CLAS Collaboration Meeting 2017

JPAC Report

(Summer'17 Edition)

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on behalf of the Joint Physics Analysis Center

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Joint Physics Analysis Center (2013)

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Joint Physics Analysis Center (2017)

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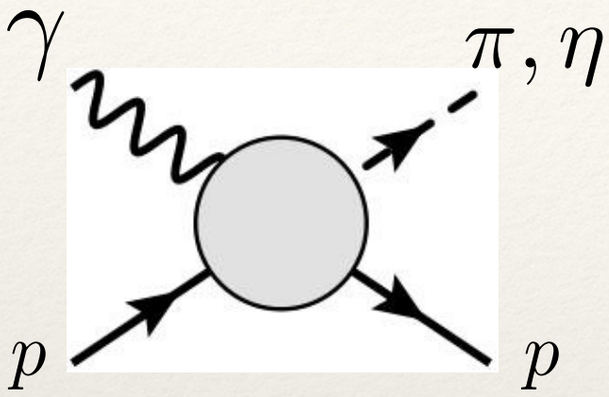
What are we doing?

- We care for hadron spectroscopy to gain insight on QCD
- We develop amplitudes following the principles of *S* matrix theory, *i.e.*
  - Unitarity, crossing symmetry, analyticity, symmetries
- Resonances = Poles in the unphysical Riemann sheets

Build Amplitude → Fit Data → Get Physics

Recent results of interest to CLAS

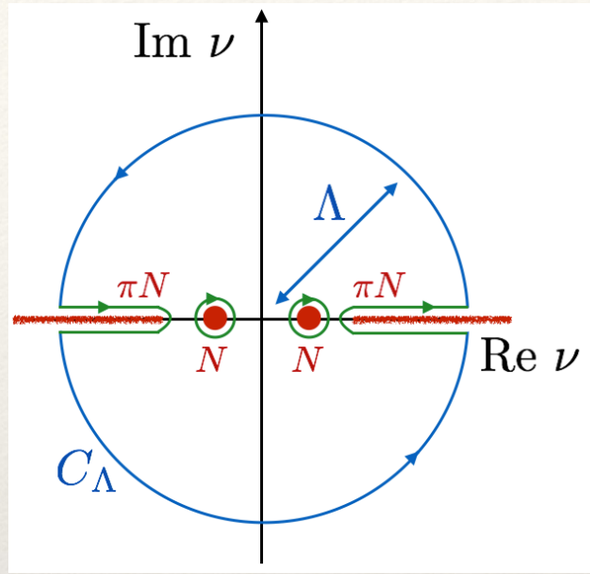
Finite Energy Sum Rules



$$\int_0^{\Lambda} \text{Im } A_i(\nu,t)\nu^k d\nu = \beta_i(t)\frac{\Lambda^{\alpha_i(t)+k}}{\alpha_i(t)+k+1} + \ldots$$

