Search for the First Strange Hexaquark

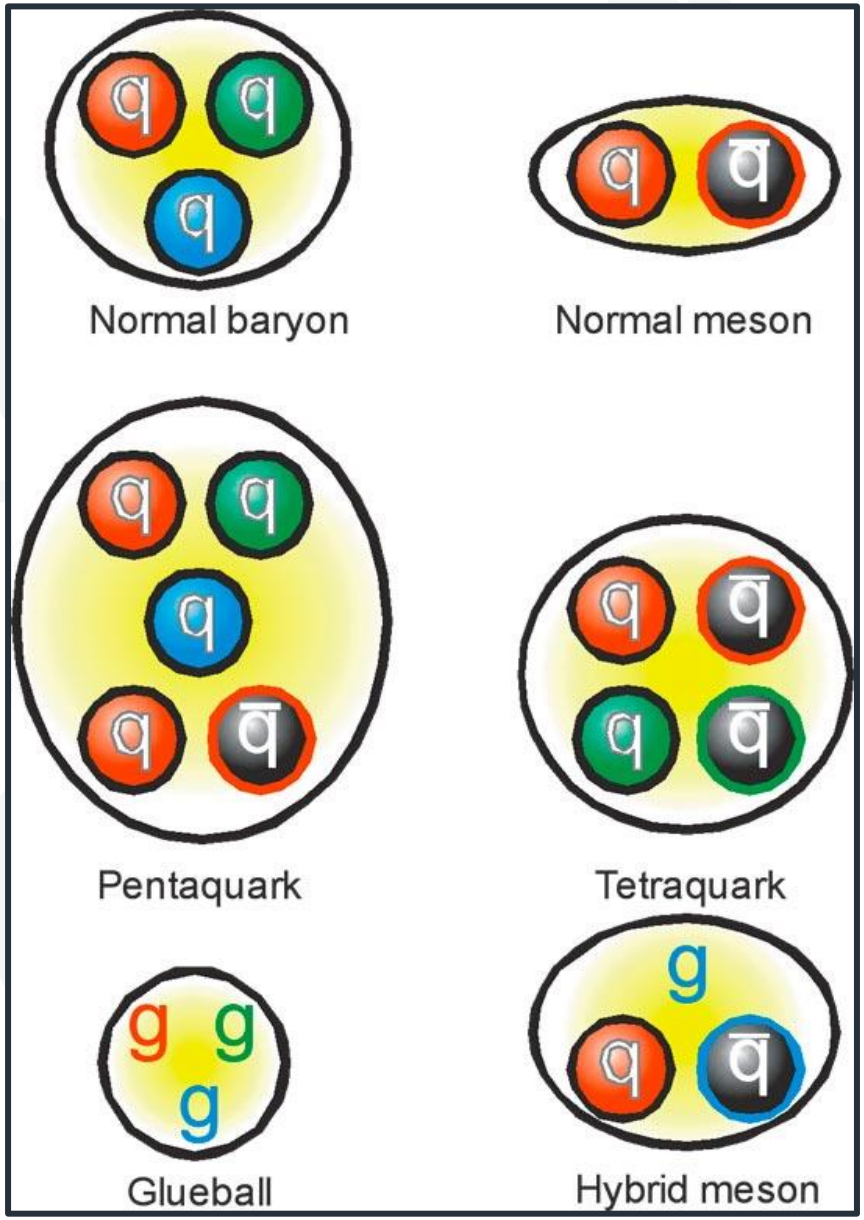
Geraint Clash

University of York, UK

Science and Technology Facilities Council

CEBAF Large Acceptance Spectrometer

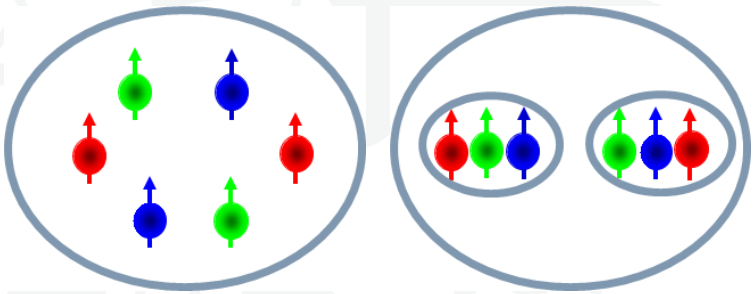
Background and Motivation

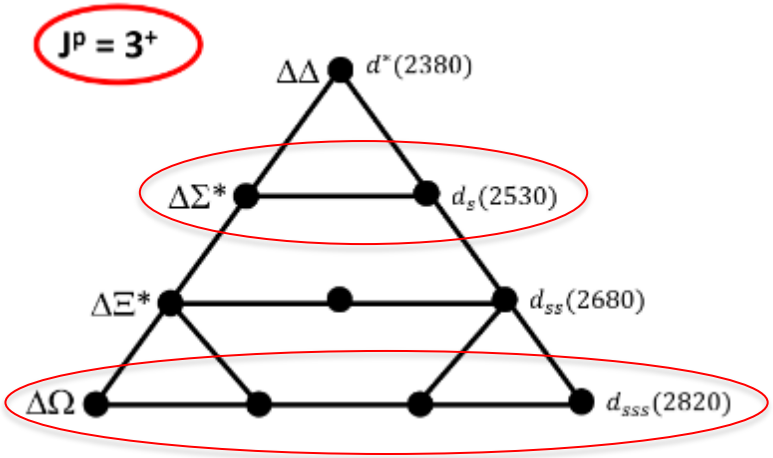


- Hadrons formed from u,d,c,s,b
- Baryons and mesons
- Exotic states

Background and Motivation

- What are Hexaquarks?
  - d* Antidecuplet
  - Hexaquark or Molecule?

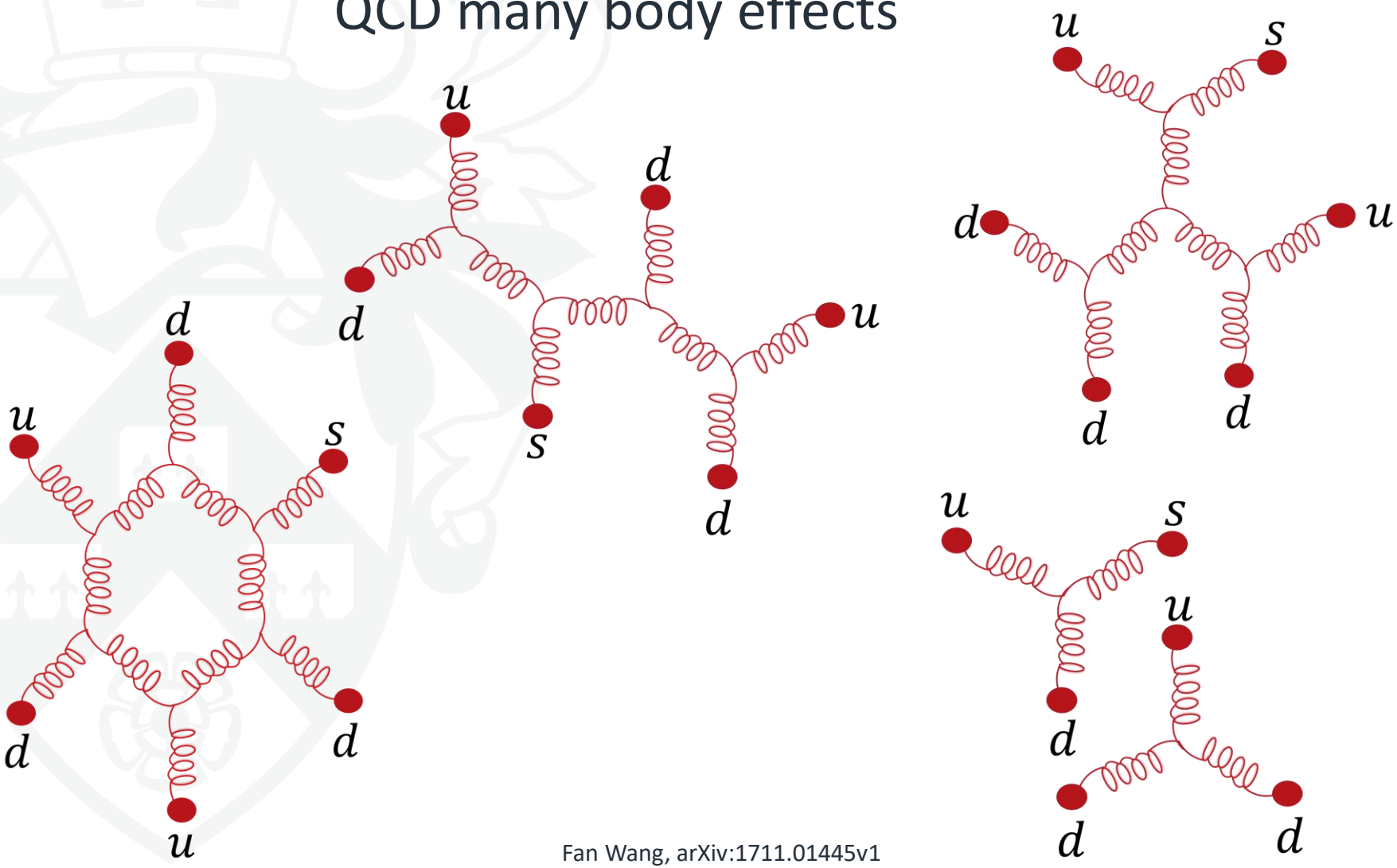




P. Adlarson et al., Phys. Rev. Lett. 112, 202301 (2014)
P. Adlarson et al., Eur. Phys. J. A (2016) 52: 147
P. Adlarson et al., Phys.Lett.B 743 (2015) 325-332
P. Adlarson et al., Phys.Rev.Lett. 106 (2011) 242302
P. Adlarson et al., Phys.Lett.B 721 (2013) 229-236
P. Adlarson et al., Phys.Rev.Lett. 112 (2014) 20, 202301

