral exchanges.** γn **couplings and resonance parameters are the same for all channels.**

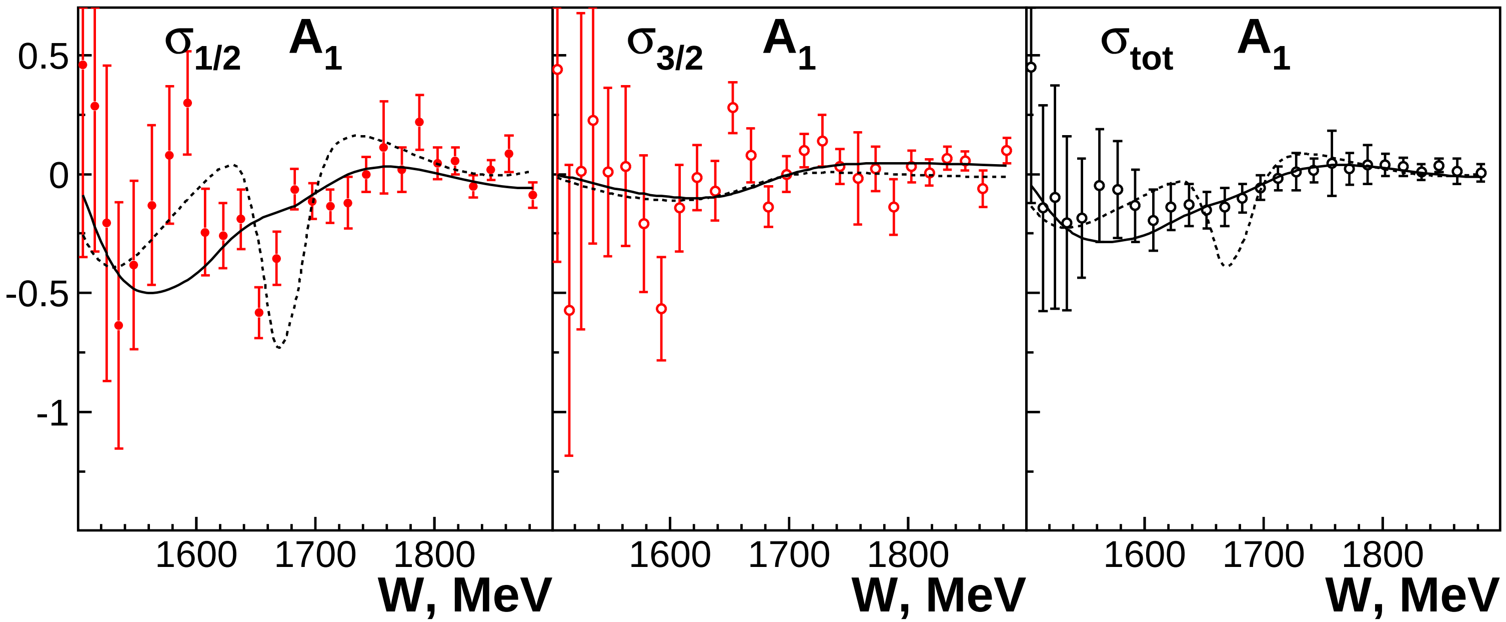
Preliminary CLAS data, differential cross sections, $d\sigma/d\Omega(\mu b/sr)$





