From GlueX/CLAS12 to the EIC

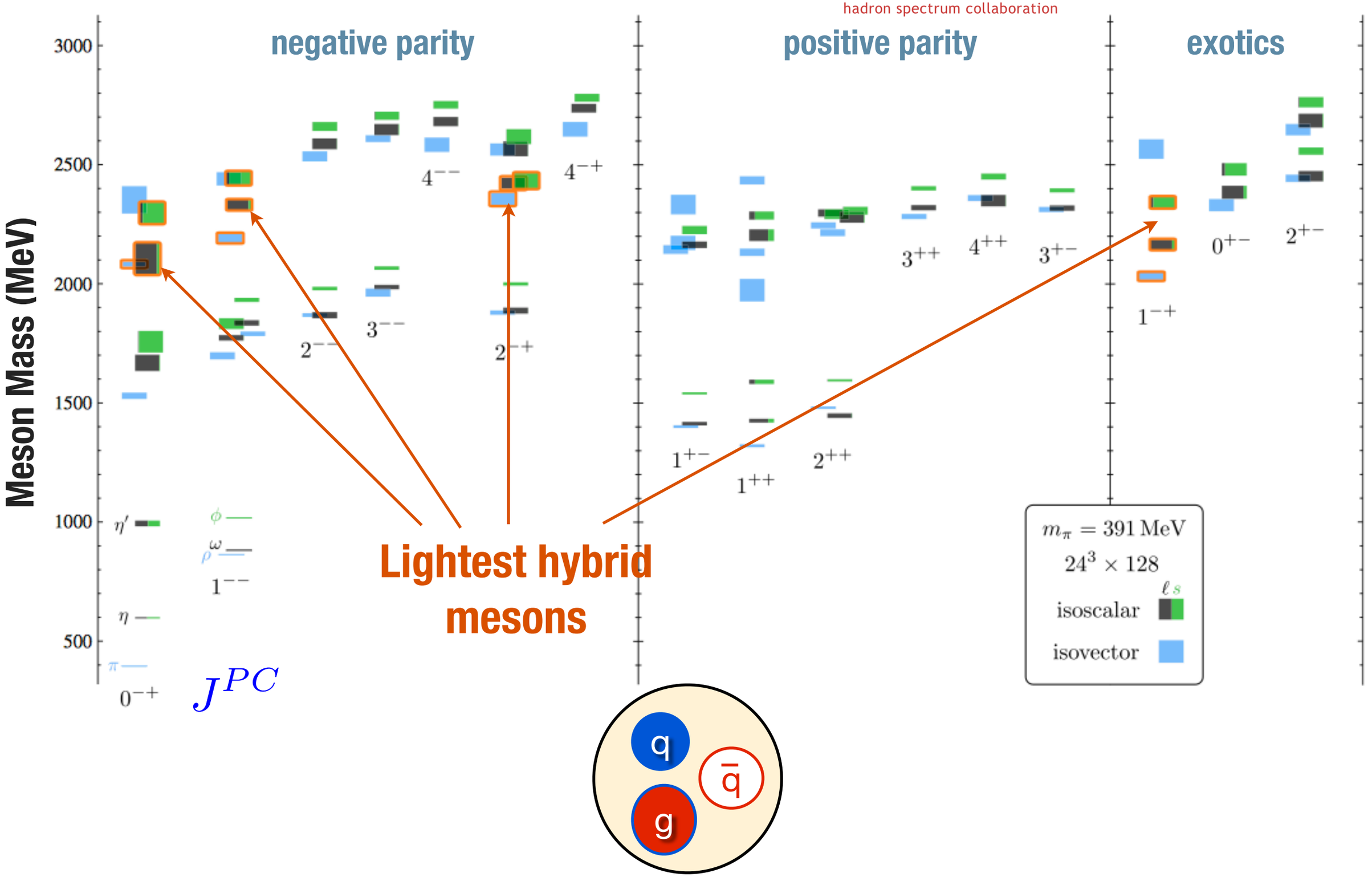
Justin Stevens

WILLIAM & MARY
CHARTERED 1693

Lattice QCD

hadspec
hadron spectrum collaboration

PRD 88 (2013) 094505

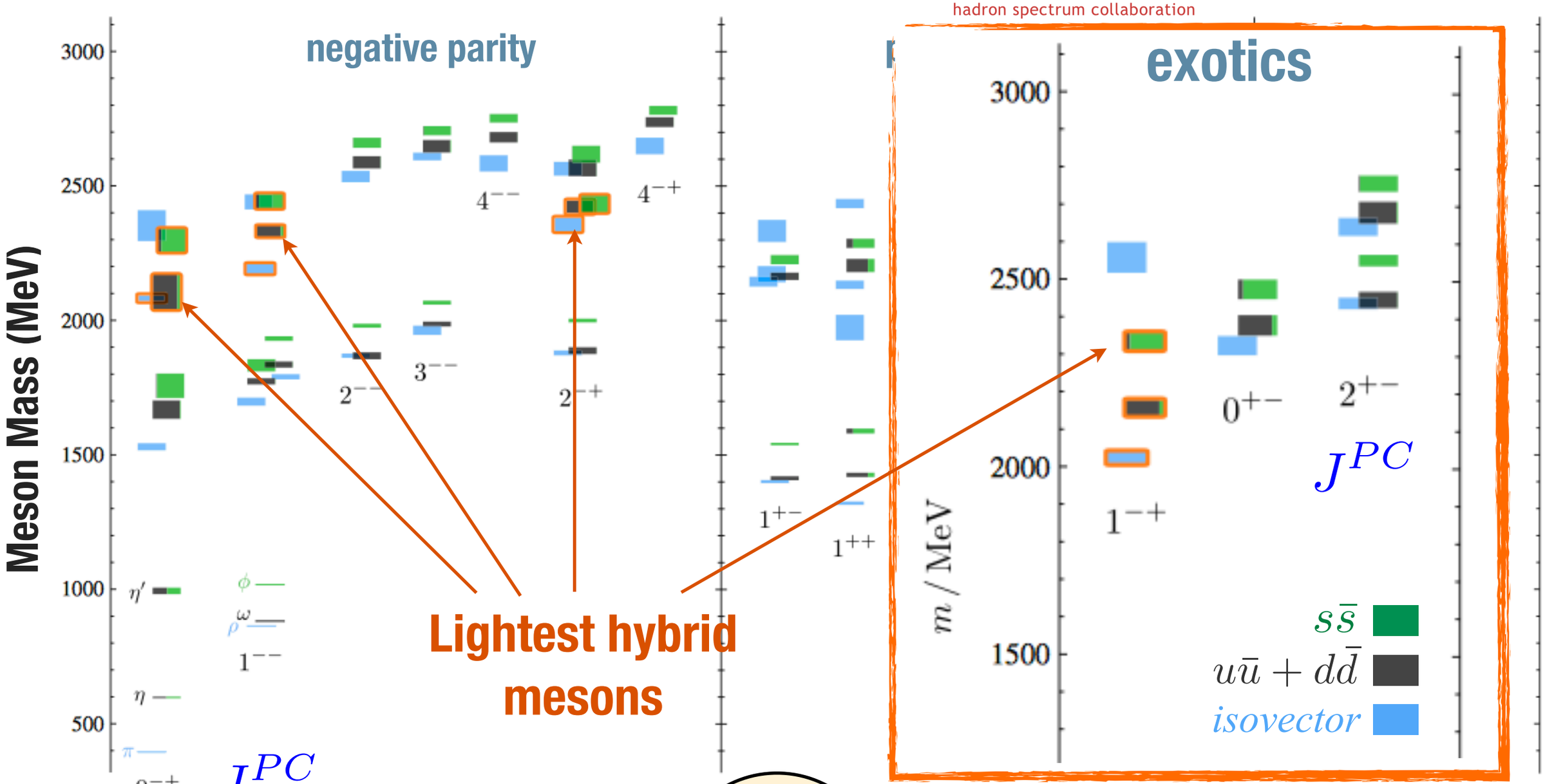


Lightest hybrid mesons

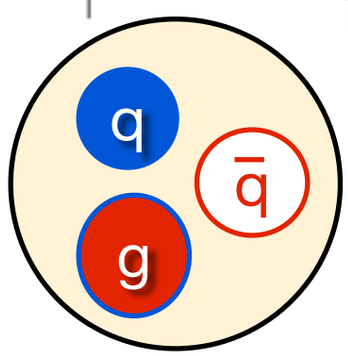
Lattice QCD

hadspec PRD 88 (2013) 094505

hadron spectrum collaboration

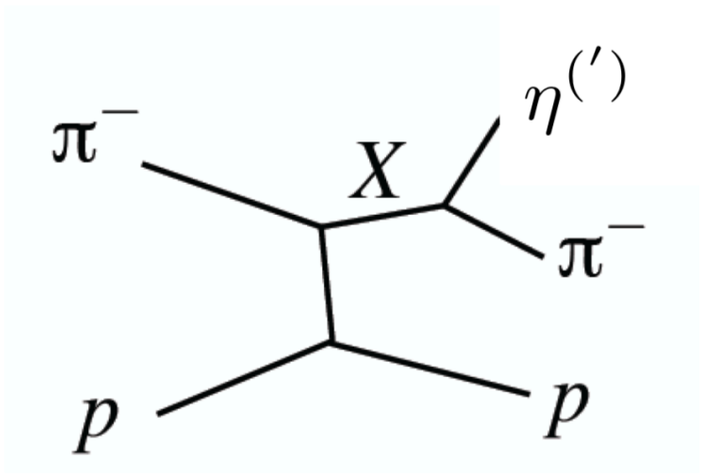


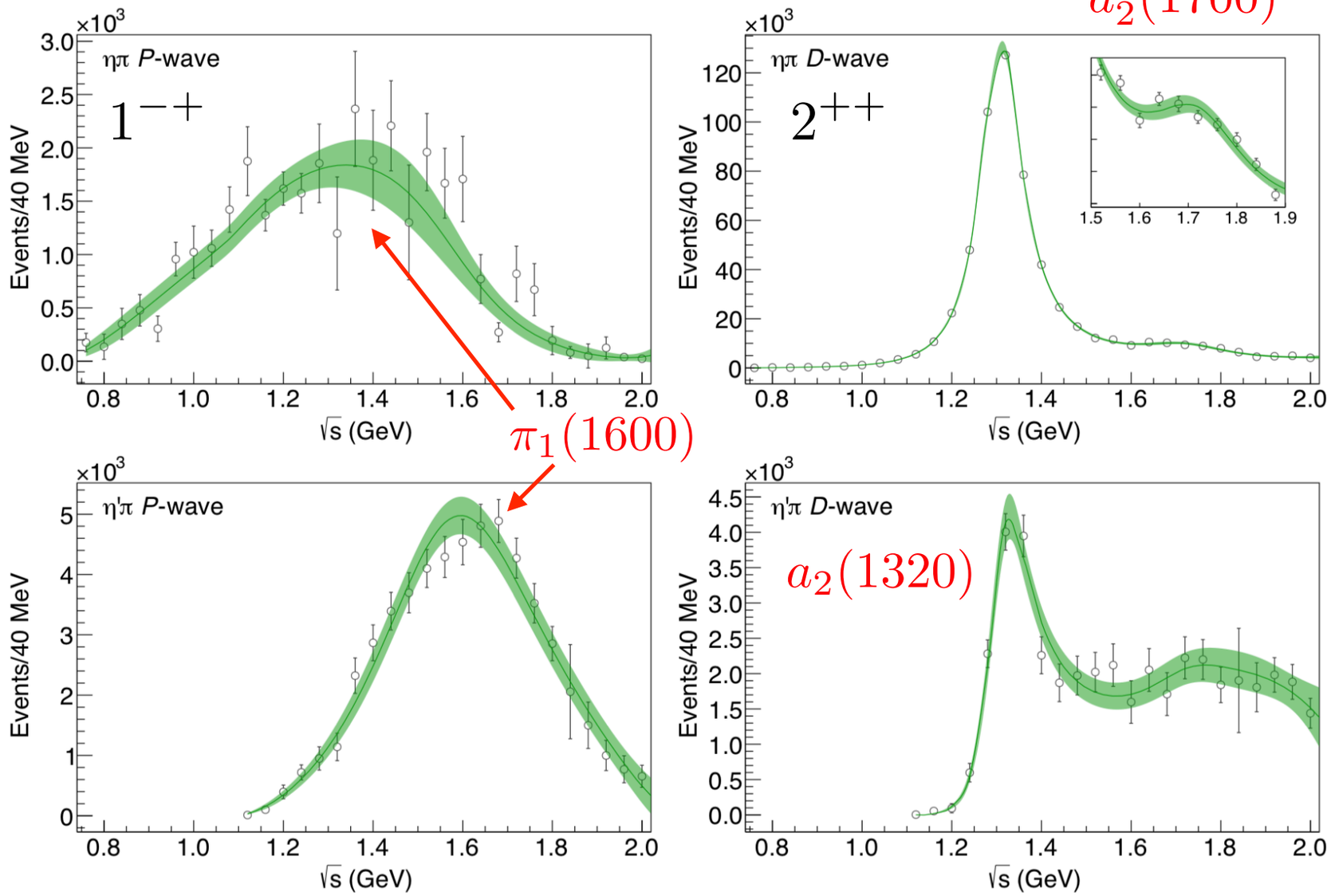
Lightest hybrid mesons



Most experimental searches for hybrids limited to the **π_1 state**

ηπ/η'π spectroscopy at COMPASS with JPAC



