

In Memoriam Bernd Krusche



27.2.1956 - 1.6.2022

Volker Metag
II. Physikalisches Institut



Bernd Krusche: Curriculum Vitae

| | |
|-------------|--|
| 27.2.1956 | borne in Salzhemmendorf (Lower Saxony; Germany) |
| 1963 - 1975 | schools in Salzhemmendorf and Hameln |
| 1975 | Abitur |
| 1975 - 1981 | study of physics, mathematics and pedagogy at Univ. of Göttingen |
| 1981 | final examination as mathematics and physics teacher at a gymnasium |
| 1982 - 1985 | PhD student at Univ. of Göttingen; advisor Prof. Peter Lieb |
| 1985 | PhD on neutron capture γ -ray spectroscopy (exp. at ILL Grenoble) |
| 1986 - 1990 | Staff Scientist at ILL Grenoble |
| 1990 - 1999 | Scientific Assistant at II. Physikalisches Institut, Univ. of Giessen |
| 1996 | Habilitation: photoproduction of π^0 and η mesons off nucleons and nuclei |
| 1999 - 2022 | Professor of Nuclear and Particle Physics, University of Basel |

collaborations: TAPS, CBELSA/TAPS, Crystal Ball, PANDA, MUSE

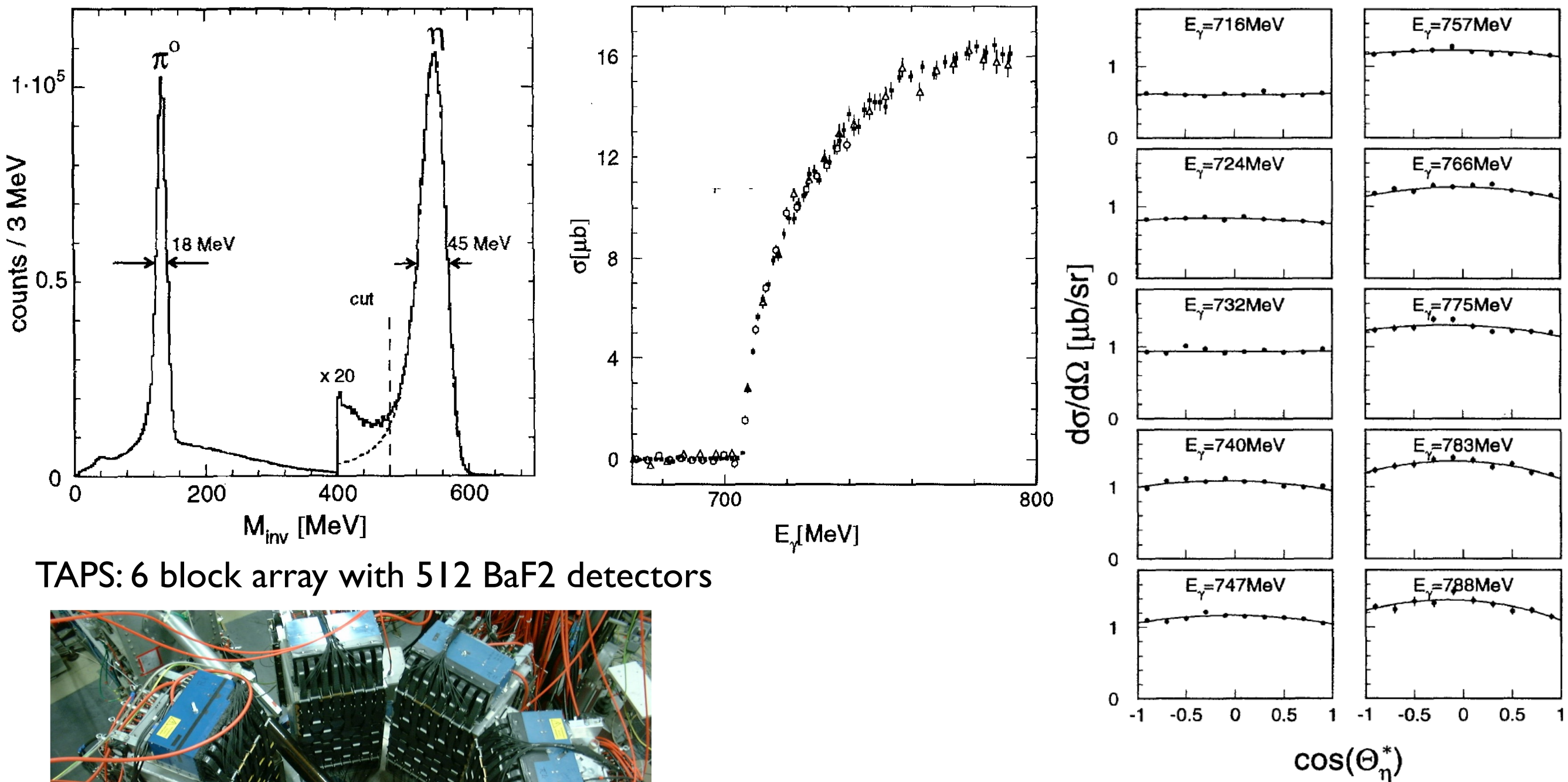
service to
community Particle Data Group, NuPECC, referee for PRL, PLB, EPJA

publications: ≈ 300 in refereed journals (thereof ≈ 70 in PRL/PLB); 2 reviews in PPNP 2

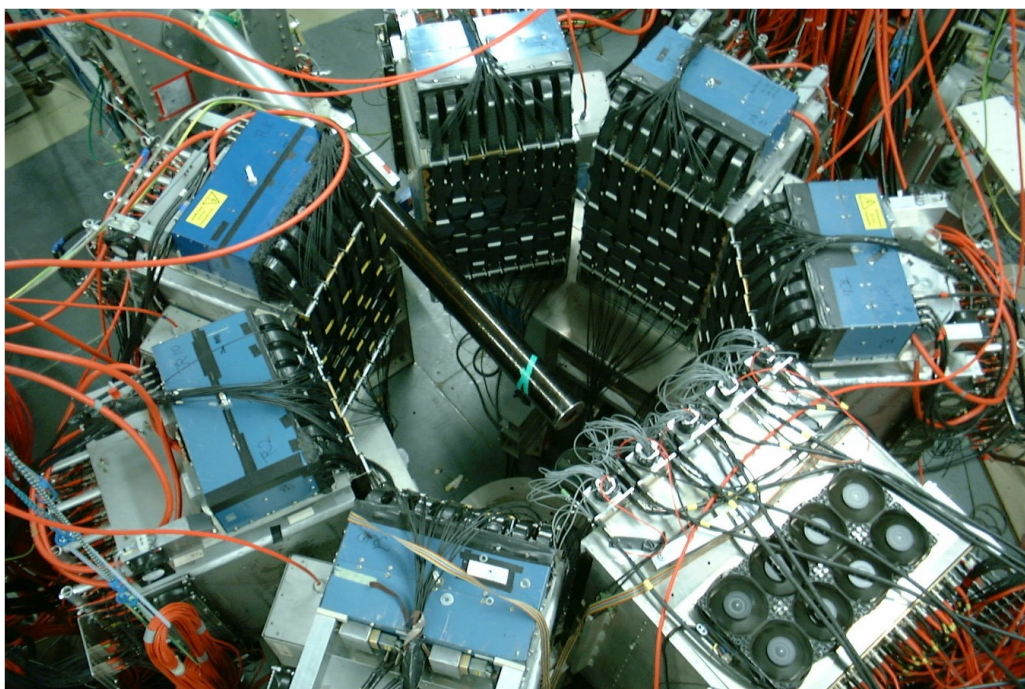
Photoproduction of η mesons off the proton

