

15th International Workshop on the Physics of Excited Nucleons

Sep 7 – 11, 2026
Europe/Madrid timezone



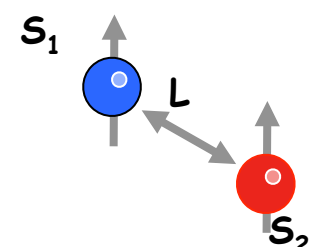
Meson Spectroscopy with the CLAS12 Detector

M. Battaglieri
INFN

What we know (light q)

Constituent Quark Model

- Quark-antiquark pairs with total spin $S=0,1$ and orbital angular momentum L



$$S = S_1 + S_2 \quad J = L + S$$

$$P = (-1)^{L+1} \quad C = (-1)^{L+S}$$

Not all the J^{PC} combinations are allowed:
 $0^{++} \ 0^{-+} \ 0^{-+} \ 0^{--} \ 1^{++} \ 1^{+-} \ 1^{-+} \ 1^{--} \ 2^{++} \ 2^{-+} \ 2^{-+} \ 2^{--} \ 3^{++} \ 3^{+-} \ 3^{-+} \ 3^{--} \dots$

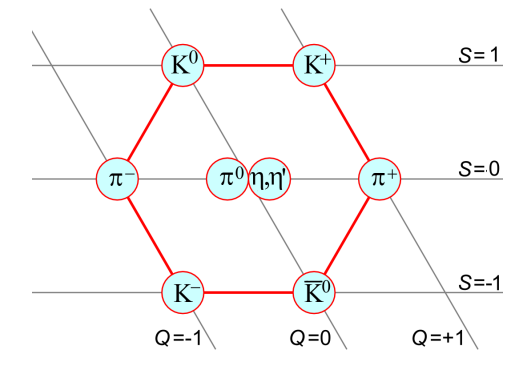
- SU(3) flavor symmetry $\rightarrow$ nonet ($8 \oplus 1$) of degenerate states

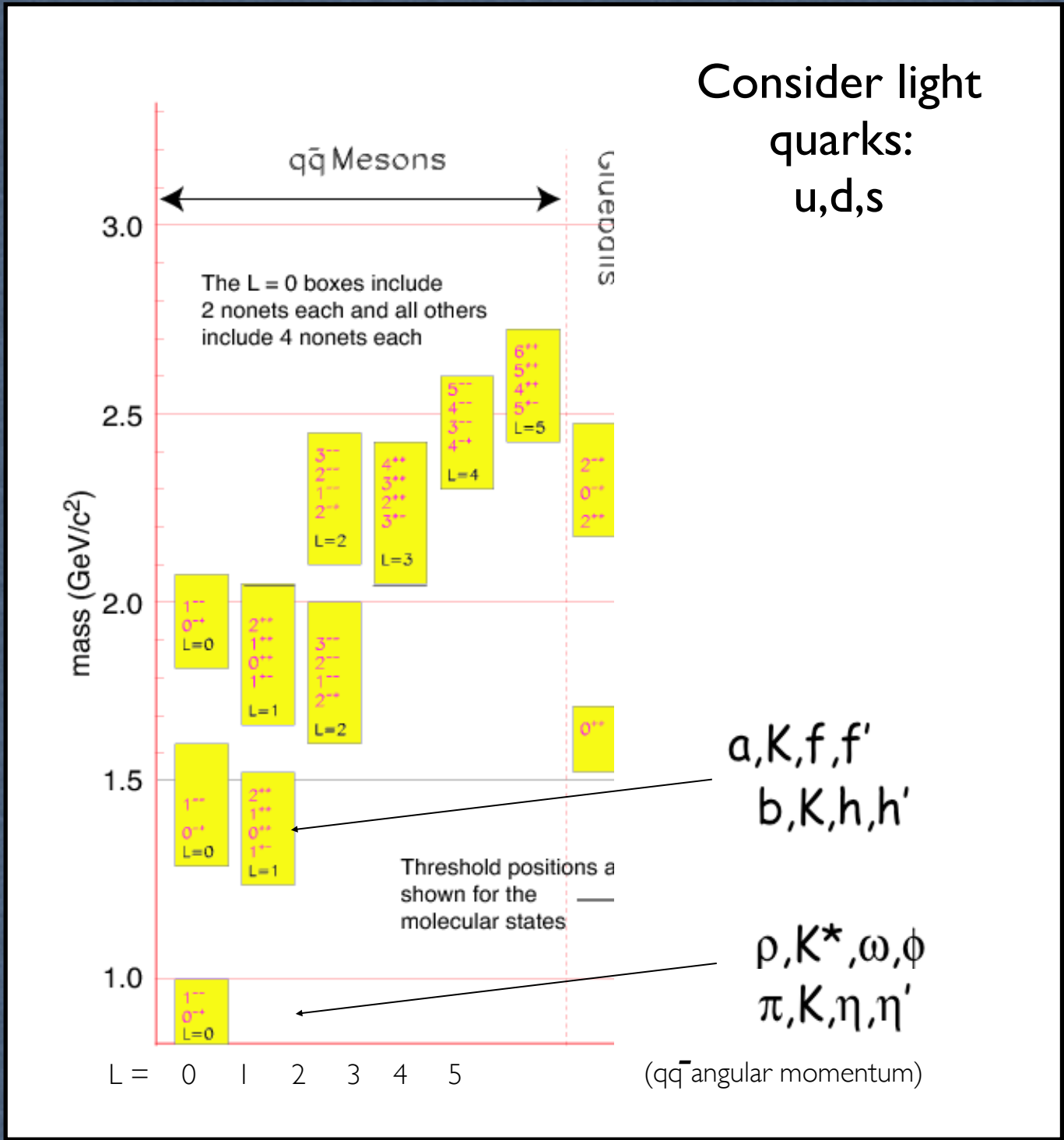
$J^{PC} = 0^{-+} \Rightarrow (\pi, K, \eta, \eta')$

$1^{--} \Rightarrow (\rho, K^*, \omega, \Phi)$

$1^{+-} \Rightarrow (b_1, K_1, h_1, h_1')$

...



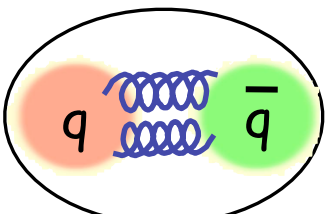


- Great success in describing the lower mass states
- but, a number of predicted states is not experimentally observed and assignments are uncertain

The gluons and the hadron spectrum

- Understanding gluonic excitations of mesons and the origin of confinement
- At high energy experimental evidence is found in jet production
- At lower energies the hadron spectrum carries information about the gluons that bind quarks
- Can we find hints of the glue in the meson spectrum?

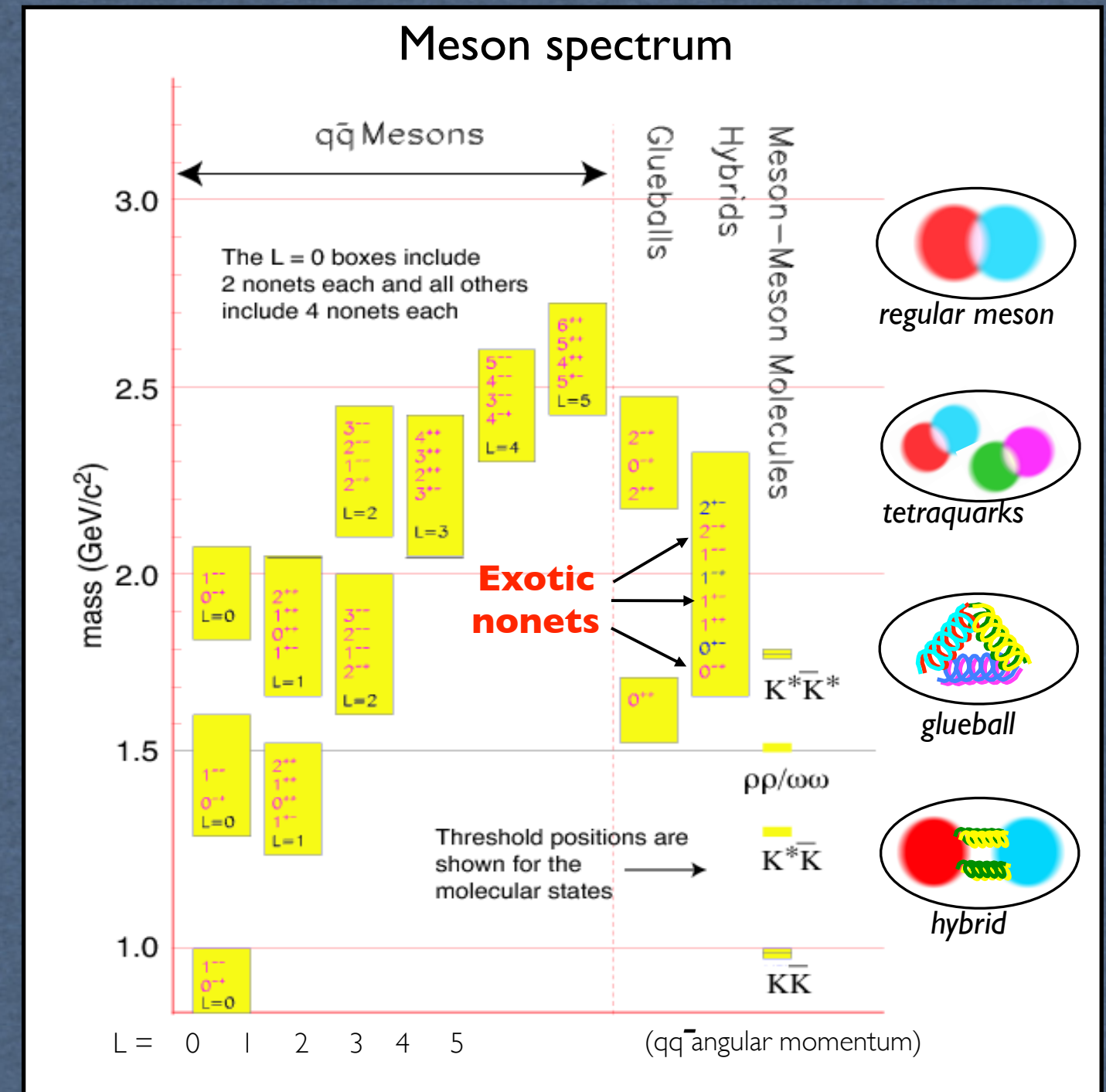
Search for non-standard states with explicit gluonic degrees of freedom



Not-allowed $J^{PC} = 0^{--}, 0^{+-}, 1^{-+}, 2^{+-} \dots$

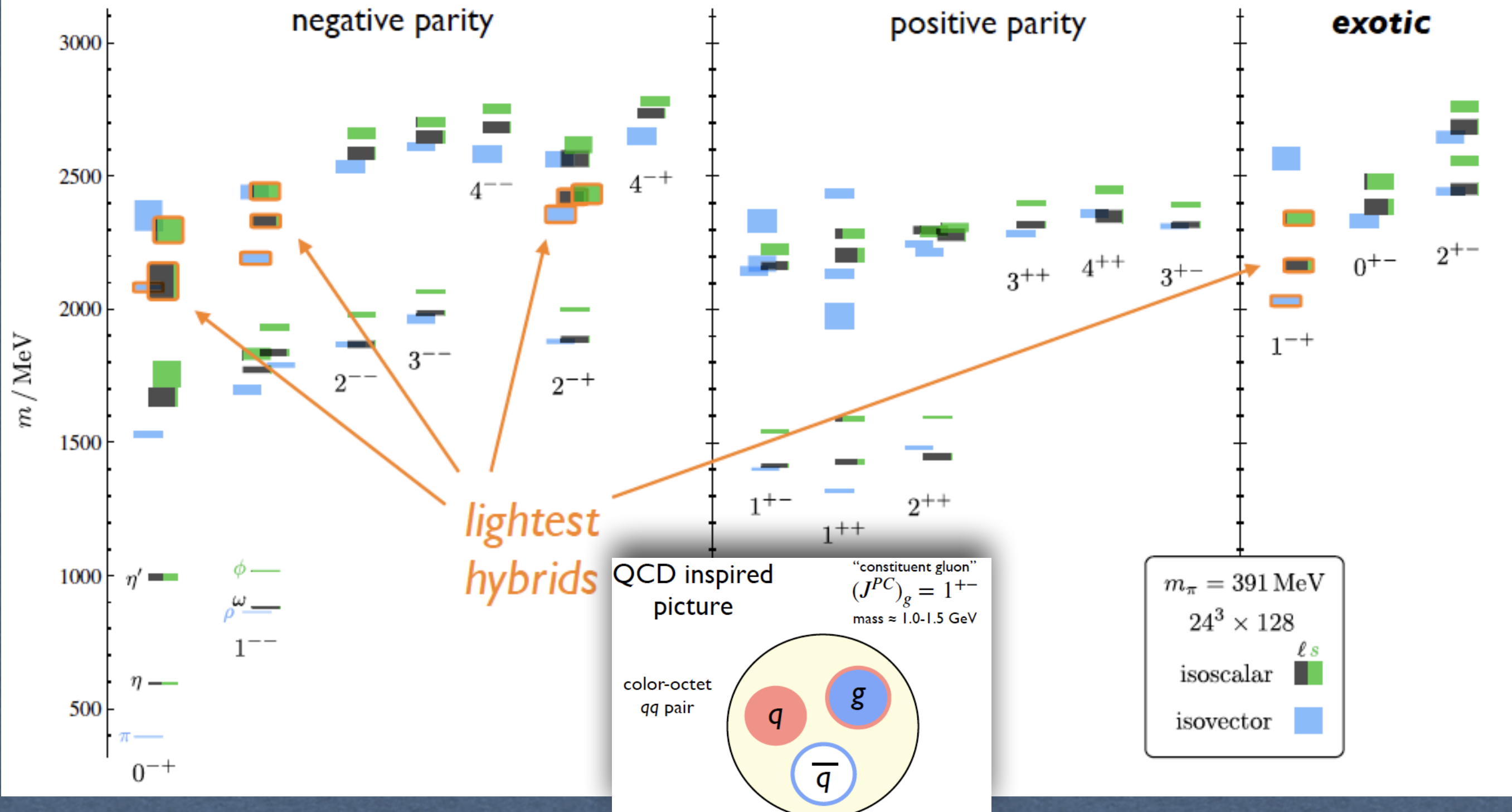
Unambiguous experimental signature for the presence of gluonic degrees of freedom in the spectrum of mesonic states

hybrid mesons



Light q spectrum from lattice QCD

Dudek, Edwards, Guo, and Thomas, PRD 88, 094505 (2013)