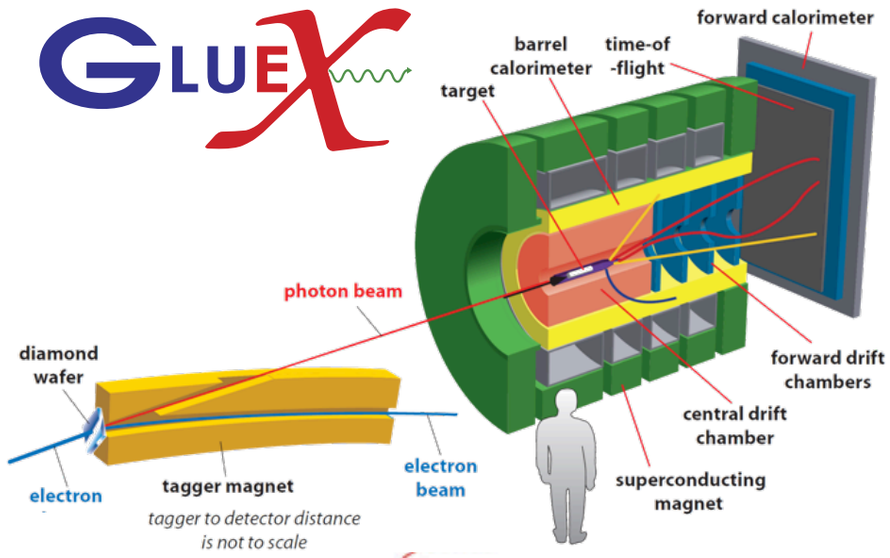


JPAC coupled channel fit to ηπ and η'π determine pole positions for a_2, a_2', and exotic π_1

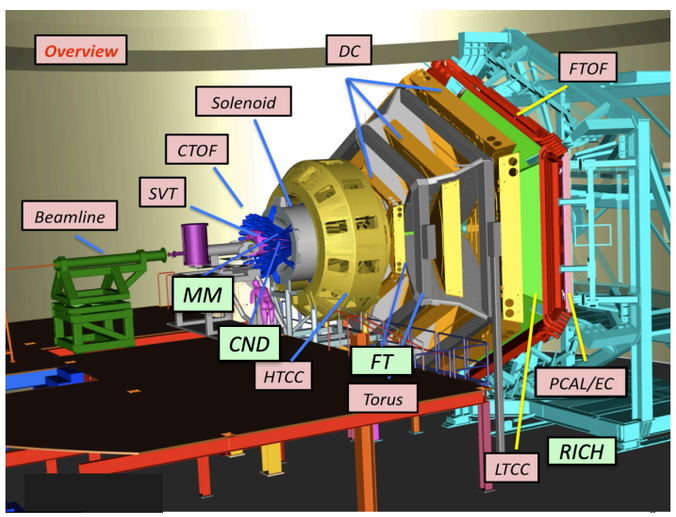
COMPASS: PLB 740 (2015) 303
JPAC: PRL 122 (2019) 042002

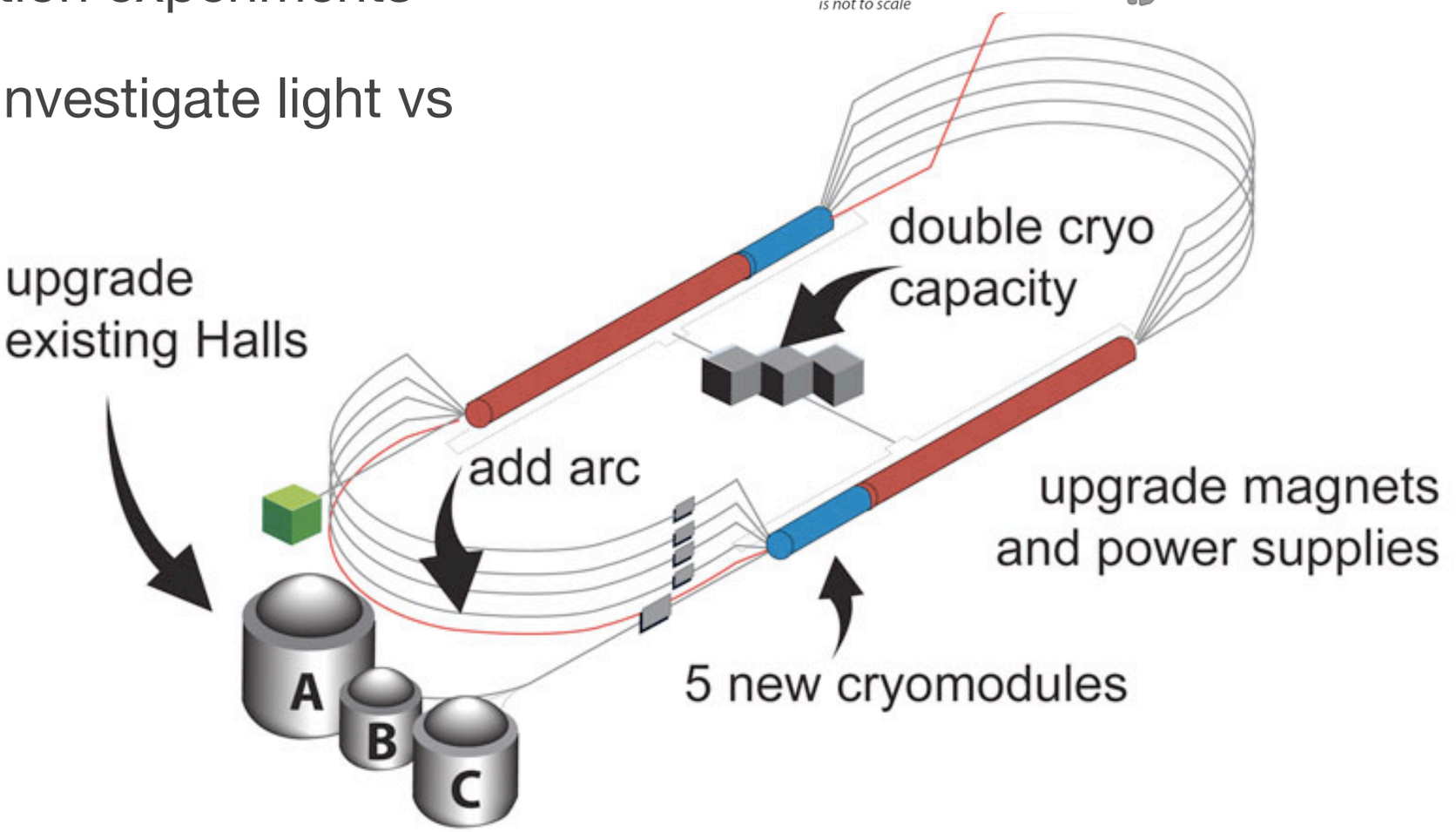
Jefferson Lab 12 GeV e- beam

- Running since 2017: programs in spectroscopy, nucleon structure, etc.
- Photoproduction process provides access to many proposed exotic decay channels
- Orders of magnitude higher statistics than previous photoproduction experiments
- Kaon identification to investigate light vs strange quark content