Background and Motivation

QCD many body effects



Fan Wang, arXiv:1711.01445v1

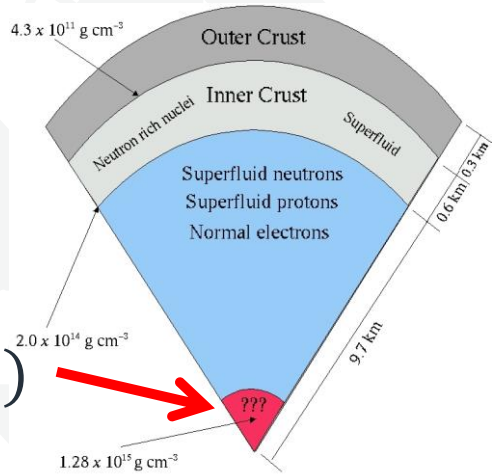
Background and Motivation

Neutron Stars

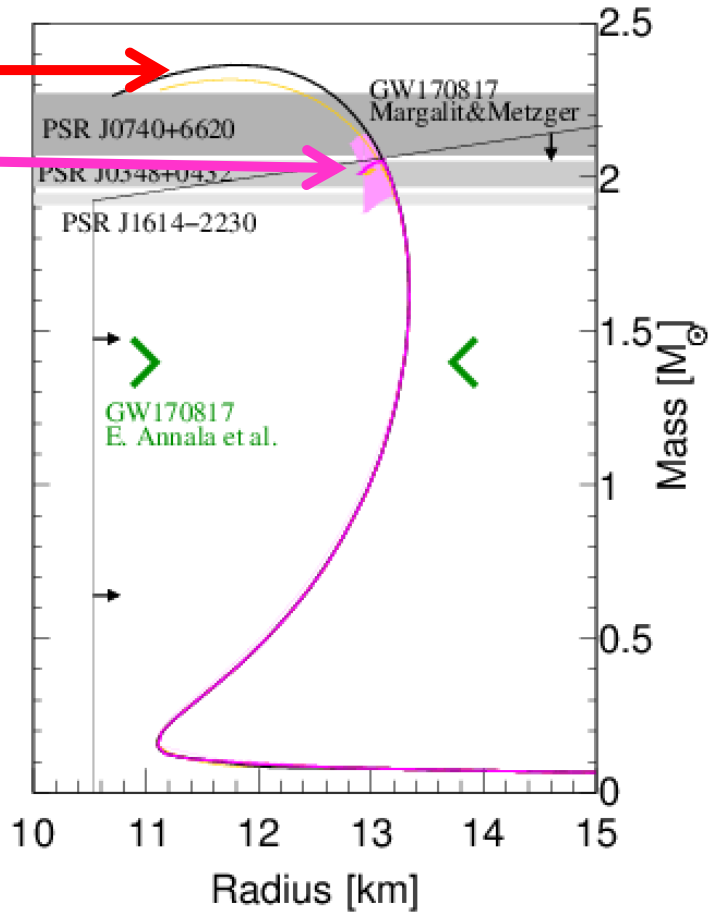
Nuclear Matter

Hexaquark Matter

$d^*(2380)$

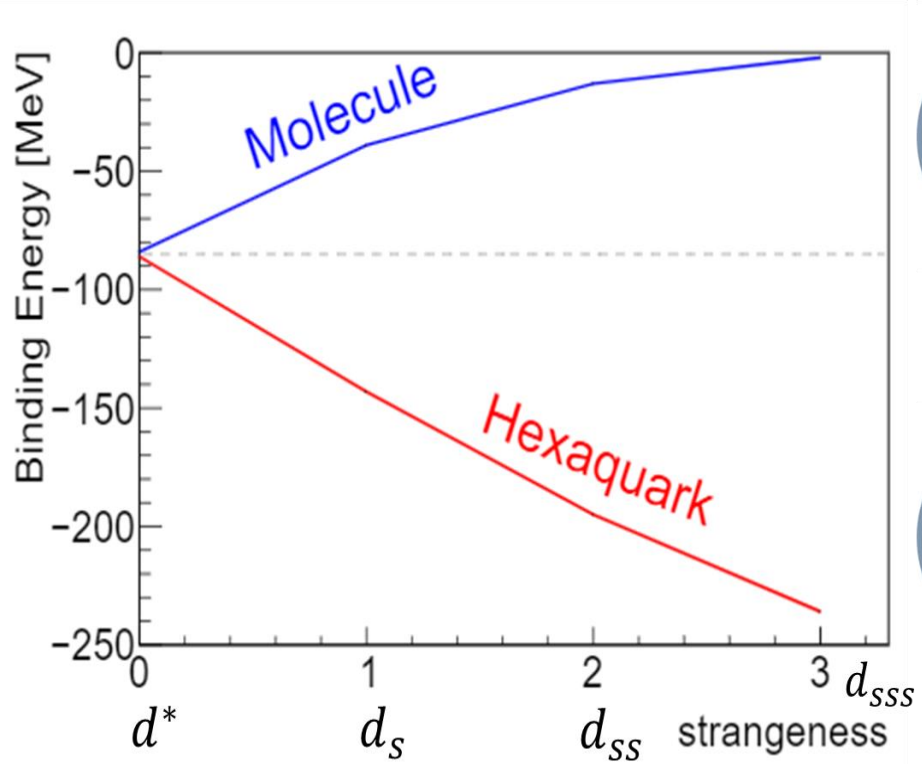


Neutron Star Pizza

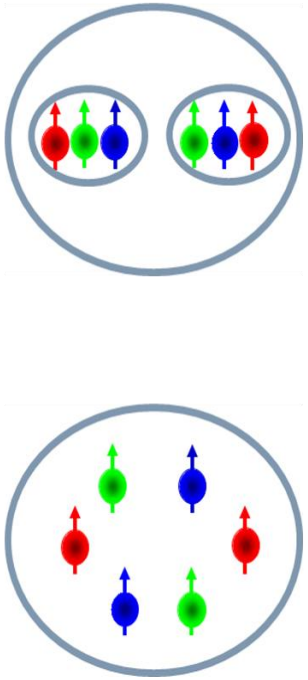


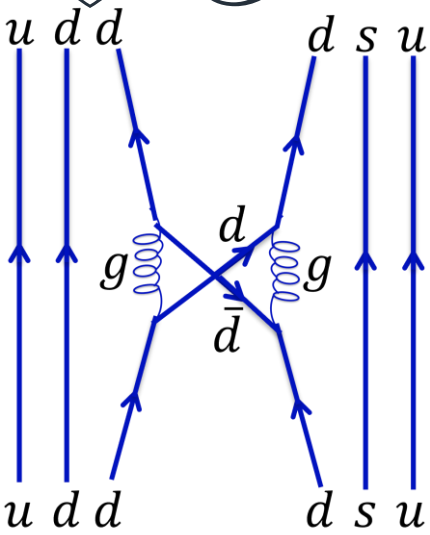
I.Vidaña et al., Phys.Lett.B 781 (2018) 112-116

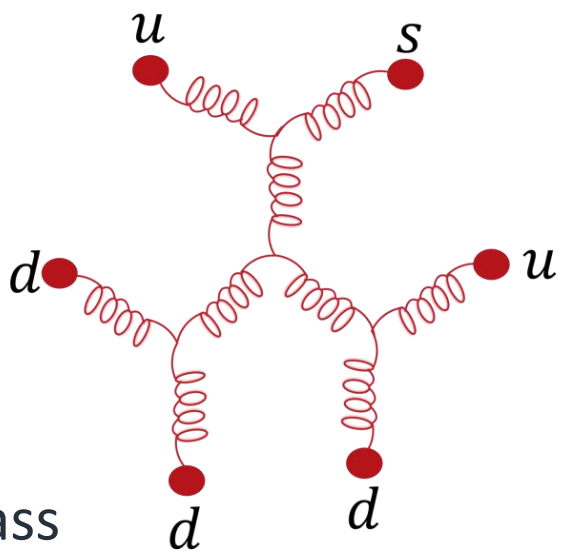
Background and Motivation



M. Bashkanov et al., arXiv:2012.11449v1



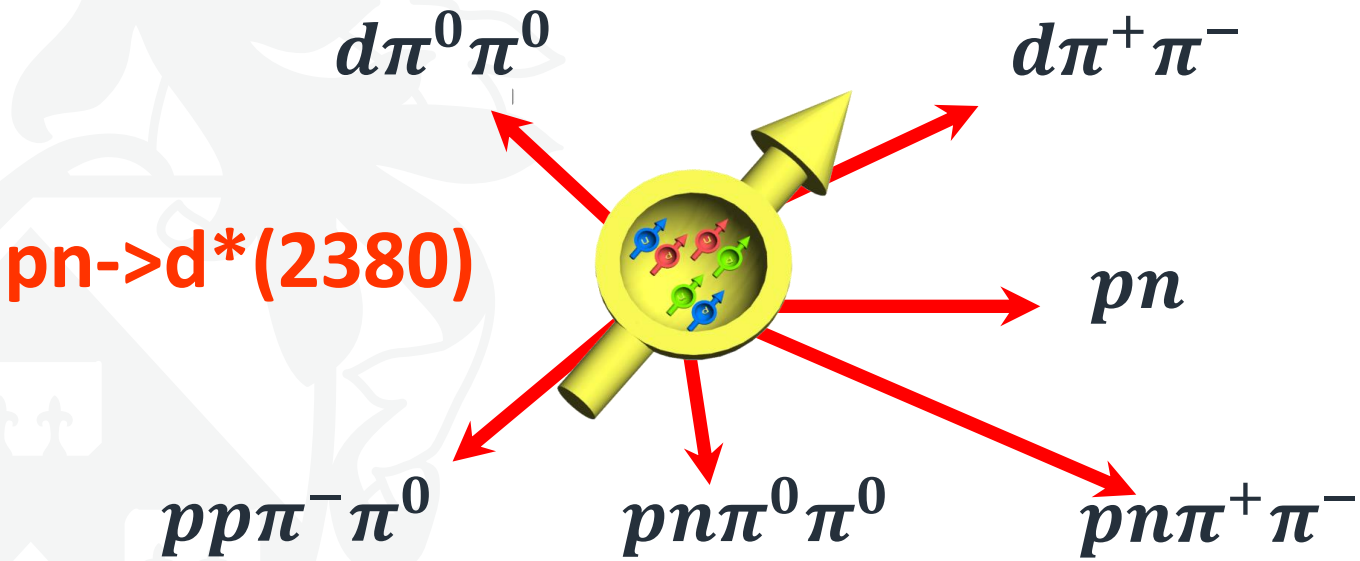




- Molecule
  - Pion exchange
  - Pion wont couple to strange quark
- Genuine hexaquark
  - Colour magnetic force scales with quark mass