B. Kutsche et al., PRL 74 (1995) 3736; cited 344 times

B.Krusche et al., Z. Phys.A 351 (1995) 237



TAPS: 6 block array with 512 BaF2 detectors



η - production dominated by $S_{11}(1535)$ excitation

$$\gamma p \rightarrow S_{11}(1535) \rightarrow p \eta$$

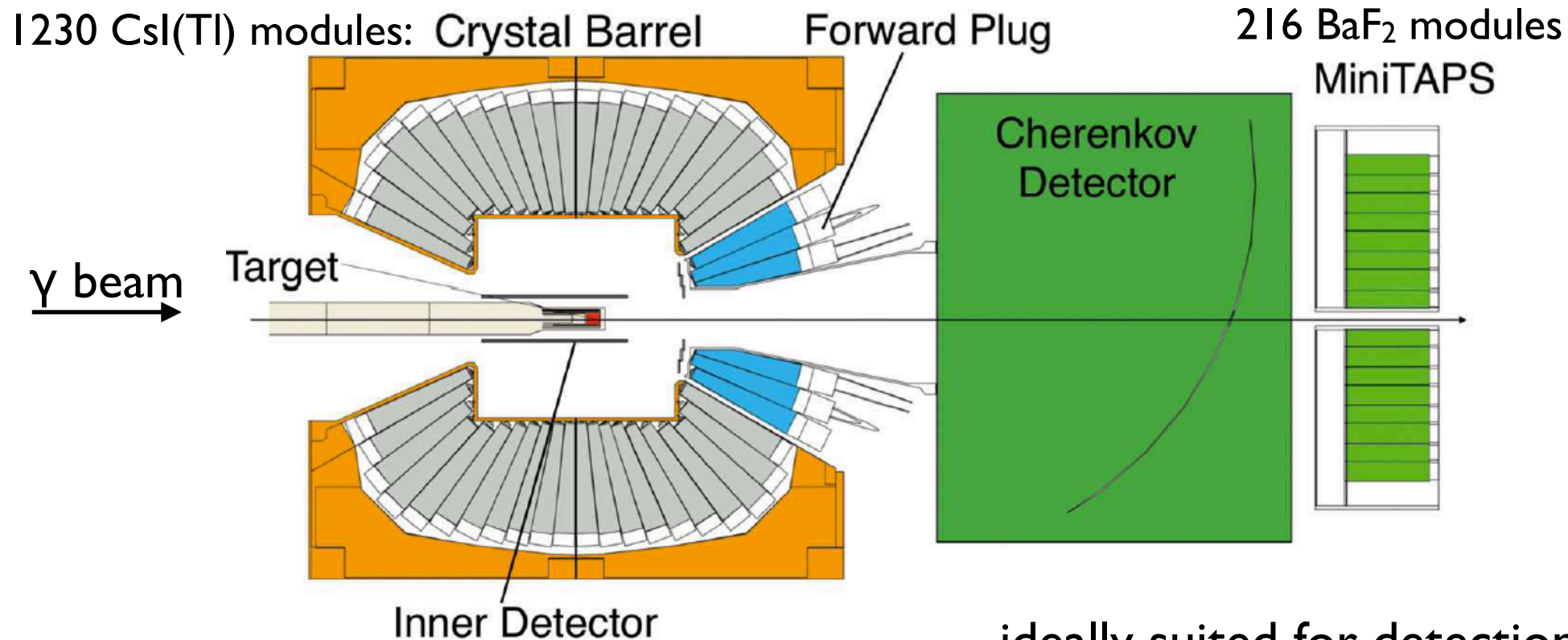
PDG: $M = (1510 \pm 10) \text{ MeV}$; $\Gamma = (130 \pm 20) \text{ MeV}$

TAPS workshop 2003 at Rauischholzhausen



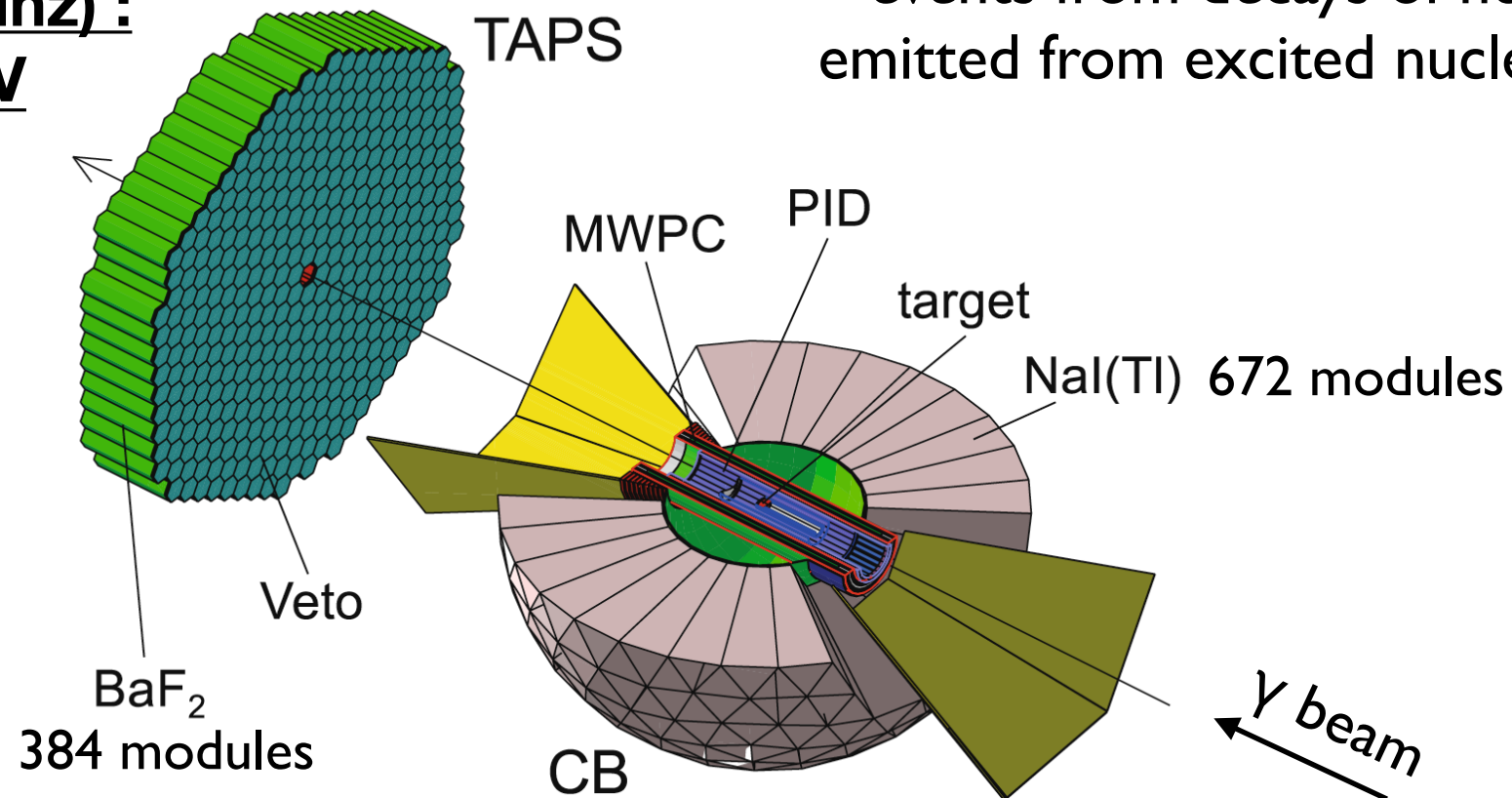
4π modular photon detector systems

CBELSA/TAPS (Bonn) : $E_\gamma \leq 3.2$ GeV



ideally suited for detection of multi-photon
events from decays of neutral mesons
emitted from excited nucleon resonances

Crystal Ball (Mainz) : $E_\gamma \leq 1.55$ GeV



Photoproduction of η mesons off the neutron (proton)