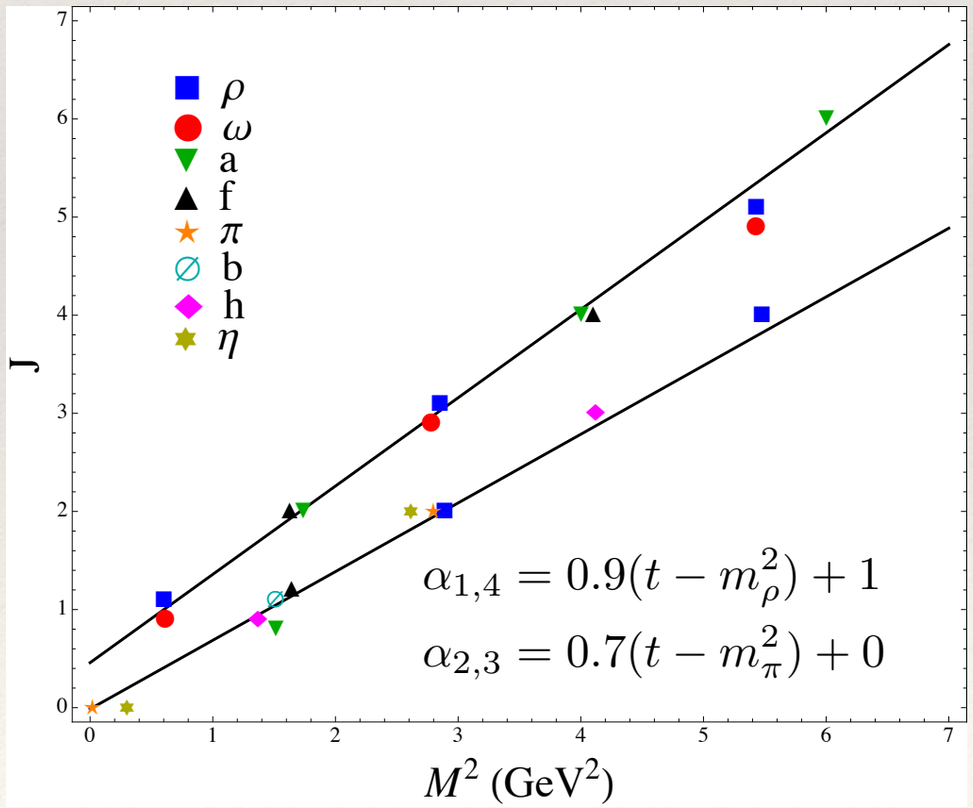
$S_i(t,k)$

$$\nu = (s-u)/2$$

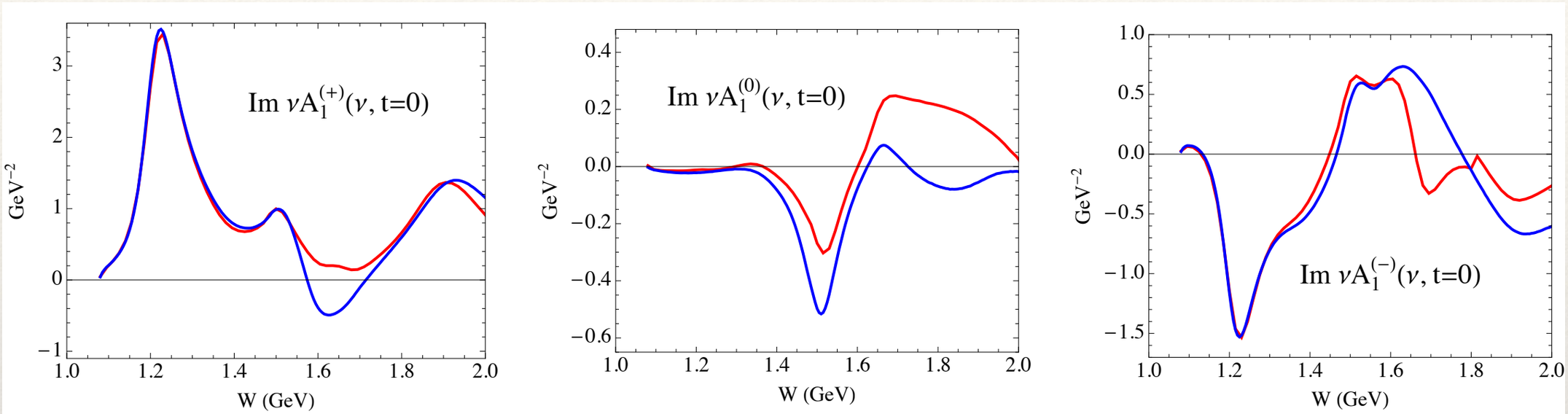


High-energy residue prediction
from low-energy data

$$\widehat{\beta}_i(t) = S_i(t,k)\frac{\alpha_i(t)+k+1}{\Lambda^{\alpha_i(t)+k}}$$
$$= \beta_i(t) + \mathcal{O}(1/\Lambda)$$