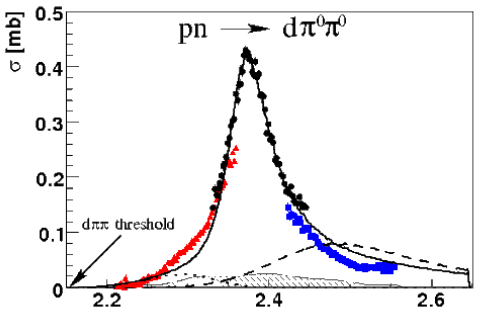
Previous Work

Evidence for $d^*(2380)$



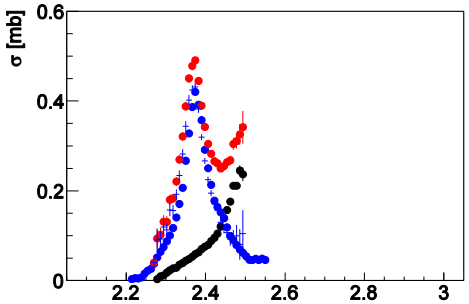
Previous Work: Evidence for $d^*(2380)$

P. Adlarson et al., Phys.Rev.Lett. 106 (2011) 242302



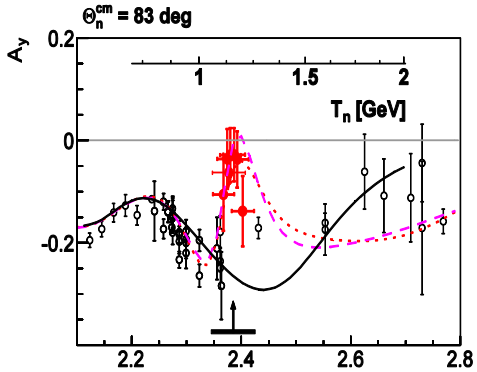
$d\pi^0\pi^0$ $\sqrt{s}$[GeV]

P. Adlarson et al., Phys.Lett.B 721 (2013) 229-236



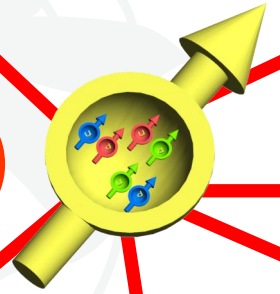
$\sqrt{s}$[GeV]

$d\pi^+\pi^-$



$\sqrt{s}$[GeV]

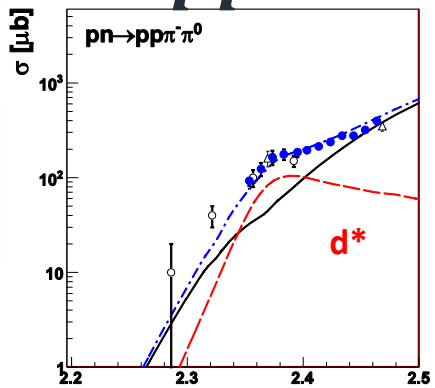
pn->d*(2380)

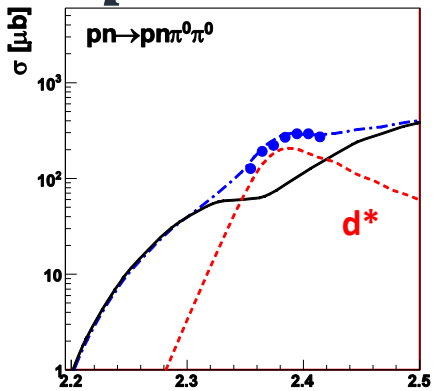


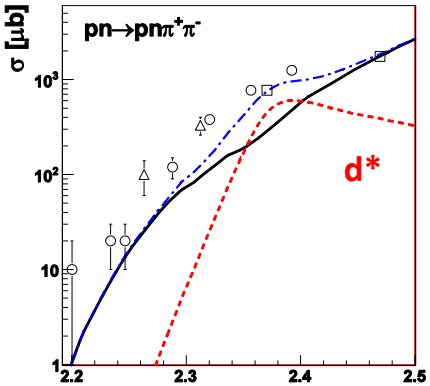
pn

$pp\pi^-\pi^0$ $pn\pi^0\pi^0$ $pn\pi^+\pi^-$

P. Adlarson et al., Phys. Rev. Lett. 112, 202301 (2014).





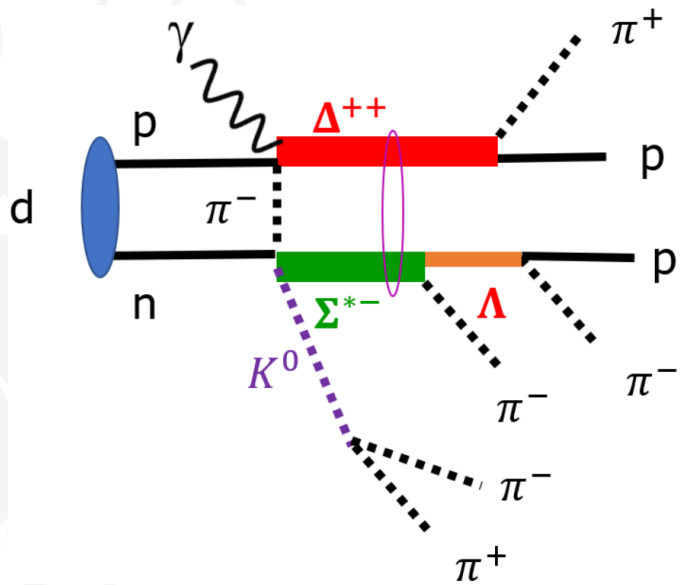


$\sqrt{s}$[GeV]