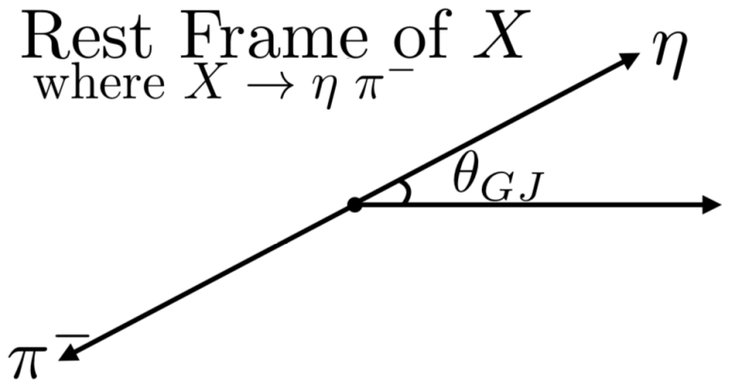
CLAS12



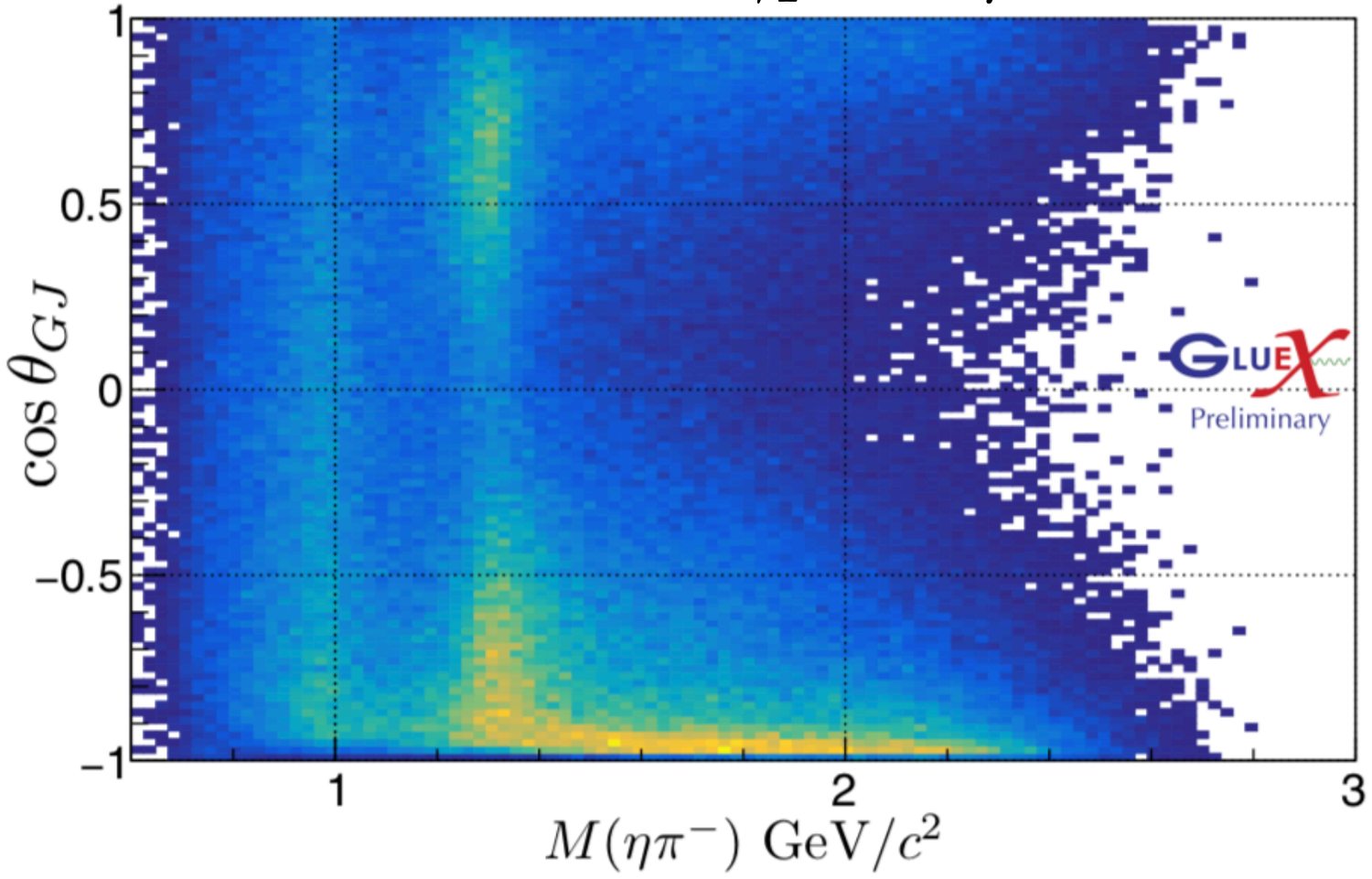


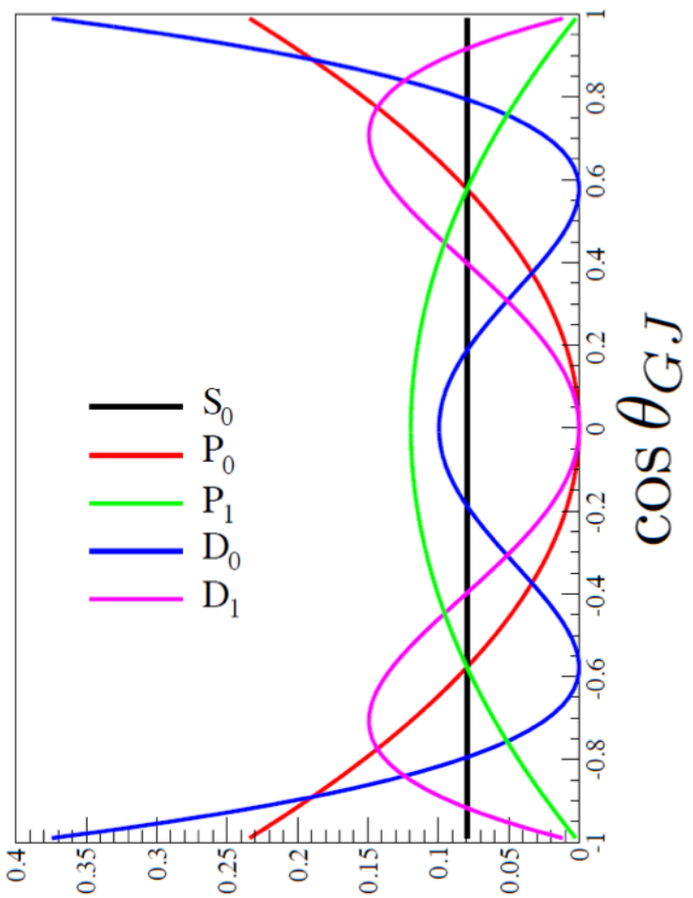
ηπ/η'π spectroscopy at GlueX

- Investigating similar channel as exotic P-wave signals reported by COMPASS
- Polarized photon beam provides new information on production mechanism, collaborating with JPAC on amplitudes