$\gamma d \to \eta n(p)$ reaction

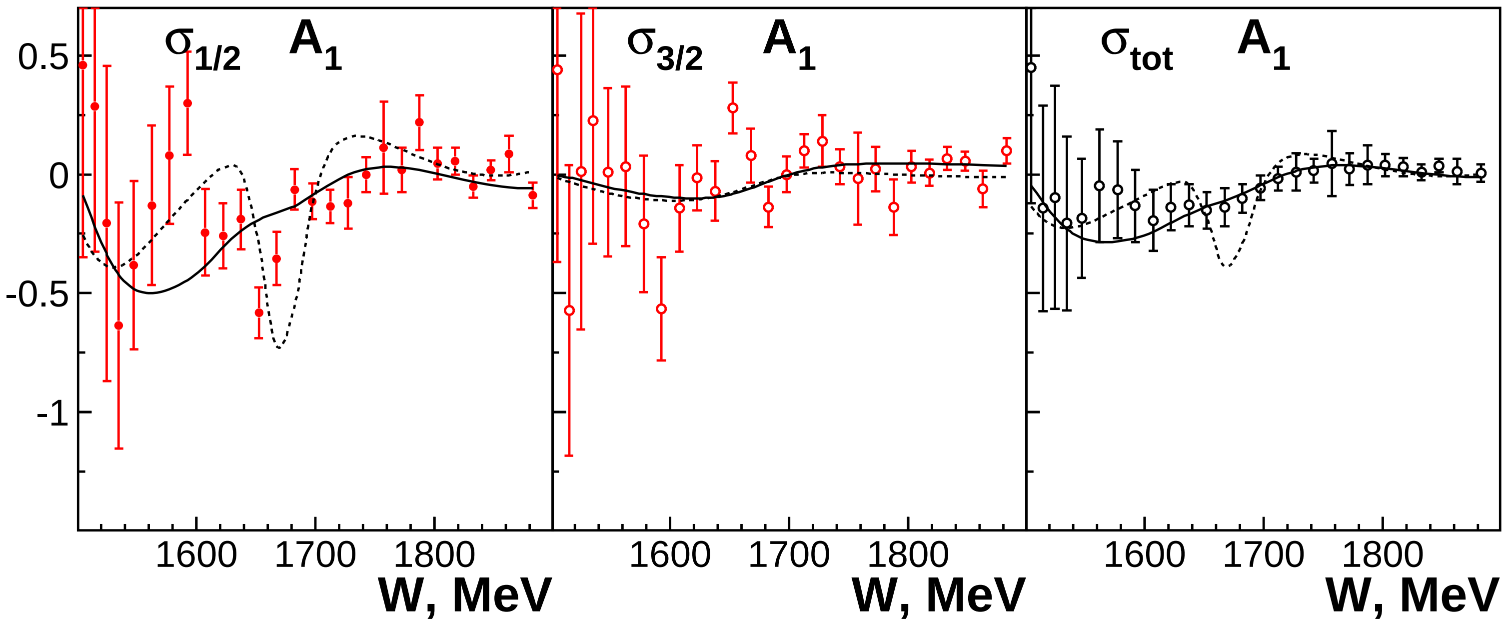
- **A narrow structure was observed at a mass of about 1685 MeV in the $\gamma d \to \eta n(p)$ excitation function and reported in a set of papers in 2007-2015.**
- **The structure was interpreted as the nonstrange member of the antidecuplet of pentaquarks with spin-parity $J^P = 1/2^+$ predicted by Diakonov, Petrov, and Polyakov.**
- **The precise data reported by the A2 Collaboration at MAMI in 2013, 2014 were used by BnGa group to study the structure. It was found that it can be explained quantitatively by interference between the two nucleon resonances $N(1535)$ and $N(1650)$ with spin-parity $J^P = 1/2^-$.**
- **Recently L. Witthauer *et al.*, Phys. Rev. Lett. 117, 132502 (2016), the A2 Collaboration at MAMI reported a measurement $\sigma_{1/2}$ and $\sigma_{3/2}$, with σ_J being the cross section for $\gamma d \to \eta n(p)$ with neutron and photon spin aligned ($J = 3/2$) or opposite ($J = 1/2$).**