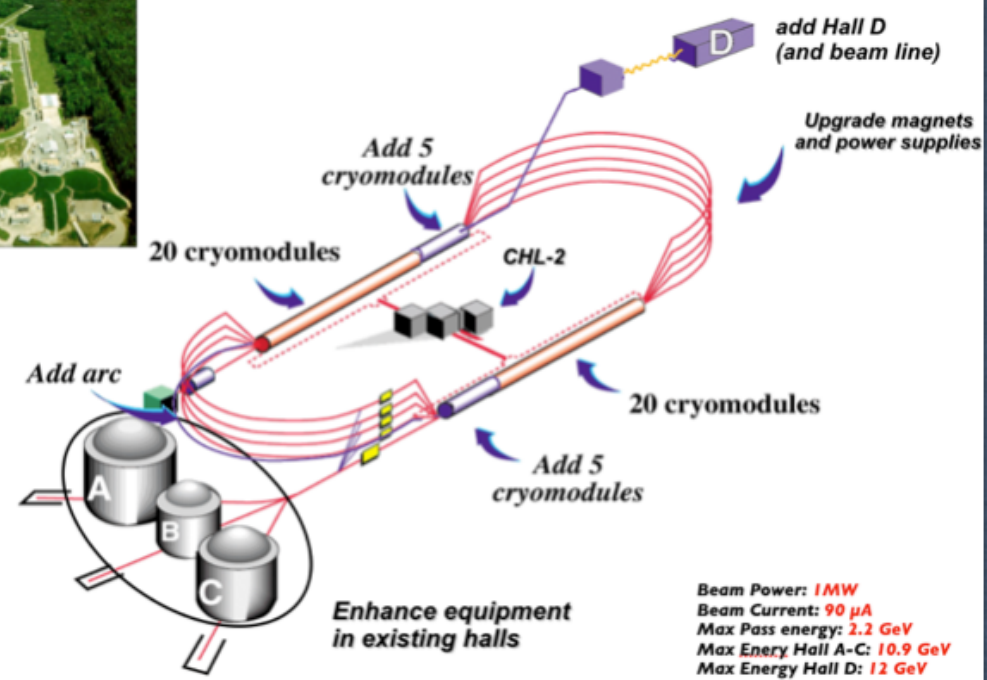
Lattice-QCD predictions
for the lowest hybrid
states

$0^{+-} \sim 2.0\text{ GeV}$
 $1^{-+} \sim 1.6\text{ GeV}$

Hybrid mesons and
glueballs mass range:
 $1.4\text{ GeV} - 3.0\text{ GeV}$

This mass range is
accessible in current
experiments
(CLAS12 and GLUEX
@JLab)

Jefferson Lab The intensity frontier



- *Primary Beam: Electrons
- * Beam Energy: 12 GeV
 - $10 > \lambda > 0.1$ fm
 - nucleon $\rightarrow$ quark transition
 - baryon and meson excited states

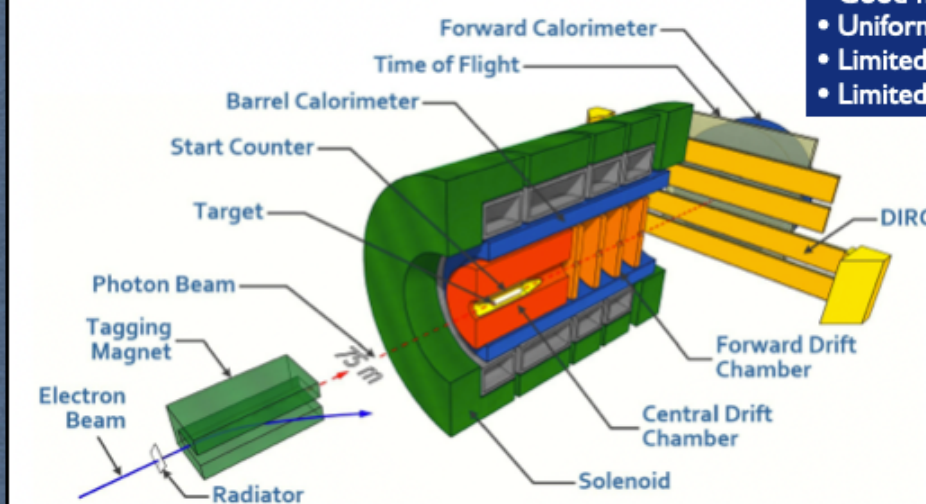
- *100% Duty Factor (CW) Beam
 - coincidence experiments
 - Four simultaneous beams
 - Independent E and I

- * Polarization
 - spin degrees of freedom
 - weak neutral currents

Meson spectroscopy with photons at JLab-12 GeV

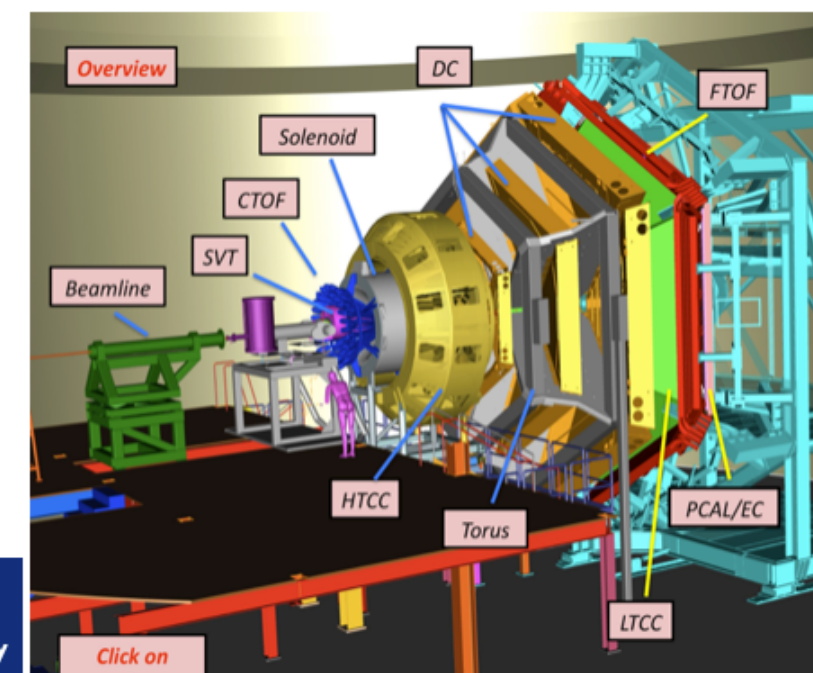
- Determination of JPC of meson states requires PWA
- Decay and production of exclusive reactions
- Good acceptance, energy resolution, particle identification

Hall-D - GlueX Detector



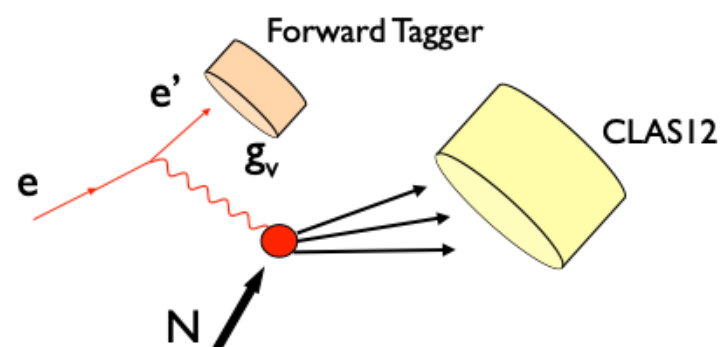
- Good hermeticity
- Uniform acceptance
- Limited resolution
- Limited PID

Hall-B - CLAS12 Detector

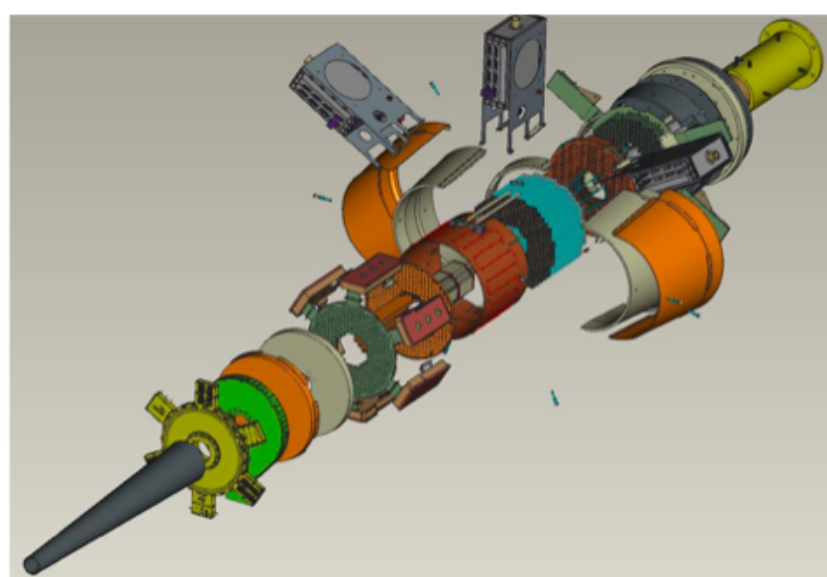


- Good resolution
- Good PID
- Reasonable hermeticity
- Un-uniform acceptance

Quasi-real photoproduction with CLAS12 (Low Q^2 electron scattering)



$E_{\text{scattered}}$	0.5 - 4.5 GeV
θ	$2.5^\circ - 4.5^\circ$
ϕ	$0^\circ - 360^\circ$
ν	6.5 - 10.5 GeV
Q^2	0.01 - 0.3 GeV^2 ($\langle Q^2 \rangle > 0.1 \text{ GeV}^2$)
W	3.6 - 4.5 GeV



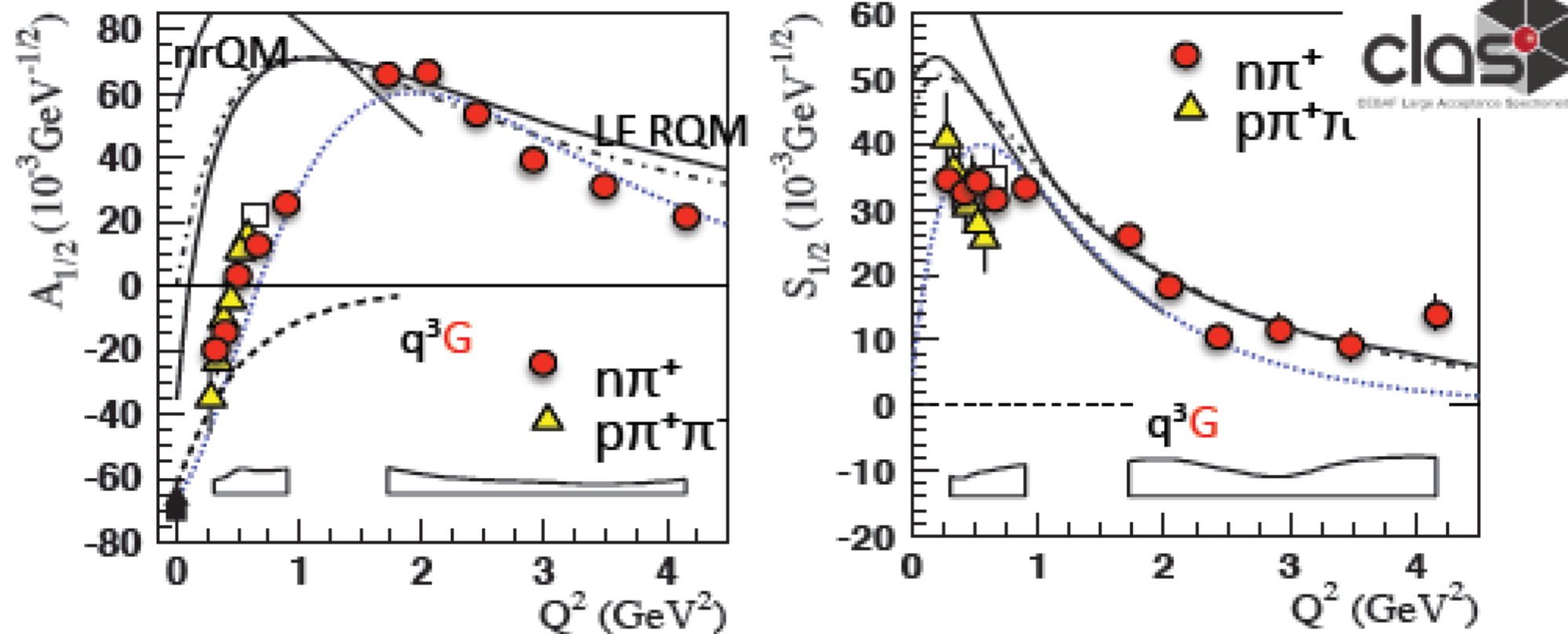
- ★ Electron scattering at “0” degrees ($2.5^\circ - 4.5^\circ$)
 - low Q^2 virtual photon $\Leftrightarrow$ real photon
- ★ Photon tagged by detecting the scattered electron at low angles
 - High energy photons $6.5 < E_g < 10.5 \text{ GeV}$
- ★ Quasi-real photons are linearly polarized
 - Polarization $\sim 70\% - 10\%$ (measured event-by-event)
- ★ High Luminosity (unique opportunity to run thin gas target!)
 - Equivalent photon flux $N_\gamma \sim 5 \cdot 10^8$ on 5cm H_2 ($L = 10^{35} \text{ cm}^{-2}\text{s}^{-1}$)
- ★ Multiparticle hadronic states detected in CLAS12
 - High resolution and excellent PID (kaon identification)

Complementary to Hall-D GLUEX

Transition form factor evolution in Q^2 as a filter?

Electro-production can be used to explore the hadron structure at different wavelengths (Q^2)

Electro-couplings of “Roper” $N(1440)1/2^+$



A suppressed longitudinal amplitude $S_{1/2}(Q^2)$ in comparison with transverse electro-excitation amplitude Q^3G

A drop of the transverse helicity amplitudes $A_{1/2}(Q^2)$ faster than for ordinary three quark states, because of extra glue-component in valence structure

- $N\pi$ and $N\pi\pi$ give consistent results
- $A_{1/2}$ changes sign and has large magnitude at high Q^2
- QM fails to reproduce low Q^2 behavior, LFQM better at large Q^2
- Both $A_{1/2}(Q^2)$ and $S_{1/2}(Q^2)$ inconsistent with hybrid model prediction

CLAS12 will map out the full meson/baryon spectrum and its evolution in Q^2

The MesonEx physics program

Photoproduction of hyperons with CLAS12

Exp-12-008 "Very Strange Experiment"

Search for missing excited hyperon states

* Excited cascades

- Hyperon spectrum less known $\Xi(1820)$
- How quark masses change the effective degrees of freedom in hadron spectra
- $\Xi(1530)$, $\Xi(1820)$
- $K^+K^+\pi^-$, $K^+K^+K^0$

* Quantum numbers and production dynamics determination

- Parity and polarisation measurement of $\Xi(1820)$
- Ω^- cross section

* Ω^- photoproduction

- 3 s quarks system poorly known
- Quantum number poorly known
- $K^+K^+K^0$, $K^+K^+K^-$

Meson spectroscopy with photons in CLAS12

Exp-11-005 "MesonEx"

Study the meson spectrum in the 1-3 GeV mass range to identify gluonic excitation of mesons (hybrids) and other quark configuration beyond the CQM

* Hybrid mesons and Exotics

- Search for hybrids looking at many different final states
- Charged and neutral-rich decay modes
- $\Upsilon p \rightarrow p 3\pi$, $\Upsilon p \rightarrow p \eta \pi$, ...

* Hybrids with hidden strangeness and strangeonia

- Intermediate mass of s quarks links long to short distance QCD potential
- Good resolution and kaon Id required
- $\Upsilon p \rightarrow p \phi \pi$, $\Upsilon p \rightarrow p \phi \eta$, $\Upsilon p \rightarrow p 2K \pi$, ...

