Scaling Behaviour of Strangeness

Matthew Nicol

Hadron Spectroscopy

Normal baryon

Normal meson

Pentaquark

Tetraquark

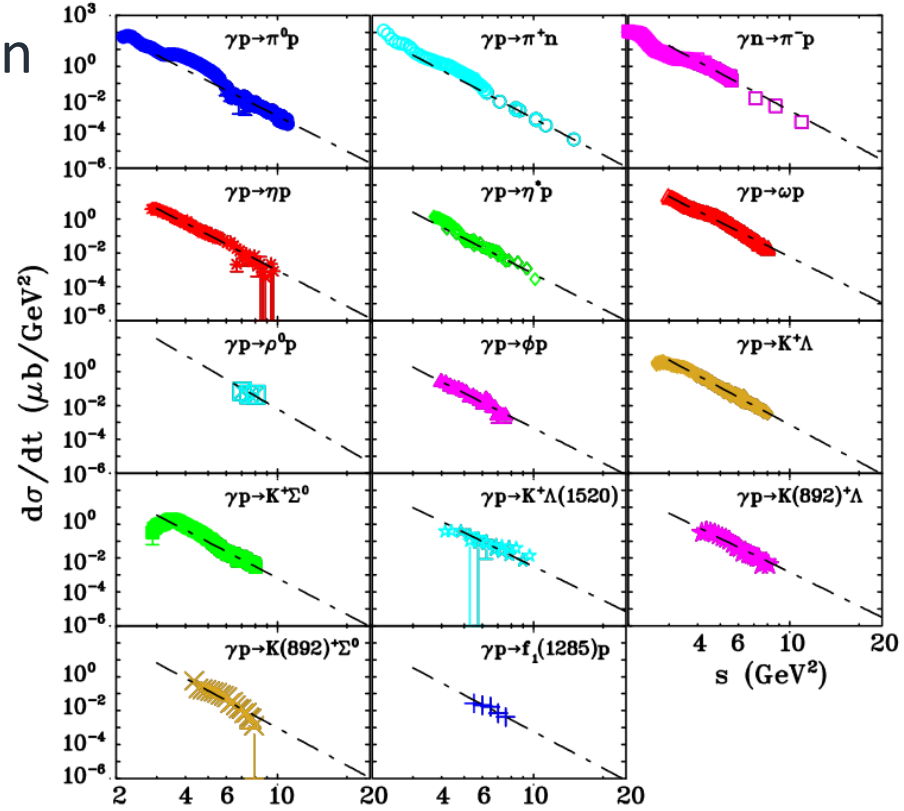
Glueball

Hybrid meson

- Hadrons: baryons (qqq) and mesons ($q\bar{q}$)
- Exotic states
- Exploring possible structures

Why Scaling?

- Scaling provides lots of information
- Confirmation of models
- Predictive behaviour



I, Strakovsky. Et al. “Experimental tests of QCD scaling laws at large momentum transfer in exclusive light-meson photoproduction”

Strangeness

3&4* resonances in PDG

Baryon	2004	2020
N*	15	21
Δ	10	12
Λ	14	14
Σ	10	9*
Ξ	6	6
Ω	2	2

*$\Sigma(2250)$ was downgraded

- Discovery of kaon and lambda
- Lack of hyperon discoveries (none in 20 years)

Strangeness

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????

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- Discovery of kaon and lambda
- Lack of hyperon discoveries (none in 20 years)
- How can we improve discovery rate?

Strangeness Scaling

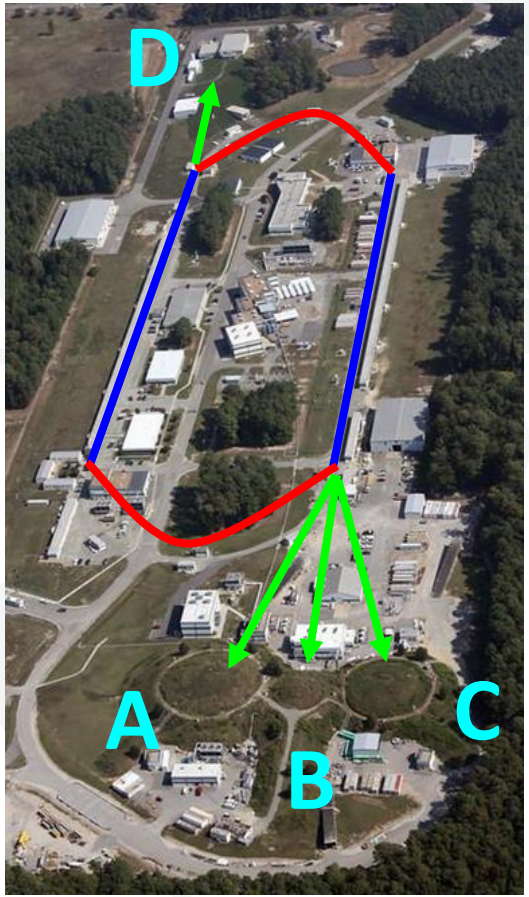
- Why strange production?
  - Strangeness enhanced for hybrids
  - proto-/neutro-phobic
  - Strange baryons are narrow -> easy to identify