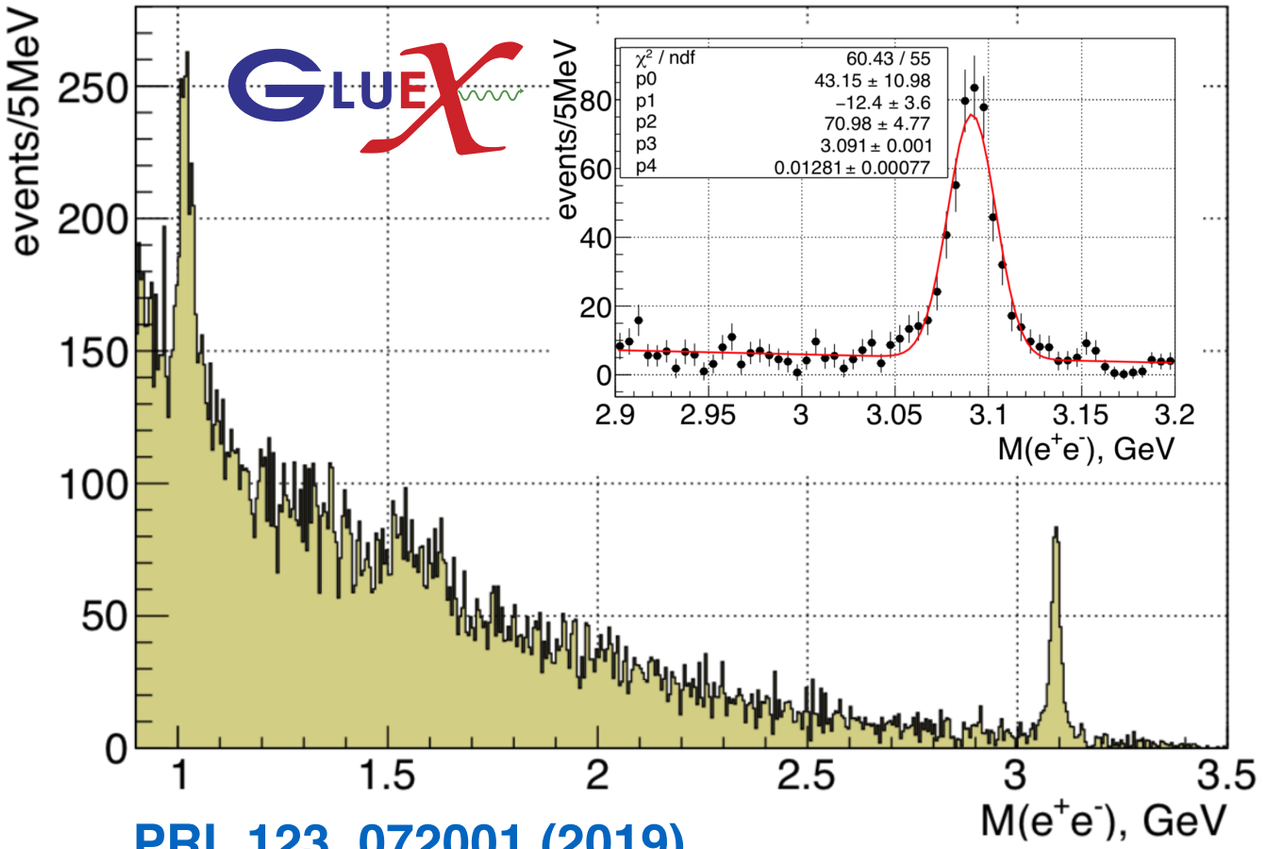
$a_0 \quad a_2 \qquad \gamma p \to \eta\pi^- \Delta^{++}$





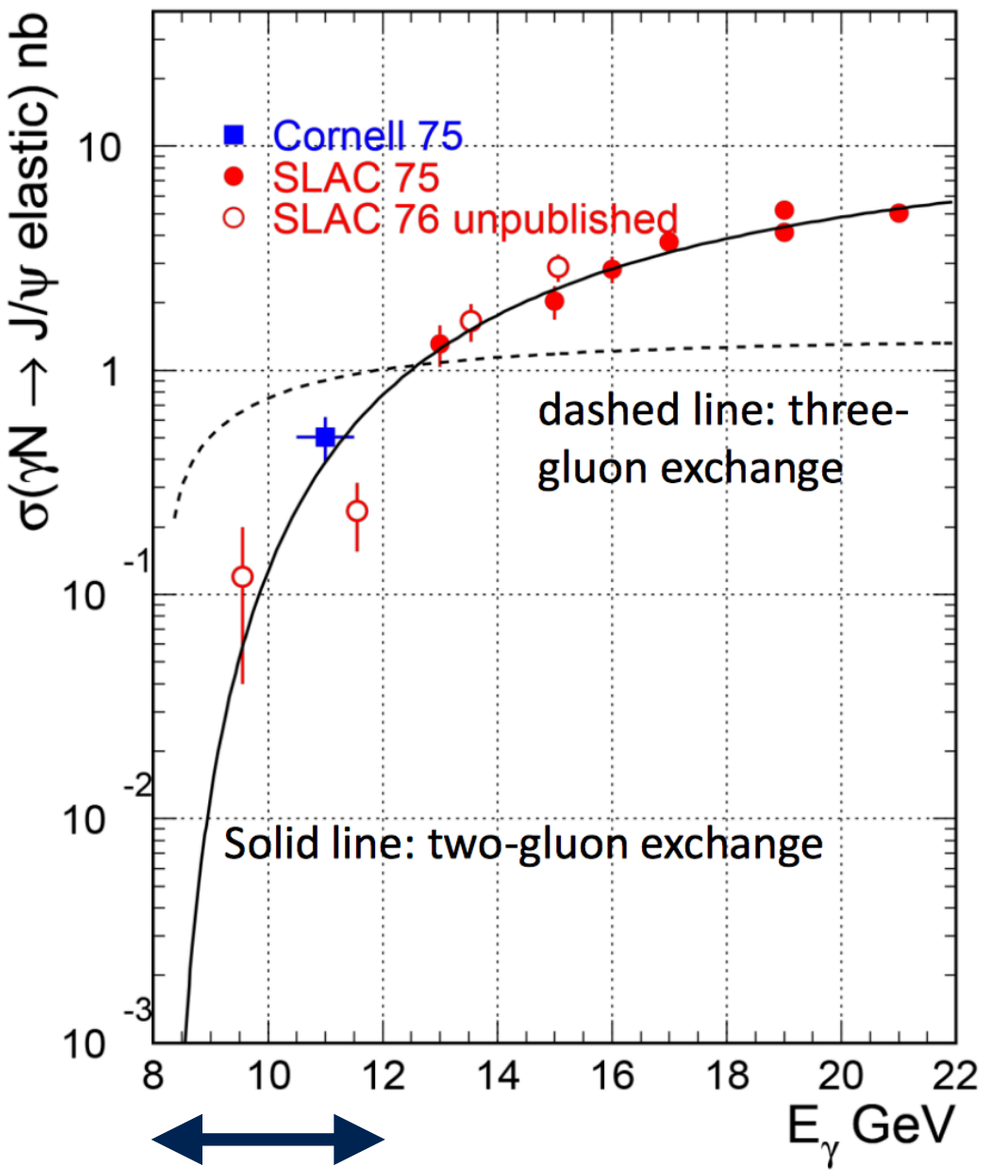
Pentaquarks and threshold charmonium

$$\gamma p \to p e^+ e^-$$



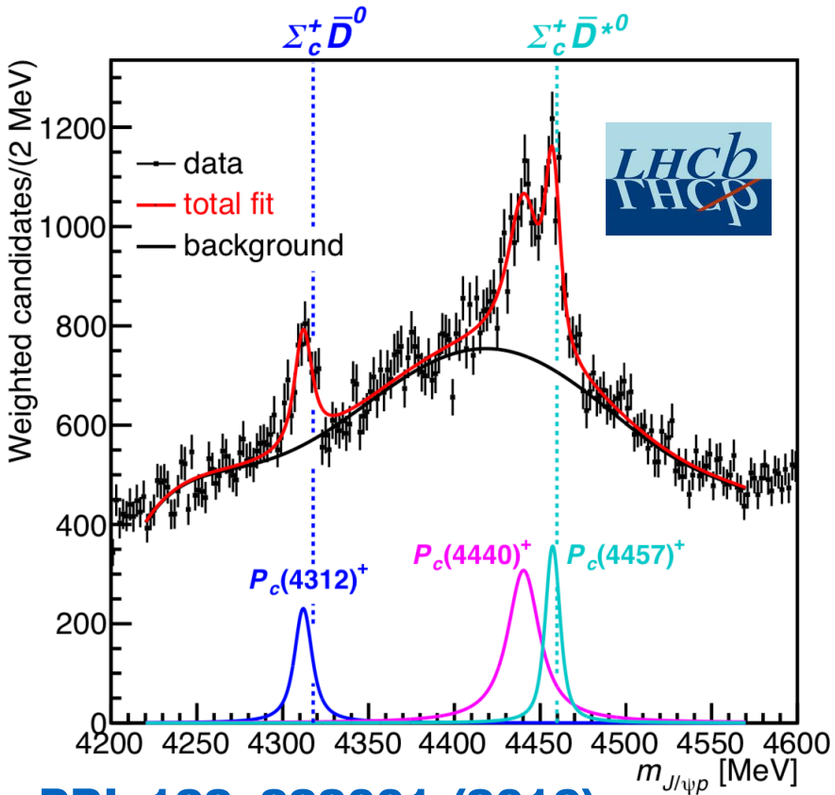
PRL 123, 072001 (2019)