B. Krusche et al., PLB 376 (1996) 331 (TAPS)

I. Jaegle et al., PRL 100 (2008) 252002 (CBELSA/TAPS)

D. Werthmüller et al., PRL 111 (2013) 232001 (Crystal Ball)

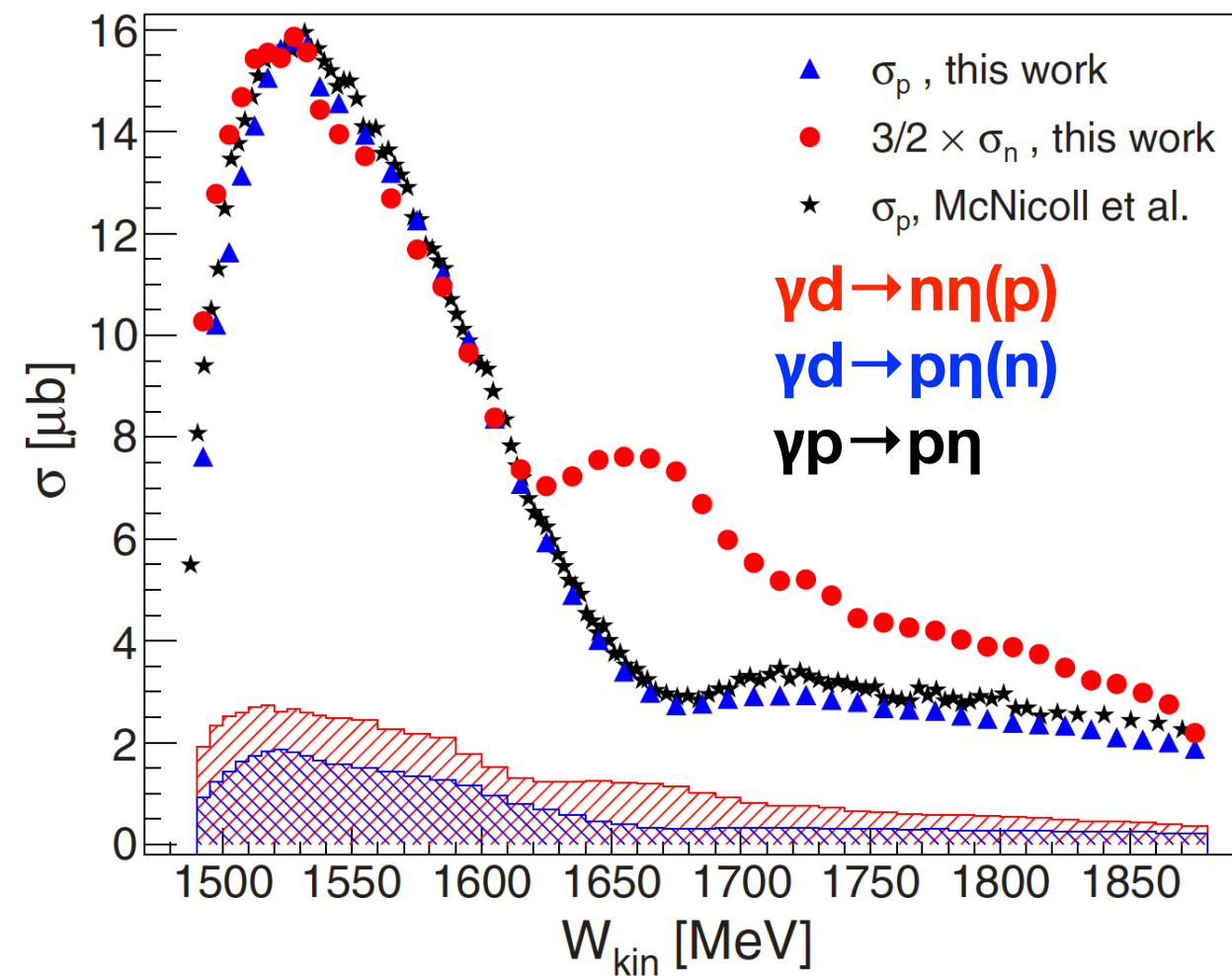
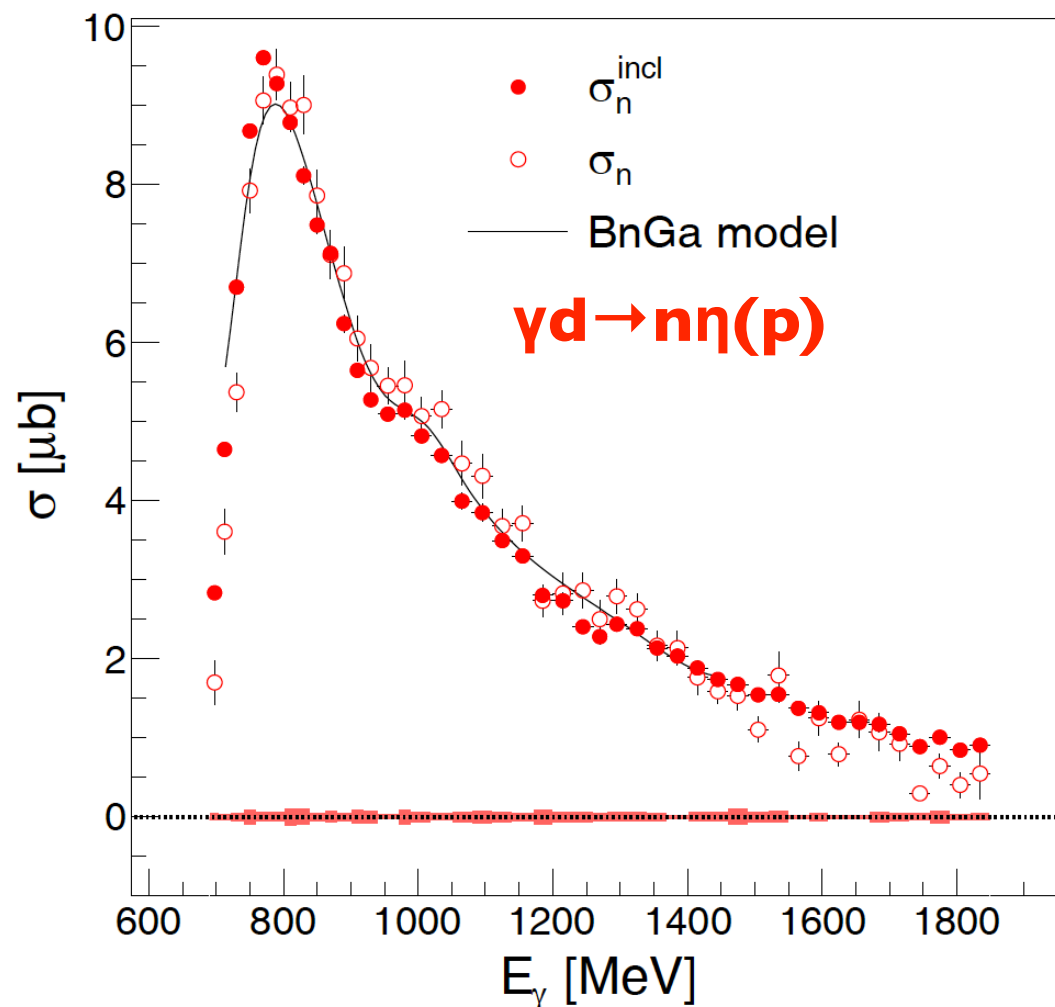
L. Witthauer et al et al., PRL EPJA 53 (2017) 58 (CBELSA/TAPS)

two problems:

1.) $\varepsilon_n \approx 30\%$, $\varepsilon_p \approx 95\%$,

2.) Fermi motion

exclusive measurement with complete reconstruction of the final state kinematics
to remove Fermi motion effects in d, ^3He



$\gamma n \rightarrow n \eta$: narrow structure at $W = (1670 \pm 5) \text{ MeV}$; $\Gamma = (30 \pm 15) \text{ MeV}$

$\gamma p \rightarrow p \eta$: dip at $W \approx 1670 \text{ MeV}$, associated with opening of $p\omega$ and $K\Sigma$ channels ?

A.V. Anisovich et al., EPJA 51 (2015) 72: interference of $S_{11}(1535) 1/2^-$ and $S_{11}(1650) 1/2^-$??

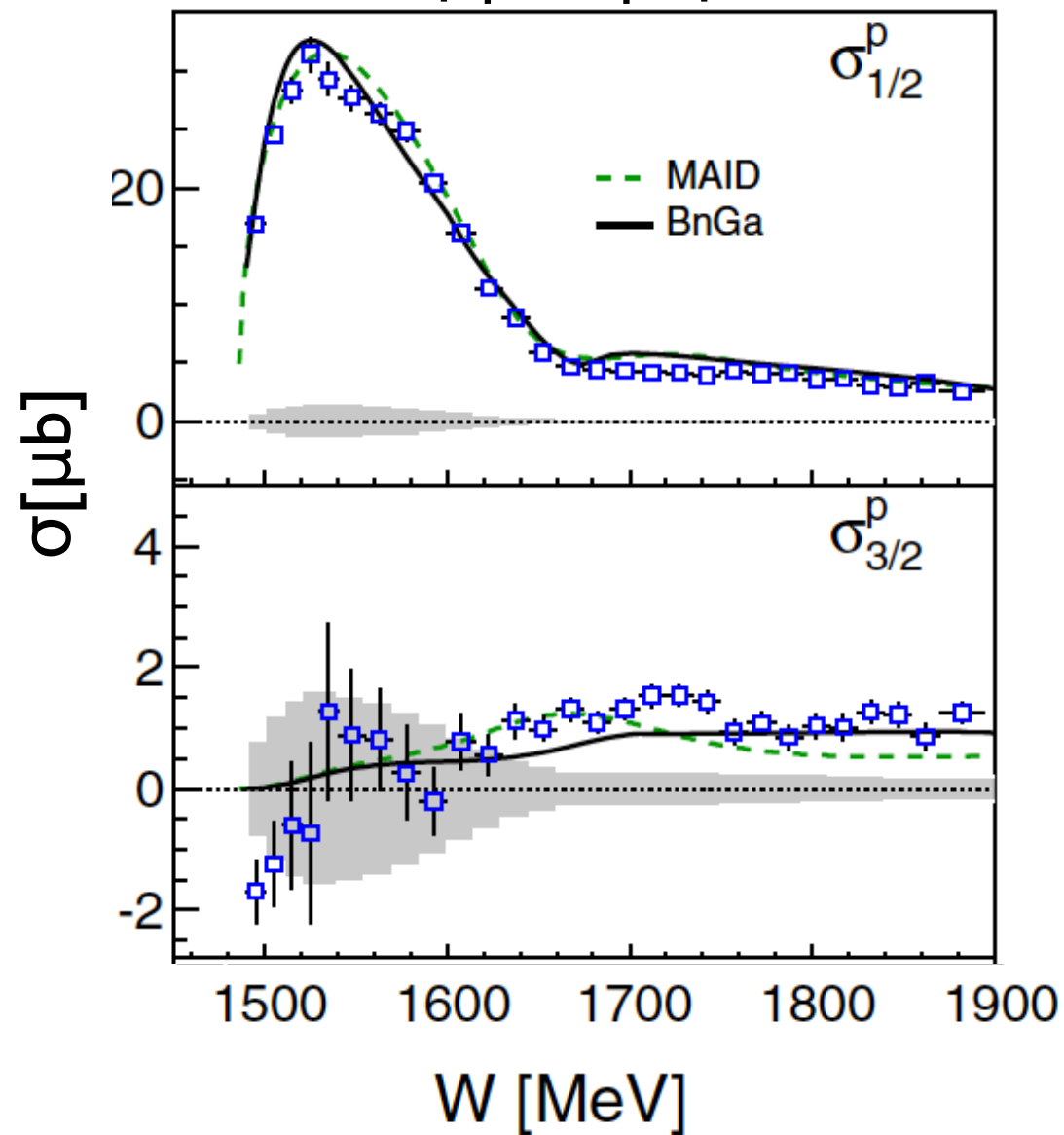
double polarization observable: E

circularly polarised γ beam and longitudinally polarized target:
decomposition of cross section into helicity-1/2 and helicity-3/2 contributions