- Determine suppression of strangeness -> less production

- Strange exotic production enhancements -> help search

Experiment

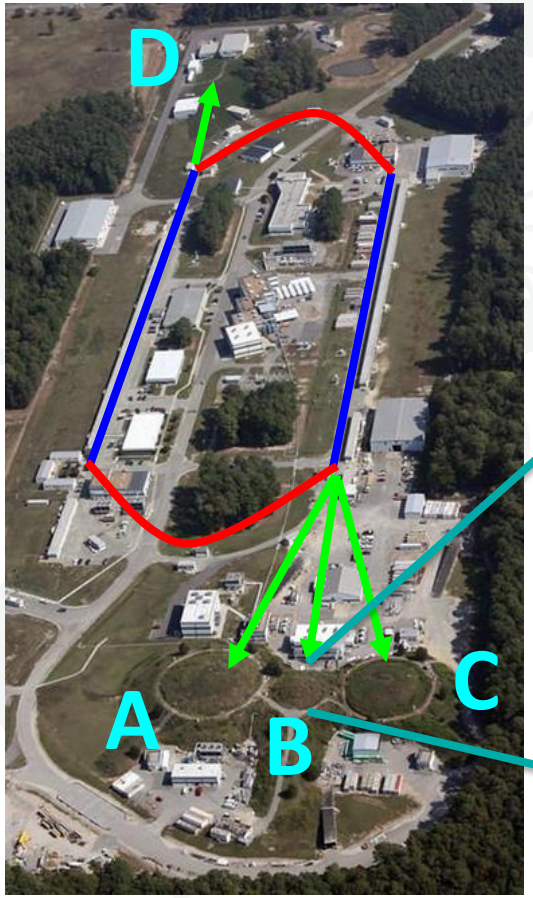
Jefferson Laboratory



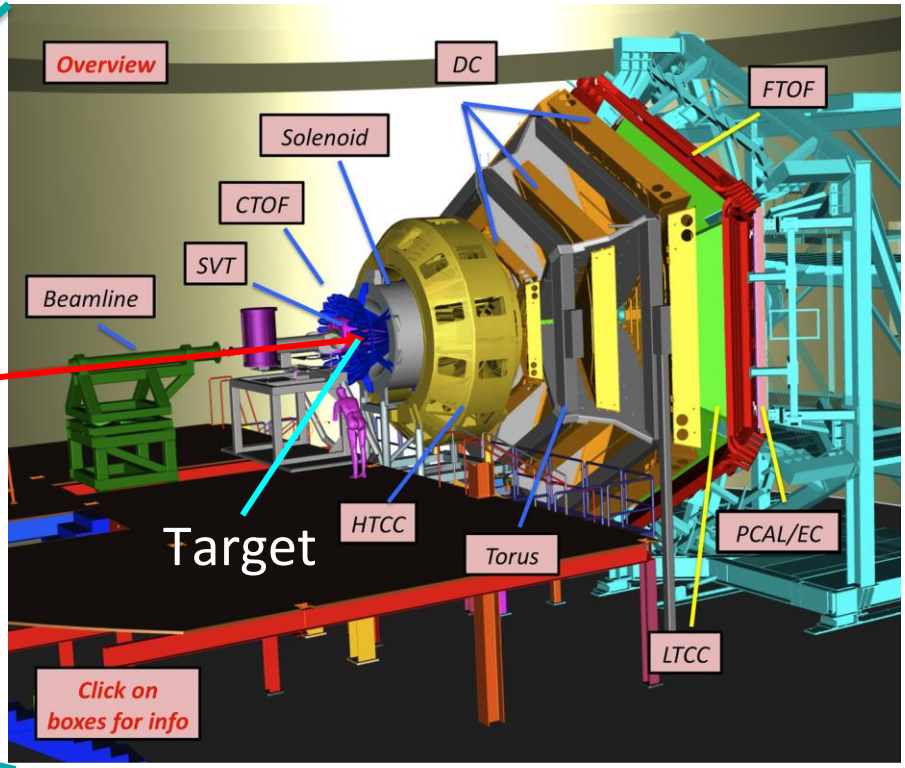
- 12 GeV e^- beam
- 4 experimental halls