* Scalar mesons

- Poorly known f_0 and a_0 mesons in the mass range 1-2 GeV
- Theoretical indications of unconventional configurations (qqqq or gg)
- $\Upsilon p \rightarrow p 2\pi$, $\Upsilon p \rightarrow p 2K$, ...

Light Meson Decay

Exp-12-06-108b "LMD"

Transition Form Factor of the eta' Meson with CLAS12

* Transition form factor of the eta' meson

- hadronic light-by-light (HLBL) contribution to the muon anomalous magnetic moment a_μ
- Dalitz decays of η' mesons, $\eta' \rightarrow \gamma e^+ e^-$
- η' produced in $e p \rightarrow e p \eta'$
- 0.5% statistical uncertainties (disregarding higher order effects)

* Radiative decays of eta'

* Access to the gamma vertex

* Competition with other experiments

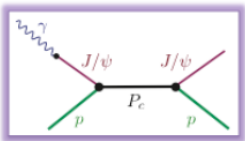
- Studied in g12 (CLAS6)
- Detector requirements: high luminosity, lepton trigger capability, large angle acceptance
- External photon pair production background suppressed by exploiting the 1 mm vertex resolution

LHCb Pentaquark with CLAS12

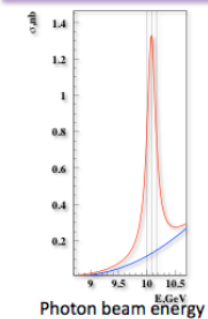
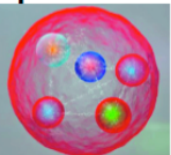
Exp-12-12-001a "Pentaquark"

Near threshold J/psi photoproduction and study of LHCb pentaquarks with CLAS12

Search for LHCb Pentaquark



$$\gamma + p \rightarrow P_c \rightarrow J/\psi + p$$
$$J/\psi \rightarrow e^+ e^-$$
$$J/\psi \rightarrow \mu^+ \mu^-$$



$BR(P_c \rightarrow J/\psi p) = 1\%$ $L = 10^{35} \text{ cm}^{-2} \text{ s}^{-1}$

	$P_c(4380)$		$P_c(4450)$	
	Minimum	Maximum	Minimum	Maximum
Untagged mode	48	500	70	220
Tagged mode	20	600	28	880
Total	68	1100	98	1100

98 events/day for narrow $P_c(4450)$ pentaquark state at nominal CLAS12 luminosity

Requirements

- 1) 4 π detector
- 2) High intensity 10 GeV electron beam

Nucleon resonances studies with CLAS12

Exp-12-009 "N*" and Exp-12-06-108a "KY"

Study the baryon spectrum to map the Q² evolution of excited states in an unexplored domain

* Single and multi pions Xsec

- Extended kinematic coverage in the unexplored Q² region between 5-10 GeV
- Precise and abundant data for many final states

* Hyperon electroproduction

- Natural extension to single and multi K final states

* Photocoupling extraction

- Mapping the NN* transition form factors to pin down the underlying dynamics
- Phenomenological models to parameterize the data, and PWA for full interpretation
- Well established analysis procedure tested with CLAS data

- Isobar model and beyond
- Detector requirements: good acceptance, energy resolution, particle Id
- Identification of exotic configuration via PWA

Requirements

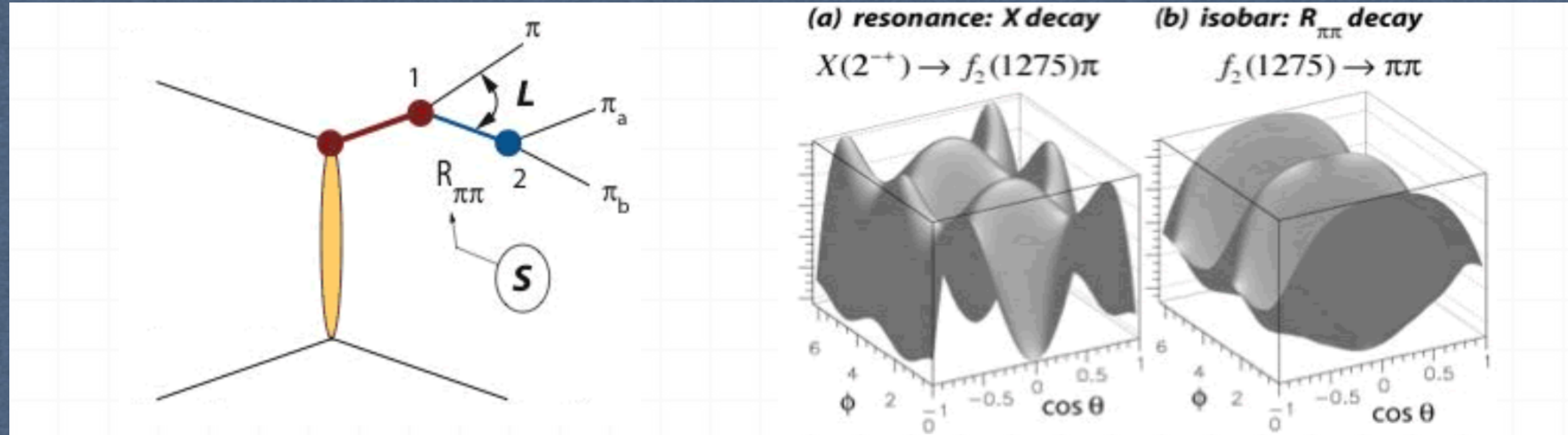
- 1) 4 π detector
- 2) High intensity 10 GeV electron beam

Resonance detection

Two main experimental approaches to identifying and studying a hadron resonance

Decay

- Easier and straightforward
- Independent on production mechanisms
- Dalitz plot for 3-body decays
- Isobar Model for higher multiplicity

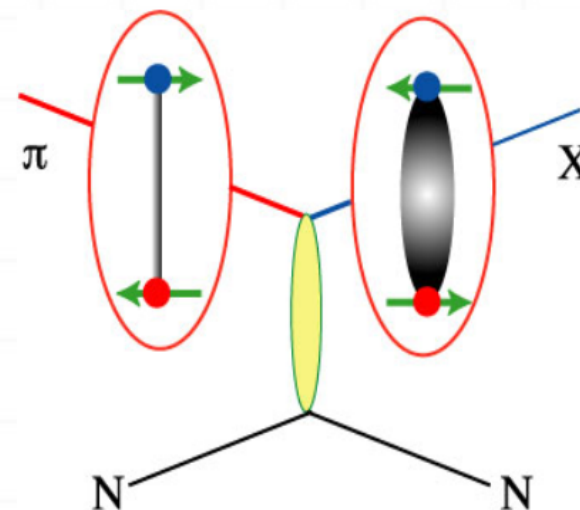


Production

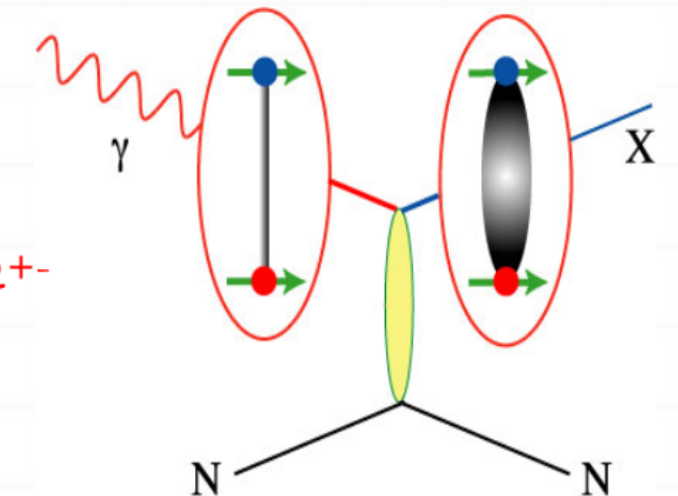
- Requires parametrisation of production vertex
- exclusive (or semi-inclusive) final state
- sensitive to the internal structure (nature)

* Photoproduction: exotic J^{PC} are more likely produced by $S=1$ probe

Pion Beam
Quark spins
anti-aligned
 $J^{PC} = 1^-, 1^{++}$

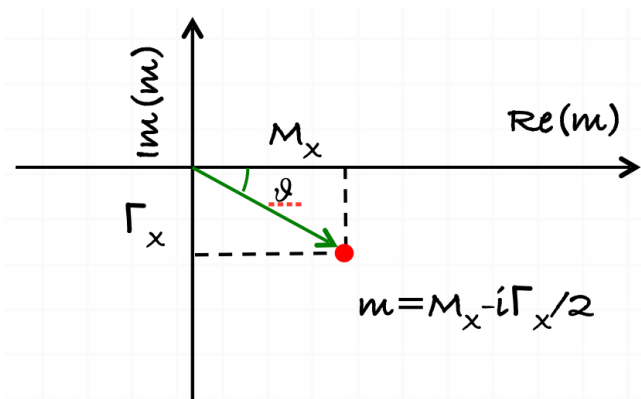


Photon Beam
Quark spins
already aligned
 $J^{PC} = 0^{+-}, 1^{-+}, 2^{+-}$



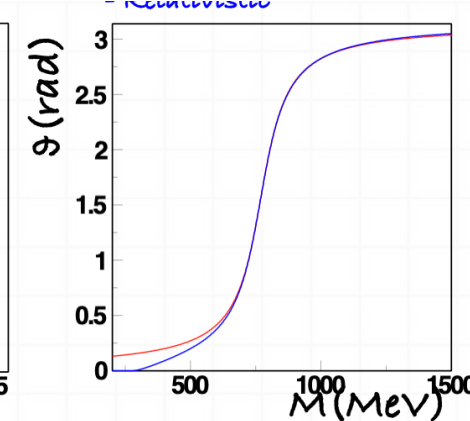
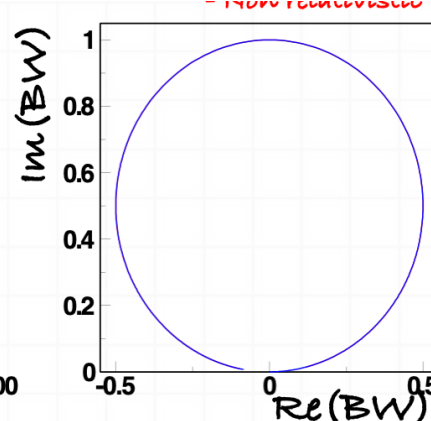
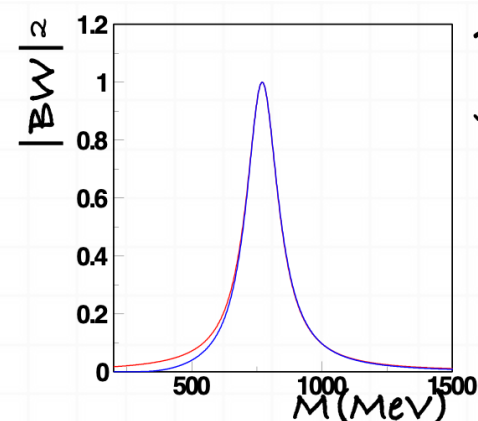
From data to the spectrum

‘resonance’ is defined by the pole in the first Riemann sheet of the complex amplitude
... not every bump is a resonance and not every resonance is a bump!

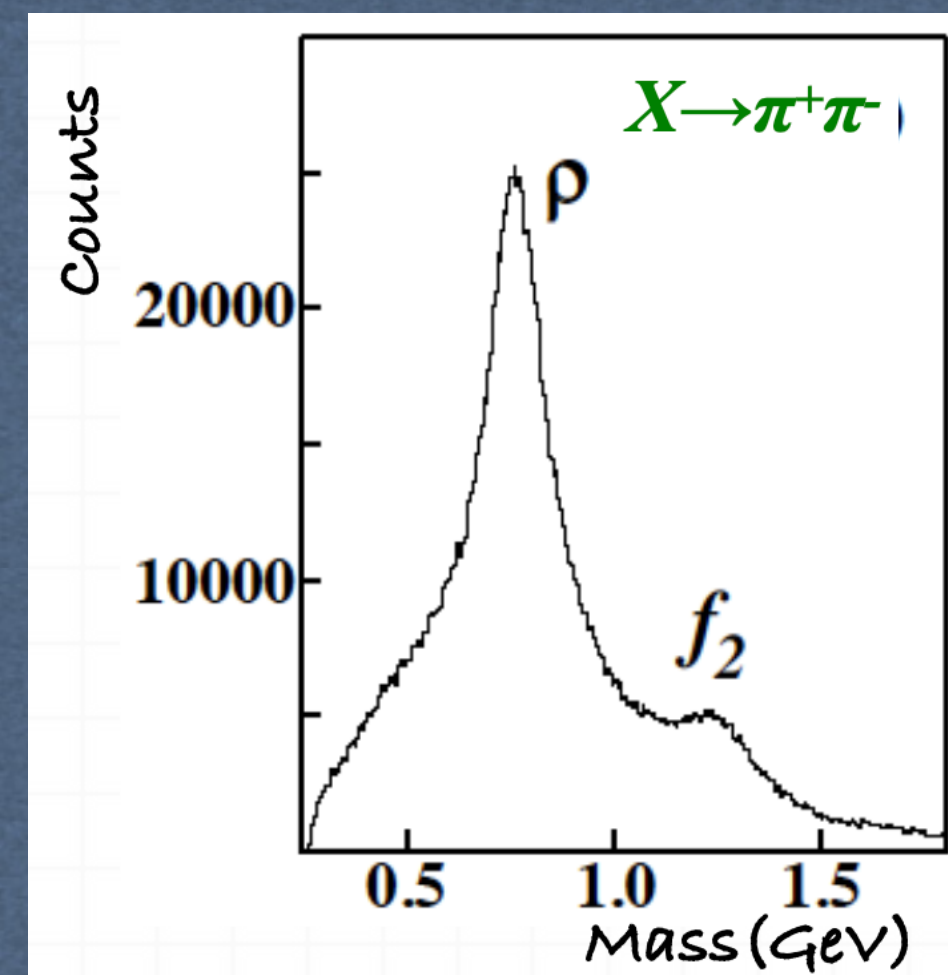


$$M_x \sim M_0$$

$$\Gamma_x \sim \Gamma_0$$



- A hadron resonance can be observed by studying the **invariant mass spectrum** of its decay product.
- In real life, resonances do not always appear so clearly in a mass spectrum because they are **not isolated**
- A resonance has specific quantum numbers with defined decay angular momentum
- Each partial wave only includes the corresponding resonances