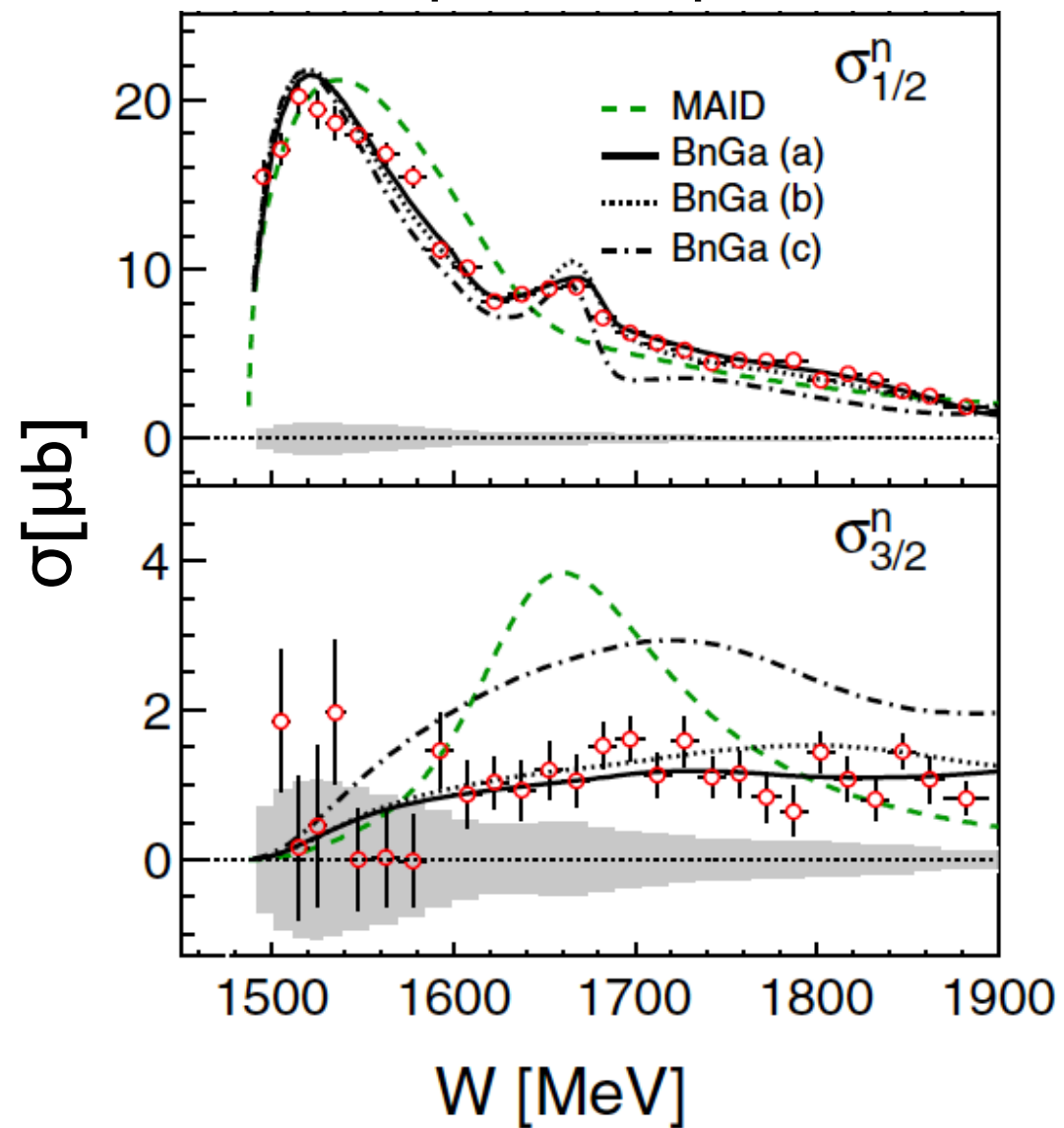


L. Witthauer et al et al., PRL 117 (2016) 132502 (Crystal Ball)

$\gamma p \rightarrow p \eta$



$\gamma n \rightarrow n \eta$



structure only seen in helicity-1/2 channel \rightarrow only S_{11} and P_{11} resonances involved
best fit with S_{11} wave + narrow P_{11} resonance at $W=1670$ MeV; but not listed in PDG

The Basel team

PhD celebration Dominik Werthmüller (3.4.2013)