P. Adlarson et al., Phys.Lett.B 721 (2013) 229-236 P. Adlarson et al., Phys.Lett.B 743 (2015) 325-332

Previous Work

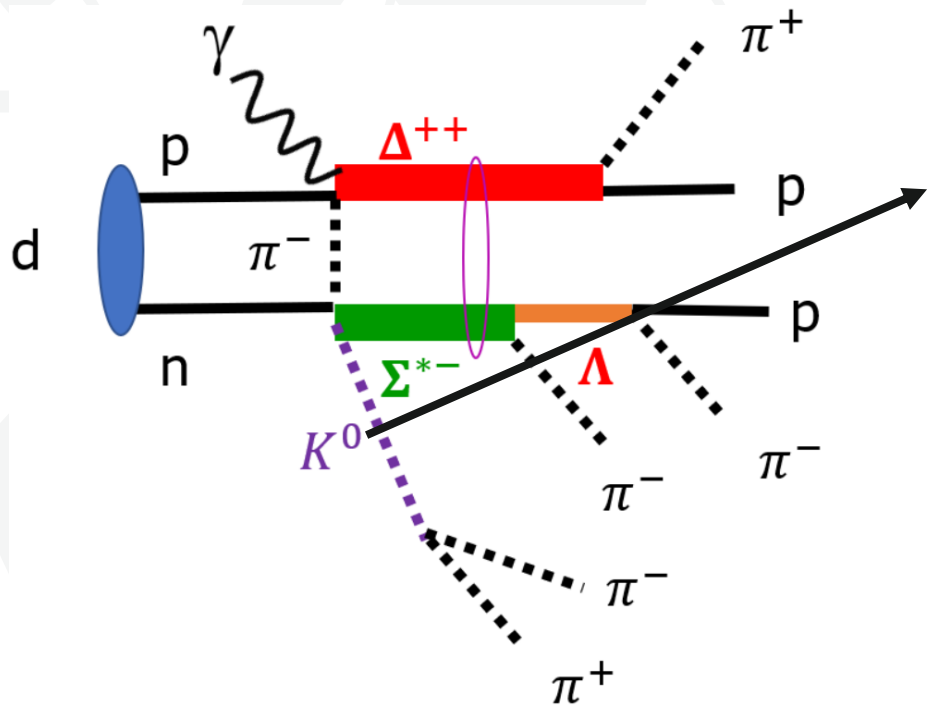
Search for d_s

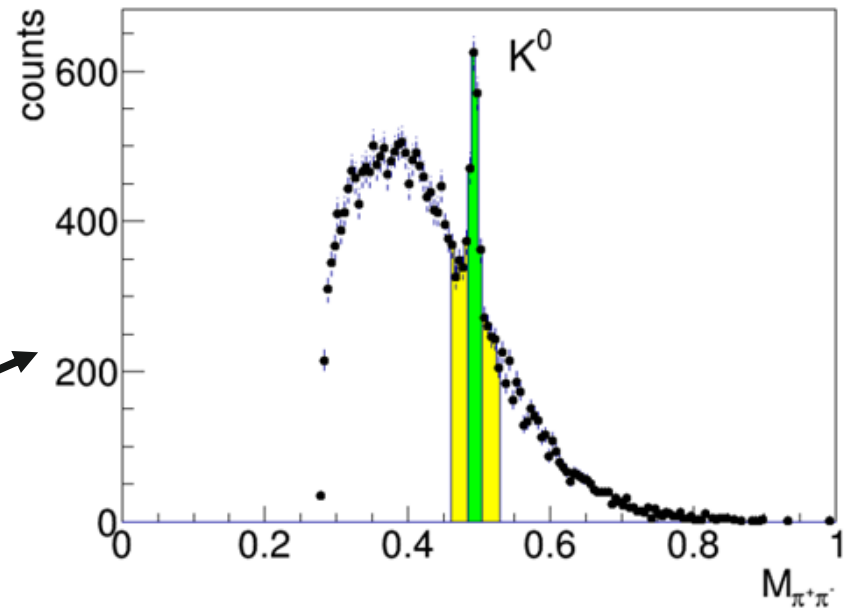


- g13 data from CLAS6
- Previous search for single strange hexaquark

Previous Work

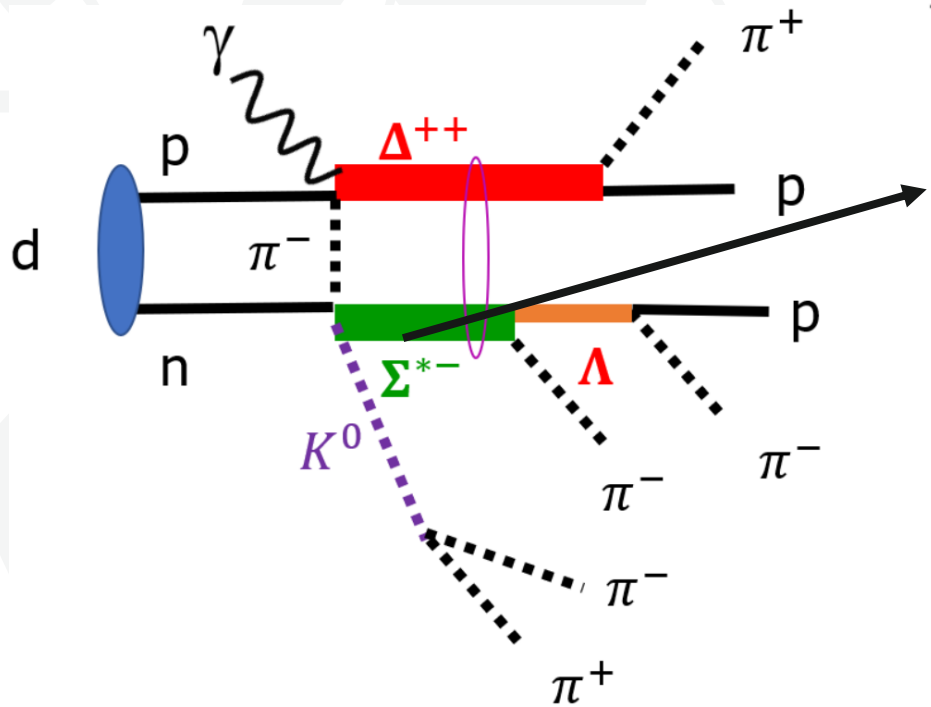
Search for d_s

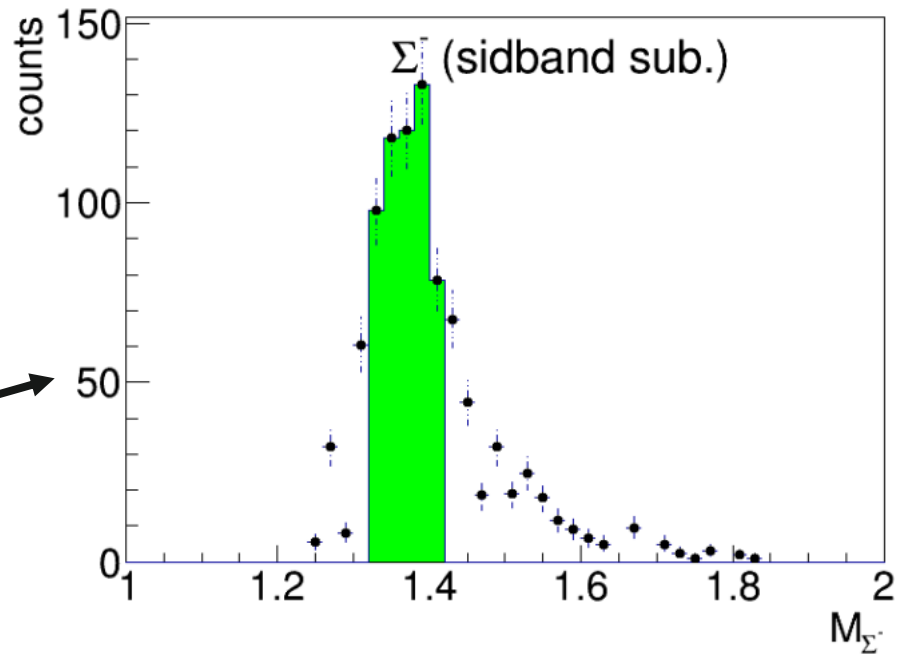