Low-energy amplitudes

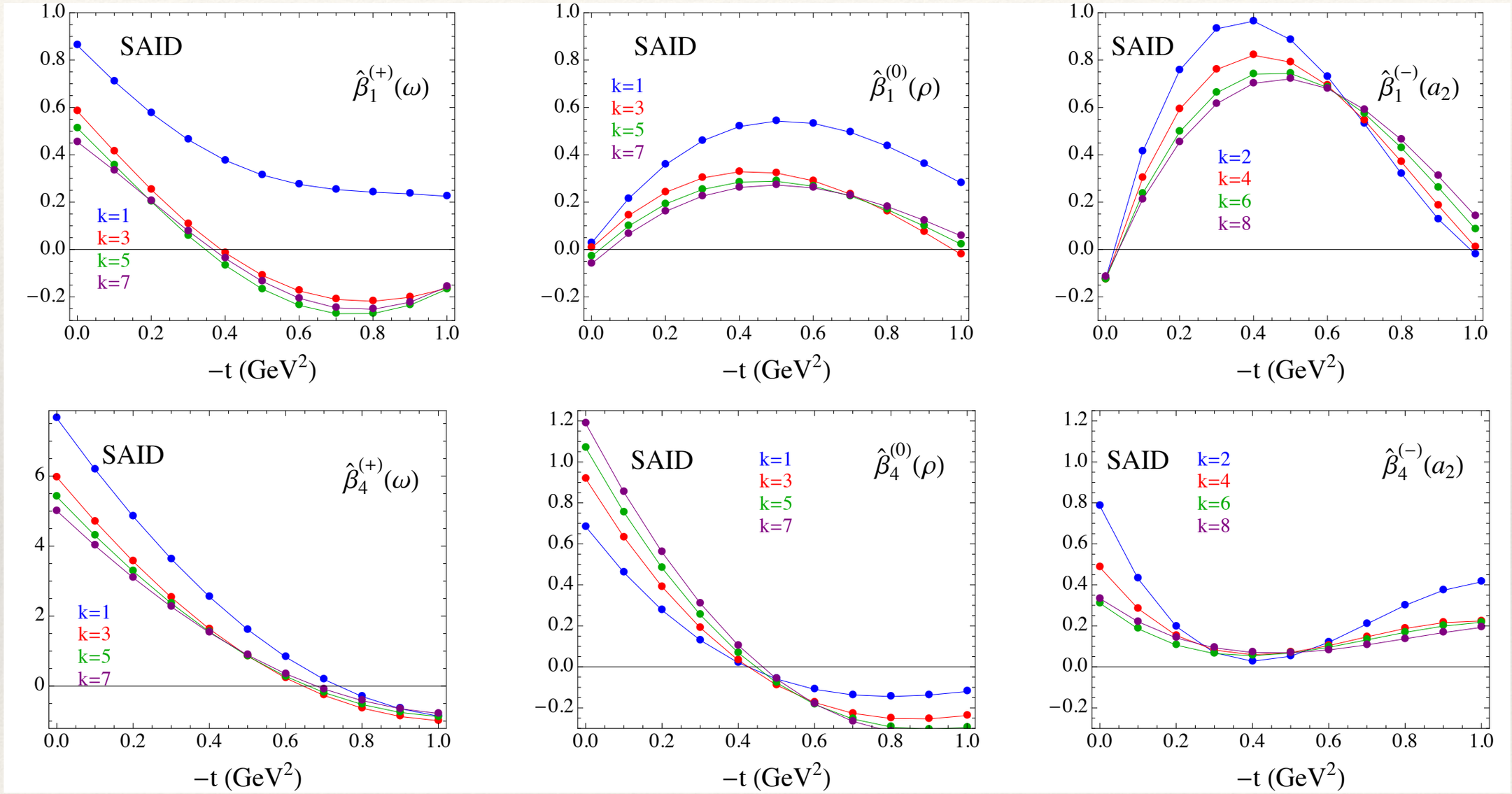


SAID

MAID

Provide the left-hand side of the FESR