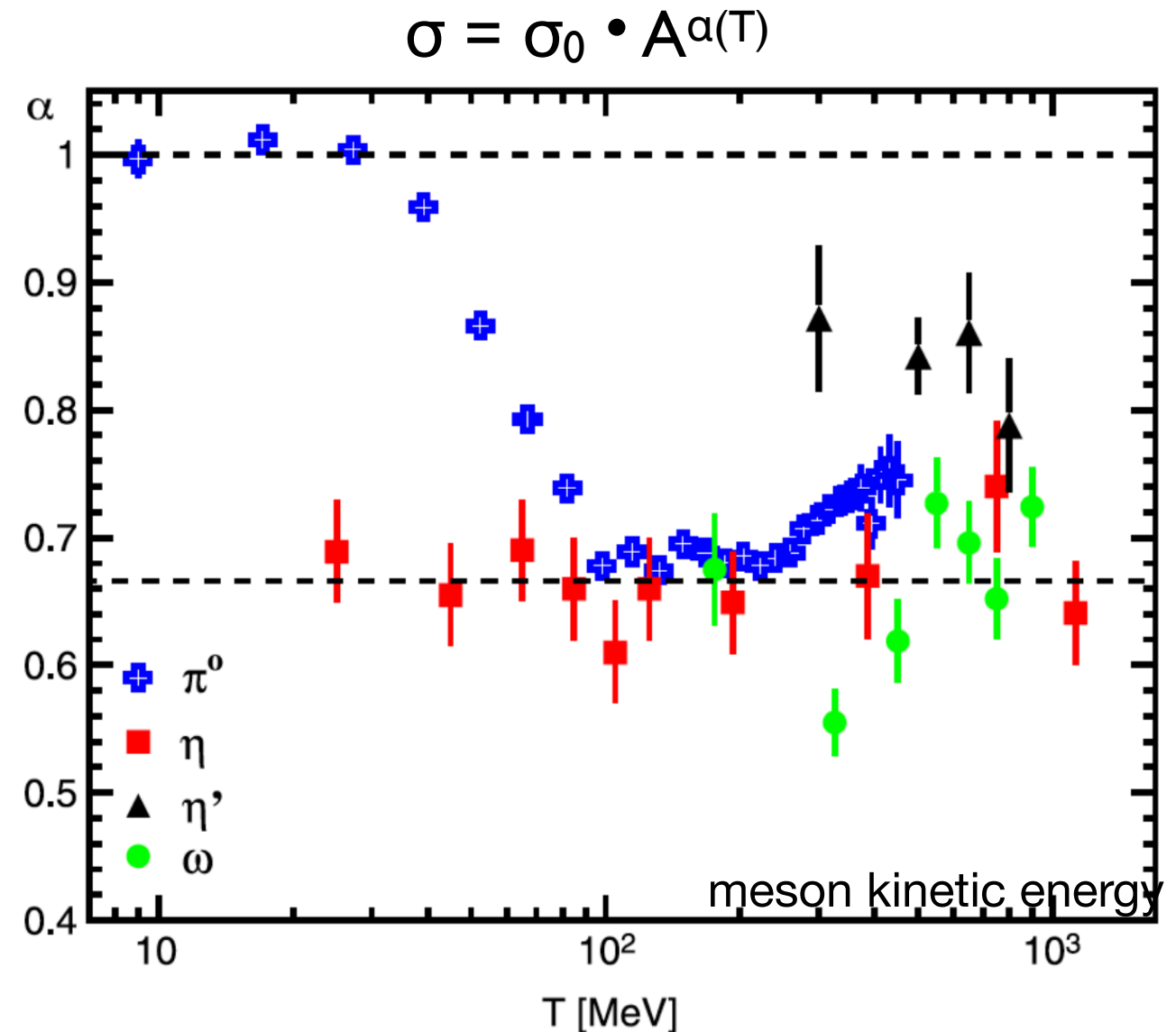
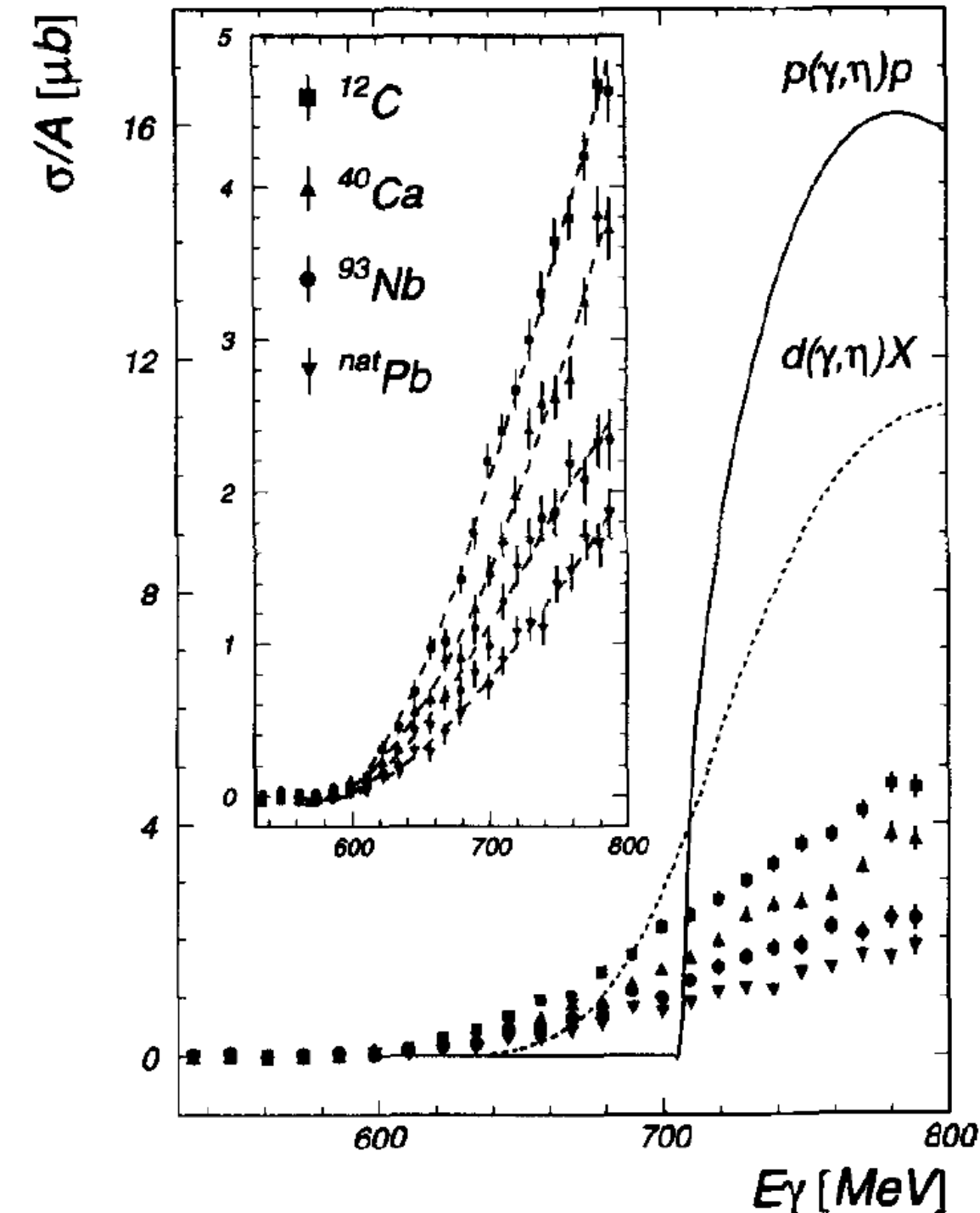


Photoproduction of η mesons off nuclei

M. Roebig-Landau et al. PLB 373 (1996) 45 (TAPS)

T. Mertens et al., EPJA 38 (2008) 195 (CBELSA/TAPS)

information on meson absorption in nuclei



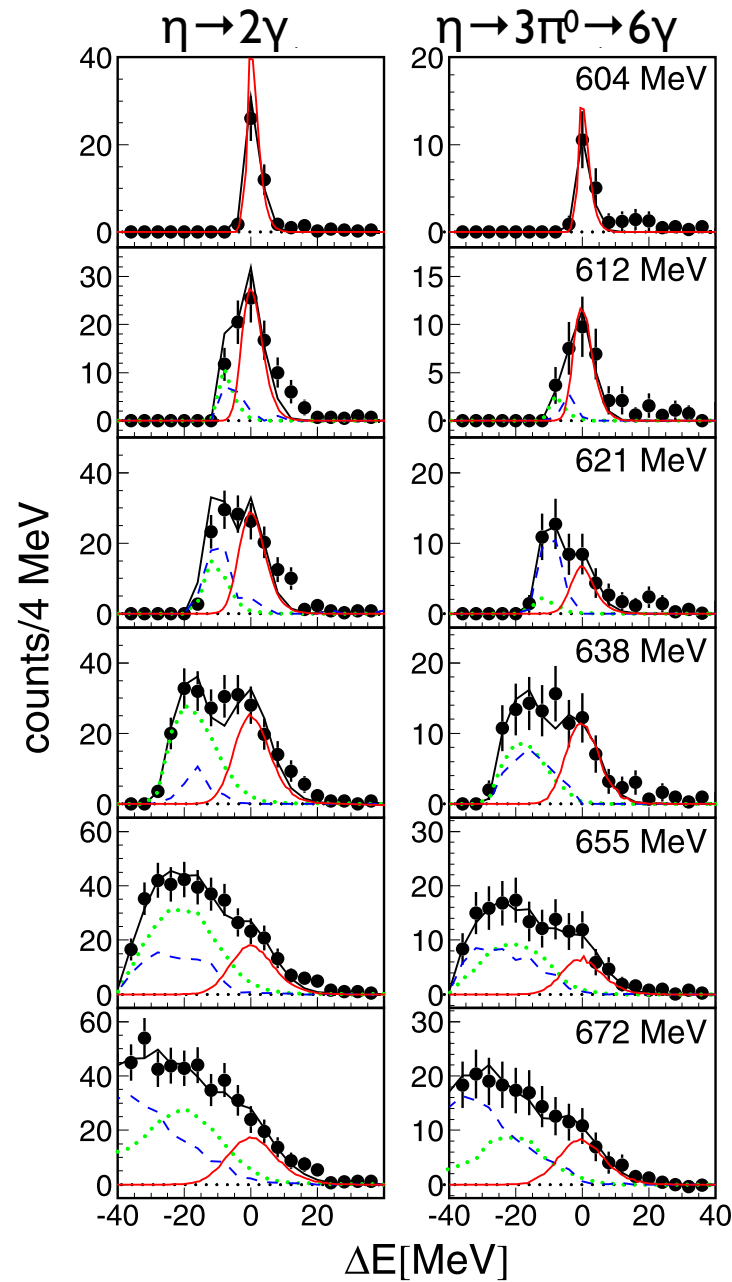
$$\sigma_{\text{abs}}^{\eta N} = (30 \pm 6) \text{ mb}$$

$\lambda = 2.0 \text{ fm} < R_{\text{nuclei}} ; \alpha \approx 2/3$
almost independent of T