Threshold J/ψ production

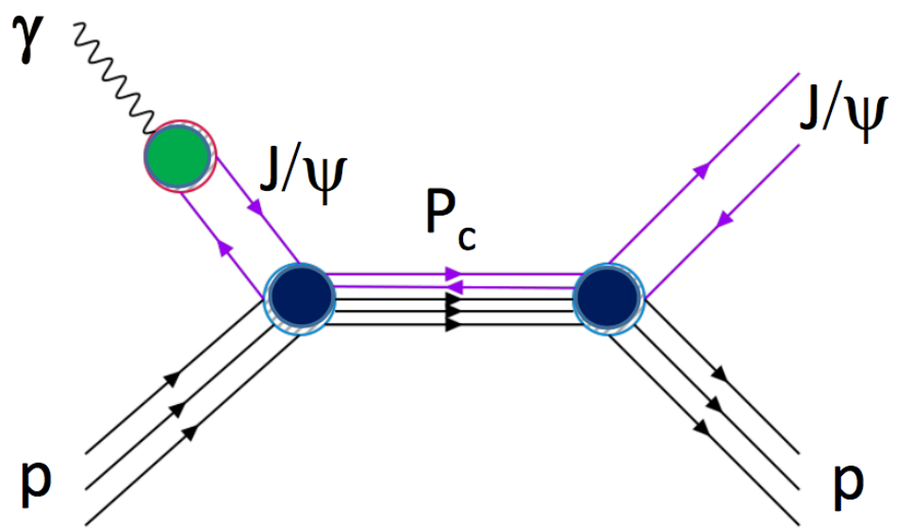


Jefferson Lab

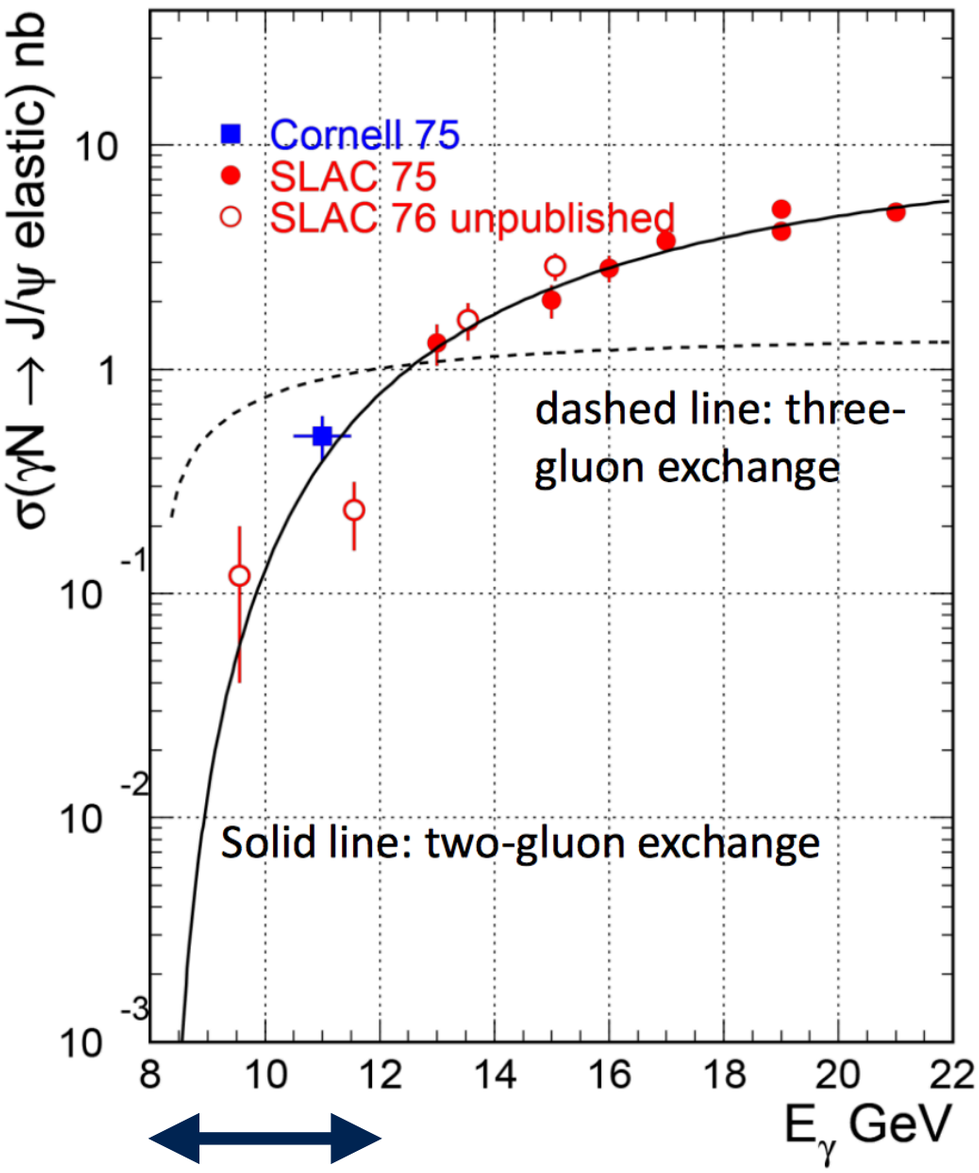
Pentaquarks and threshold charmonium



PRL 122, 222001 (2019)