Residues prediction



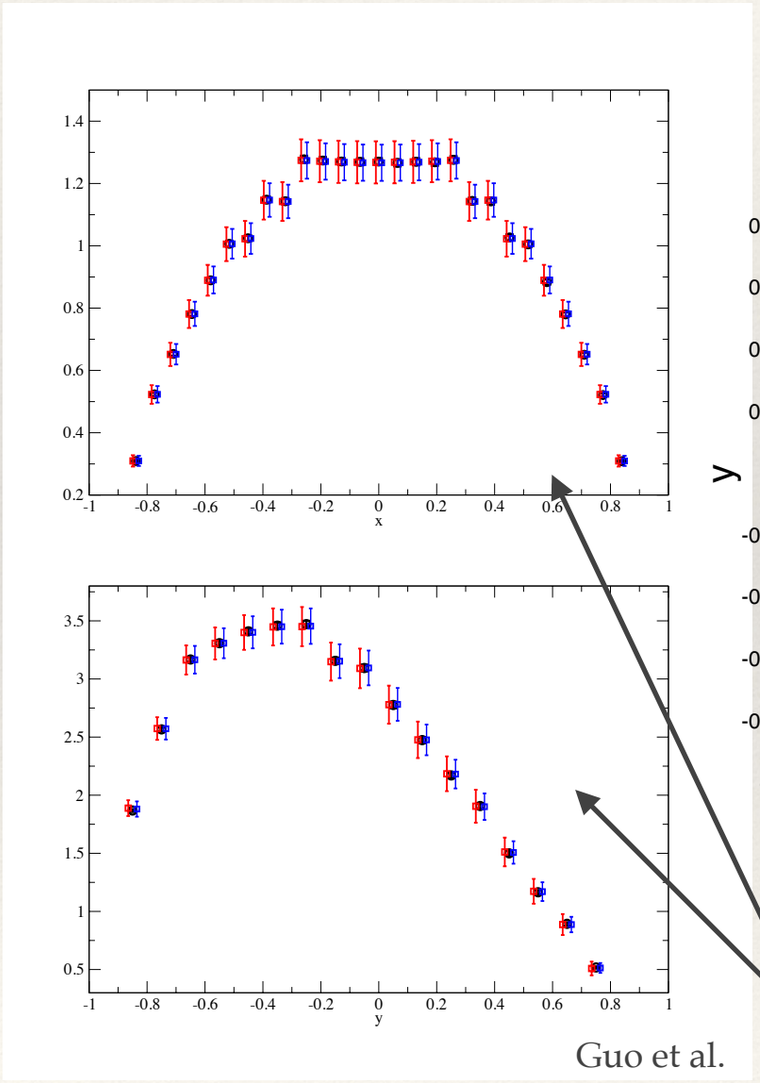
Mathieu *et al.*, in preparation (2017)