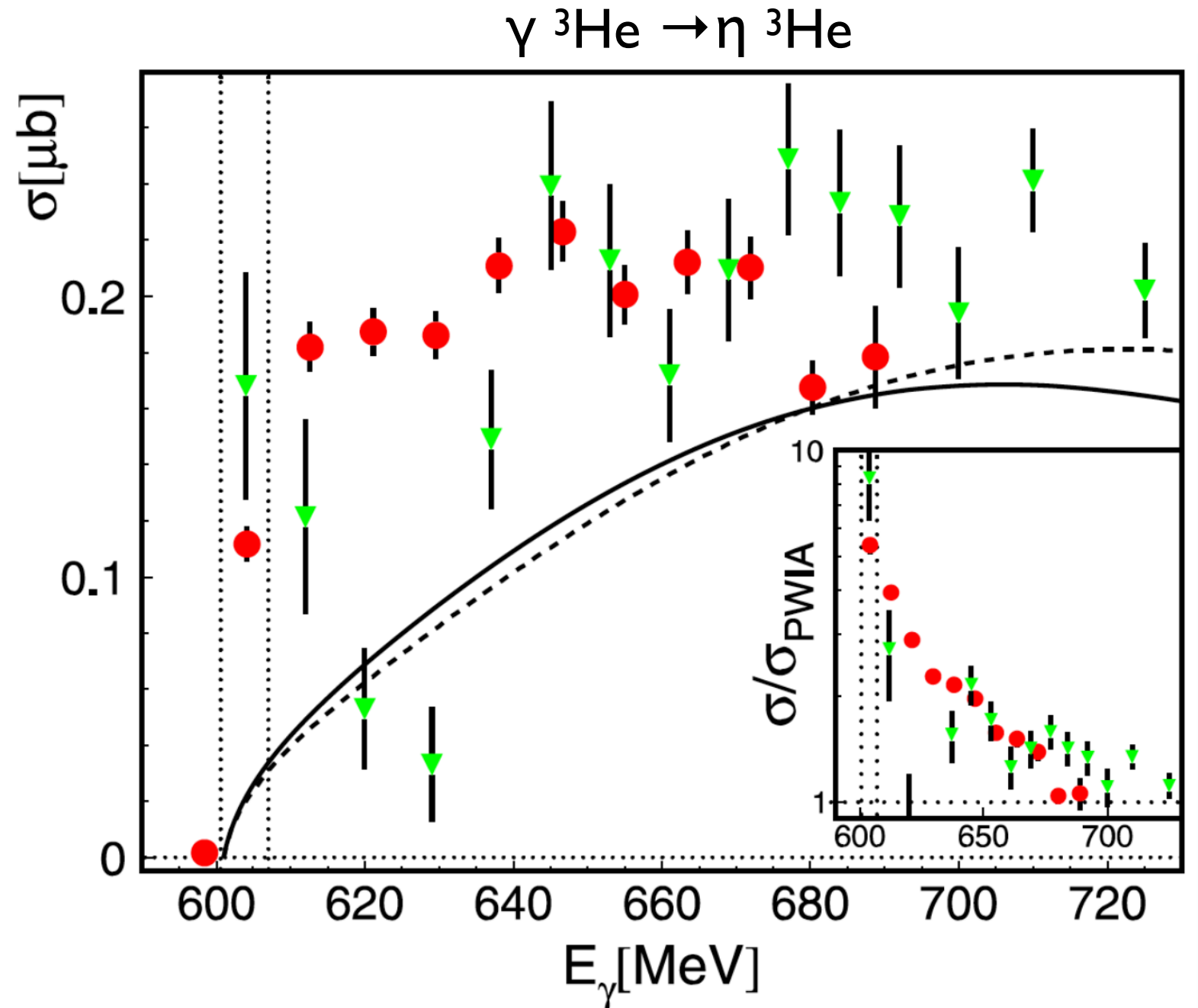
search for η - nucleus bound states

$$\gamma \ ^3\text{He} \rightarrow \eta \ X$$

missing energy spectra to select
coherent η production



- ▼ M. Pfeiffer et al. 92 (2004) 252001 (TAPS)
- F. Pheron et al., PLB 709 (2012) 21 (Crystal Ball)

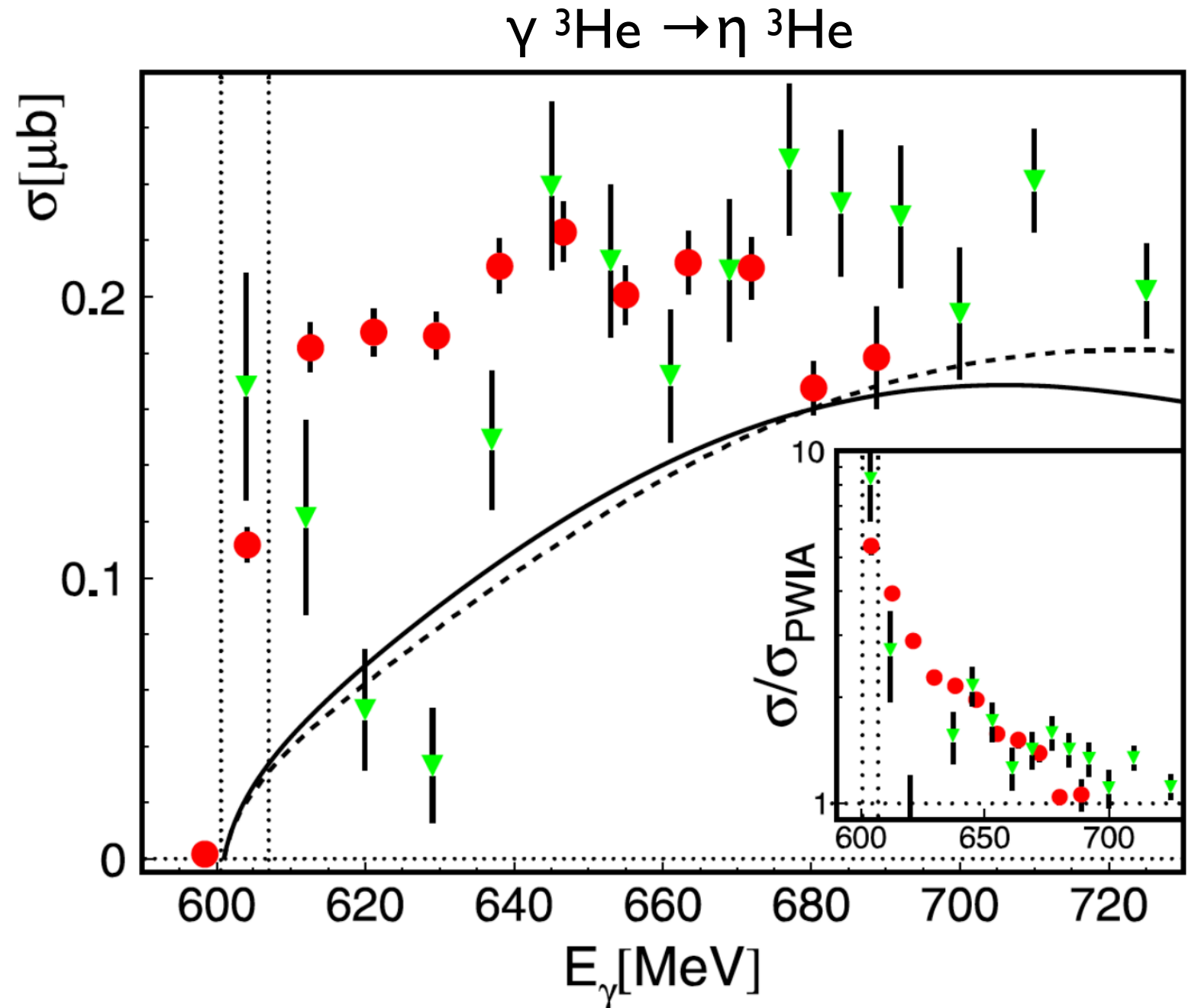
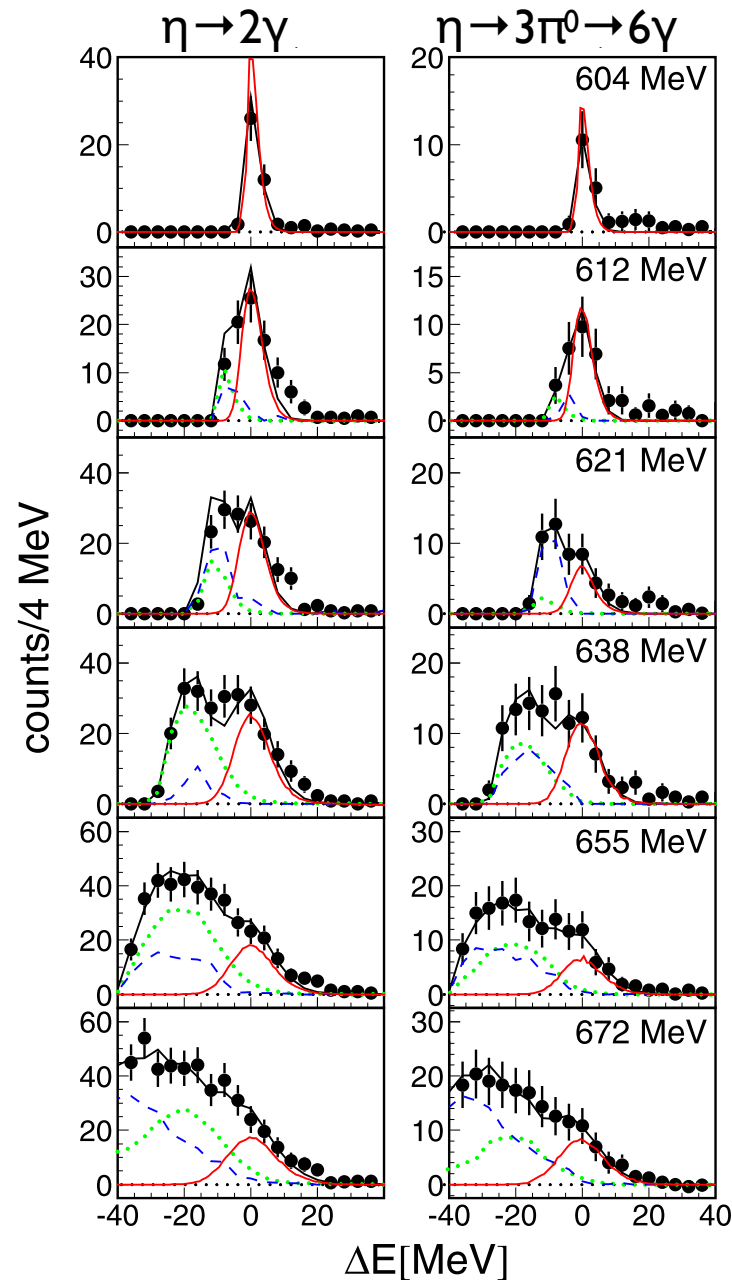