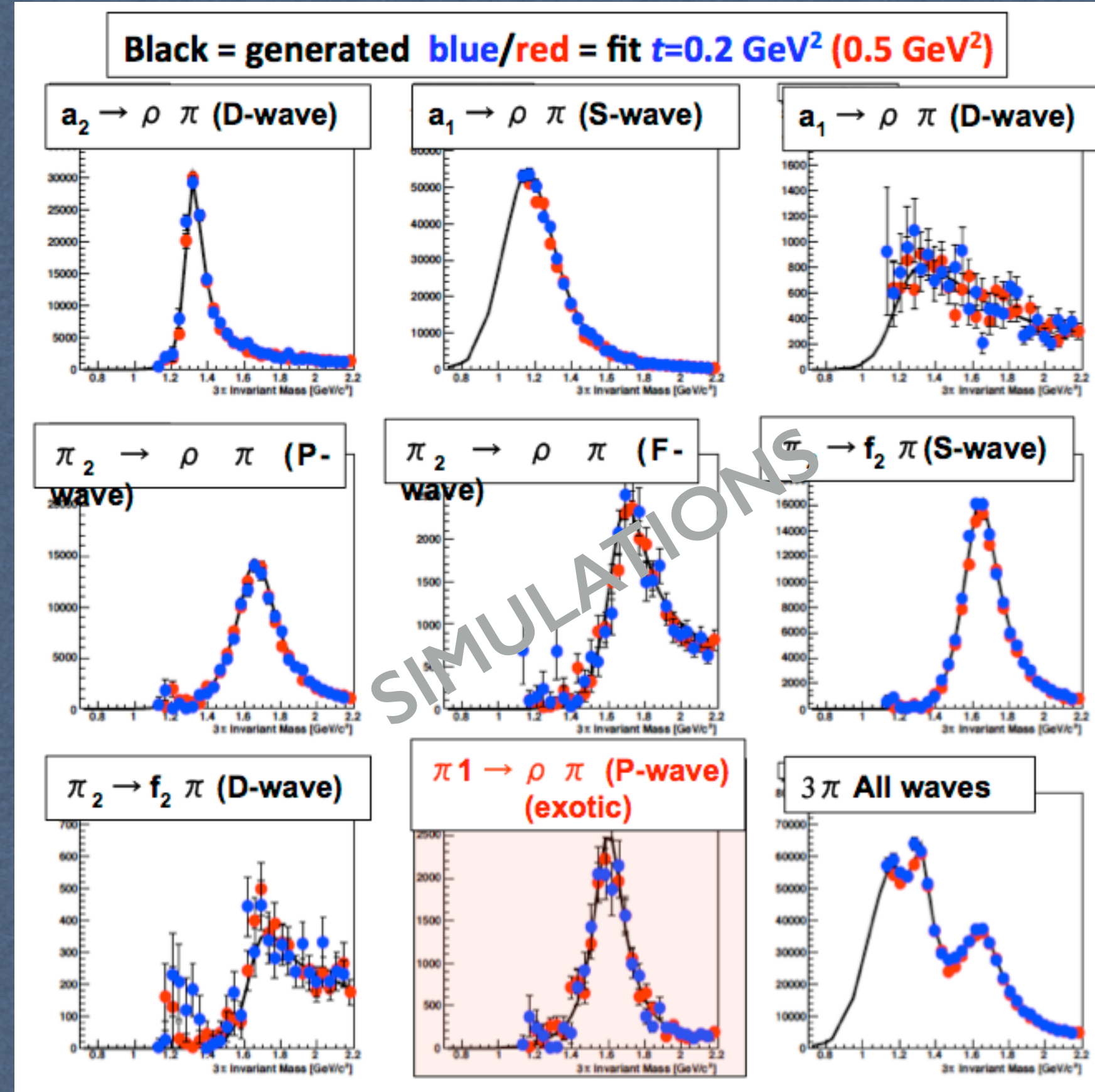
Partial Wave Analysis (PWA)

- Goal: extract the intensity of the different angular waves as a function of the invariant mass of the final state particles
- Measure events for the process of interest
- Build a model that describes the process
- Fit the model to the data

PWA with CLAS12

$$\gamma p \rightarrow n \pi^+ \pi^+ \pi^-$$

- The process is described as sum of 8 isobar channels:
 - $a_2 \rightarrow \rho \pi$ (D-wave)
 - $a_1 \rightarrow \rho \pi$ (S-wave)
 - $a_1 \rightarrow \rho \pi$ (D-wave)
 - $\pi_2 \rightarrow \rho \pi$ (P-wave)
 - $\pi_2 \rightarrow \rho \pi$ (F-wave)
 - $\pi_2 \rightarrow f_2 \pi$ (S-wave)
 - $\pi_2 \rightarrow f_2 \pi$ (D-wave)
 - $\sim 3\% \pi_1 \rightarrow \rho \pi$ (P-wave) (exotic)
- Amplitudes calculated by A.Szczepaniak and P.Guo
- CLAS12 acceptance projected and fitted
- PWA is stable against CLAS12 acceptance/ resolution distortion



Tools for data analysis from CLAS6 to CLAS12

- We want to extract the moments are calculated as fit parameters of the intensity:

$$\mathcal{I}(\Omega) = \sum_{JMS\Lambda} \left(\frac{2J+1}{4\pi} \right) \left(\frac{2S+1}{4\pi} \right) H(JMS\Lambda) \times D_{M,\Lambda}^{J*}(\phi_{GJ}, \theta_{GJ}, 0) D_{\Lambda,0}^{S*}(\phi_{HF}, \theta_{HF}, 0), \quad (1)$$

- The moments relate to partial waves:

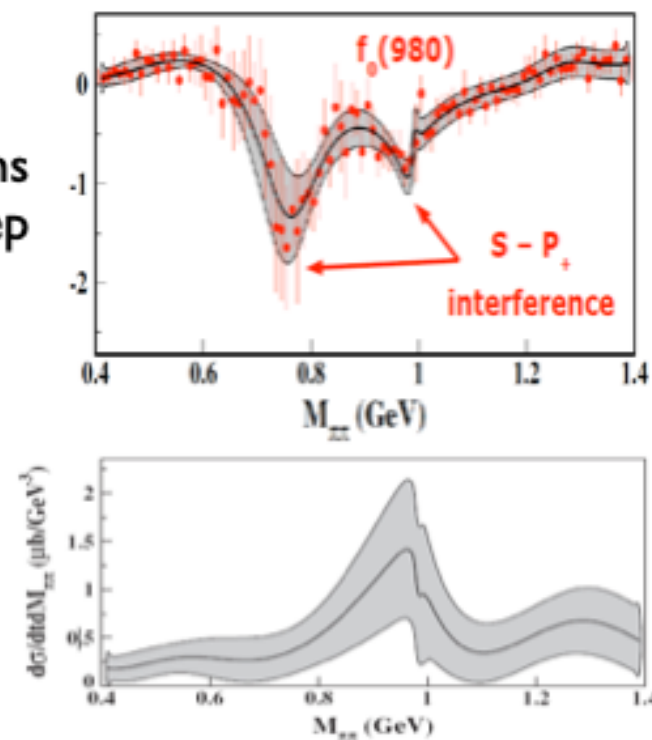
$$H(JMS\Lambda) = \sum_{b,b'} \sum_{\lambda,\lambda'} \left(\frac{\sqrt{(2l'+1)(2l+1)}}{2j'+1} \right) \left(\sqrt{\frac{2s+1}{2s'+1}} \right) (l, 0; s, \lambda | j, \lambda) \times (l', 0; s', \lambda' | j', \lambda') (s, \lambda; S, \Lambda | s', \lambda') (s, 0; S, 0 | s', 0) \times (j, m; J, M | j', m') (j, \lambda; J, \Lambda | j', \lambda') \times \rho_{bb'}. \quad (2)$$

Strategy

- Moments of the angular distributions can be used as an intermediate step toward a full PWA

$$\langle Y_{\lambda\mu} \rangle(E_\gamma, t, M) = \frac{1}{\sqrt{4\pi}} \int d\Omega_\pi \frac{d\sigma}{dt dM d\Omega_\pi} Y_{\lambda\mu}(\Omega_\pi)$$

- Fit of amplitudes with moments lead to the first observation of the $f_0(980)$ using CLAS6 data

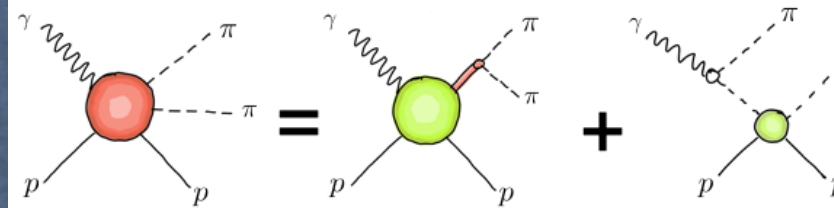


$M(\pi^+\pi^-)$ spectrum below 1.5 GeV:

- P-wave: ρ meson
- D-wave: $f_2(1270)$
- S-wave: σ , $f_0(980)$ and $f_0(1320)$

Regge-Amplitude Model for $\gamma p \rightarrow \pi^+\pi^-p$ by JPAC, [PRD 111, 014002 \(2025\)](#)

L.Bibrzycki



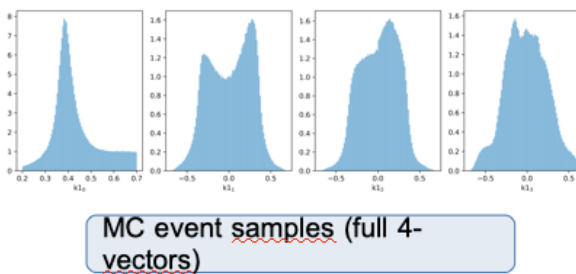
Physics Model:

- Resonances: $\rho(770)$, $f_0(500)$, $f_0(980)$, $f_0(1370)$, $f_0(1500)$, $f_2(1270)$
- Regge exchanges: Pomeron, a_2/f_2 , ρ/ω
- Non-resonant Deck mechanism

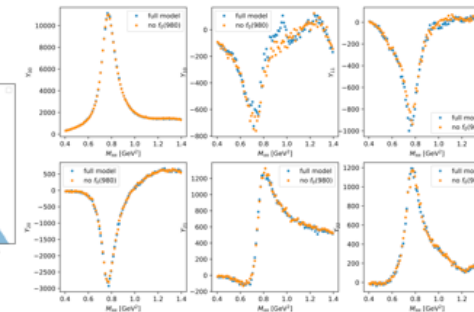
Workflow:

Amplitude model $\rightarrow$ fit to angular moments $\rightarrow$ 4-fold cross section $\rightarrow$ MC generator

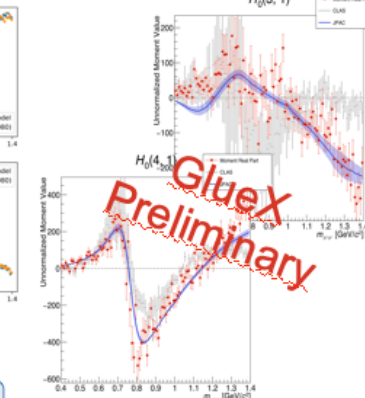
Deliverables:



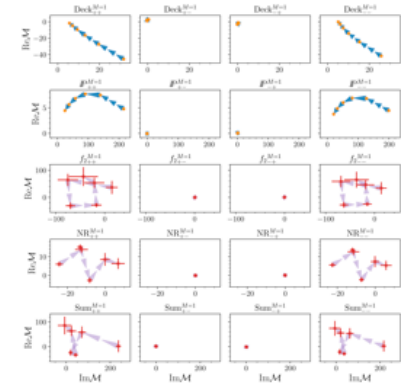
MC event samples (full 4-vectors)



Angular moments derived from the MC dataset



Higher moments



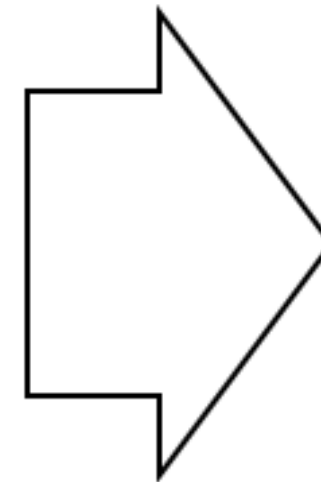
Amplitude phase motion

Modern AI-supported tools for data analysis

AI for NP/HEP

- Data collected by NP/HEP experiments are (always) affected by the detector's effects
- Before starting physics analysis the detector's effects unfolding are required
- Traditional observables may not be adequate to extract physics in multidimensional space (multi-particles in the final state)
- At High-Intensity frontiers, data sets are large and difficult to manipulate/preserve

Shall AI support NP/HEP experiments to extract physics from data in a more efficient way?



A(i)DAPT

AI for Data Analysis and PreservaTion

Develop AI-supported procedures to:

- Data preparation for unfolding detector effects
- Accurately fit data in multiD space
- Extract physics observables (xsec, asymmetries, ...) from *synthetic* data (AI-generated)
- Interpret physics observables
- in all steps, quantifying the uncertainty (UQ)

Collaborative effort (regular meeting)

- ML experts (ODU, JLab)
- Experimentalists (JLab Hall-B, GlueX)
- Theorists (JPAC, JAM)

Detector unfolding

Detector effects make measured observables (detector-level) DIFFERENT from 'true' observables (vertex-level)

Resolution

- Any detector has a finite resolution that spreads the measurement
- A spike could be not resolved
- The measurement may extend in an unphysical region (e.g. negative squared missing mass)

Acceptance

- Any measurement covers only a fraction of the reaction phase-space
- Difficulty: the cross section (Probability Density Function) can not be constrained by general rules (other than being positive) since it reflects the underlying (a-priori unknown) physics
- No model-independent extrapolation of PDF outside detector's acceptance is possible (based on measured phase space)

[Efficiency]

- Detection is a non-deterministic process provides different results in multiple measurements of the same observable

Use AI:

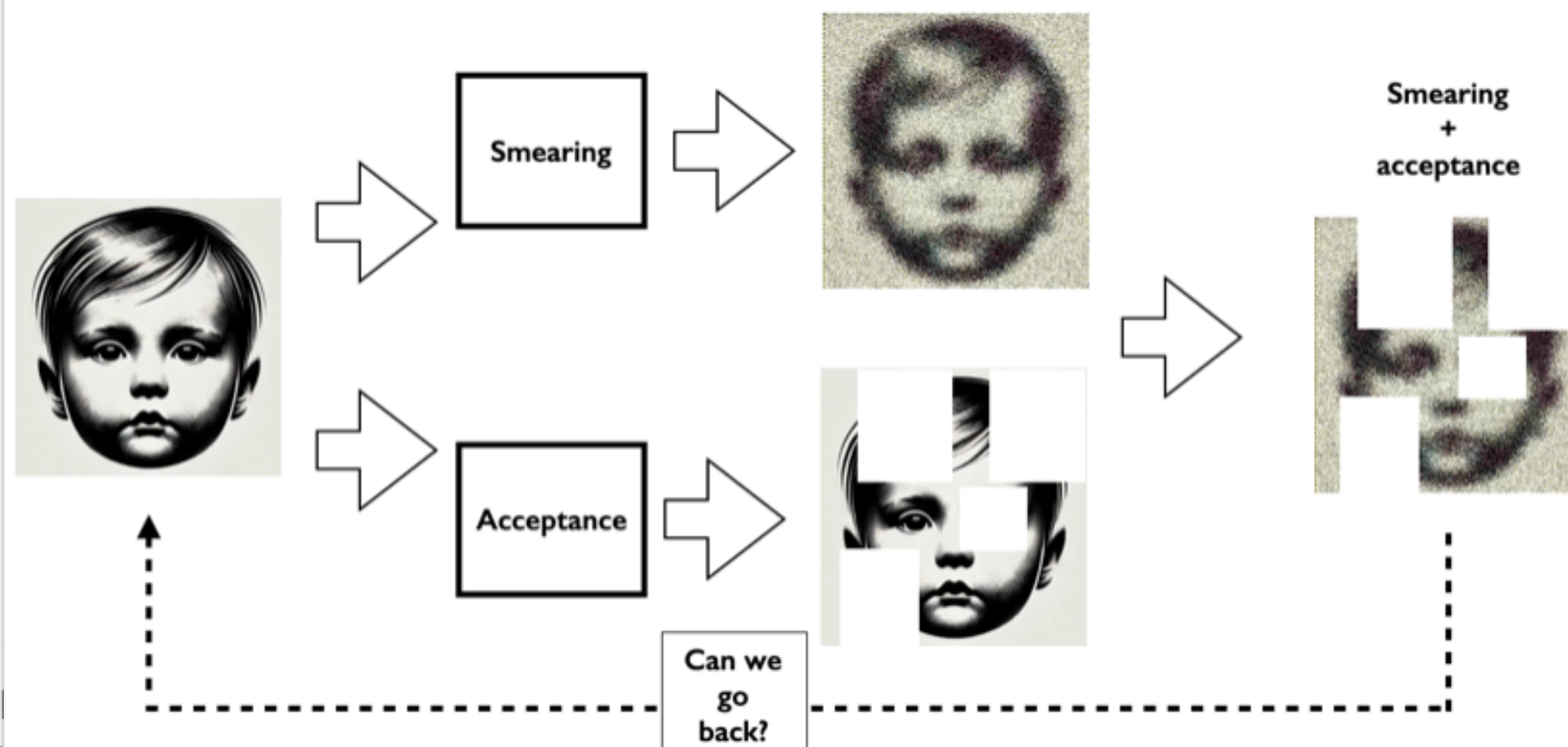
- **INSIDE ACCEPTANCE** to replace data with a synthetic replica statistically identical to the original but w/o smearing
- **OUTSIDE ACCEPTANCE:** to generate pseudo-data according a physics informed model

Detector unfolding

Detect
(vertex

Detector unfolding

Can we recover the original image?