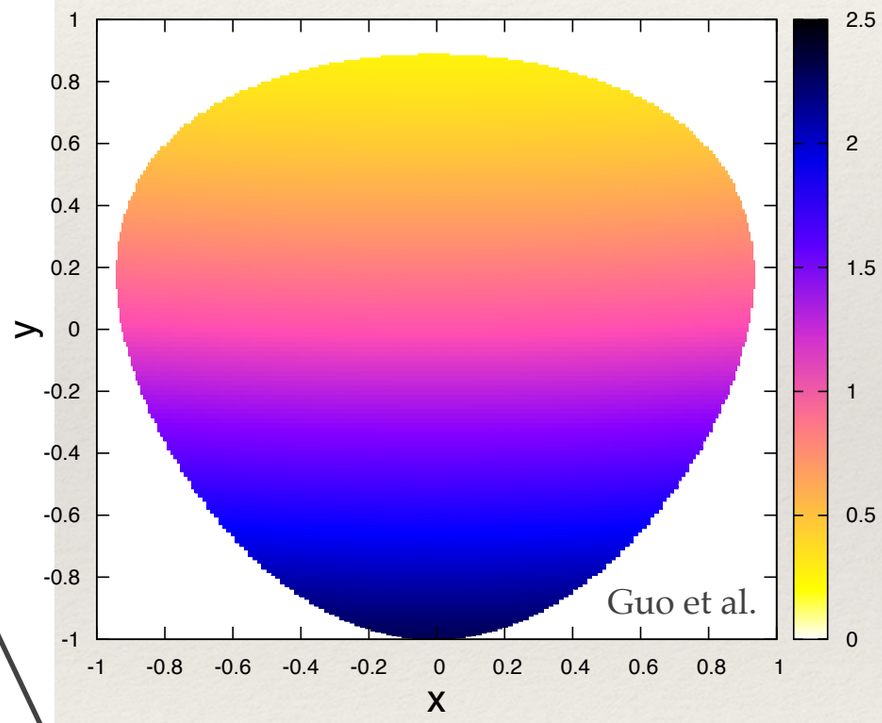
$\eta \to 3\pi$

Two different approaches ⇒ model dependencies and systematics under control

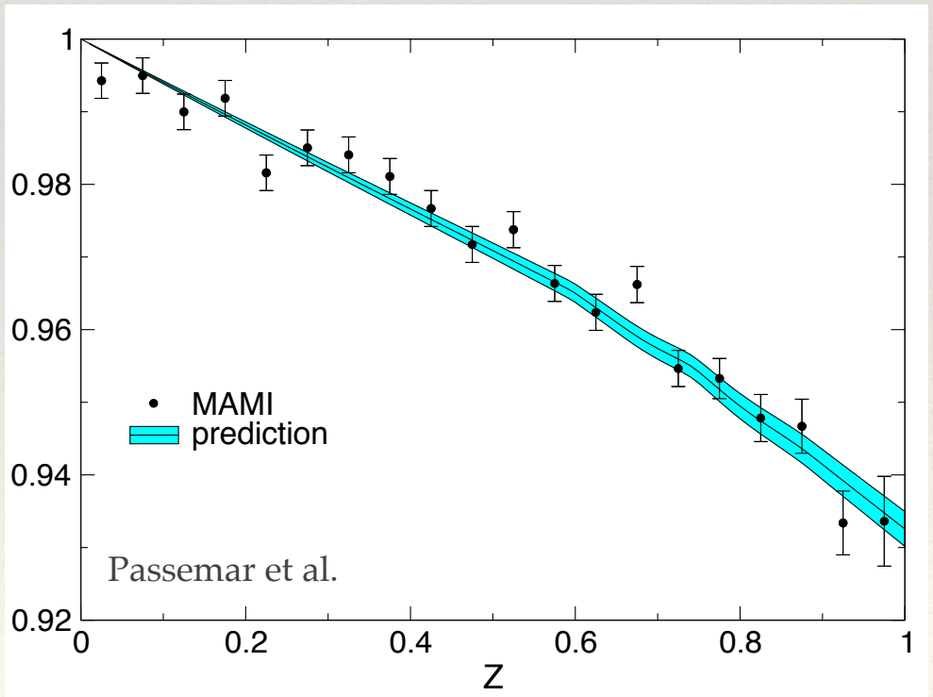
Guo *et al.* PRD 92 (2015) 054016 , PLB 771 (2017) 497