Previous Work

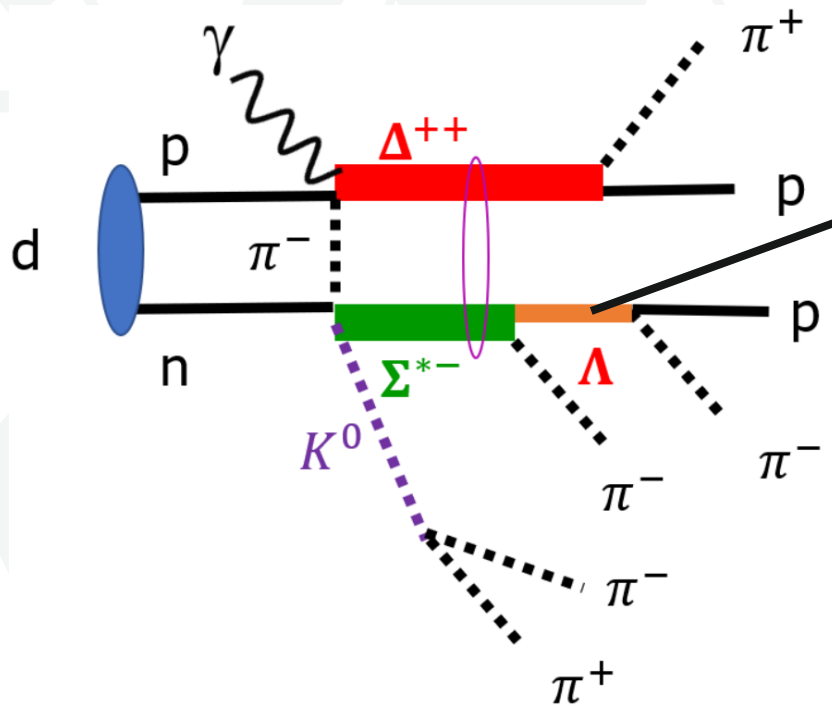
Search for d_s

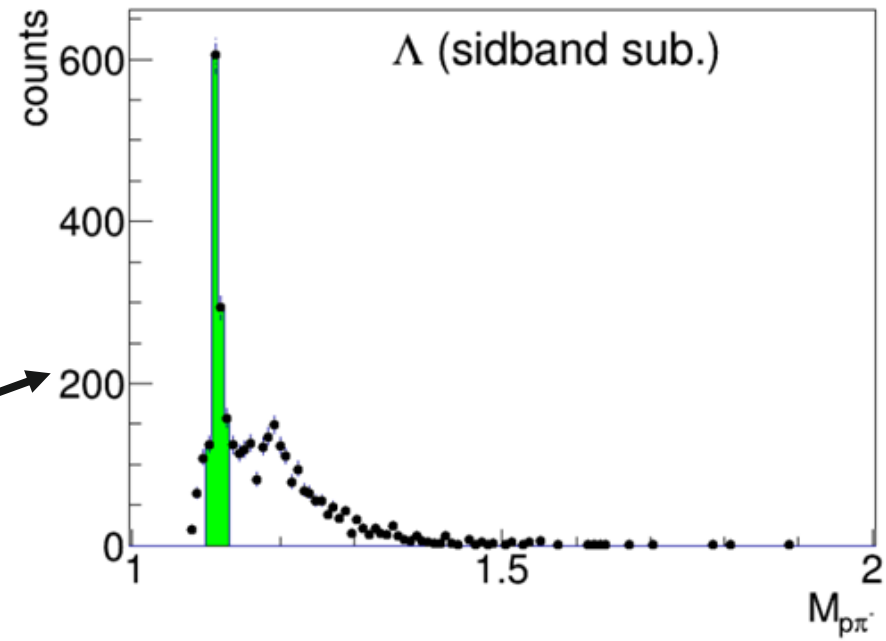




Previous Work

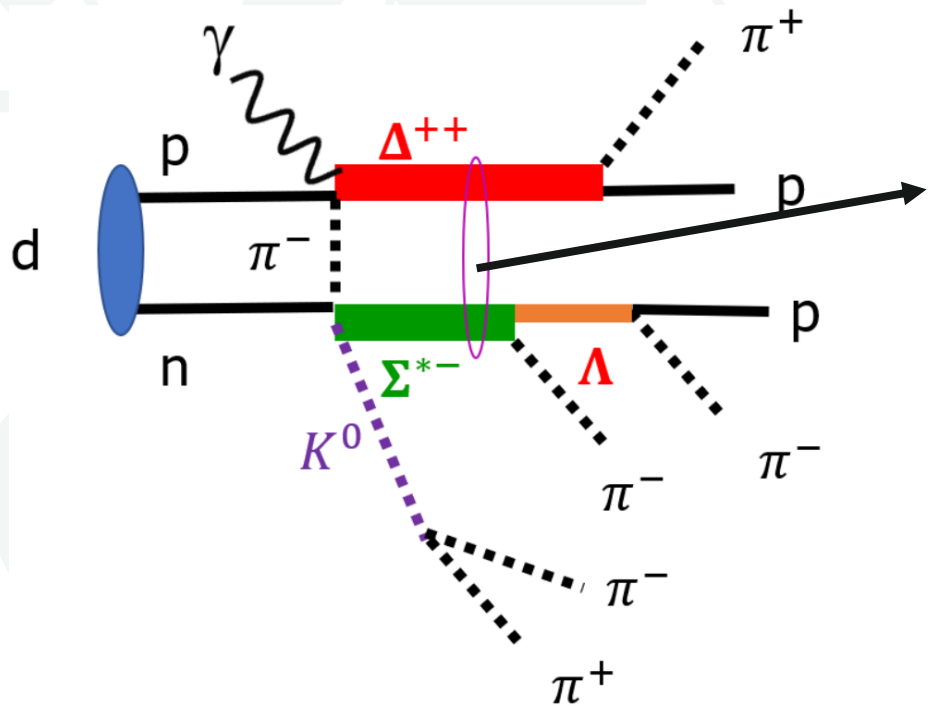
Search for d_s

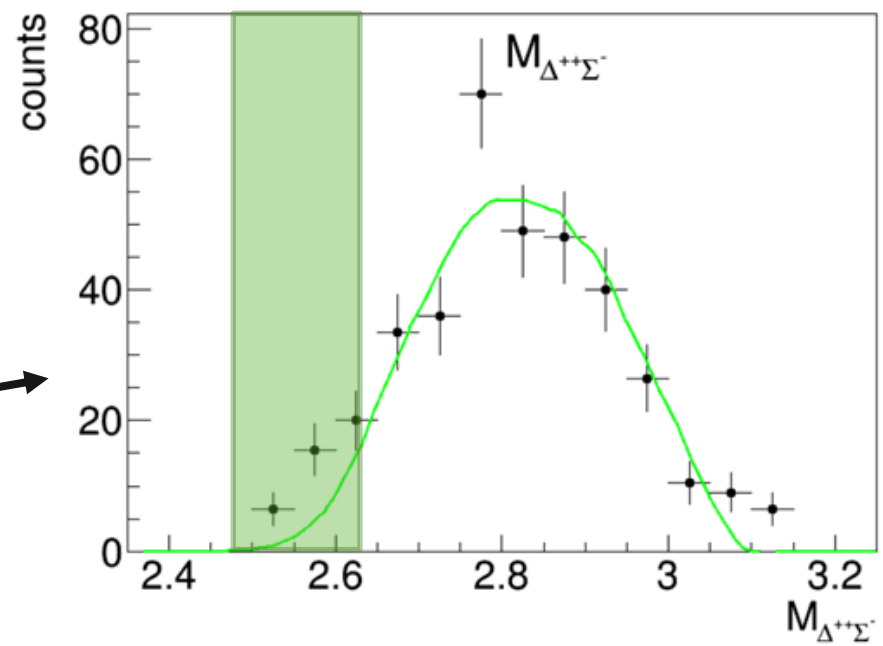




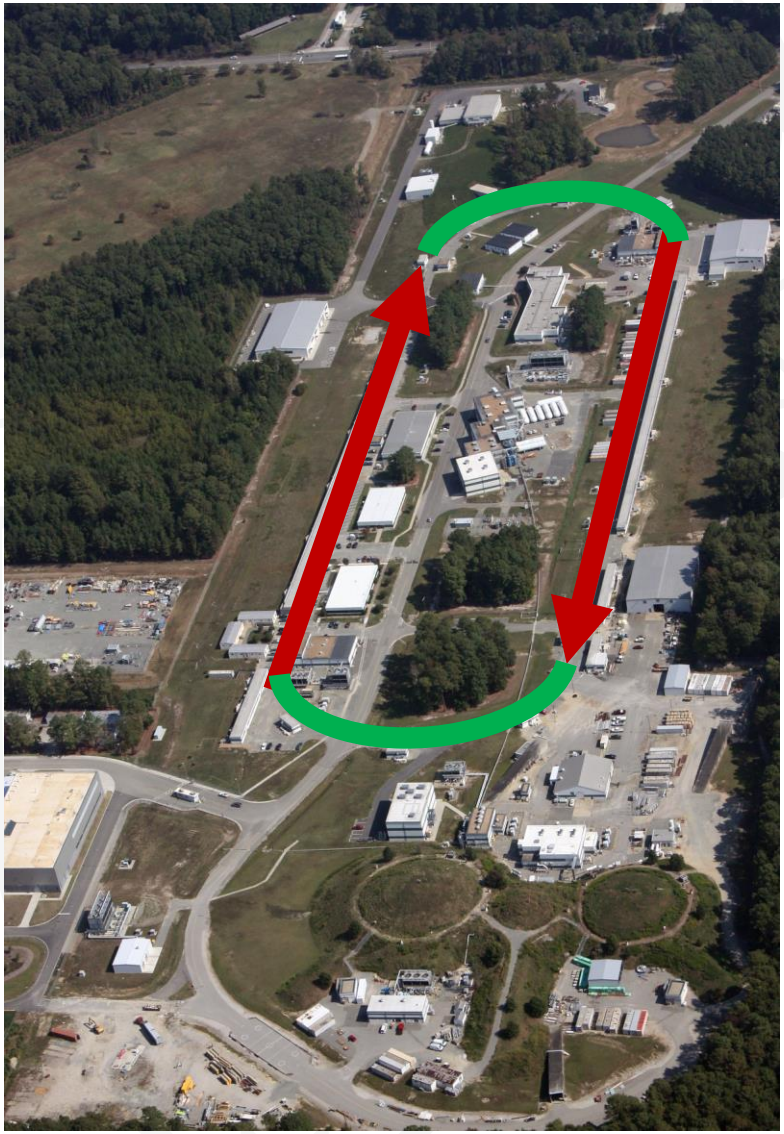
Previous Work

Search for d_s



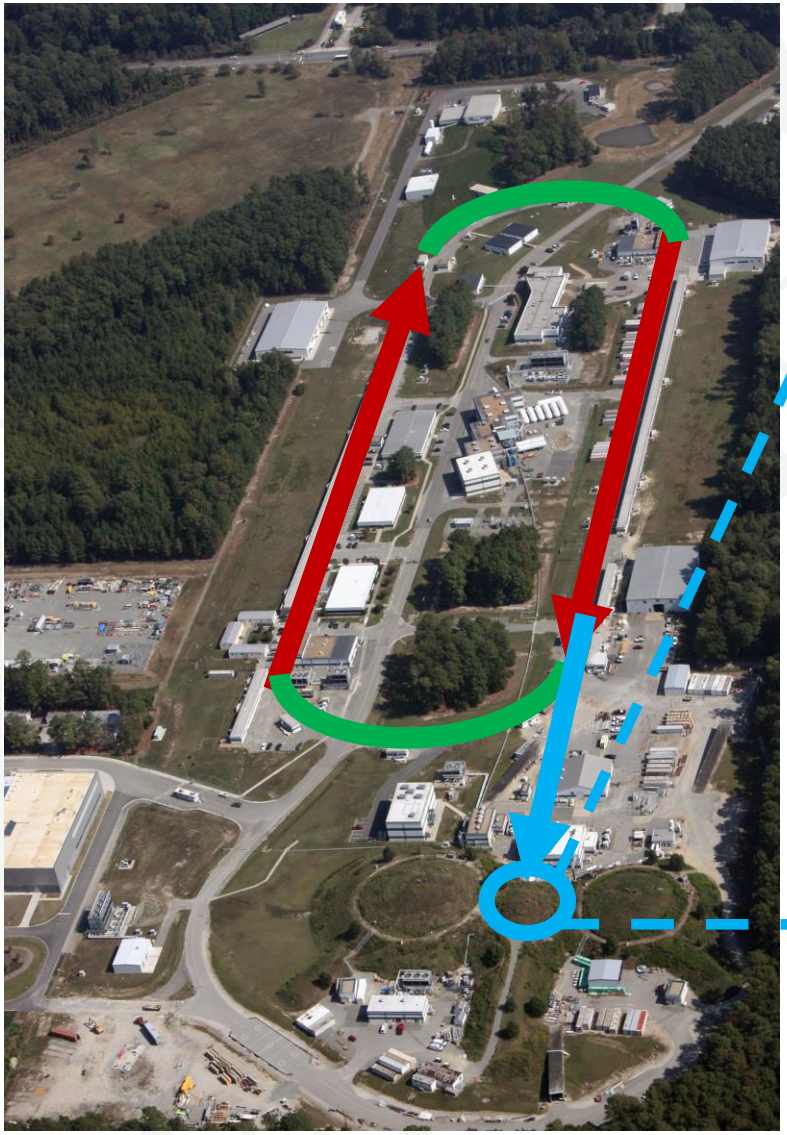


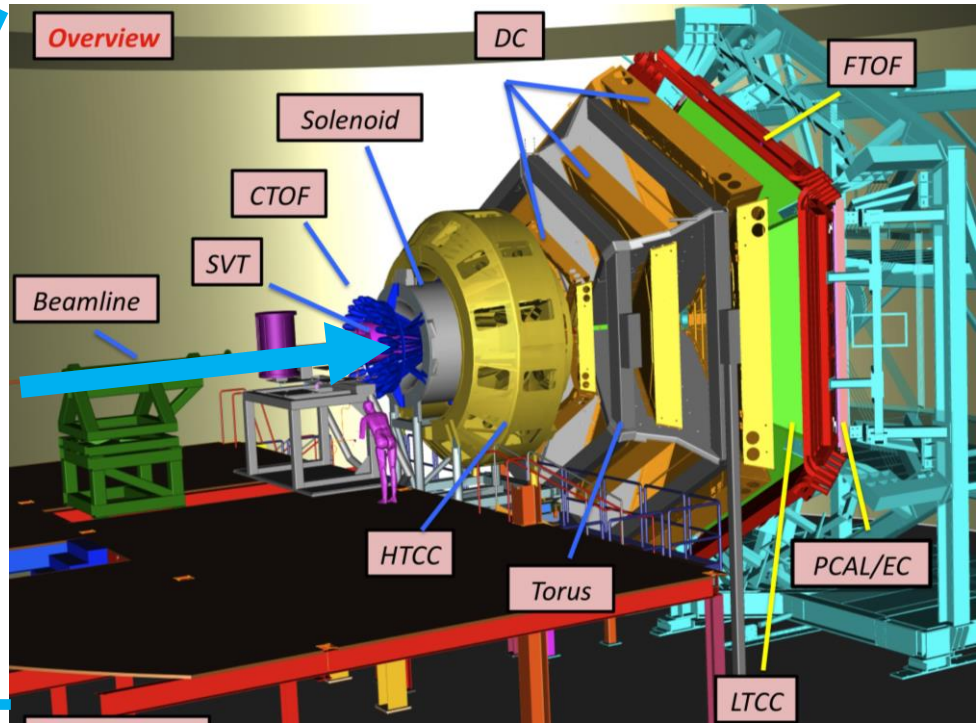
CLAS12 at JLab