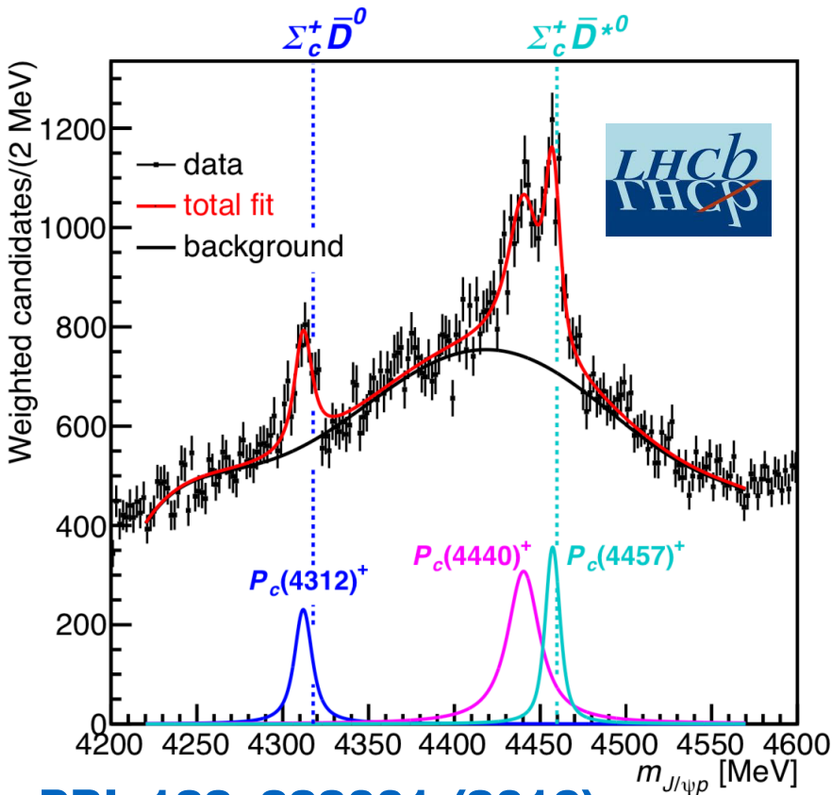


Threshold J/ψ production

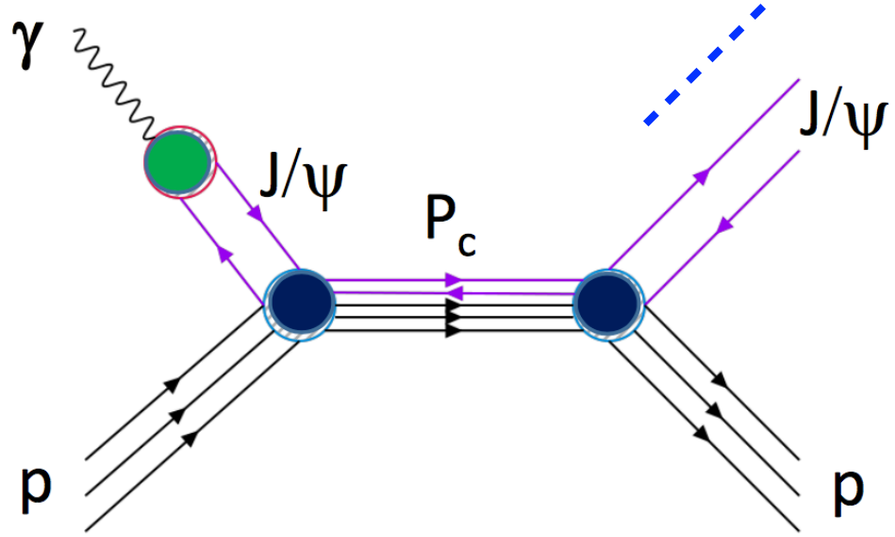


Jefferson Lab

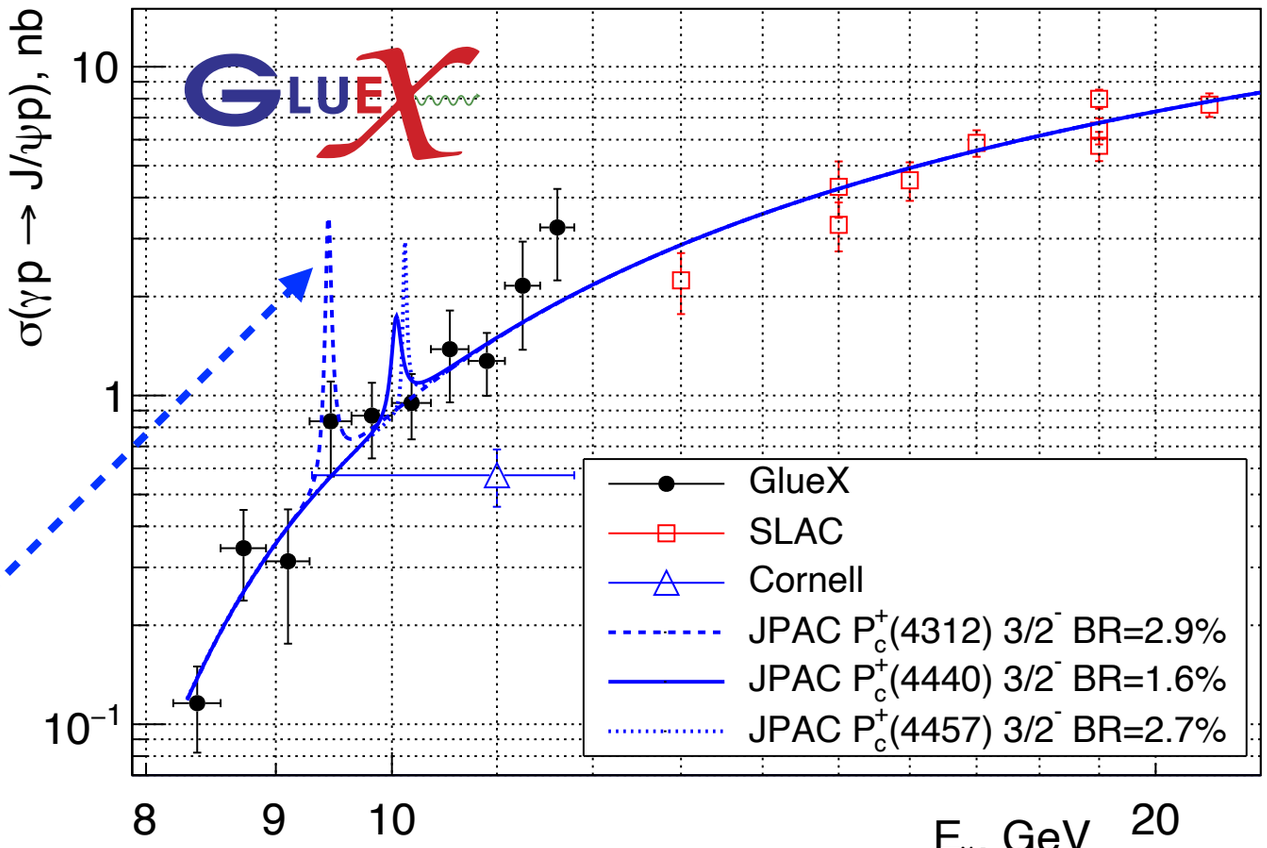
Pentaquarks and threshold charmonium



PRL 122, 222001 (2019)



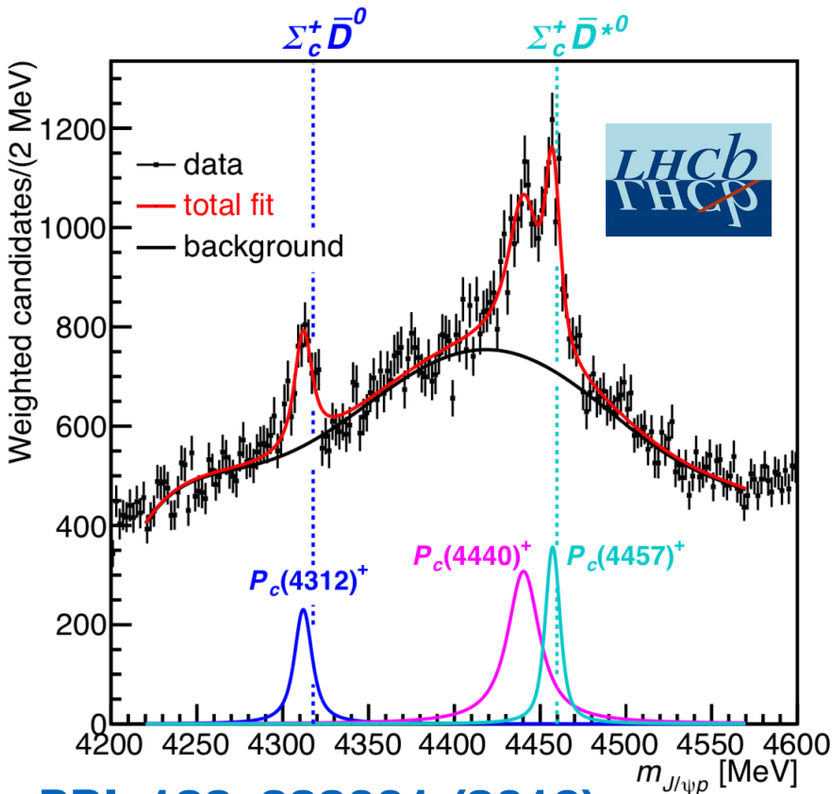
Threshold J/ψ production



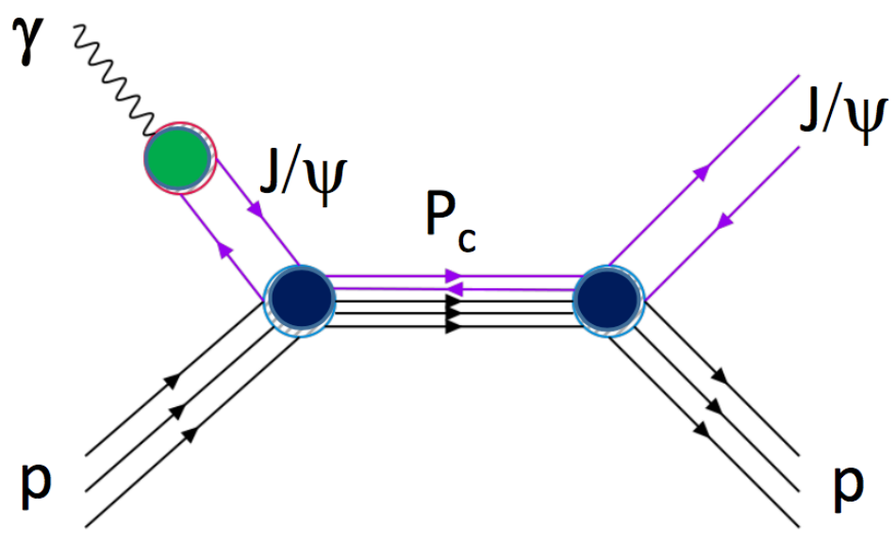
PRL 123, 072001 (2019)

Limits BR($P_c \to J/\psi p$) < 2-4%, providing additional model constraints

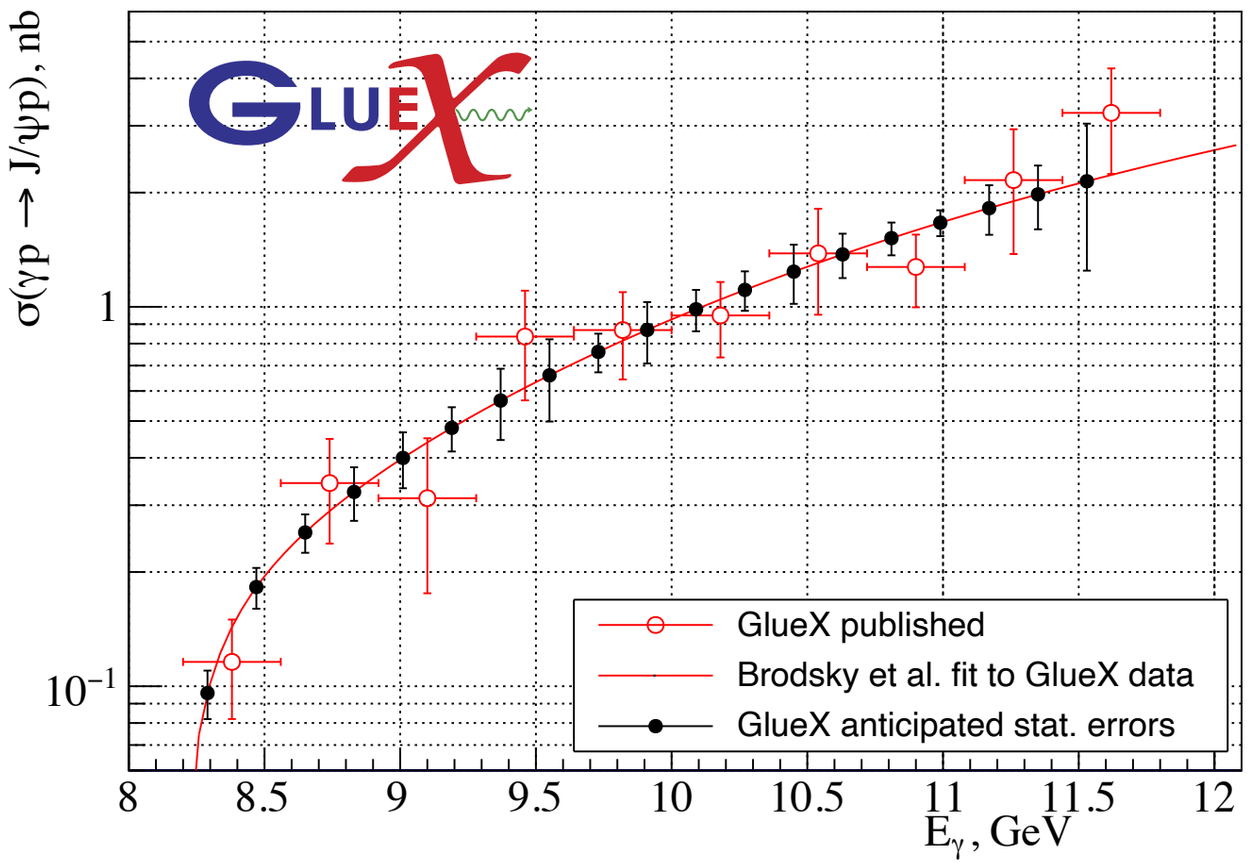
Pentaquarks and threshold charmonium



PRL 122, 222001 (2019)