Colangelo, Lanz, Leutwyler, Passemar, PRL 118 (2017) 022001





Latest KLOE data



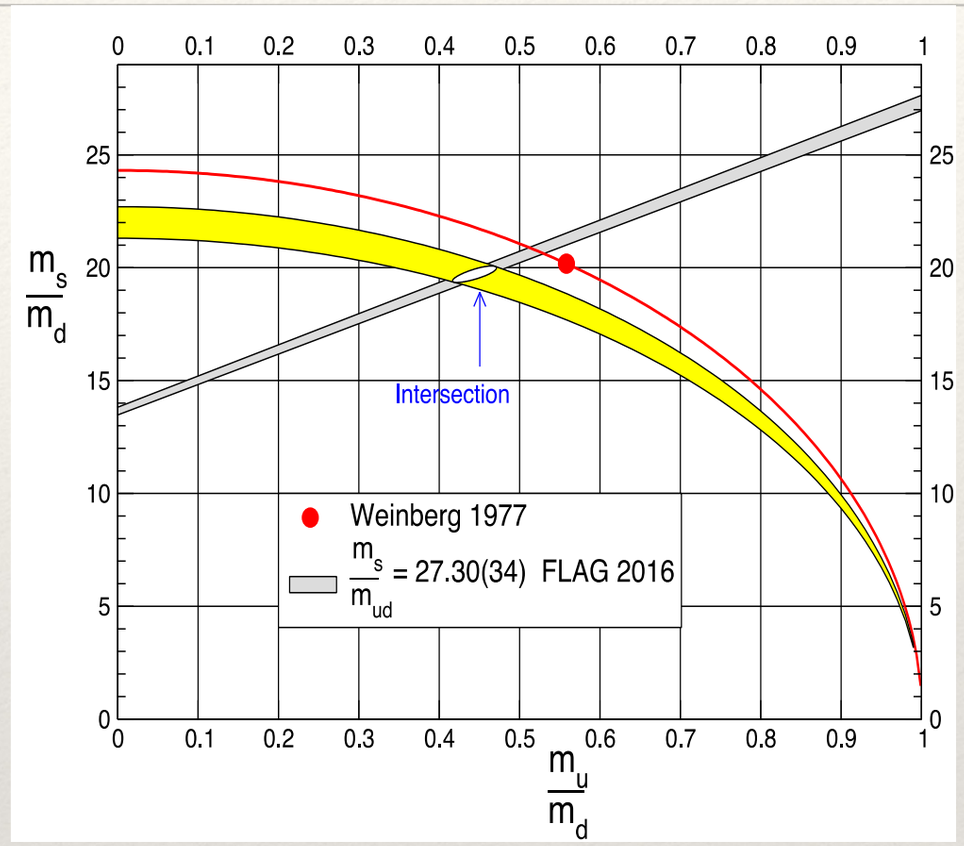
Quark mass ratio

Matching ChPT to the dispersive amplitude we can obtain the quark mass ratio

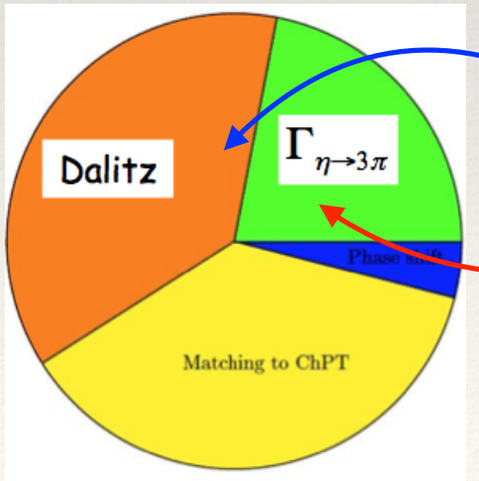
$$Q^2 = \frac{m_s^2 - m_{ud}^2}{m_d^2 - m_u^2} \qquad m_{ud} = \frac{m_u + m_d}{2}$$

$Q = 21.6 \pm 1.1$ [Guo et al. (2017)]

$Q = 22.0 \pm 0.7$ [Passemar et al. (2017)]



Error sources



Can be investigated & reduced at *GlueX, JEF, **CLAS***

Pentaquark Photoproduction

- We need independent confirmation of the LHCb signal
- J/Ψ photoproduction on the proton is a perfect reaction for an independent confirmation (if the pentaquark couples strongly enough to the photon)
- The pentaquark signal should be clearly visible with the current experimental resolution at CLAS
- If P_c is confirmed, we need to:
  - Study the electromagnetic properties
  - Look for the other members of the P_c multiplet

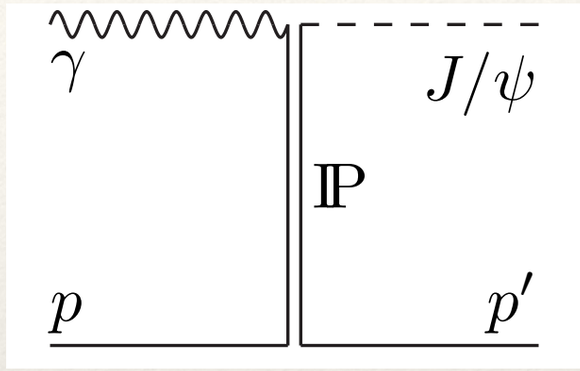
Bijker, arXiv:1705.10252
Bijker, F-R, in preparation (2017)