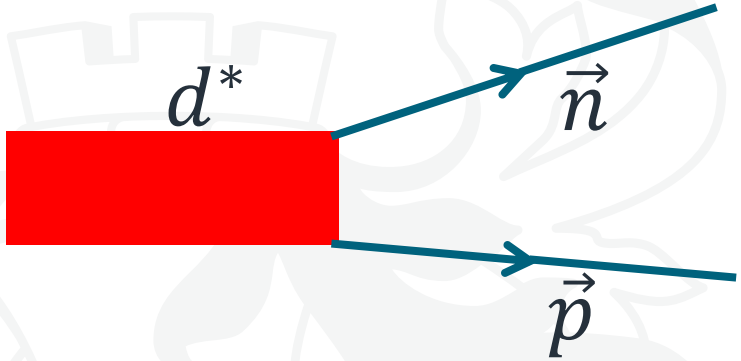
- CEBAF gives electron beam
- 2 parallel linacs
- At energy (10.2 – 10.6 GeV) beam enters halls
- Hall b is where CLAS12 lives

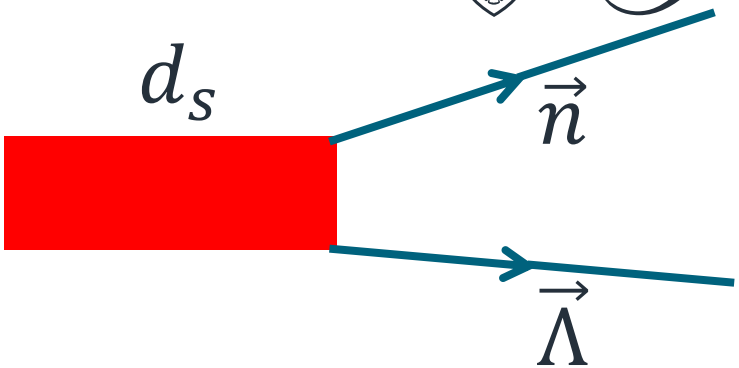
CLAS12 at JLab

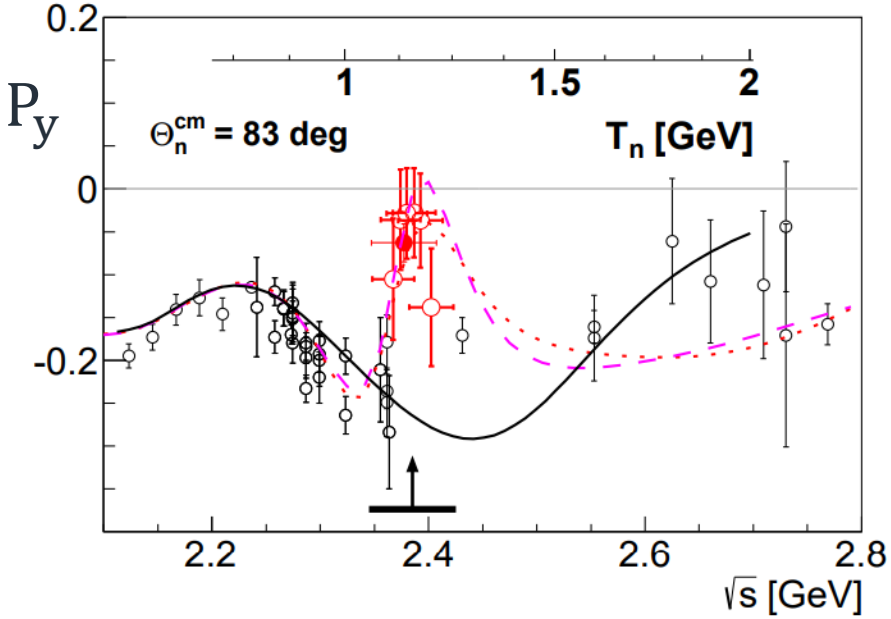




Channel Advantages







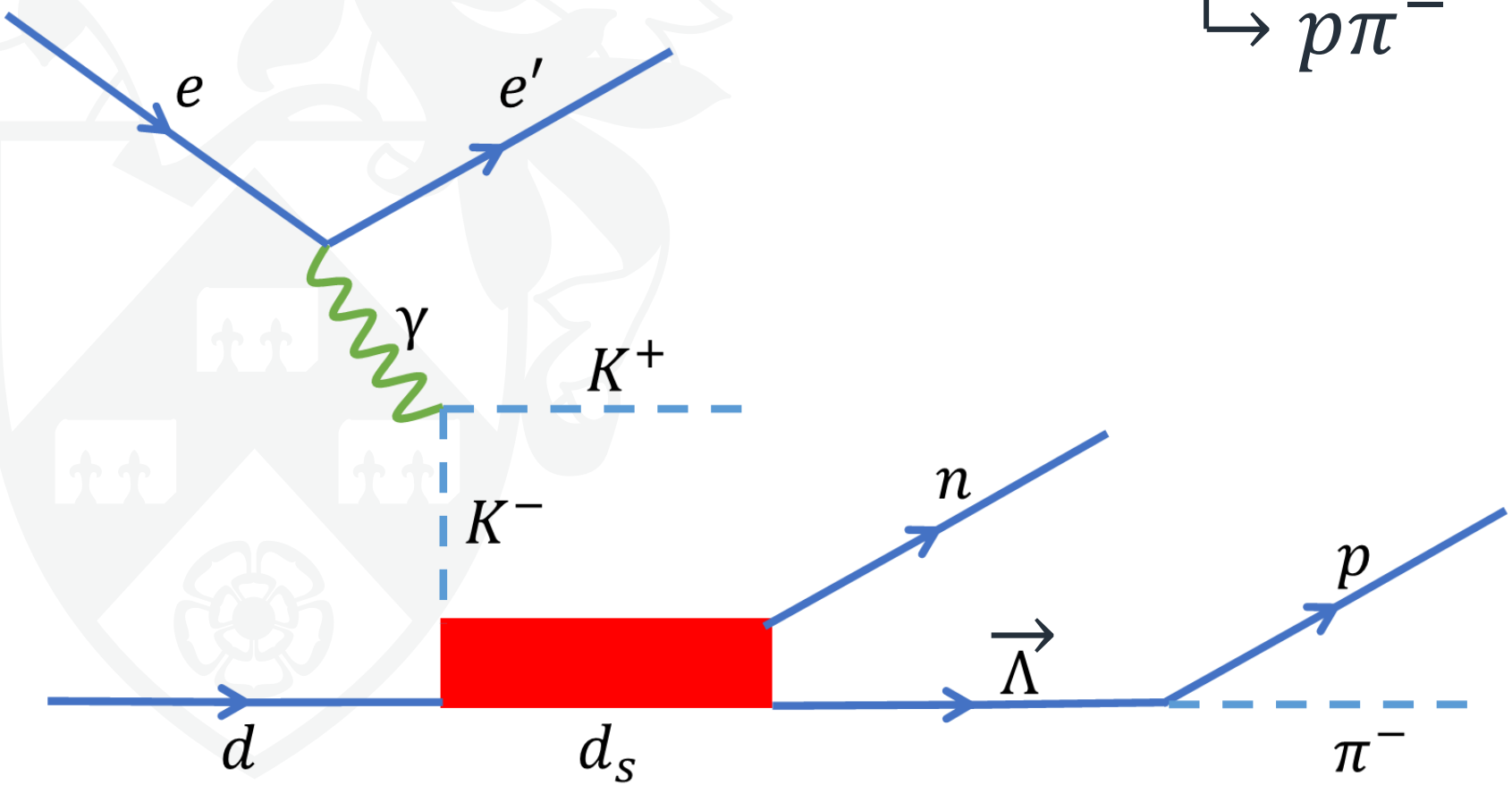
P. Adlarson et al., Phys. Rev. Lett. 112, 202301 (2014).