Use AI:
• INSID
• OUTS

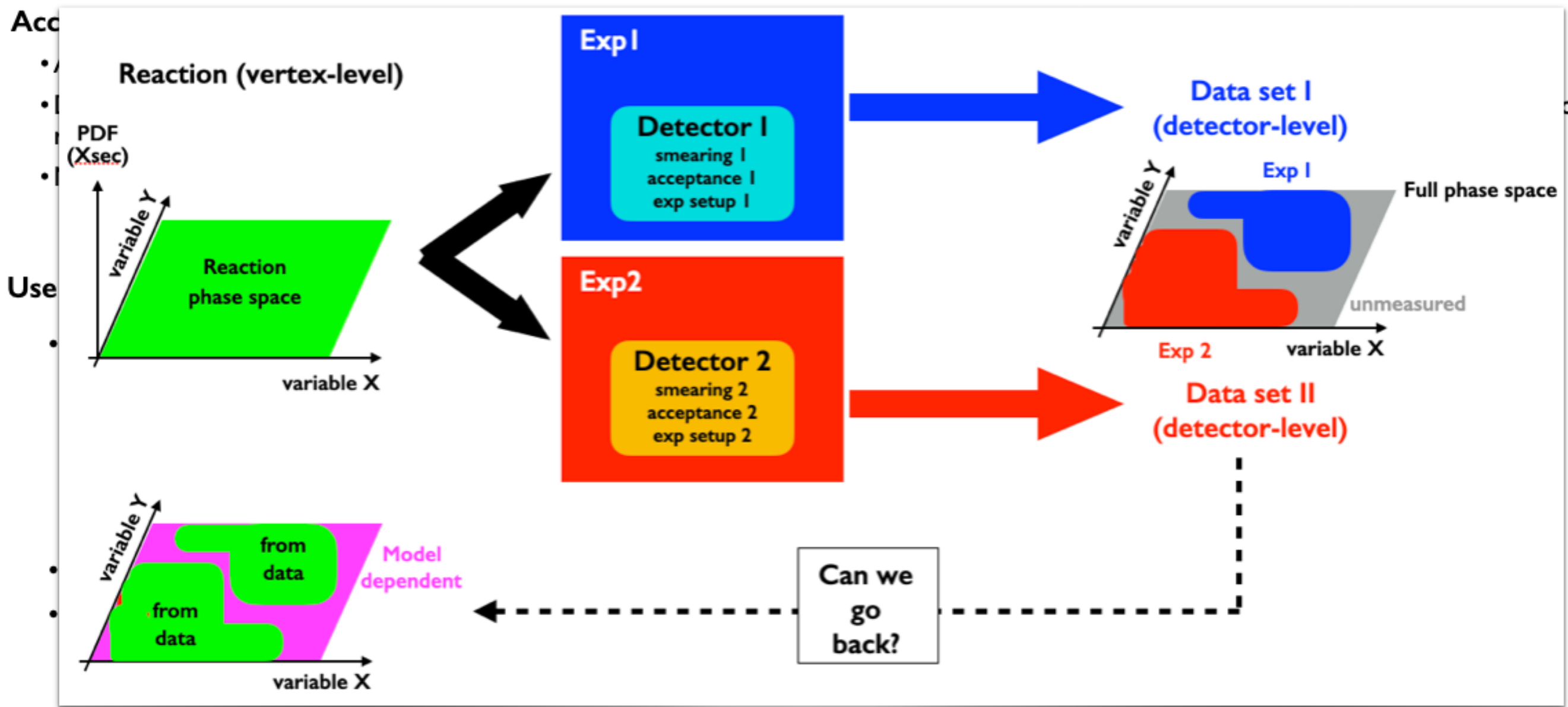
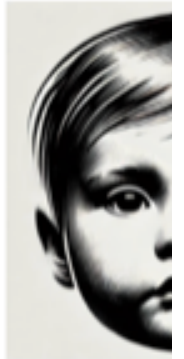
GANs for detector unfolding

Detector unfolding

Detector unfolding

Detect
(vertex

Unfolding detector's acceptance



Credit: T.Vittorini, Y.Alanazi, T.Alghamdi, Y. Li

Use AI:
• INSID
• OUTS

GANs for detector unfolding

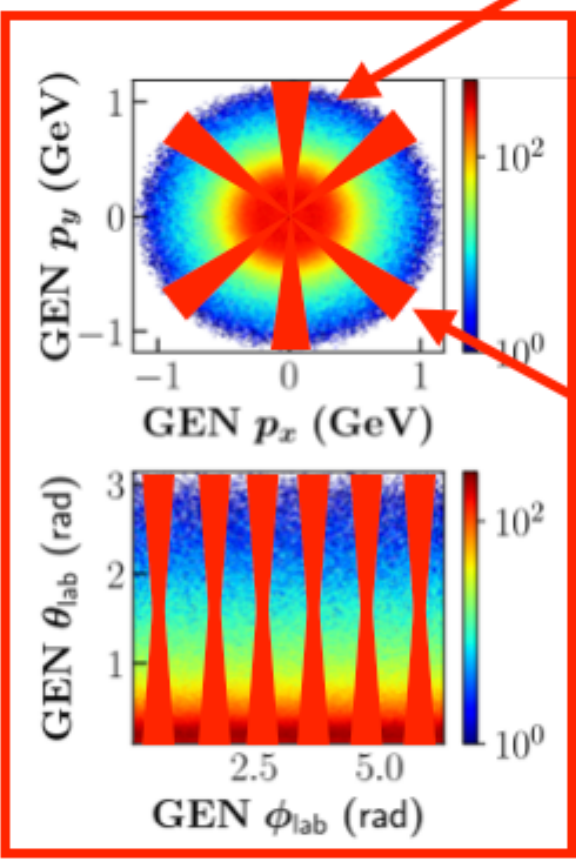
Detector unfolding

Detector unfolding

Detect
(vertex

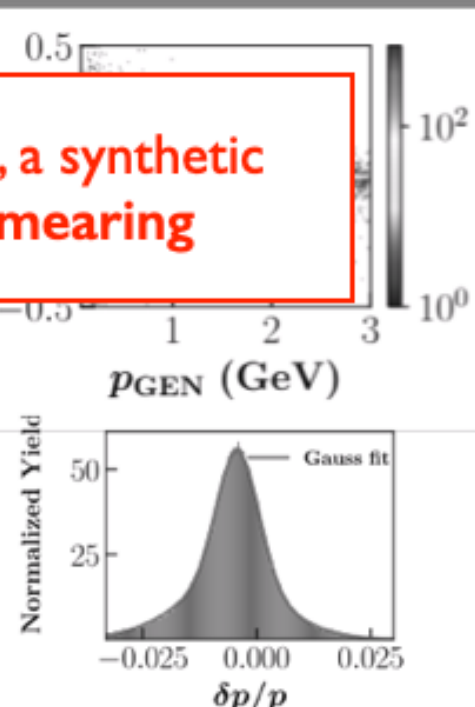
Detector unfolding

Vertex-level



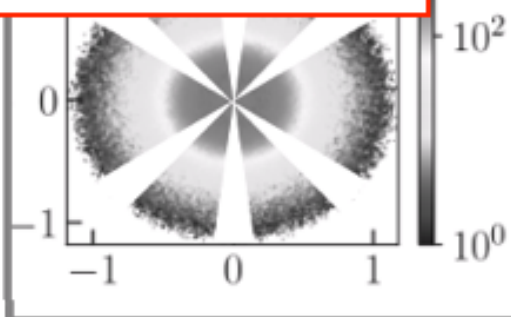
within the acceptance, a synthetic replica of data w/o smearing

Smearing

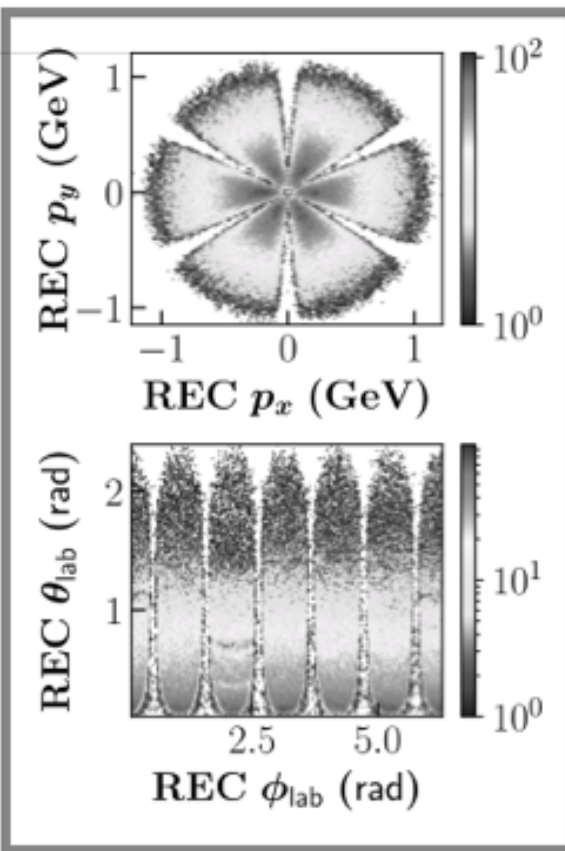


outside the acceptance pseudo-data generated according a physics-informed model

Acceptance



Detector-level



with generative AI we can go back, by generating a synthetic copy of the original data

