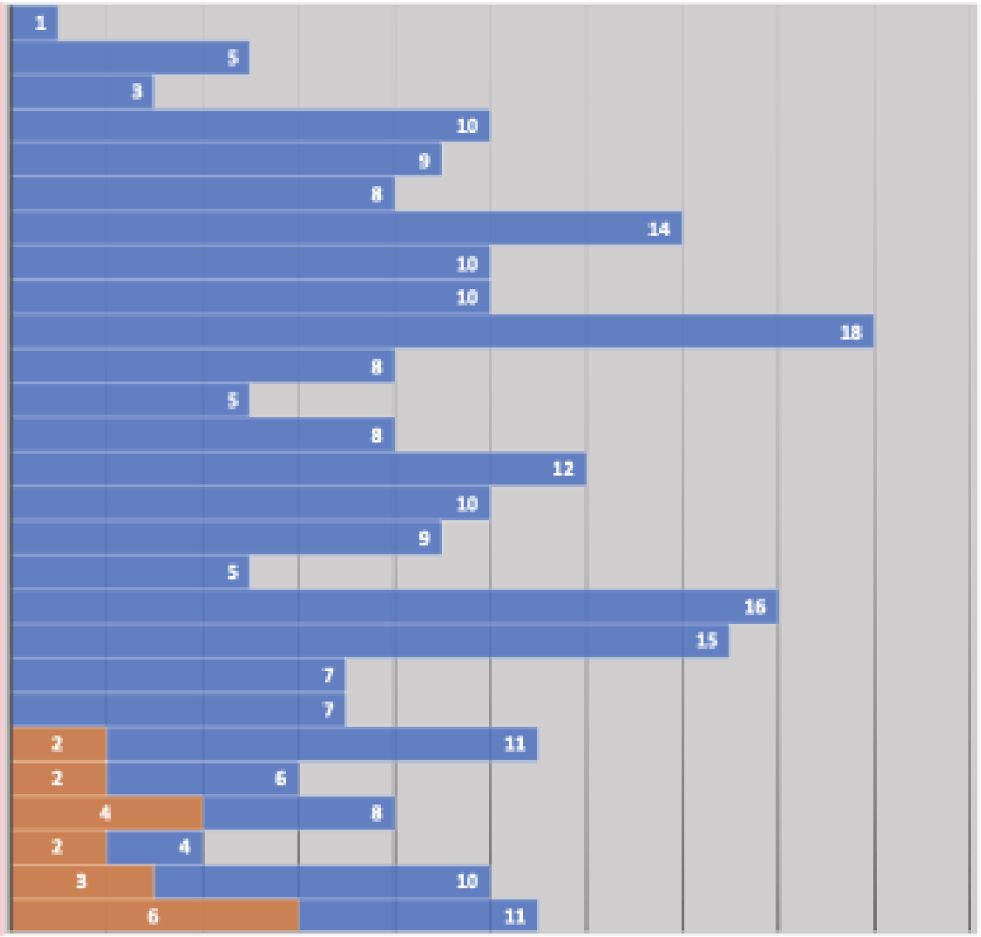
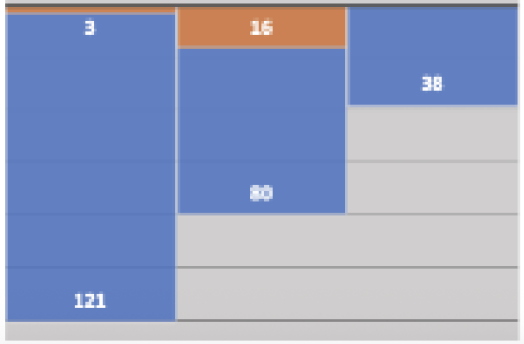
# Hadron Spectroscopy Statistics