- Sensitive to polarization
- Lambda self analysing
- Lambda 100% polarized

Specific Channel

$$ed \rightarrow e'K^+d_s \rightarrow e'K^+\vec{\Lambda}n$$

$$\hookrightarrow p\pi^-$$



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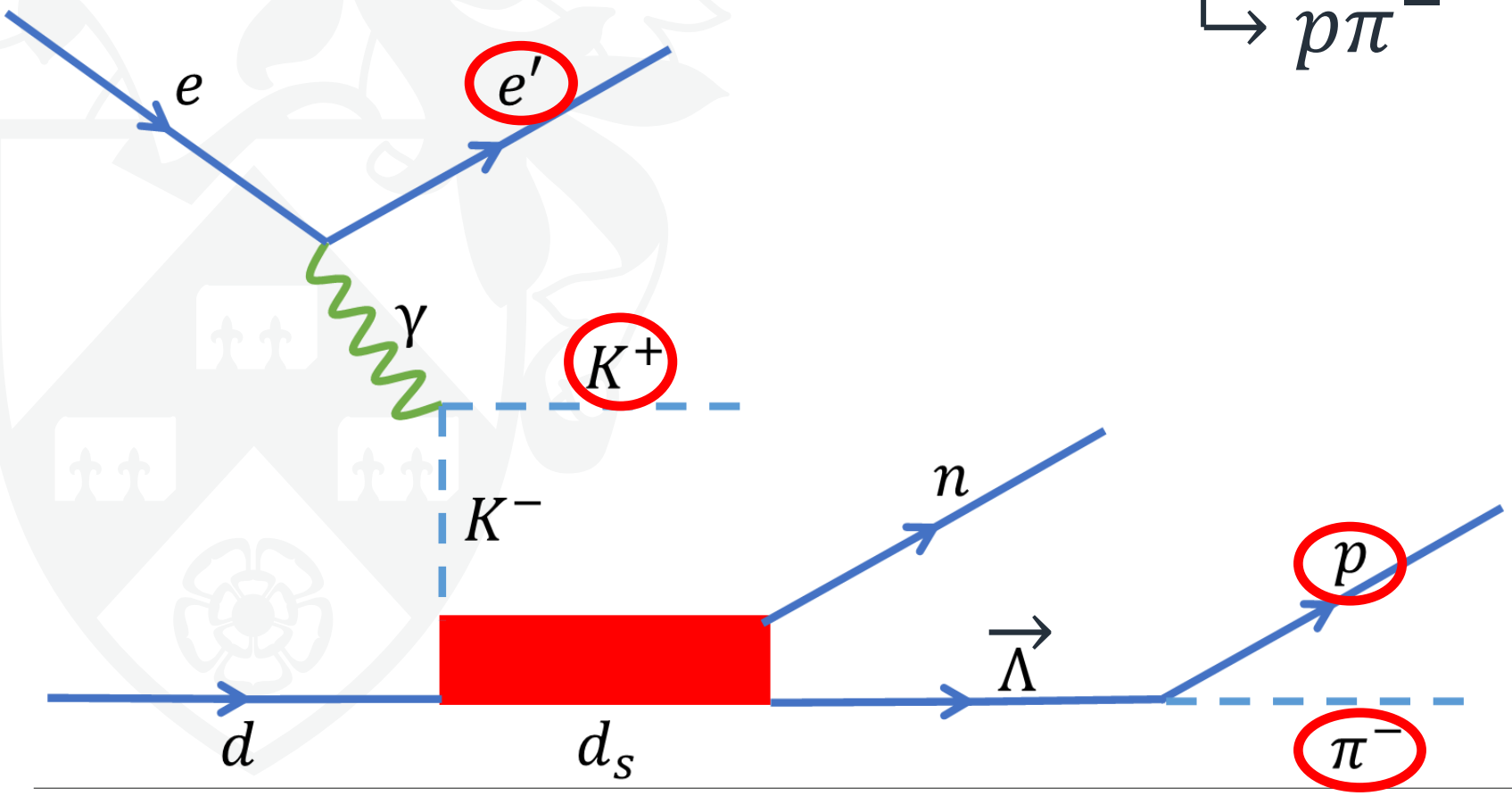
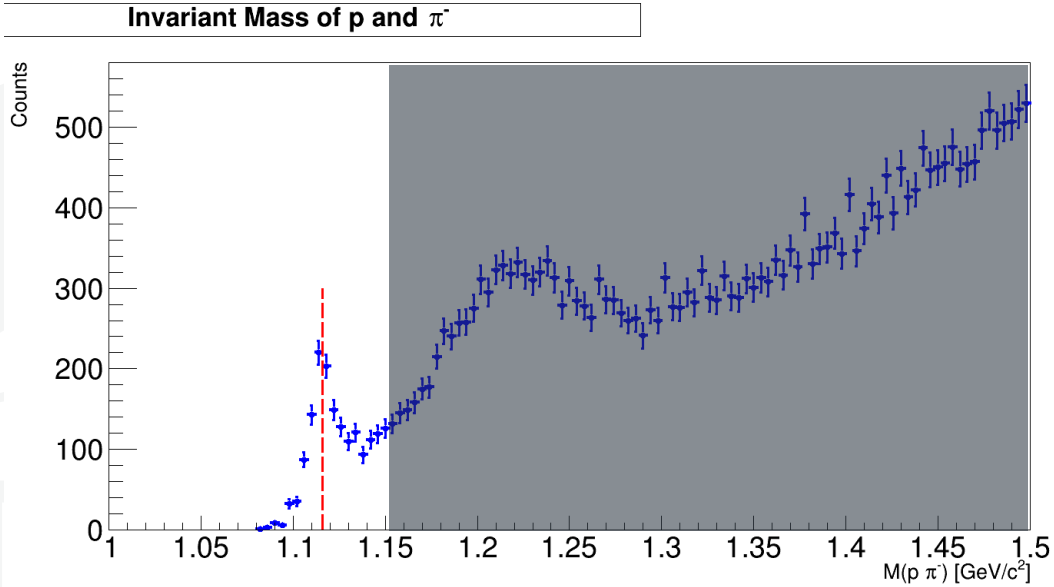
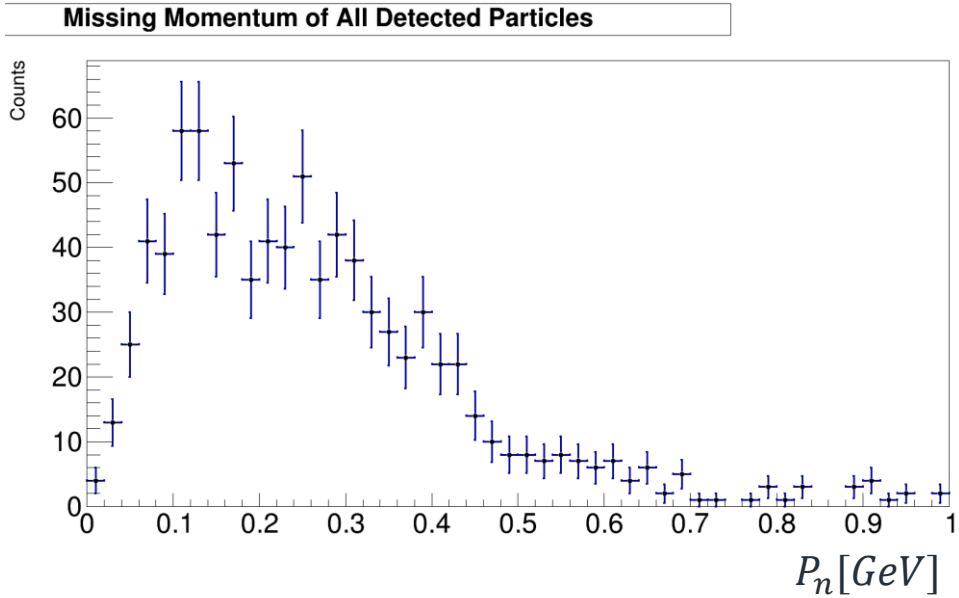