Use AI:
• INSID
• OUTS

Detector unfolded

Detector

Detector

Detector

Detector

Detector

Detector

Detector

Detector

Detector

Detector

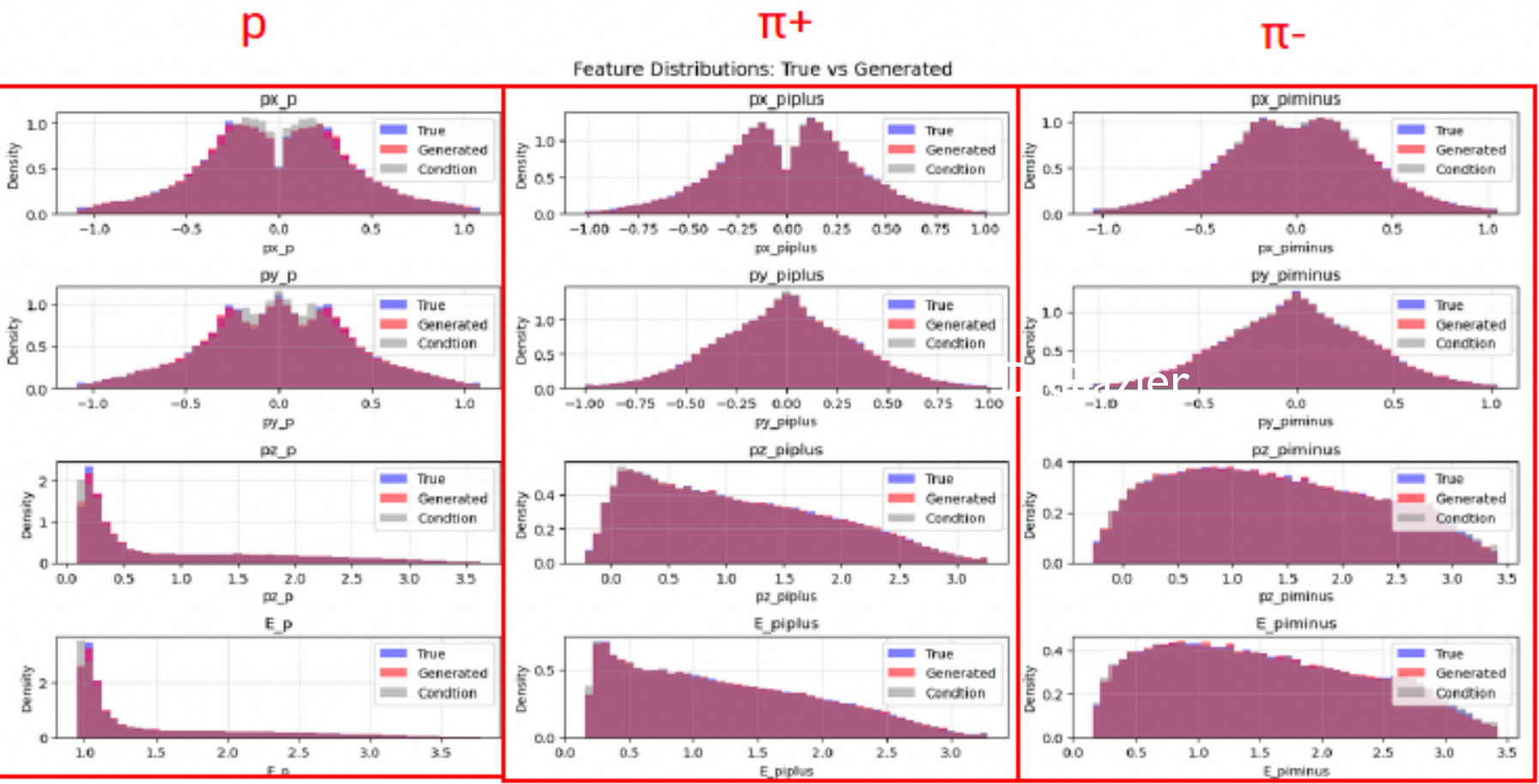
Detector

Detector

Detector

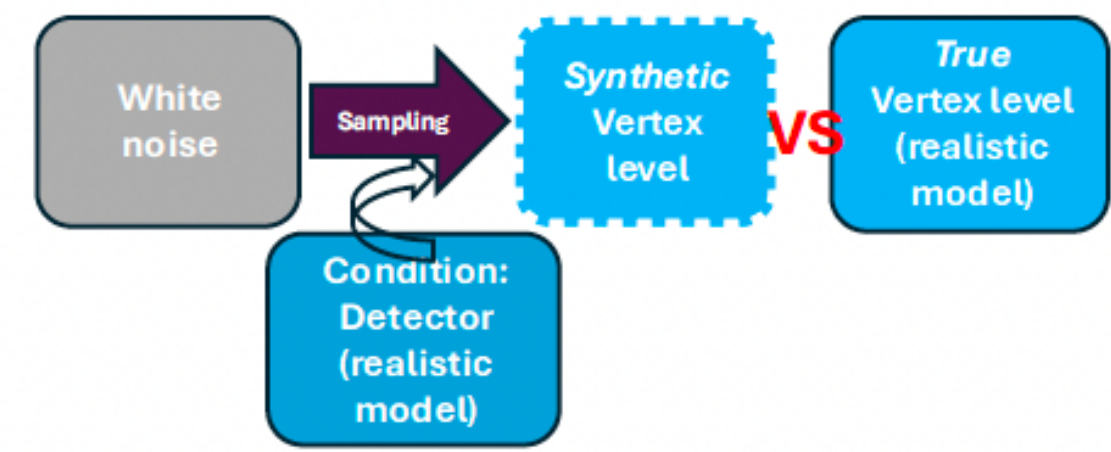
Detector

A(i)DAPT: unfolding through diffusion models II

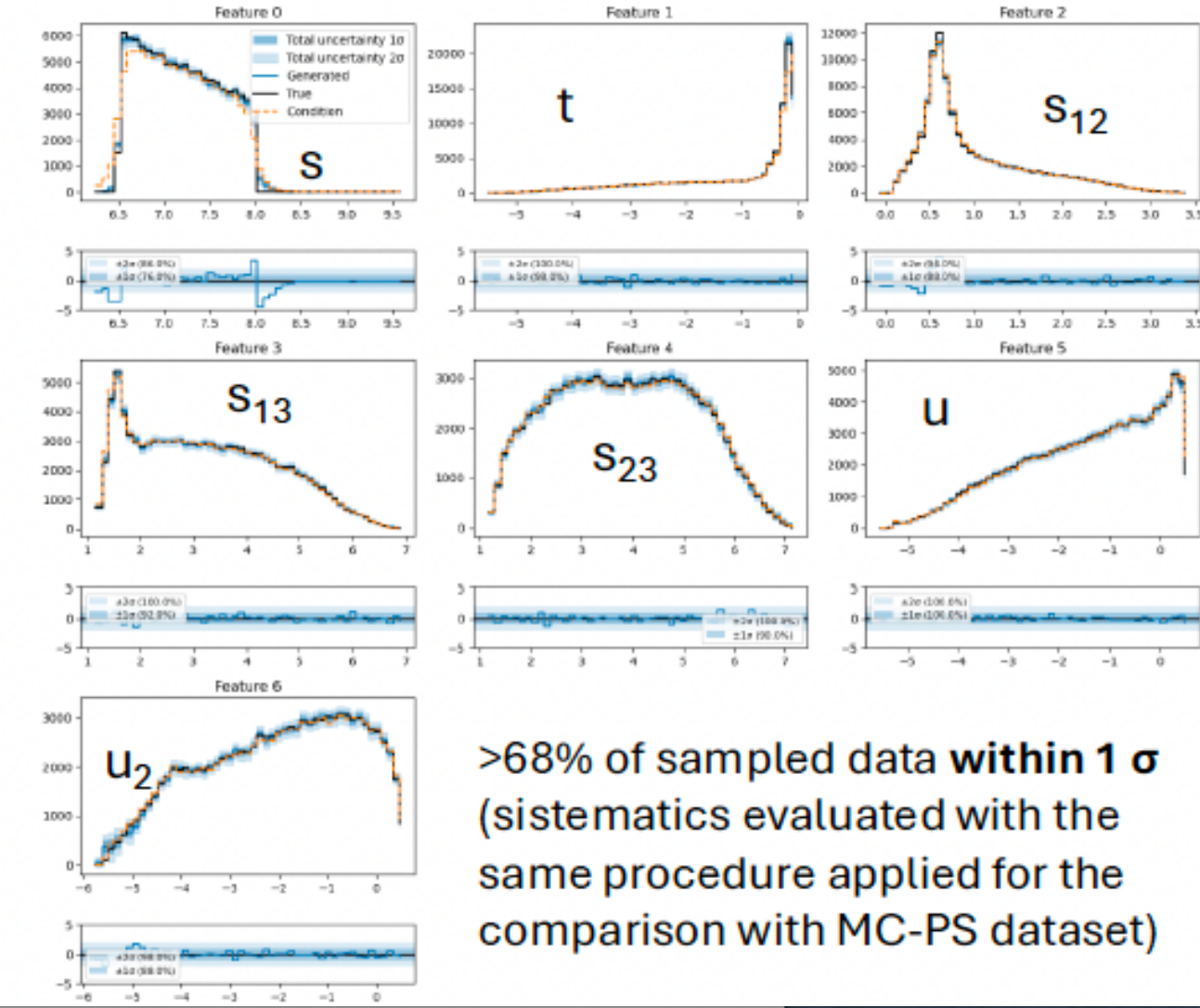


Using the same cDM trained just on MC-PS data, we manage to **satisfactorily sample the vertex from a realistic-MC dataset never seen by the model**: production is factorized and the model has really learned how to smear

G.Foti



Correlations are preserved also in this case



>68% of sampled data within 1 σ (sistematics evaluated with the same procedure applied for the comparison with MC-PS dataset)

AI for extracting amplitudes

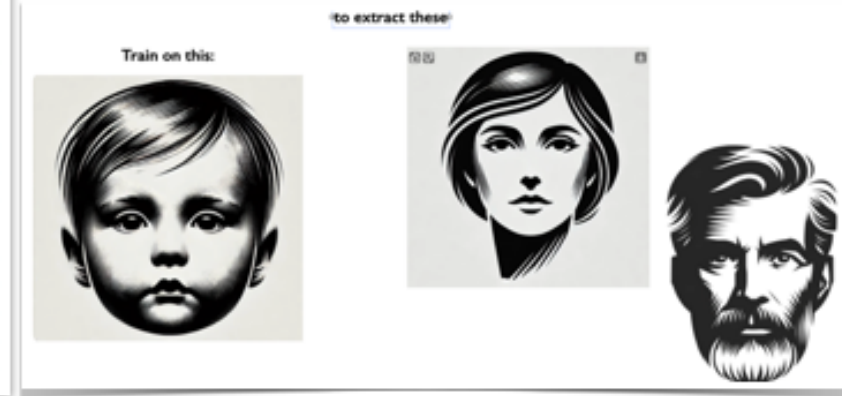
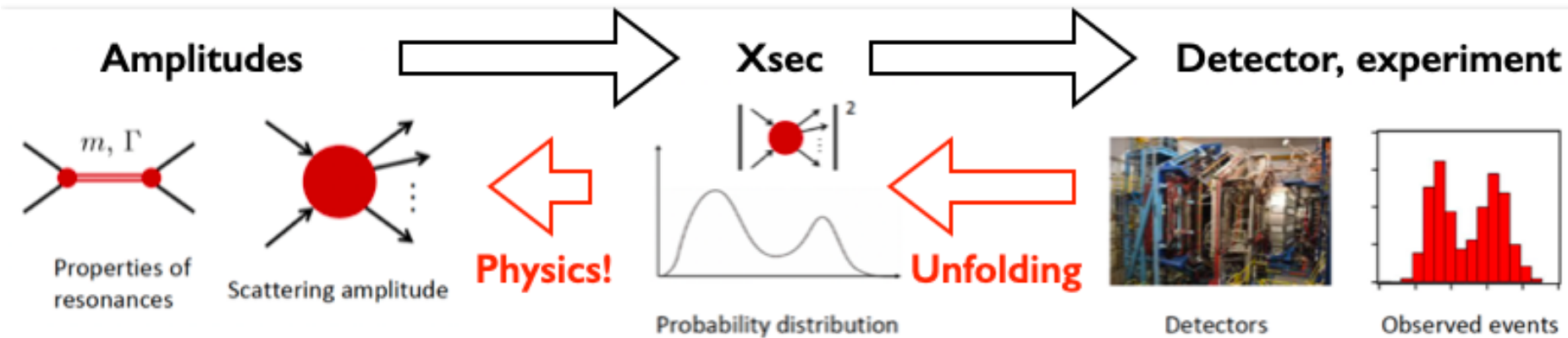
Extract amplitude from differential cross sections, using unitarity constraint

Train an AI model to extract amplitudes (complex numbers satisfying some physics constraints, e.g. unitarity) from events generated with Monte Carlo simulations according to a theoretical model (and eventually from experimental data)

Scattering amplitudes extraction

Credit: G.Montaña, Y. Li, A.Pillioni, N.Sato

Train a generative AI model to extract scattering amplitudes



Amplitudes (A_i)
=
complex numbers
satisfying some general
physics constraint

S-matrix theory →
Fundamental principles of scattering

* Rotational invariance → **Partial wave expansion**

$$\langle \text{out} | T | \text{in} \rangle \equiv A(s, \cos \theta) = \sum_{\ell=0}^{\infty} (2\ell + 1) f_{\ell}(s) P_{\ell}(\cos \theta)$$

* Probability conservation → **Unitarity**

$$S S^{\dagger} = 1 \rightarrow \text{Im} f_{\ell}(s) = |f_{\ell}(s)|^2$$

* Causality → **Analyticity**

$$f_{\ell}(s) = \frac{1}{\pi} \int ds' \frac{\text{Disc } f_{\ell}(s')}{s' - s - i\epsilon}$$

* Existence of antiparticles → **Crossing symmetry**

$$A(s, \cos \theta_s) = A(t, \cos \theta_t) = \sum_{\ell=0}^{\infty} (2\ell + 1) f_{\ell}(t) P_{\ell}(\cos \theta_t)$$

Generative Adversarial Networks (GANs)

- Generate A_i training on xsec
- impose only general properties (e.g. unitarity)

➡ **Physics agnostic**

Conditional diffusion model (cDM)

- Generate A_i training on xsec and amplitudes
- amplitude parametrization

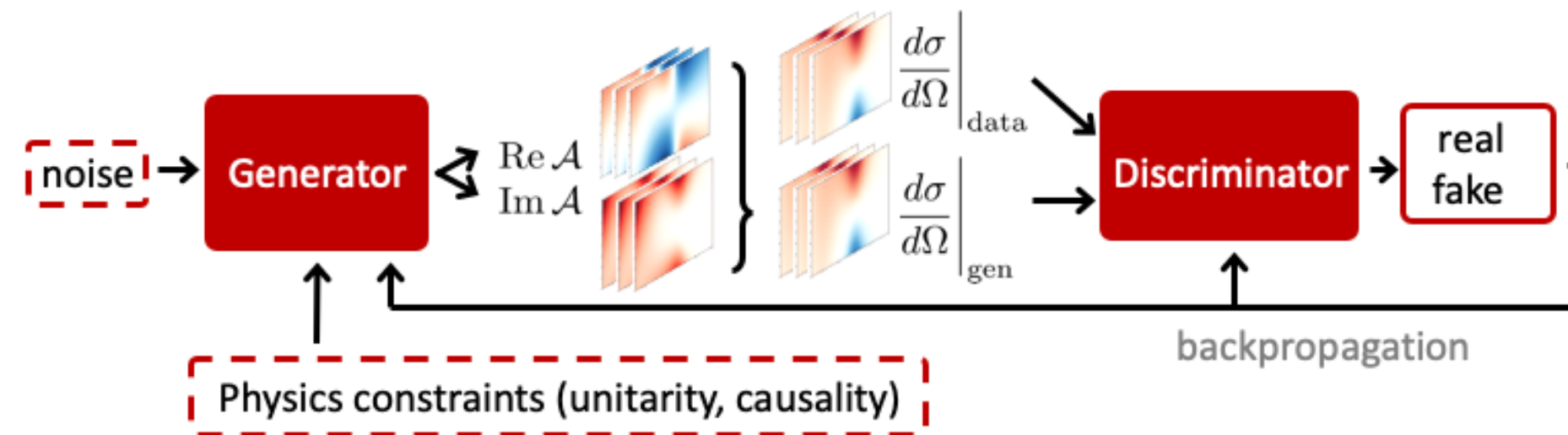
➡ **Physics informed**

AI for extracting amplitudes

G.Montaña

Reconstruction of scattering amplitudes with physics-informed GANs

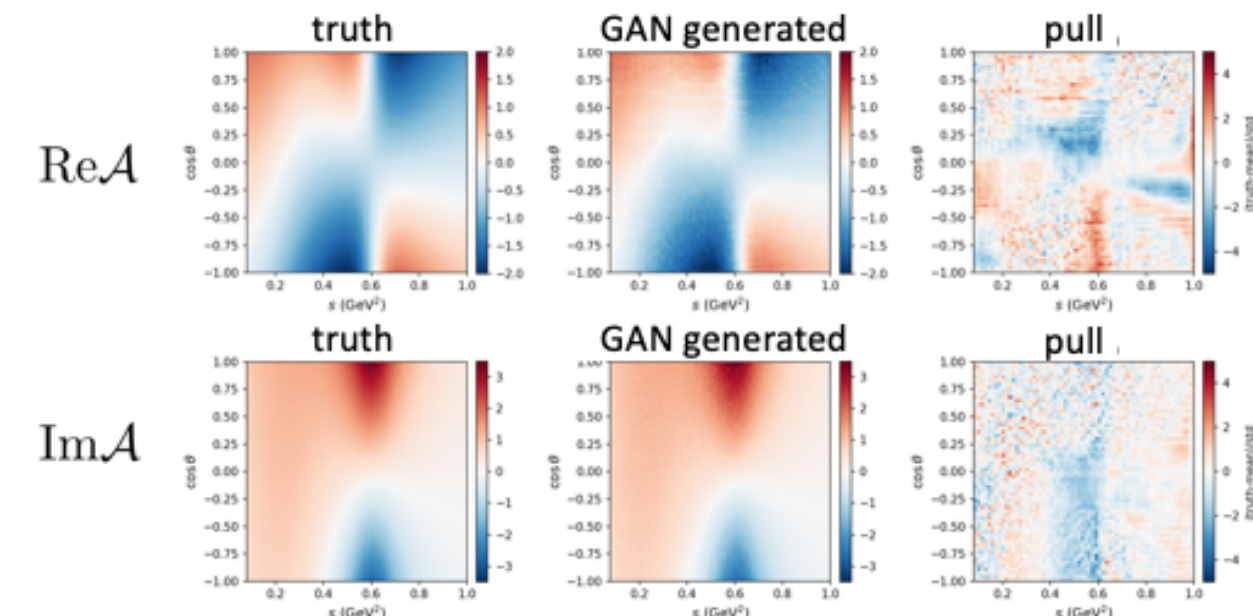
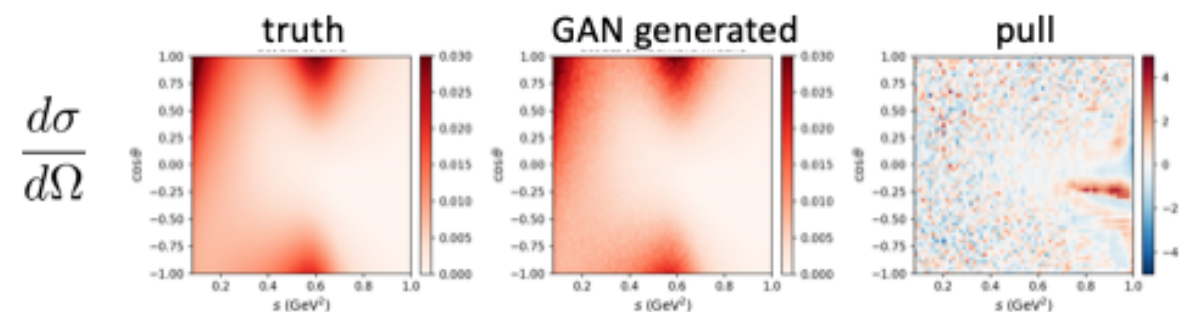
G. Montaña, J. Xu, Y. Li, A. Pilloni, M. Battaglieri and others (A(i)DAPT)