| Year | HSWG | DPWG | NPWG |
|---|---|---|---|
| 2000 | 1 | | |
| 2001 | 2 | 3 | |
| 2002 | 1 | 2 | |
| 2003 | 4 | 5 | 1 |
| 2004 | 2 | 3 | 4 |
| 2005 | 4 | 2 | 2 |
| 2006 | 9 | 3 | 2 |
| 2007 | 8 | 1 | 1 |
| 2008 | 5 | 5 | 0 |
| 2009 | 13 | 4 | 1 |
| 2010 | 4 | 2 | 2 |
| 2011 | 3 | 1 | 1 |
| 2012 | 4 | 2 | 2 |
| 2013 | 7 | 3 | 2 |
| 2014 | 5 | 4 | 1 |
| 2015 | 3 | 5 | 1 |
| 2016 | 4 | 1 | |
| 2017 | 8 | 7 | 1 |
| 2018 | 8 | 4 | 3 |
| 2019 | 2 | 2 | 3 |
| 2020 | 5 | 1 | 1 |
| 2021 | 4 | 5 | 2 |
| 2022 | 3 | 1 | 2 |
| 2023 | 2 | 4 | 2 |
| 2024 | 1 | 2 | 1 |
| 2025 | 6 | 3 | 1 |
| 2026 | 4 | 5 | 2 |
| | 121 | 80 | 38 |




**CLAS Collaboration Total 239**

**CLAS12 Publications 19**

HSWG Publications 121

## Completed Ad-Hoc Committee Reviews

| Review Type (Committee) & Initiator | Paper Title | Contact Author | Exp | Status |
|---|---|---|---|---|
| **Ad-hoc review** (by Brian Raue, Patrick Achenbach, Lucilla Lanza) – *Initiated by Bryan McKinnon* | Measurement of Measurements of γvp → π+π−p′ Cross Section with the CLAS detector for Q2 from 2-5 GeV2 and W from 1.4-2.125 GeV | Dan Carman | CLAS | Ended on June 1, 2026 **Submitted to PRC** |
| **Ad-hoc review** (by Chaden Djalali, Cole Smith, Eugen Isupov) – *Initiated by Maria Zurek* | Measurements of $\gamma_v p \rightarrow p'\pi^+\pi^-$ Cross Sections with the CLAS12 Detector for $Q^2$ from 2.4-8.0 $GeV^2$ and W from 1.4-2.1 GeV | Krishna Neupane | CLAS12 | Ended on September 10, 2026 **Submitted to PRC** |

# Hadron Spectroscopy Working Group: news and actions

**Susan Schadmand** is the new representative of the Hadron Spectroscopy Working Group in the CLAS Speaker Committee

1. Set up **regular meetings** to acknowledge the status of the on-going projects
   **WhenToMeet request submitted: please respond!**

2. Update the Hadron Spectroscopy Wiki Page
   https://www.jlab.org/Hall-B/secure/hadron/wiki/index.php/Main_Page

3. Update the Official list of CLAS12 and CLAS Analysis Projects
   **Please update the information on the on-going Analysis Projects, or send the information to me**
   https://www.jlab.org/Hall-B/secure/hadron/wiki/index.php/CLAS12_Analysis_projects
   https://www.jlab.org/Hall-B/secure/hadron/wiki/index.php/Analysis_projects

**CEBAF 2037: Collect inputs for the December Kick-OFF meeting at MIT**

# Hadron spectroscopy and exotic searches: from the photon point to $Q^2$ evolution

## Leading questions and why they matter

- Lattice QCD predicts hybrid mesons with exotic quantum numbers and hybrid baryons with an excited gluonic field.
- Their existence, together with the nature of the hidden-charm X and Z states, is a decisive test of QCD in the confinement regime.
- Hybrid baryons share quantum numbers with ordinary three-quark states: they can only be identified through their dynamics.
- The X and Z states are still debated: compact multiquark states, molecules or kinematic effects?