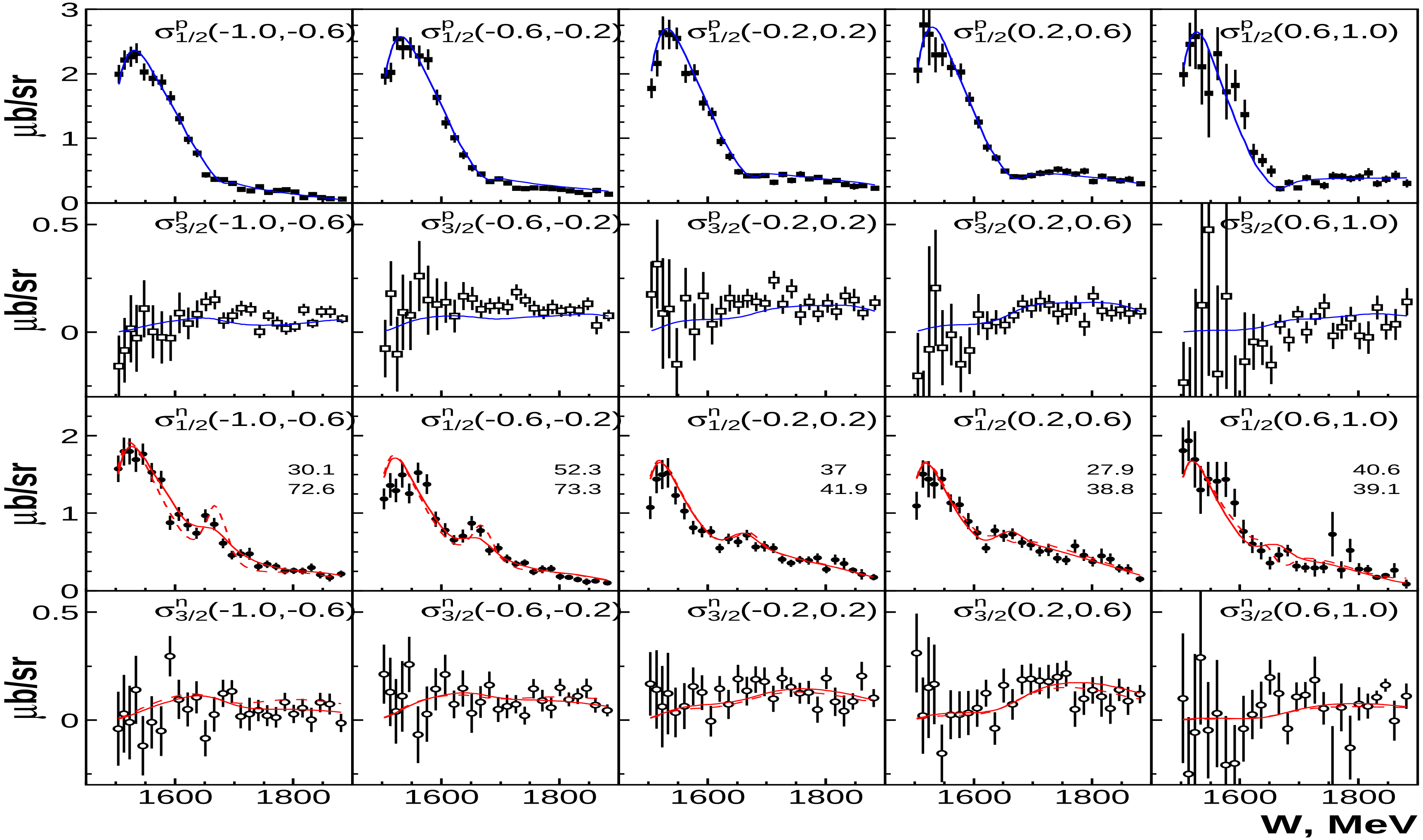
The authors fitted the angular distributions with third-order Legendre polynomial functions and found a narrow dip at 1650 MeV in the first order Legendre coefficient. They concluded:

The extracted Legendre coefficients of the angular distributions for $\sigma_{1/2}$ *are in good agreement with recent reaction model predictions assuming a narrow resonance in the* P_{11} *wave as the origin of this structure.*

A comparison with fits to the data 2013-2014 shows that a model assuming no $N(1685)$ **does not reproduce the dip while a model which includes a narrow** $N(1685)$ **gives qualitative agreement between data and prediction.**