Benchmark for elastic $\pi\pi$ scattering

$$\mathcal{A}_{\text{truth}}(s, \cos \theta) = f_0(s) + 3f_1(s) \cos \theta$$

Results for reconstruction from noisy training samples:



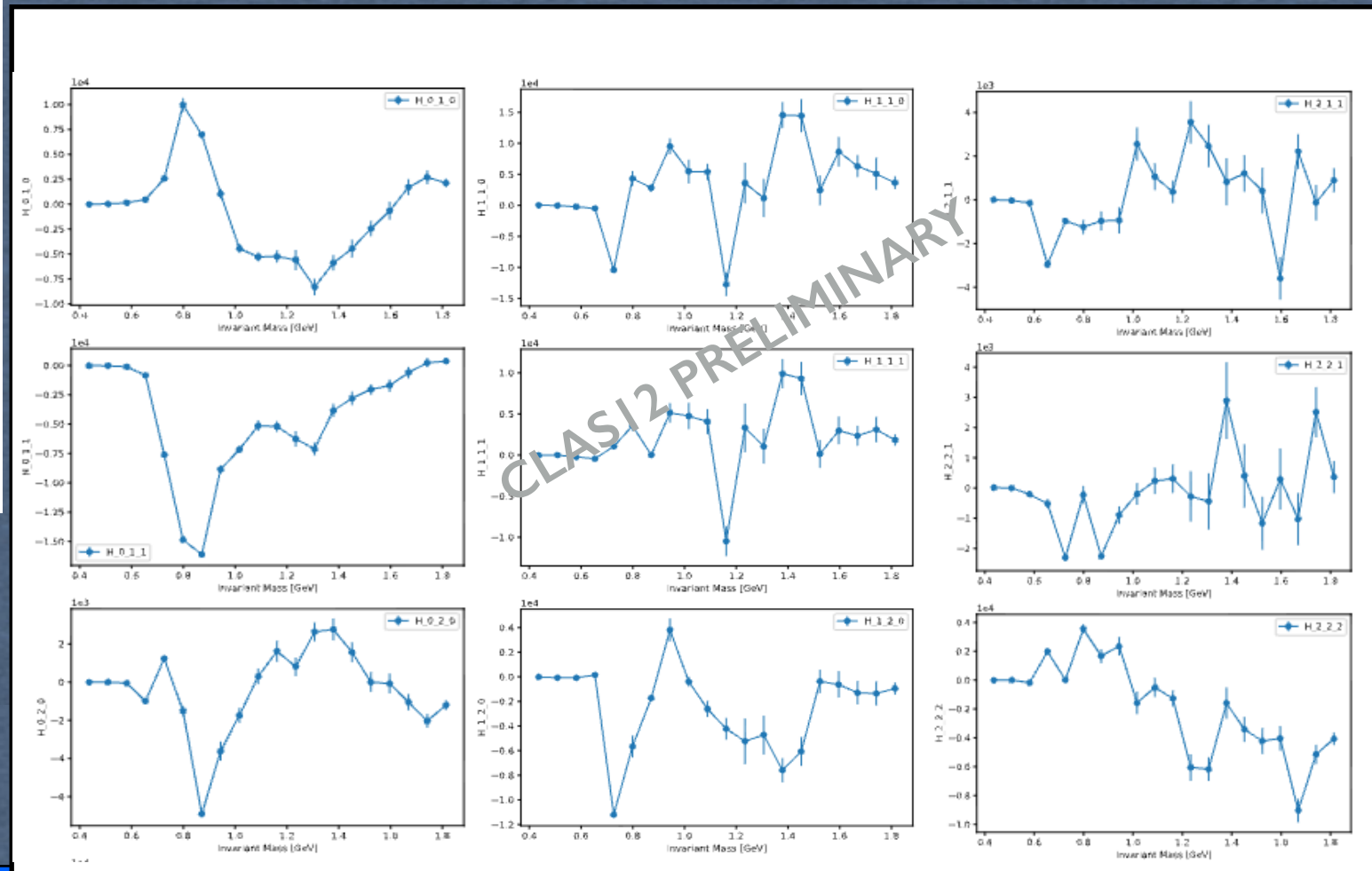
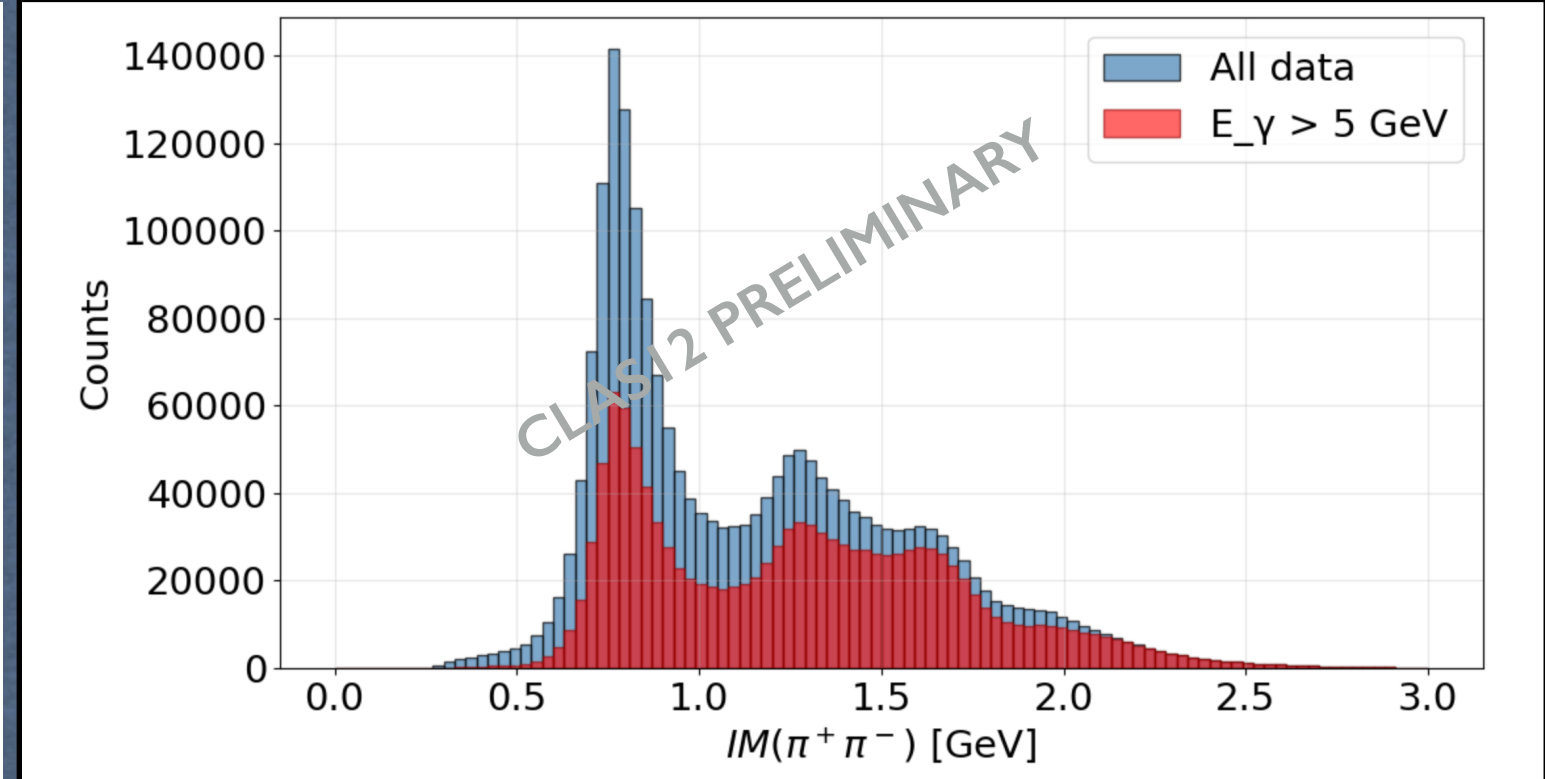
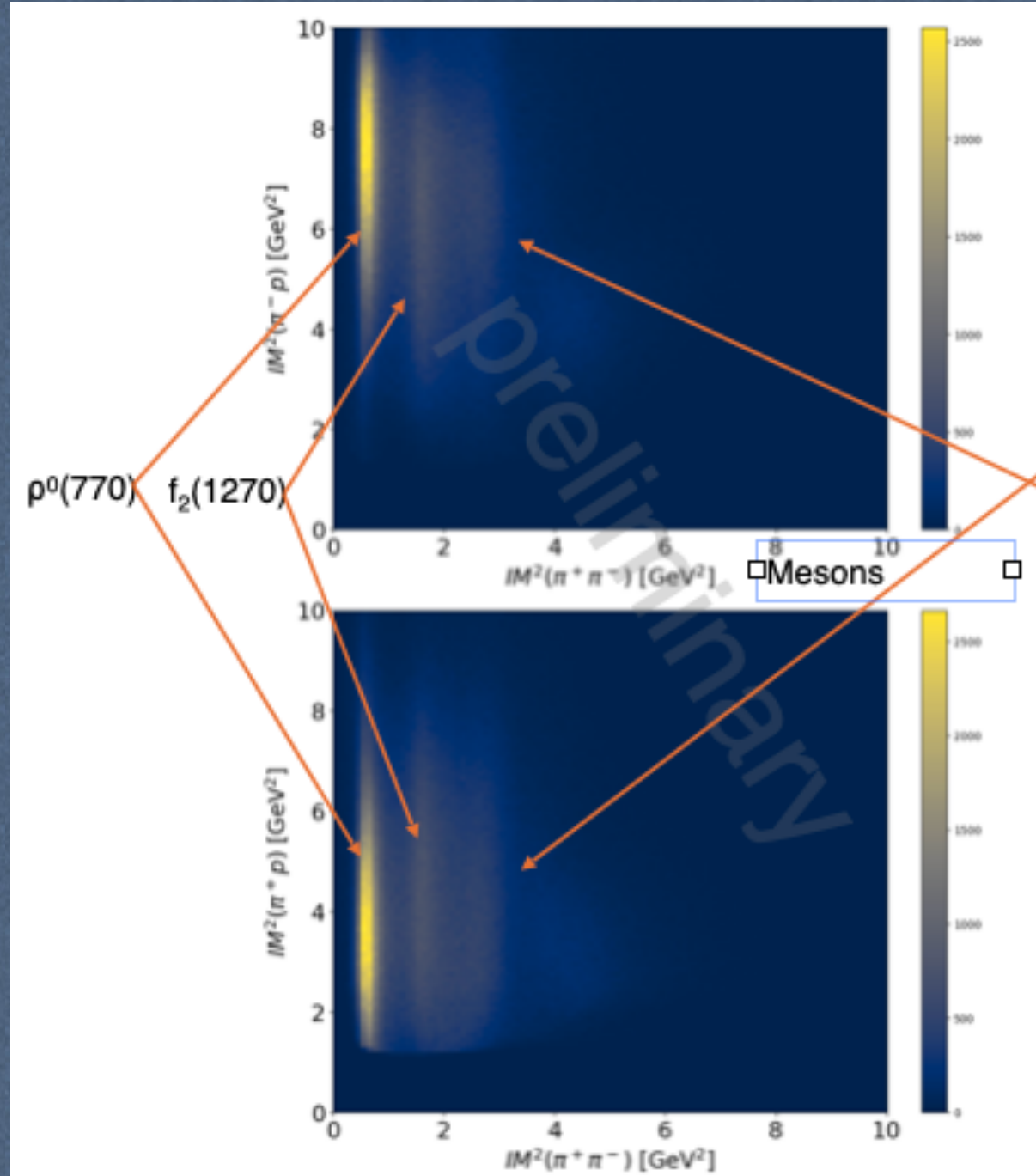
Extract amplitude from differential cross sections, using unitarity constraint

Train an AI model to extract amplitudes (complex numbers satisfying some physics constraints, e.g. unitarity) from events generated with Monte Carlo simulations according to a theoretical model (and eventually from experimental data)

MesonEx data

$$\gamma p \rightarrow p \pi^+ \pi^-$$

- Use standard CLAS12 PID (FT based start time)
- $p\pi^+\pi^-$ exclusive reaction (all hadrons detected)
- All $-t$
- $\langle Q^2 \rangle = 0.07 \text{ GeV}^2/c^2$
- $E_{\text{Beam}} = 10.6 \text{ GeV} \rightarrow E_\gamma > 5 \text{ GeV}$