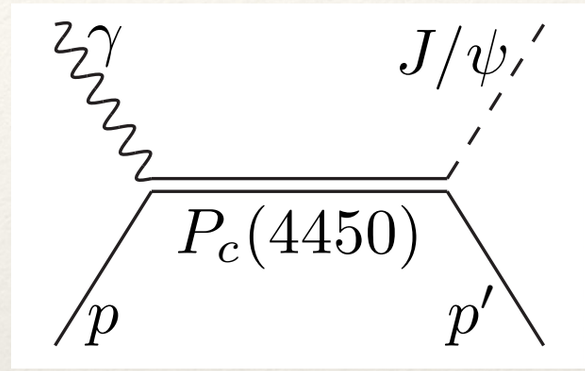
Pentaquark Photoproduction

Model for J/Ψ photoproduction

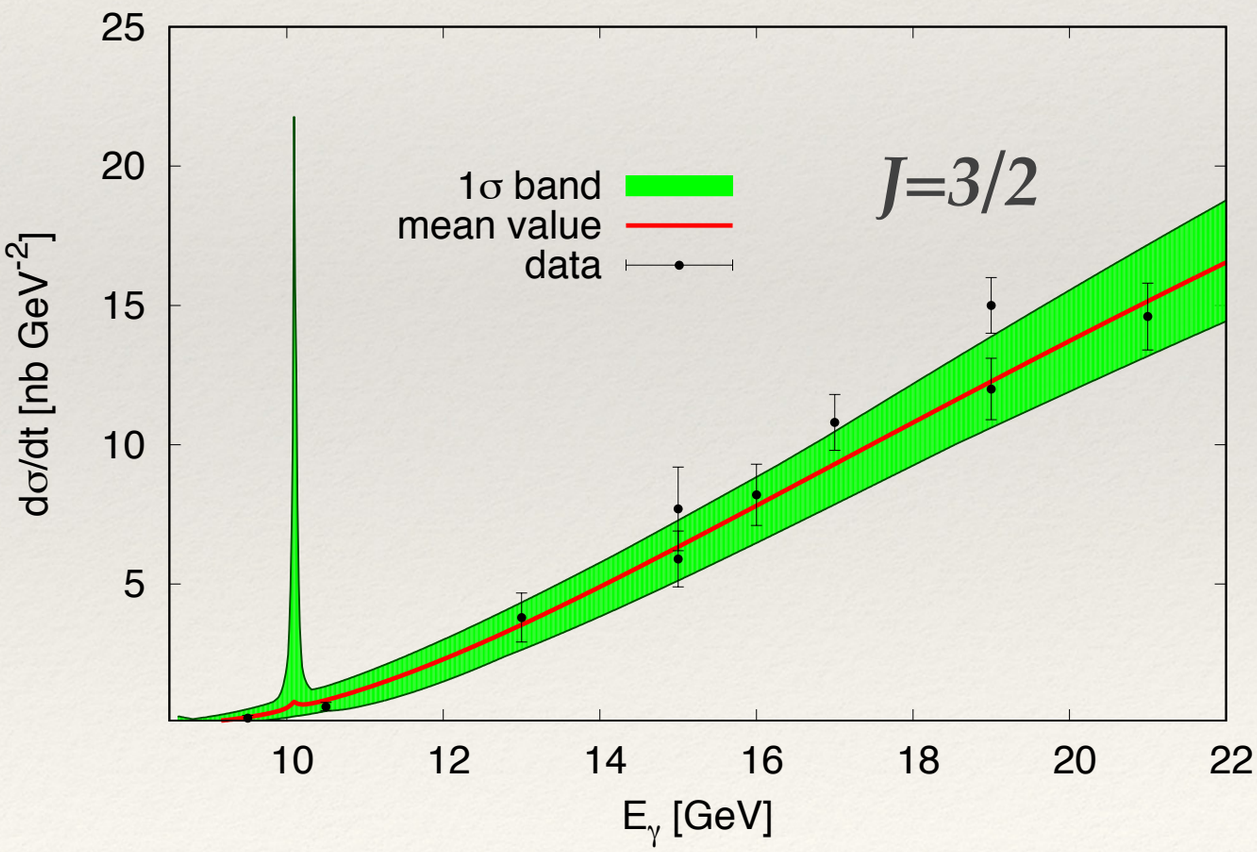
Pomeron + Resonance

- High-energy dominated by Pomeron exchange
- Resonance added as a Breit-Wigner
- We assume vector meson dominance (we do not know the em couplings)