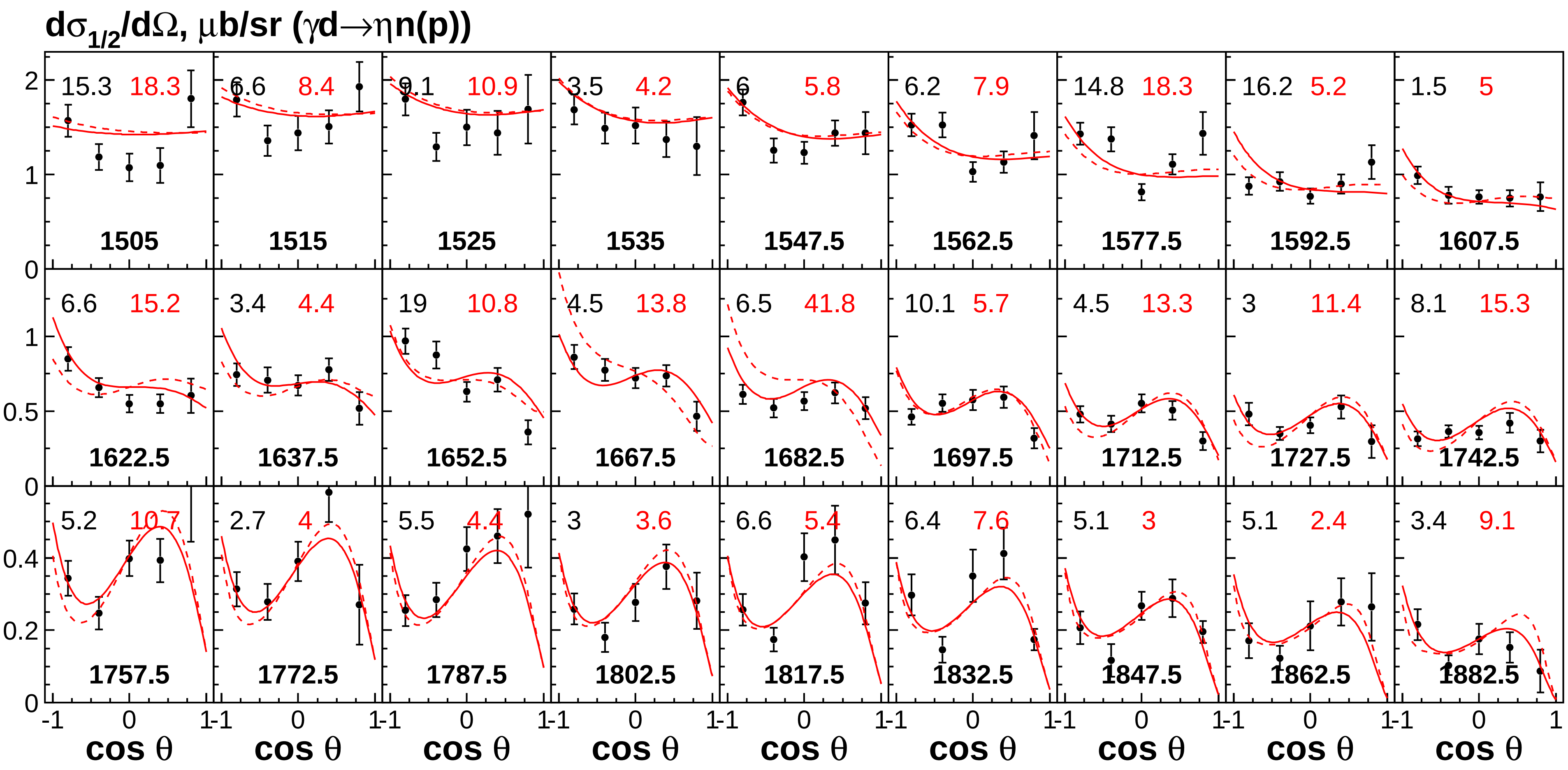


- **The dip in A$_1^{\sigma_{1/2}}$ is statistically significant. Relative to the solid line it contributes χ^2=15.9 for two data points.**
- **A$_1^{\sigma_{\rm tot}}$ follows precisely the fit with no $N(1685)$, the data are compatible with the fit, with $\chi^2 = 2.1$.**