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corresponding data with higher statistics obtained with hadron beams at COSY

strong rise of cross section at threshold →

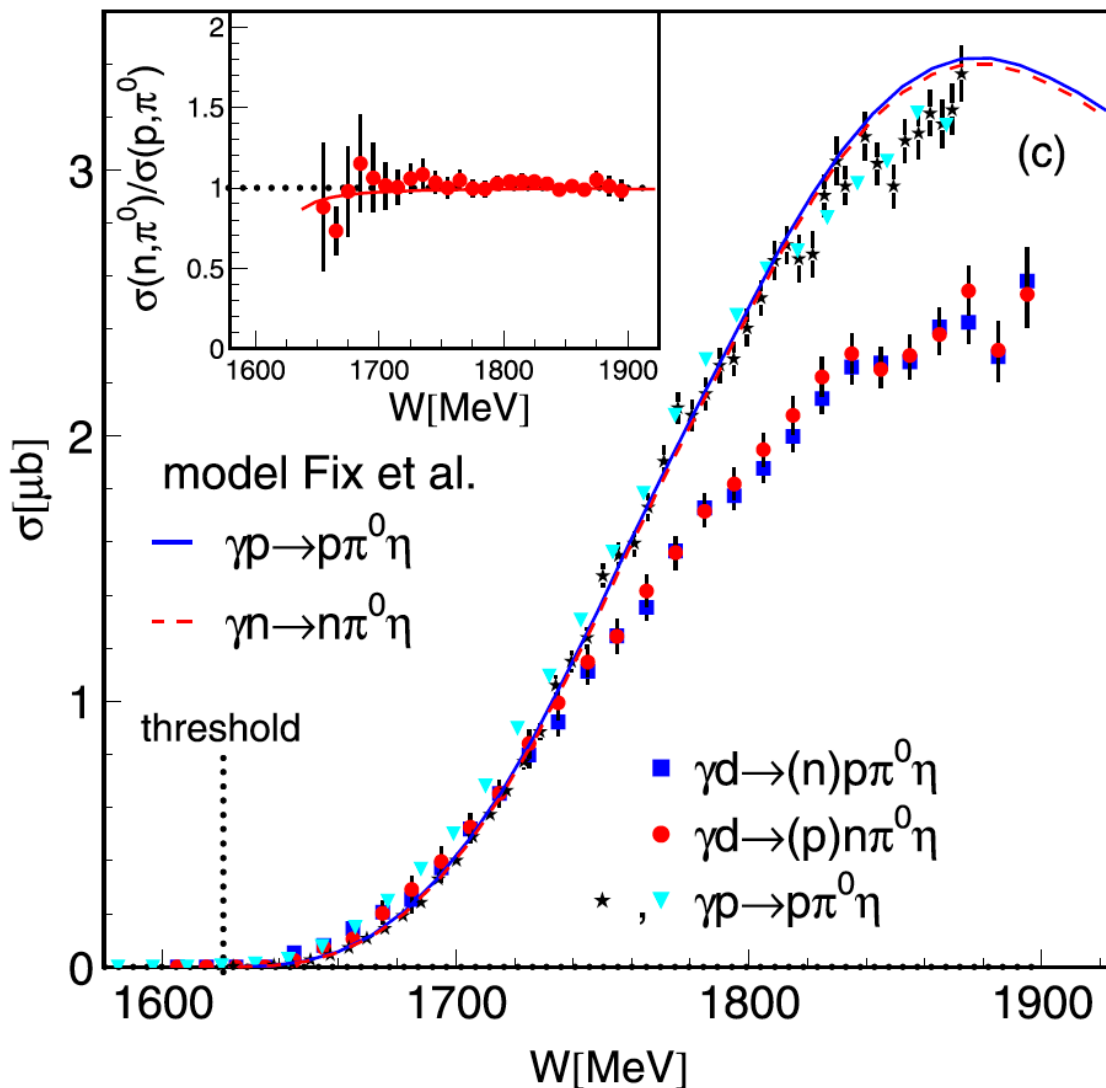
strong η - ^3He final state interaction, but no convincing evidence for η - ^3He bound state

photoproduction of meson pairs

A. Käser et al., PLB 748 (2015) 244 (Crystal Ball/TAPS)

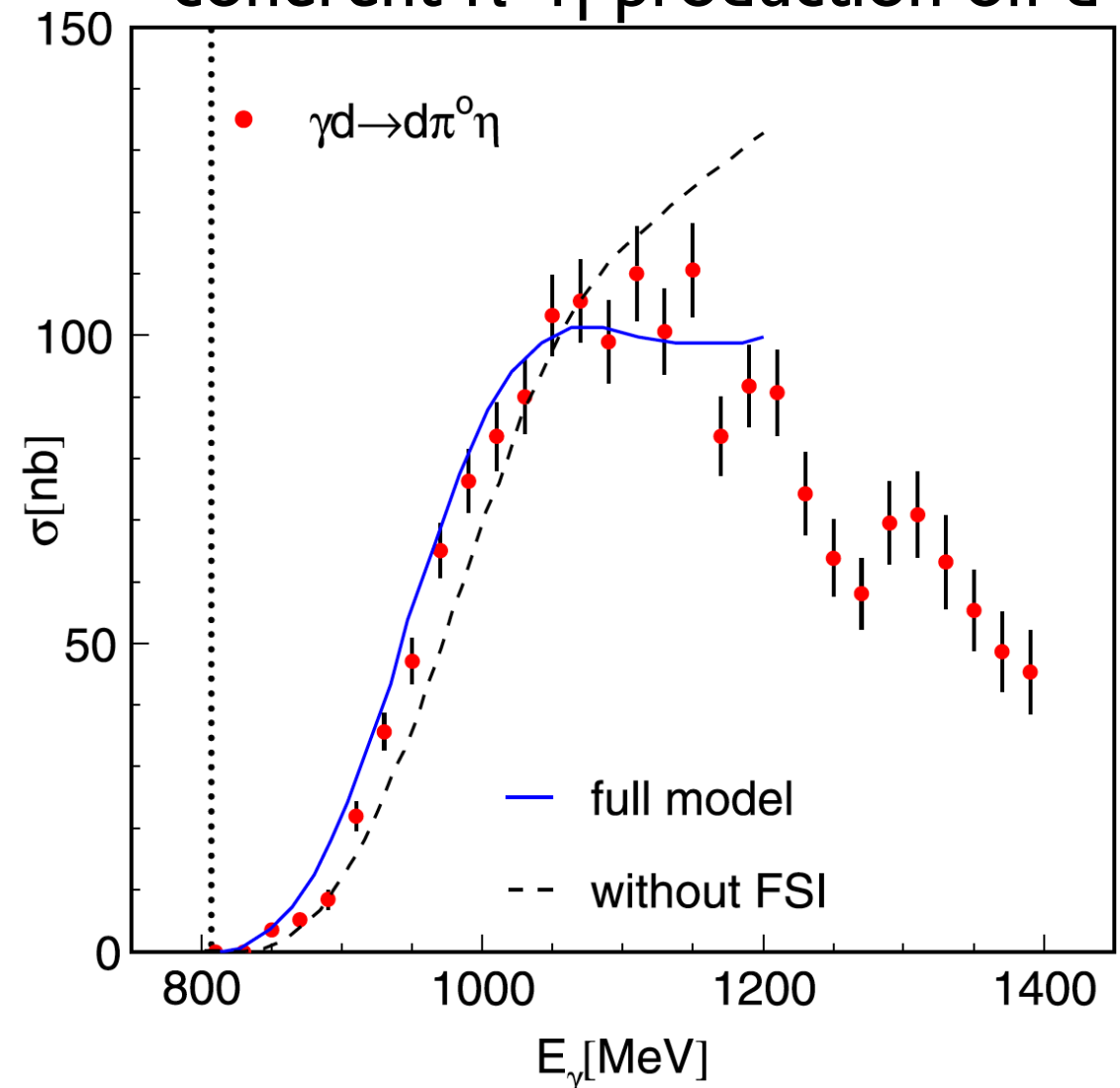
$$\gamma d \rightarrow \pi^0 \eta (p, n, d)$$