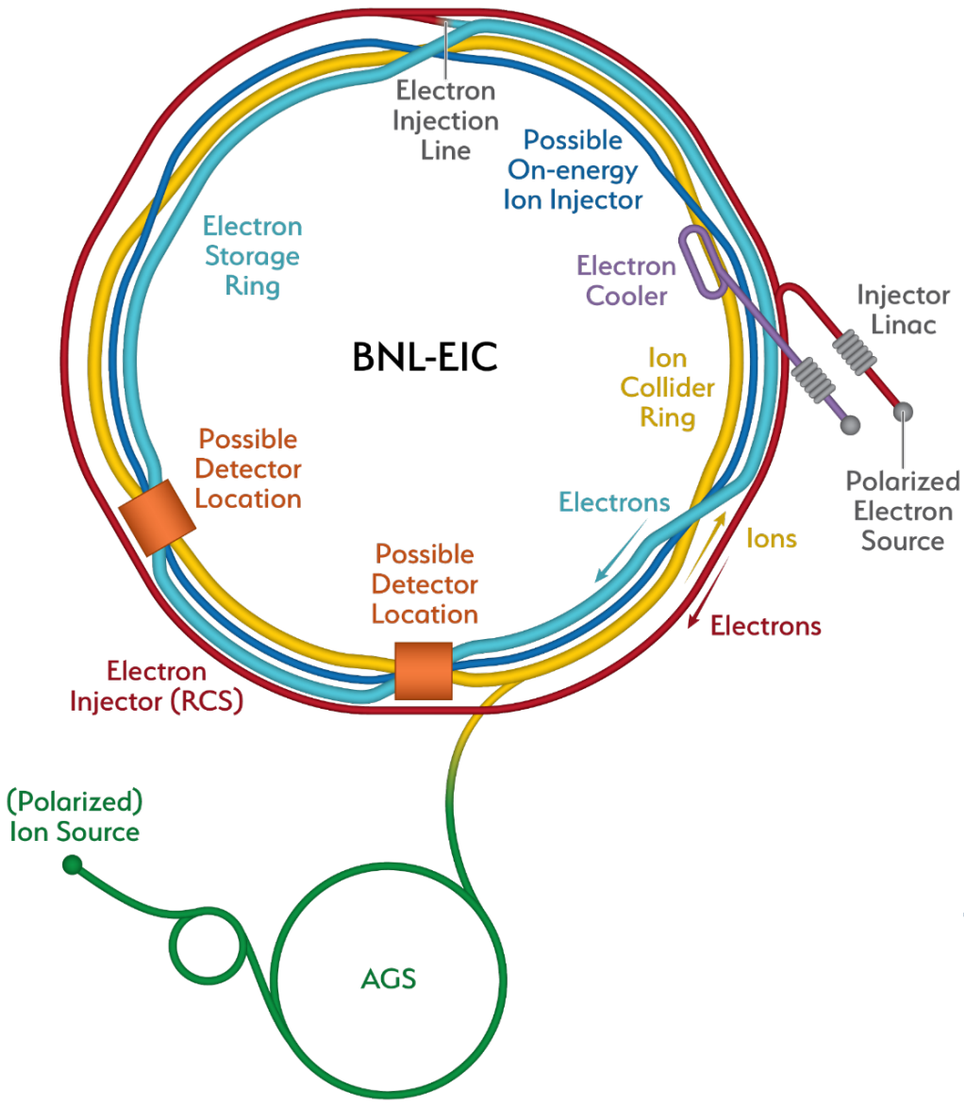


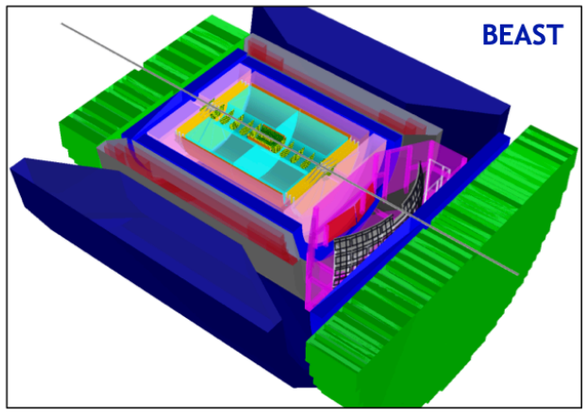
GlueX Phase I: Existing Data

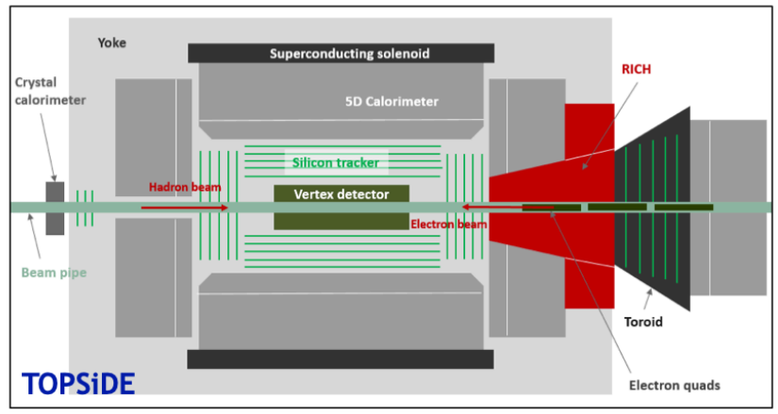


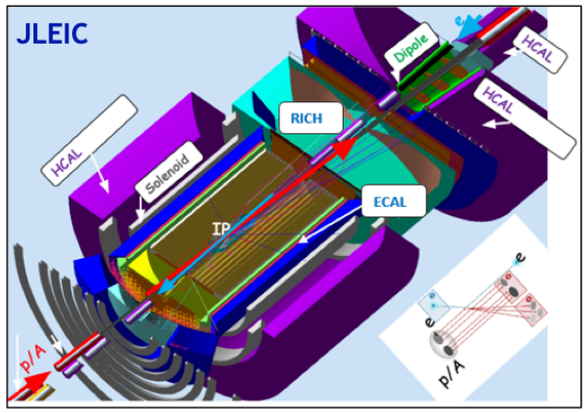
Multiple complementary measurements at JLab will continue to improve limits

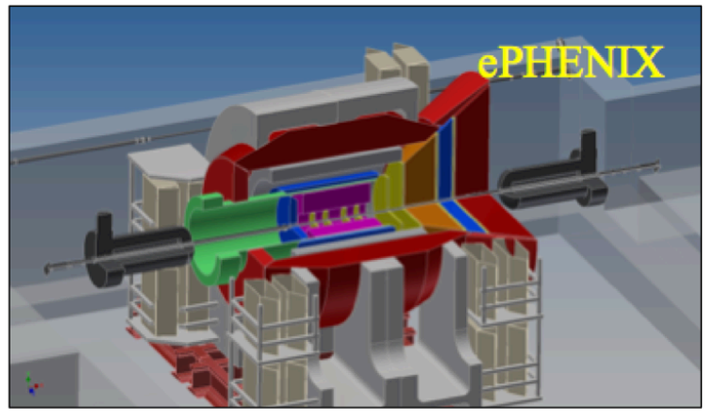
Electron Ion Collider (EIC)











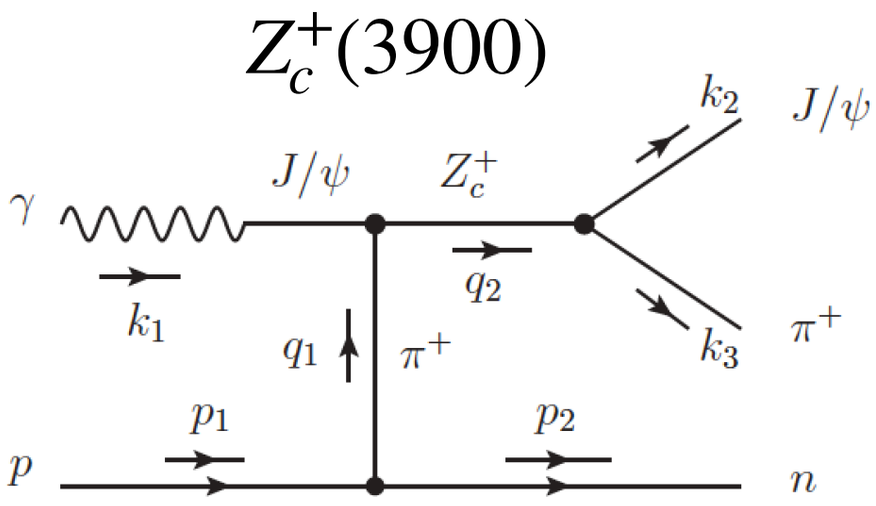
$$\sqrt{s} = 20 - 141 \text{ GeV}$$

$$\mathcal{L} = 10^{34} \text{ cm}^{-2}\text{s}^{-1}$$

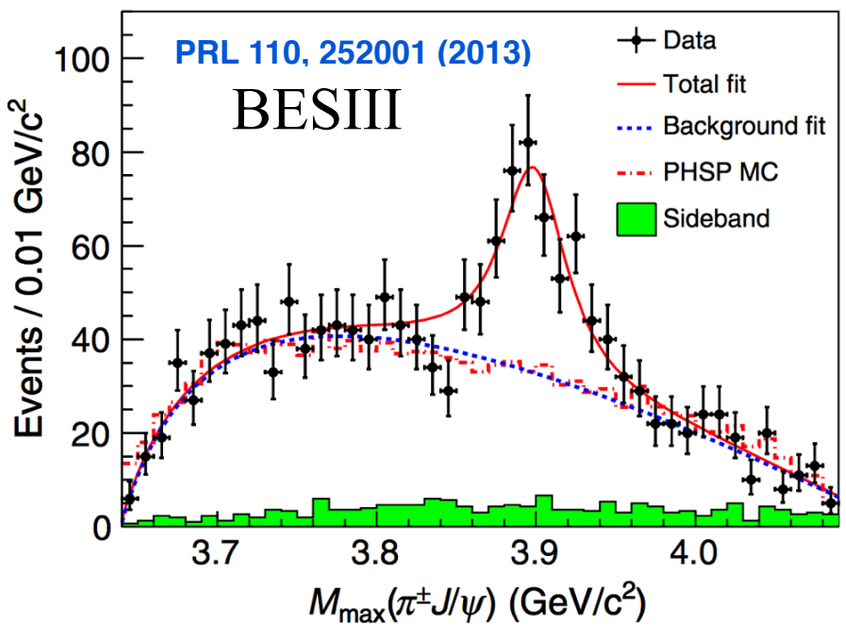
- Versatile high-luminosity, polarized e+p and e+A collider, recently received DOE CD0
- Construction could begin in a few years with first data in ~2030(?)
- Very active development of detector conceptual designs (EIC Yellow Report)