## Example measurements

1 **Light meson spectrum**
High-statistics mapping, including exotic $J^{PC}$ states and channels with several neutral particles

2 **Hybrid baryons**
Searches through the $Q^2$ dependence of their electrocouplings

3 **Strange baryons**
Spectroscopy of strange and multi-strange baryons

4 **Hidden charm - with some financial help**
high-statistics J/ψ program
Photoproduction of X(3872), $Z_c$ and related states;

# Why CEBAF: one facility from real photons to finite $Q^2$




**$Q^2 = 0$**
Real photons

**$Q^2 \approx 0$**
Quasi-real photons

**Finite $Q^2$**
Electroproduction

*The same final states are measured continuously, with high luminosity and large acceptance*

## $Q^2$ evolution: a model-independent tool

- Production amplitudes and transition form factors evolve with $Q^2$ according to the size and internal structure of a state.
- This identifies exotic baryons and mesons without relying on a specific model.

## A moderate energy increase (~1–2 GeV)

- Raises J/ψ yields to the level needed for precision studies.
- Crosses the X(3872) and Zc photoproduction thresholds (~12 GeV), opening hidden-charm spectroscopy at much lower cost than the full 22 GeV option.

**Connections** Complements COMPASS/AMBER, BESIII, Belle II, LHCb and PANDA, which use different production mechanisms, and relies on close collaboration with lattice QCD and amplitude analysis. The EIC will study the same states at higher $Q^2$ and energy, with lower luminosity.

# Hadron Spectroscopy Session

**09:00** → 12:30 **Day 2 Parallel: HS Parallel I** — F224-225

**Convener**: Annalisa D'Angelo (University of Rome Tor Vergata and INFN Roma Tor Vergata)

| | | | |
|---|---|---|---|
| 09:00 | **HSWG Intro**<br>**Speaker**: Annalisa D'Angelo (University of Rome Tor Vergata and INFN Roma Tor Vergata) | 15m | F224-225 |
| 09:15 | **RG-K Spr24 KY Cross Section Analysis**<br>**Speaker**: Daniel Carman (JLab) | 35m | F224-225 |
| 09:50 | **Resonance contributions to polarized structure functions in inclusive electron scattering**<br>**Speaker**: Dr Bogdan Fadeenko (Moskow State University)<br>Resonant_contrib... Resonant_contrib... | 35m | F224-225 |
| 10:30 | **Coffee Break (F113)** | 30m | F113 (JLab) |
| 11:00 | **eLambda(1116)X polarization and eLambda(1520) BSA from RG-K**<br>**Speaker**: Dr Aron Kripko (Jefferson LAb) | 30m | F224-225 |
| 11:30 | **K+Lambda(1520) Beam Spin asymmetry measurement from RG-K**<br>**Speaker**: Chiara Ammendola | 30m | F224-225 |
| 12:00 | **Elucidating Strangeness with Electromagnetic Probes**<br>**Speaker**: Asli Acar | 30m | F224-225 |

# Hadron Spectroscopy Session

**14:00** → 18:00 **Day 2 Parallel: HS Parallel II** — F224-225 (Jlab)

**Convener**: Annalisa D'Angelo (University of Rome Tor Vergata and INFN Roma Tor Vergata)

| | | |
|---|---|---|
| 14:00 | **Cross Section Measurements of Ground State Cascade Hyperons in RG-K**<br>**Speakers**: Bianca Gualtieri (Florida International University), Bianca Gualtieri (Florida International University) | 30m |
| 14:30 | **Update on MaseonX data analysis (TBD)**<br>**Speaker**: Marco Filippini | 30m |
| 15:00 | **Cross Sections of Proton Antiproton Electroproduction off Protons**<br>**Speakers**: Leonel Martinez (Florida International University), Leonel Martinez (Florida International University) | 30m |
| 15:30 | **Coffee Break** | 30m |
| 16:00 | **Quark–hadron duality in inclusive electron–proton scattering at high $Q^2$: Structure functions and W-truncated moments from CLAS12**<br>**Speaker**: Aleksandr Bulgakov (University of Connecticut) | 30m |
| 16:30 | **Search for the Omega- in electro-production**<br>**Speakers**: Dr Veronique Ziegler, Veronique Ziegler (Jefferson Lab)<br>OmegaSearch.pdf | 30m |