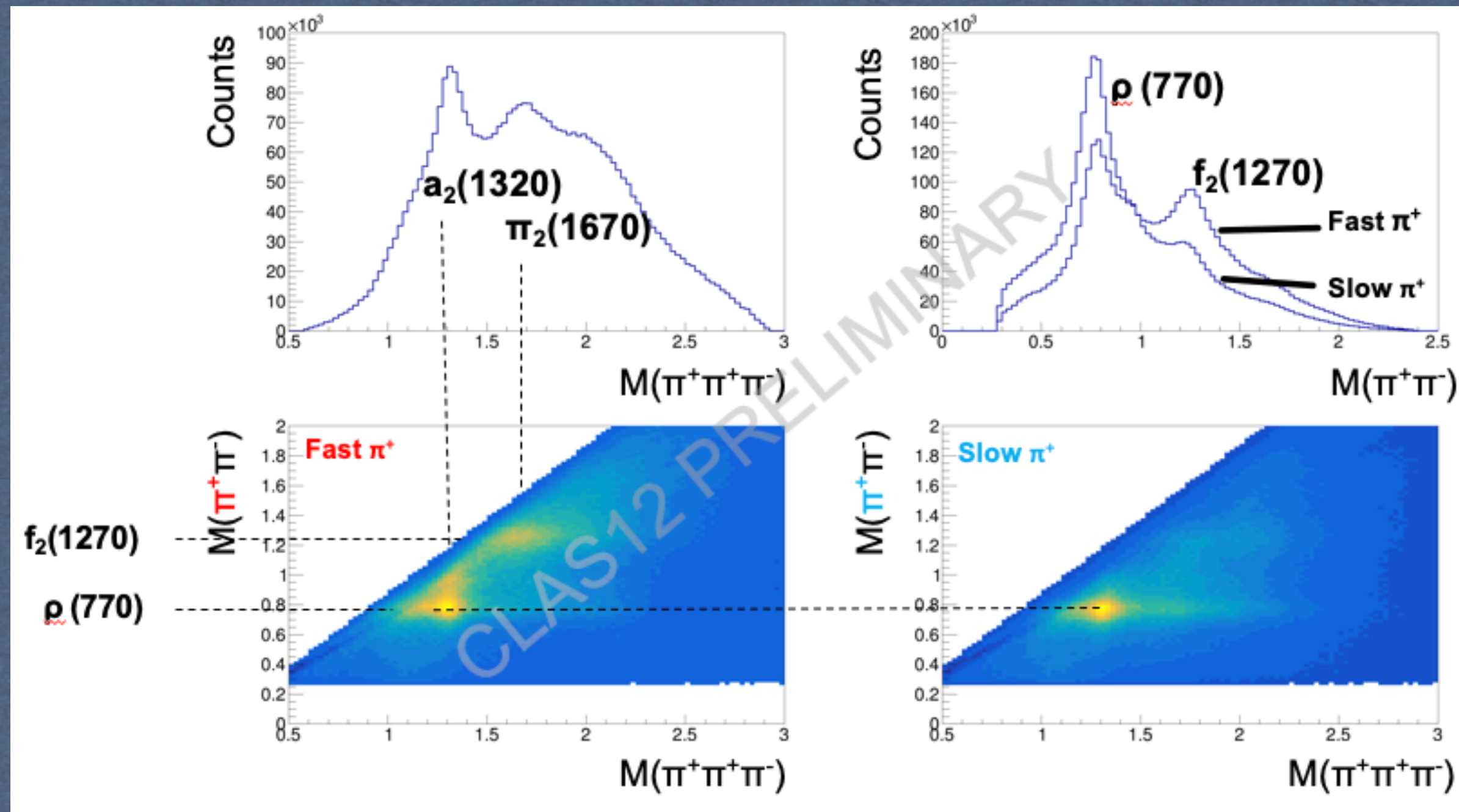


- Complementary cuts select baryons for further studies
- First extraction of angular moments

MesonEx data

$$\gamma p \rightarrow (n) \pi^+ \pi^+ \pi^-$$

- Search for $\pi_1(1600)$ exotic meson
- $E_{\text{beam}} = 10.6$ GeV on LH2 target
 - $-t < -2$ GeV
 - $6 < E_\gamma < 10$ GeV
- Use standard CLAS12 PID (FT based start time)
- $p\pi^+\pi^-$ (missing n) exclusive reaction



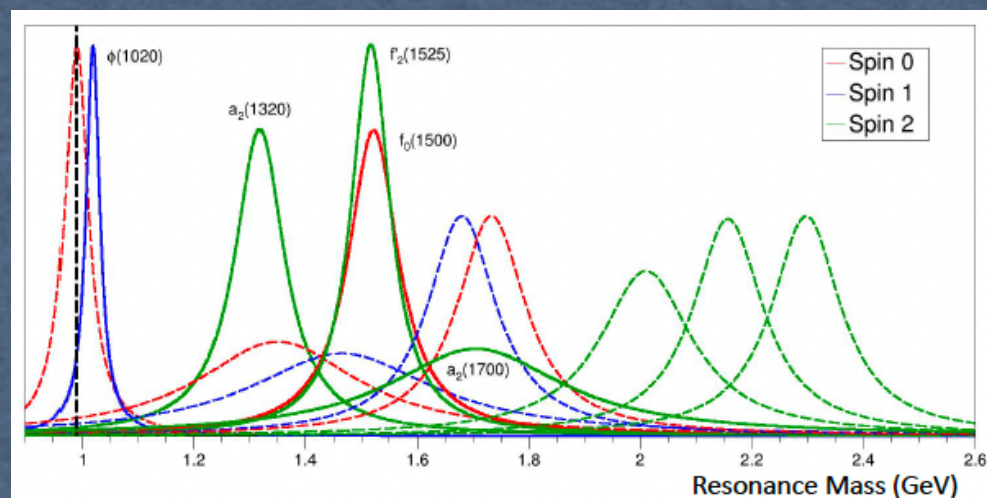
- Need to include $N^*/\Delta + 2\pi$ contributions in the analysis
- Trigger/Torus Field/Detector $\rightarrow$ Low acceptance for $M < 1.3$ GeV

MesonEx data

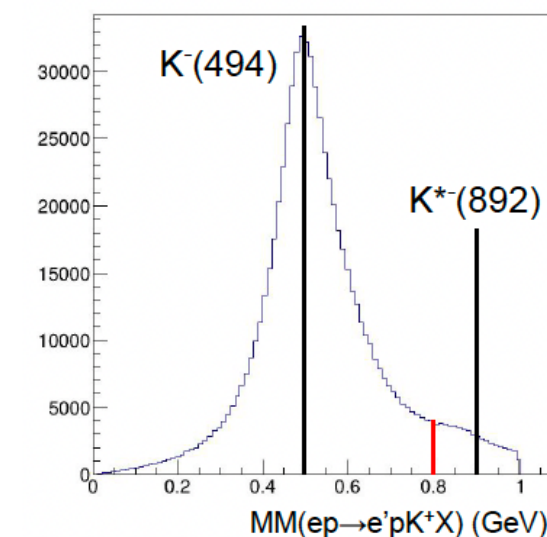
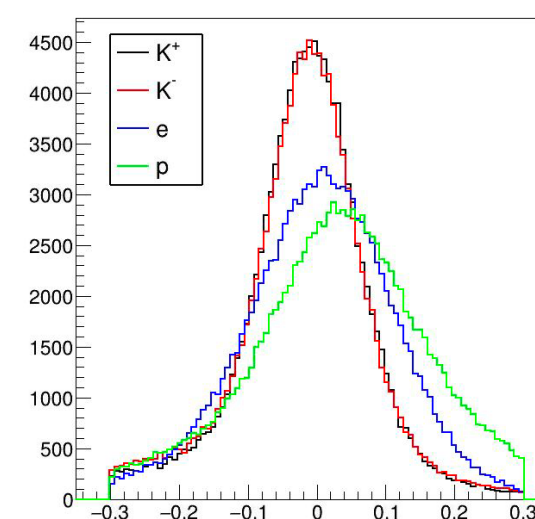
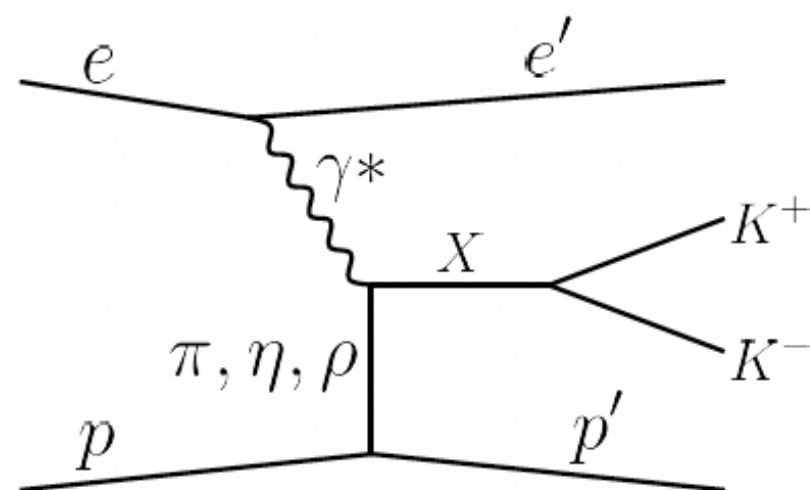


- $E_{\text{beam}} = 10.2$ GeV on LH2 target
- Q^2 between 0.07 and 0.3 GeV
- e^- in FT, hadrons in FD
- p and K^+ detected (K^- missing)

Resonances	Mass (MeV)	Width (MeV)	Spin
$\phi(1020)$	1019.5	4.3	1
$a_2(1320)$	1318.2	107.8	2
$f_0(1500)$	1522	108	0
$f'_2(1525)$	1517.3	84.4	2
$a_2(1700)$	1706	380	2



- Moment analysis



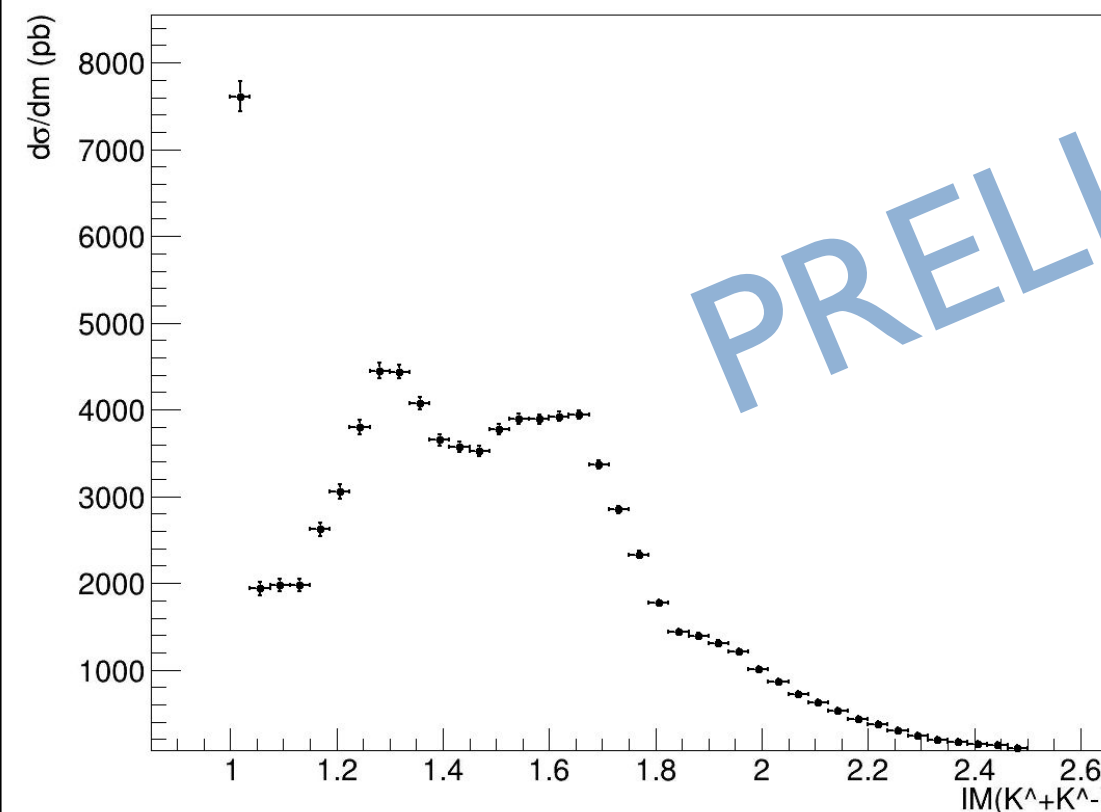
Differential cross-section

$$\frac{d\sigma}{dm_{K^+K^-}} = \frac{N_i}{\Gamma \epsilon_i \Delta m_i T B R_i}$$

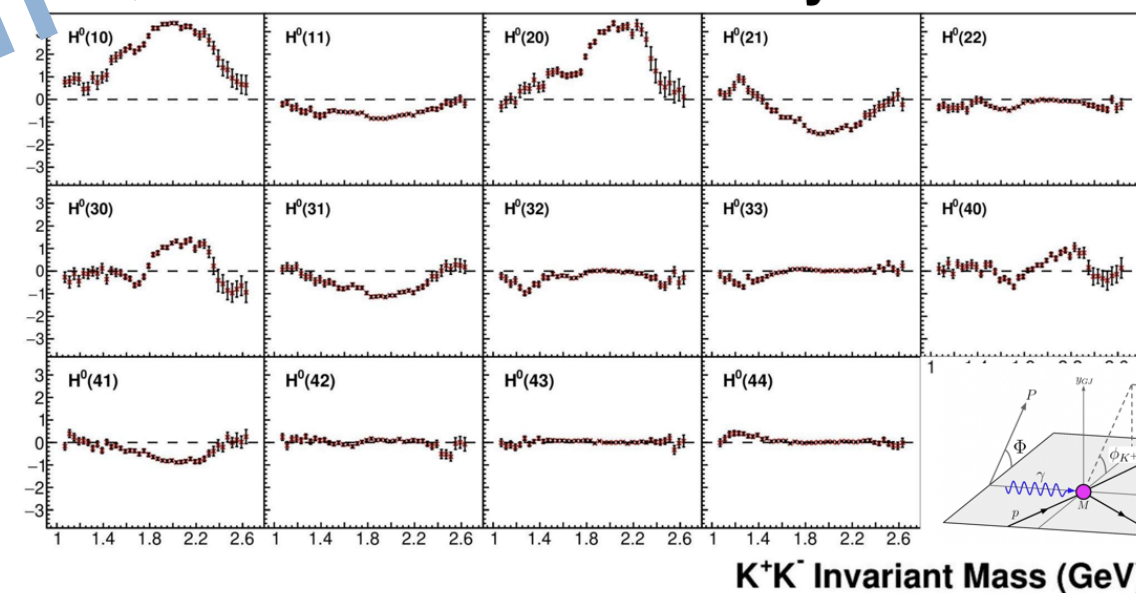
$$H^0(LM) = \frac{1}{2\pi} \int_0^{2\pi} \int_0^{2\pi} \int_{-1}^1 I(\Omega, \Phi) d_{M0}^L(\theta) \cos M\phi d(\cos \theta) d\phi d\Phi$$

$$H^0(00) = H^1(00) + 2 \left[|P_1^{(+)}|^2 + |D_1^{(+)}|^2 + |D_2^{(+)}|^2 \right]$$

$$H^1(00) = 2 \left[|S_0^{(+)}|^2 + |P_0^{(+)}|^2 + |D_0^{(+)}|^2 \right]$$



Moments of K+K- decay



Conclusions and outlook

- * Hadron spectroscopy (now as in the past) demonstrates to be an important tool to study strong forces
- * Several new multi-quark states that do not fit into the Quark Model have been discovered
- * Quark bound-states are genuine manifestation of non-perturbative regime of QCD
- * Jefferson Lab has a comprehensive spectroscopy program (GlueX & CLAS12)
- * Exotics and strangeness-rich mesons search exploit excellent resolution and particle ID
- * CLAS12
 - Low Q^2 e- scattering for high intensity, linear pol, quasi-real photon beams
 - High Q^2 e- scattering to map out baryon/meson internal dynamics
- * Abundant and precise data requires a solid PWA analysis framework
- * New analysis tools based on AI are being developed in parallel to be ready for physics analyses

Many other CLAS12 electroproduction contributions at NSTAR26!

High-performance detectors, high intensity e/ γ beams, strong analysis framework are the ingredients to make JLab a leading facility in modern hadron spectroscopy