https://www.flickr.com/photos/jeffersonlab/

Jefferson Laboratory



e⁻ beam



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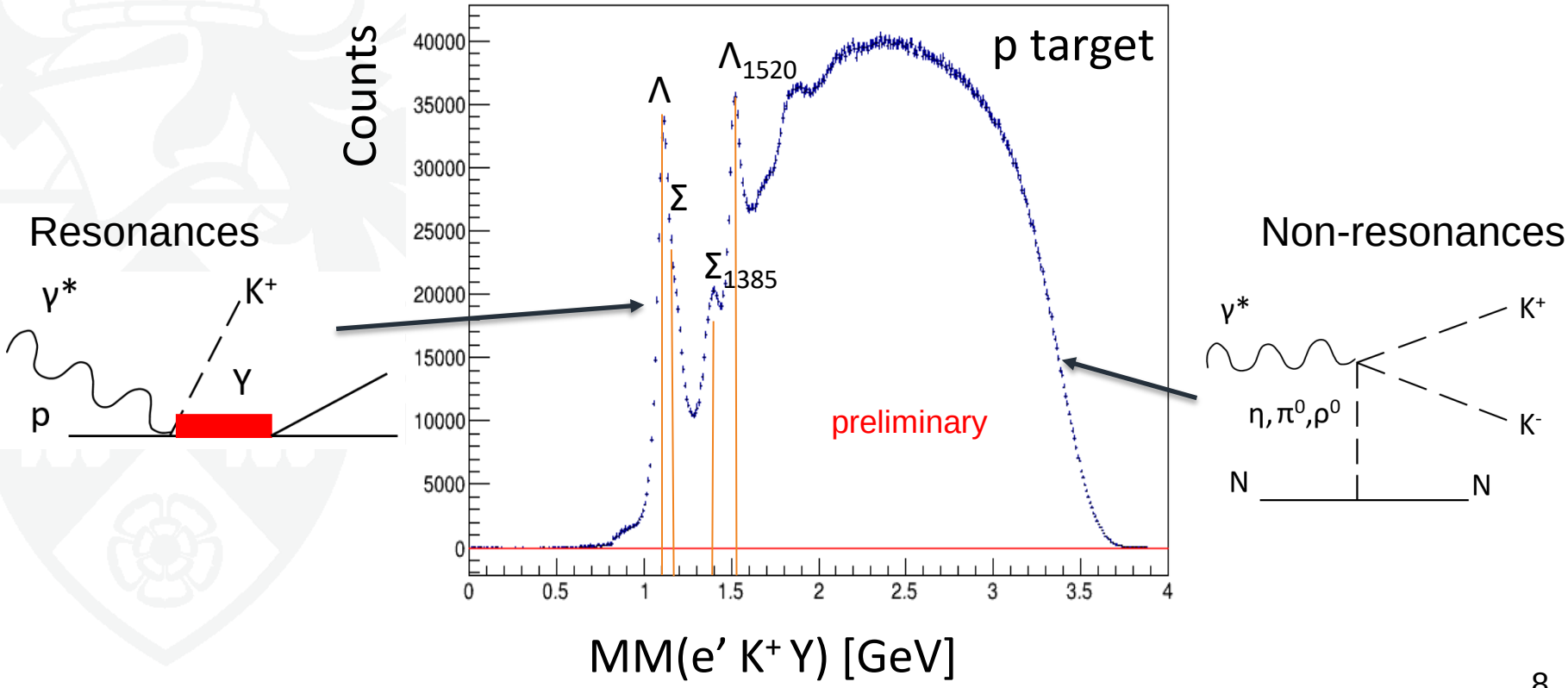
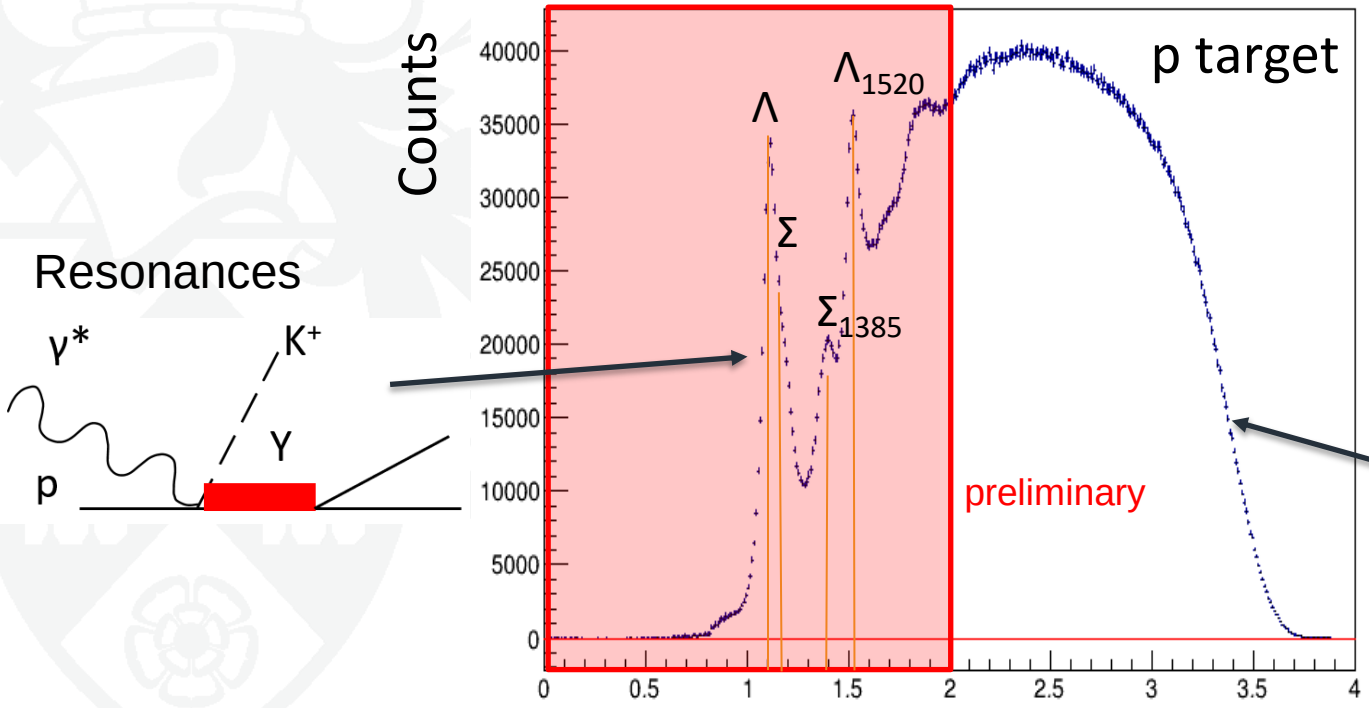
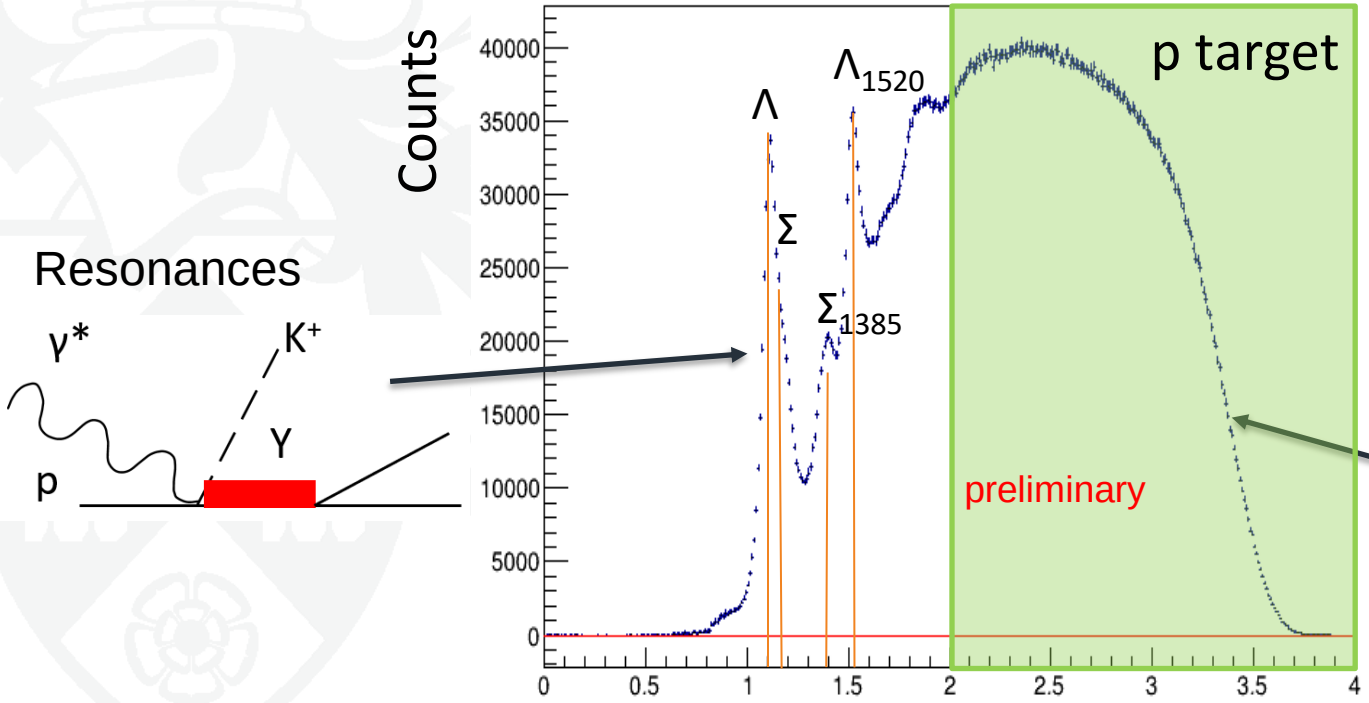
Resonant and non-resonant production