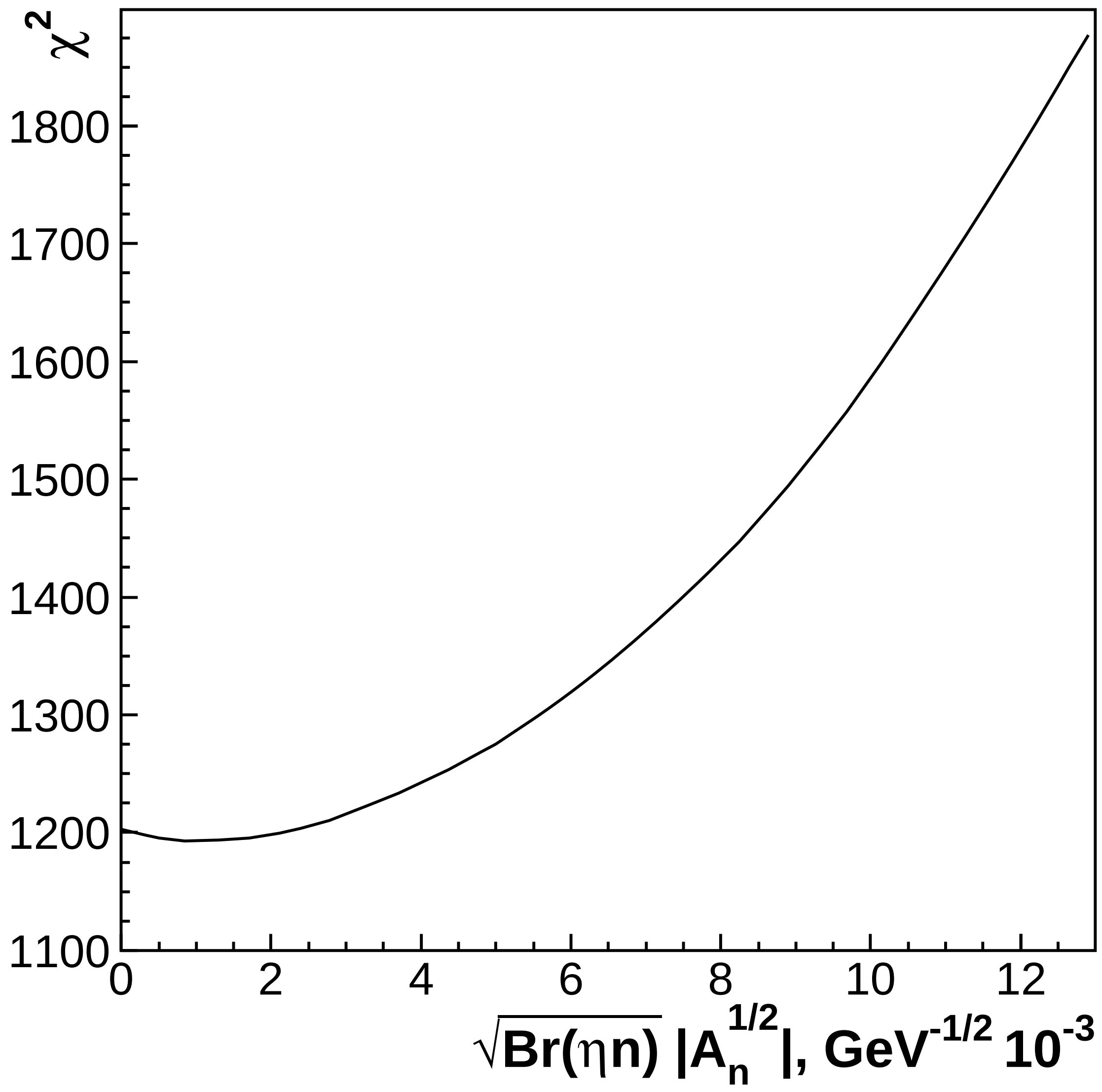


Fits of all data + new MAMI data were performed. $\chi^2 =$ **188 and 266.**

$N(1685)$**:** $M = 1670$ **MeV,** $\Gamma = 30$ **MeV, and** $\sqrt{Br(\eta n)}A_n^{1/2}$ =**12.3 [GeV**$^{-\frac{1}{2}}$ **10**$^{-3}$**].**



Differential cross sections are shown.



If the production strength fitted freely, it reduced to 1.2 [GeV$^{-\frac{1}{2}}$ 10^{-3}].

Helicity amplitudes determined from a fit without a narrow $N(1685)$ resonance. The T-matrix couplings are the quantities which are listed in the RPP; K-matrix couplings are given in addition. The new results are compared to those obtained before which are listed in small numbers. The comparison shows the impact of the new data.

		$N(1535)1/2^-$	$N(1650)1/2^-$				$N(1535)1/2^-$	$N(1650)1/2^-$	
p	T-matrix	0.093 ± 0.009	0.032 ± 0.006	GeV$^{-1/2}$	n	T-matrix	-0.088 ± 0.004	0.016 ± 0.004	GeV$^{-1/2}$
	[23]	0.114 ± 0.008	0.032 ± 0.007	GeV$^{-1/2}$		[23]	-0.095 ± 0.006	0.019 ± 0.006	GeV$^{-1/2}$
	Phase	$8\pm4^\circ$	$7\pm7^\circ$			Phase	$5\pm4^\circ$	-$28\pm10^\circ$	
	[23]	$10\pm5^\circ$	-$2\pm11^\circ$			[23]	$8\pm5^\circ$	$0\pm15^\circ$	
	K-matrix	0.112 ± 0.008	0.075 ± 0.006			K-matrix	-0.160 ± 0.030	-0.052 ± 0.005	
	[23]	0.096 ± 0.007	0.075 ± 0.007			[23]	-0.120 ± 0.006	-0.052 ± 0.006	

SUMMARY

1. **Data of reactions $\gamma n \to \Lambda K^0$ and $\gamma n \to \Sigma^- K^+$ were analysed in coupled-channel PWA.**
2. **New $\frac{d\sigma^{1/2}}{d\Omega}$, $\frac{d\sigma^{3/2}}{d\Omega}$ (MAMI) were analysed.**
3. **We cannot confirm the conclusions that the dip in the first-order Legendre coefficient in an expansion of the angular distributions of $\sigma_{1/2}$ is due to a narrow $J^P = 1/2^+$ resonance.**
4. **Partial wave analysis without a narrow $J^P = 1/2^+$ resonance is excellent, the inclusion of it with the reported properties leads to a significantly worse description of the data.**