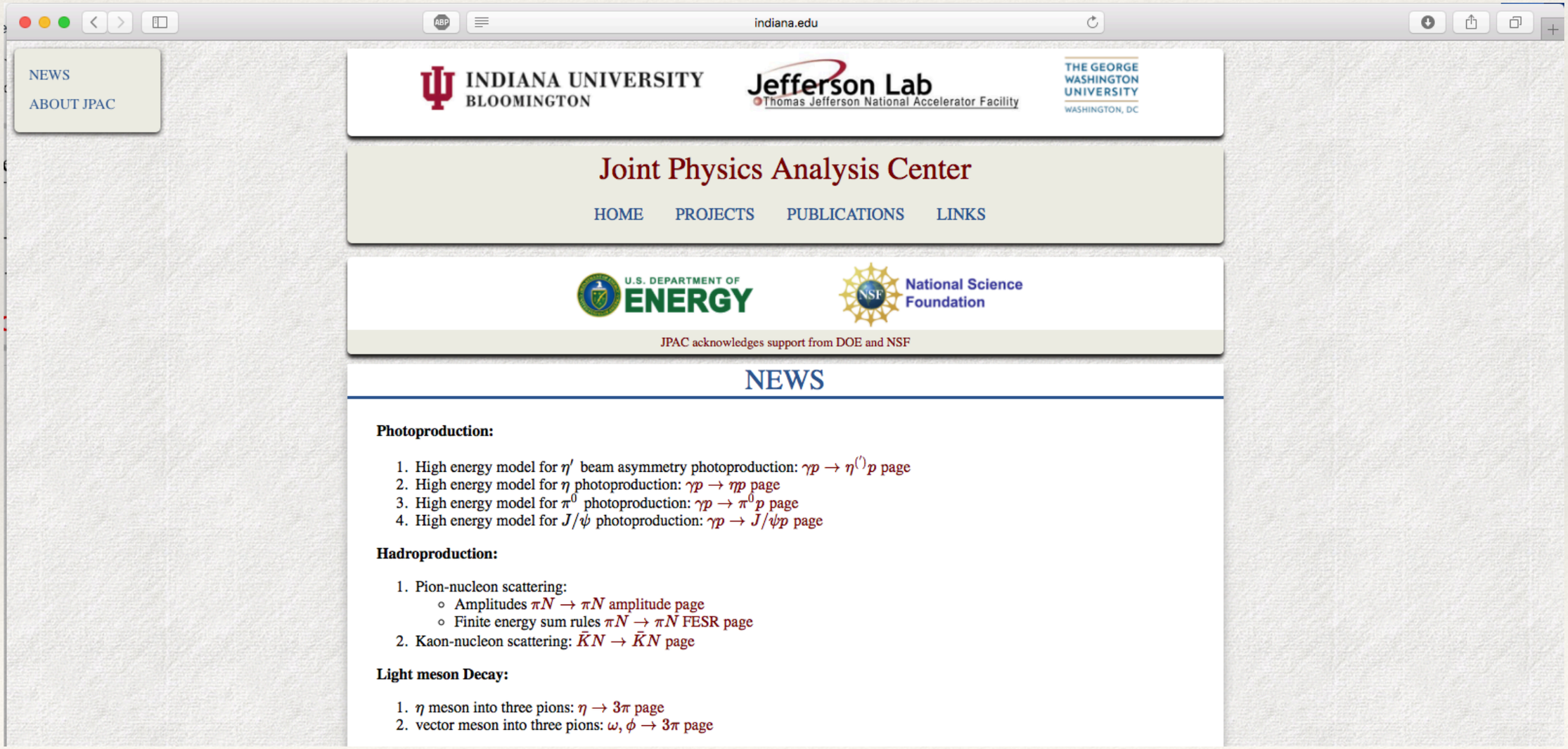
Hiller Blin *et al.*, PRD 94 (2016) 034002
F-R, Hiller Blin, Pilloni, arXiv:1703.06928



Webpage

http://www.indiana.edu/~jpac/

- Codes and documentation can be downloaded
- Codes can be run online



Summary

- JPAC keeps producing results on amplitude analyses
- Several projects of interest to CLAS
  - FESR as high-energy constrains on the resonance region
  - $\eta \to 3\pi$
  - Pentaquark electro- and photo-production
    - If confirmed, it opens an exciting opportunity for CLAS
- All goes to the webpage, take advantage!