$\pi^0 \eta$ production off
the free and bound nucleon



cross section off bound nucleon
suppressed by FSI

coherent $\pi^0 \eta$ production off d



promising tool for studying η -nucleus interaction
(search for η -A bound states) by selecting high
momentum π^0 and thus low momentum η mesons

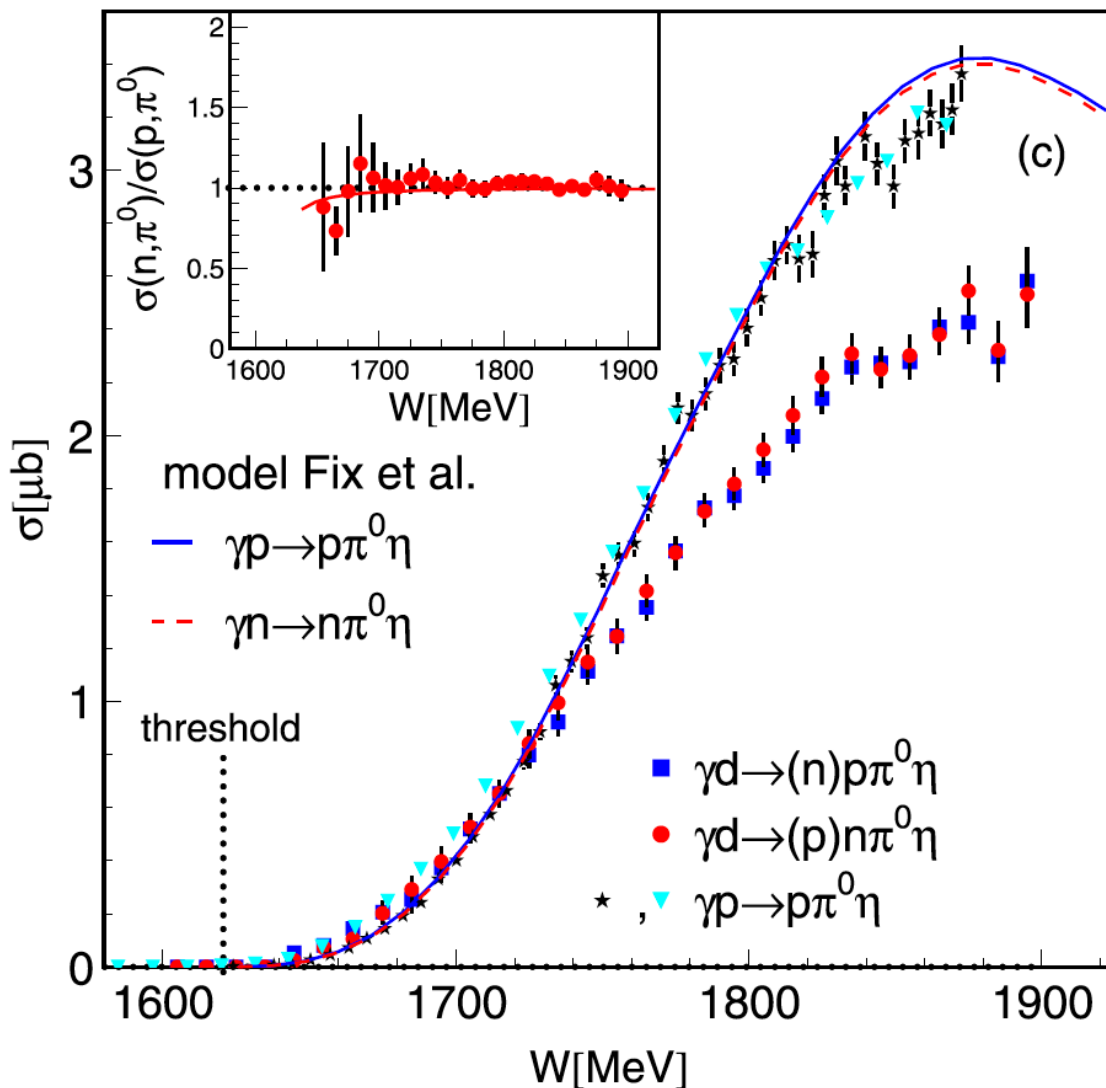
interesting results obtained by Ishikawa et al. (ELPH) PRC 104 (2021) L052201

photoproduction of meson pairs

A. Käser et al., PLB 748 (2015) 244 (Crystal Ball/TAPS)

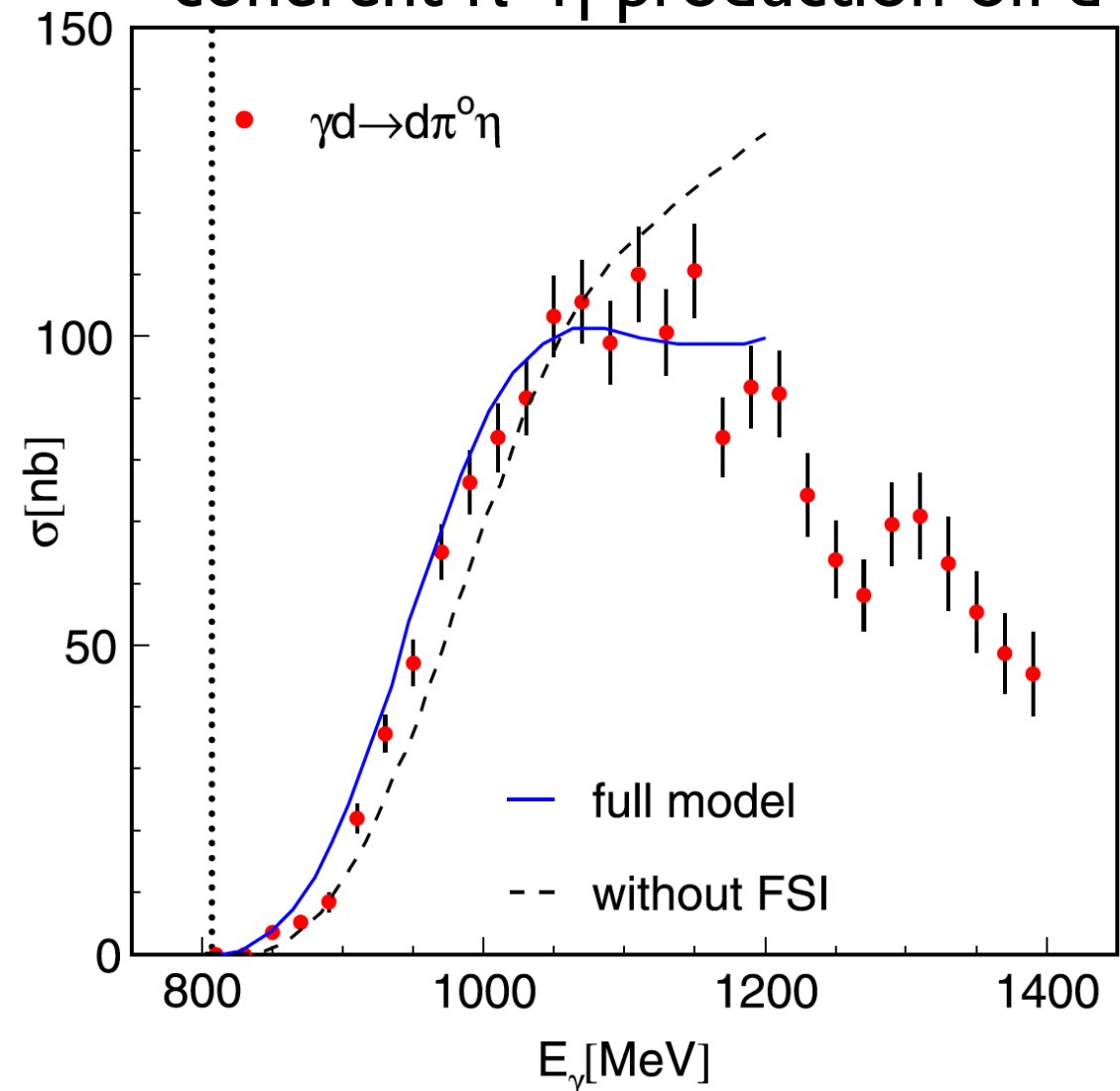
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interesting results obtained by Ishikawa et al. (ELPH) PRC 104 (2021) L052201

more results from the Basel group; S. Lutterer; Thursday 17:00



Bernd Krusche
27.2.1956 - 1.6.2022

Bernd,
you left us far too early
we miss you

thank you
for all your achievements
and
for your friendship