Preliminary Results



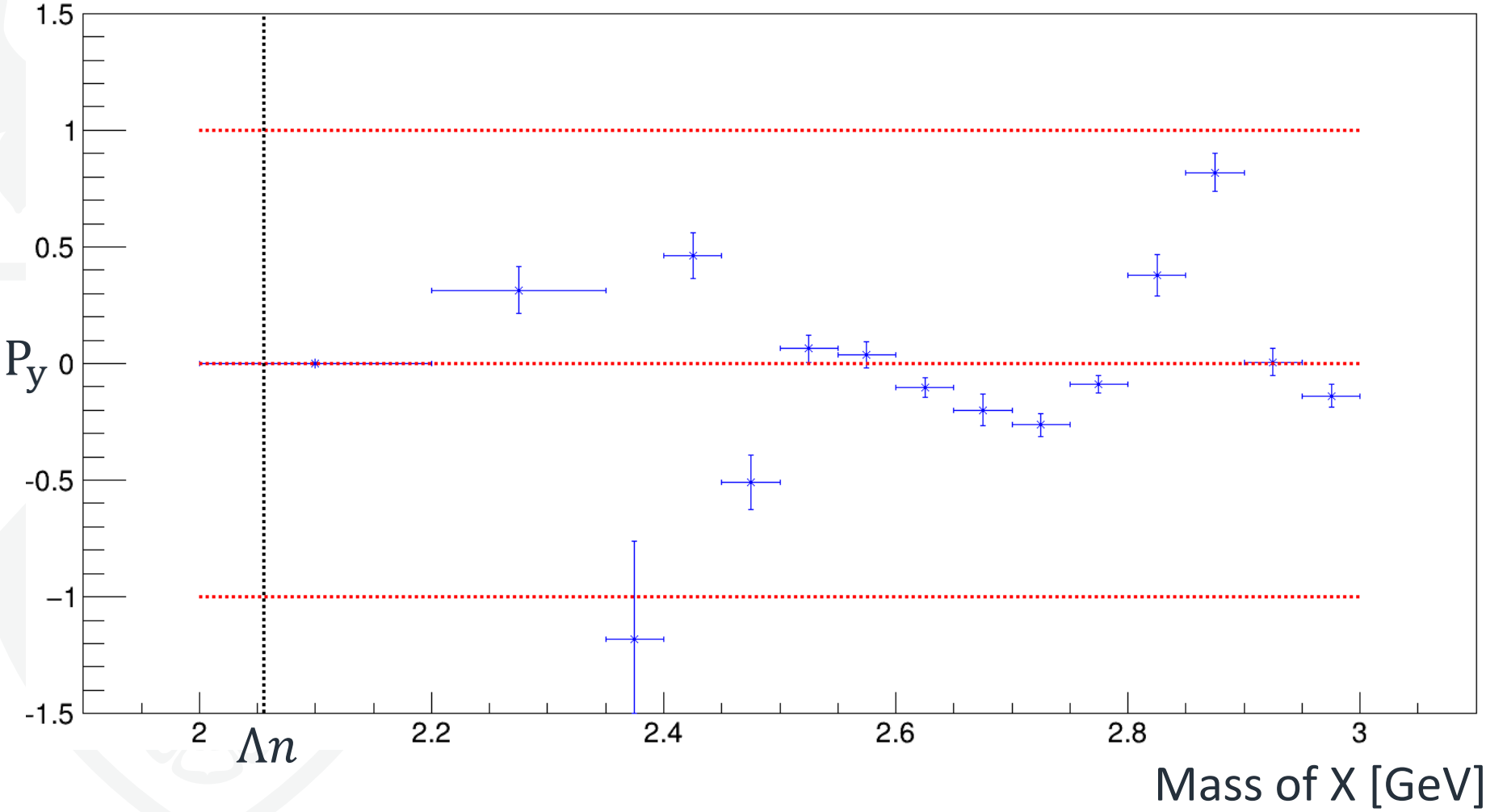
$$\vec{\Lambda} \rightarrow p\pi^-$$

$$ed \rightarrow e' K^+ n\Lambda$$



Preliminary Results

$$ed \rightarrow e'K^{+}X \rightarrow e'K^{+}n\Lambda$$



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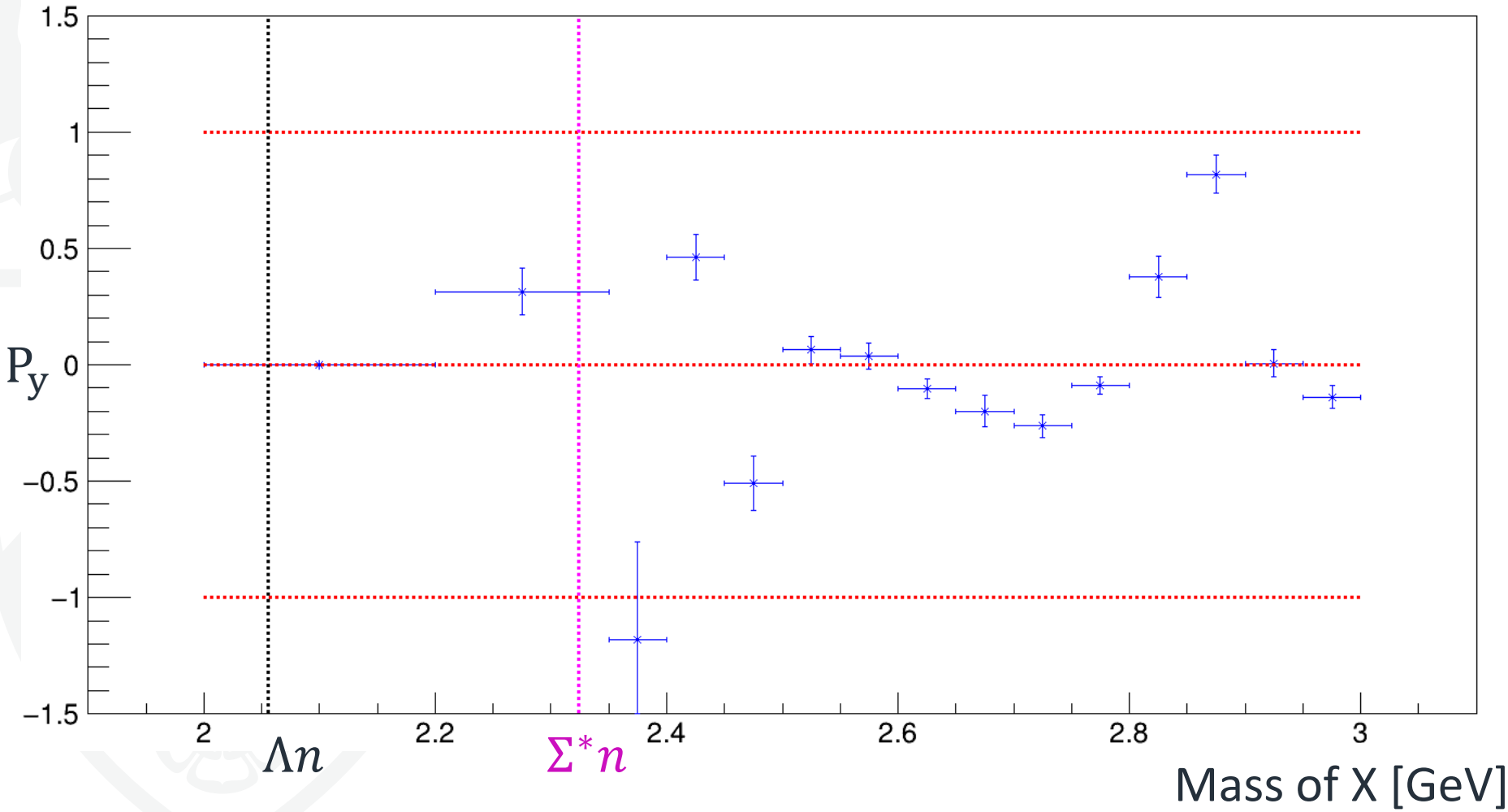

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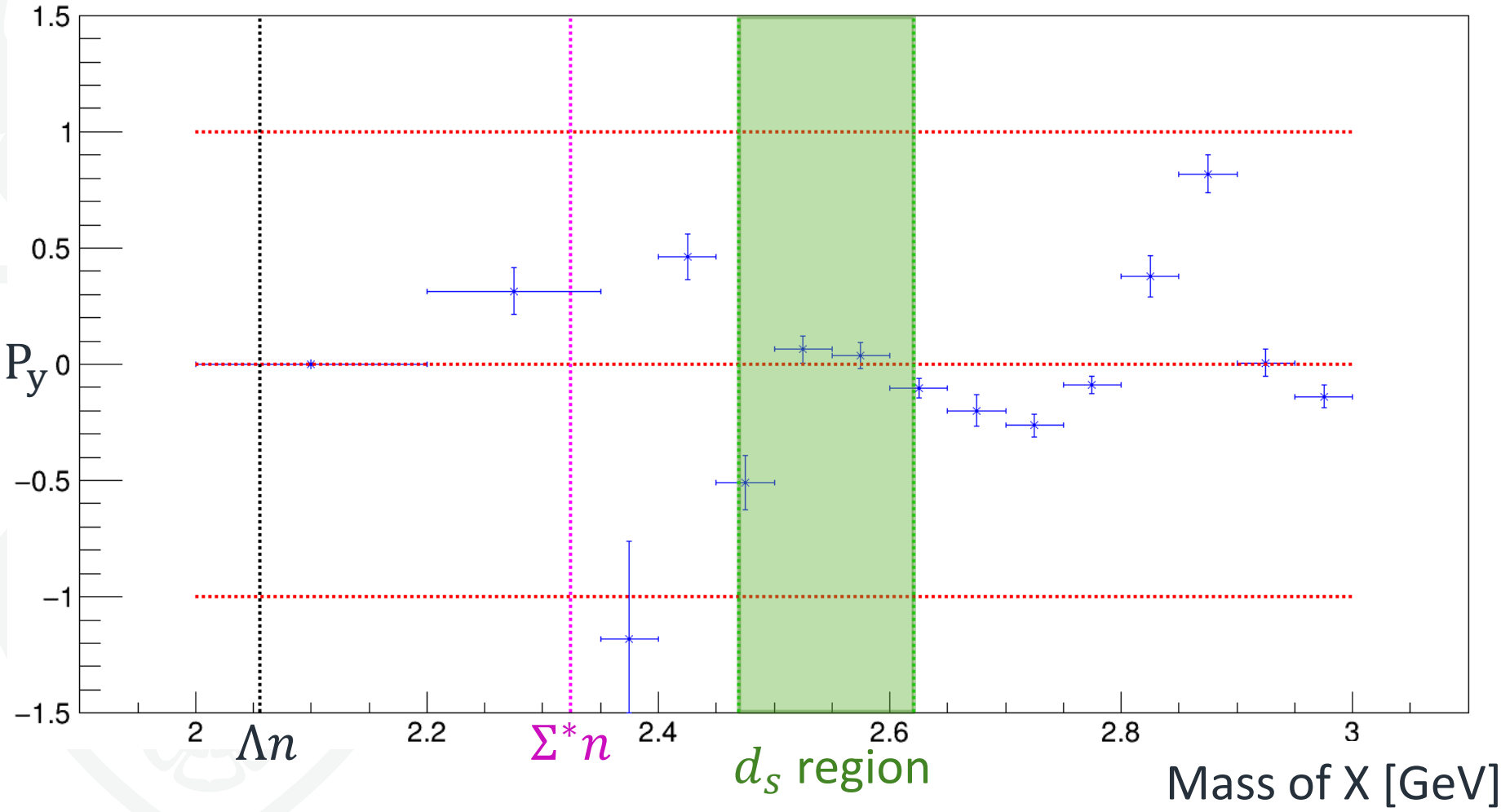

Summary

- Work is still ongoing
- Polarization and cross section extraction
- Some promising results
- Other topologies
  - $d_s \to dK^+K^-$
- More data

Thank you
Any Questions?

Science and Technology Facilities Council

CEBAF Large Acceptance Spectrometer