Exotic Photoproduction @ EIC

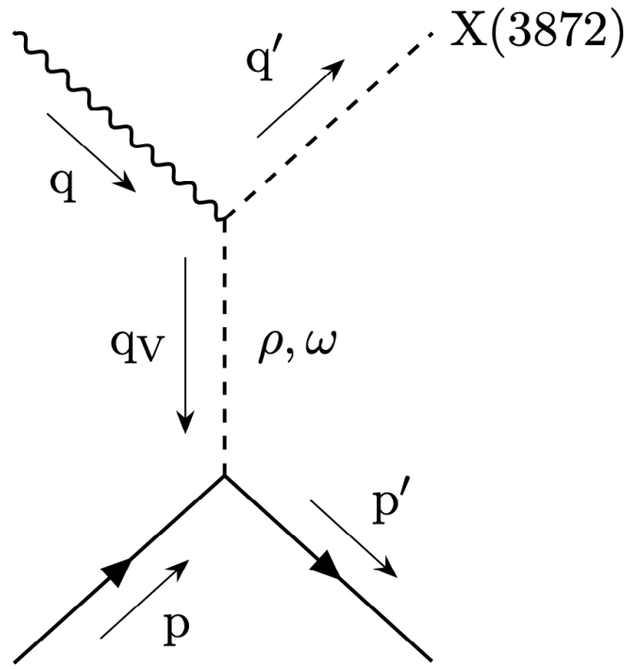
- Higher energy provides opportunities in XYZ, P_c, etc.



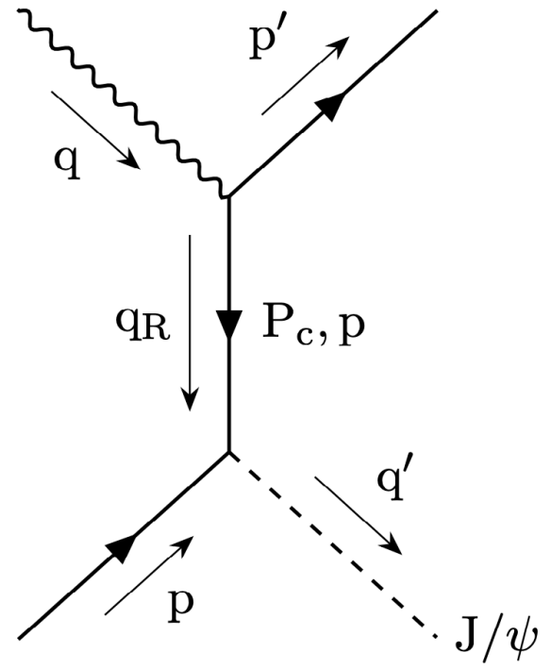
PRD 88 (2013) 114009



Vector meson exchange couple to and X(3872)→J/ψρ



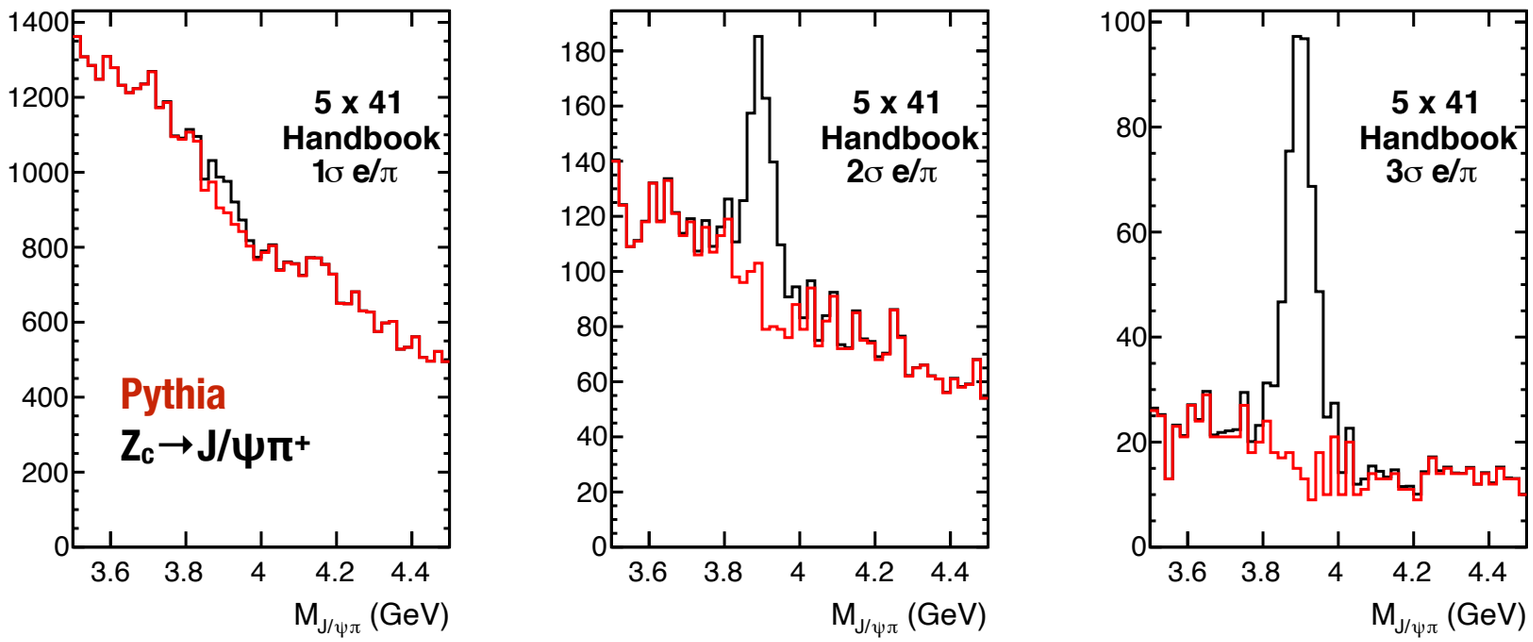
u-channel exchange of P_c results into "backward" J/ψ



Model development by JPAC: Szczepaniak, Pilloni, Hiller Blin, Winney, Albaladejo, Mathieu

Exotic Photoproduction @ EIC

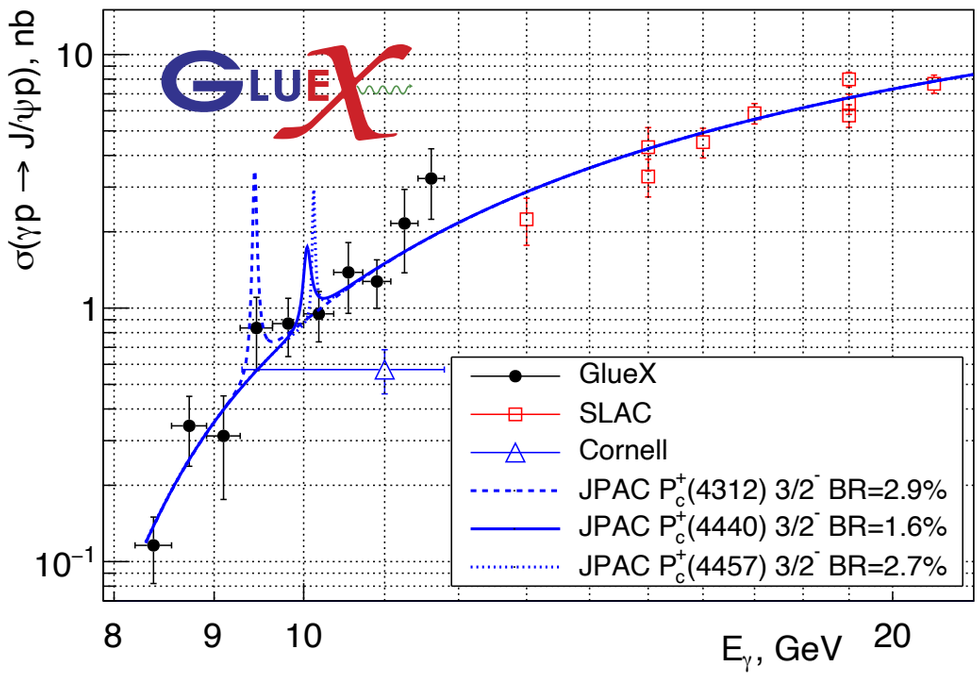
- Higher energy provides opportunities in XYZ, P_c, etc.
- EIC Yellow Report: detector requirements for spectroscopy (PID, recoil nucleon tagging, etc.)



Many groups participating: JPAC, JLab, Florida State, Indiana, W&M, Glasgow, INFN, Regina. More welcome!

Summary and Outlook

- Fixed target spectroscopy focused on light quark hybrids and threshold J/ψ production (s-channel P_c)
  - Jefferson Lab has a decade-long spectroscopy program with GlueX and CLAS12
- EIC Spectroscopy program focused on alternative production mechanisms for heavy quark exotics



PRL 123, 072001 (2019)