Resonant and non-resonant production

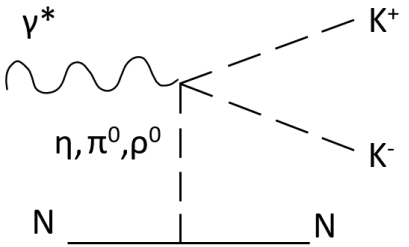


Resonant and non-resonant production

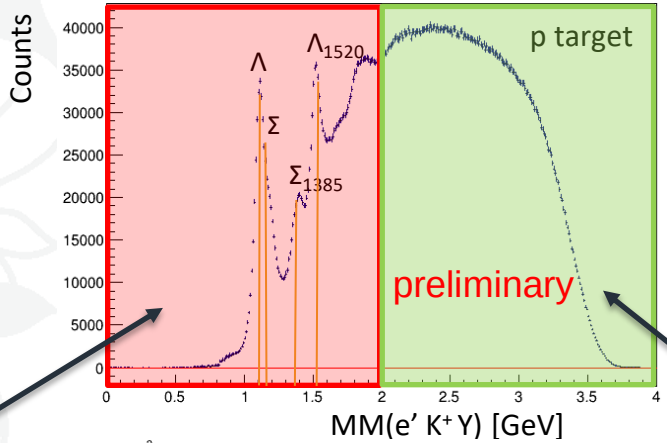


Resonances

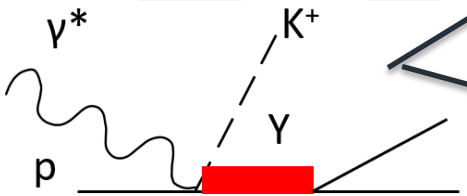
Non-resonances

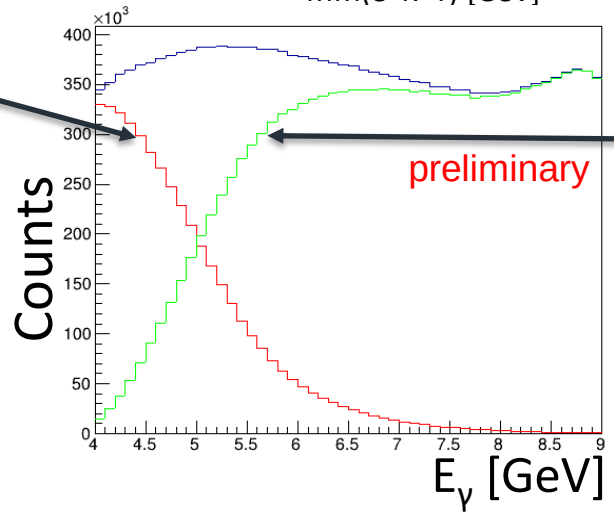


Resonant and non-resonant production

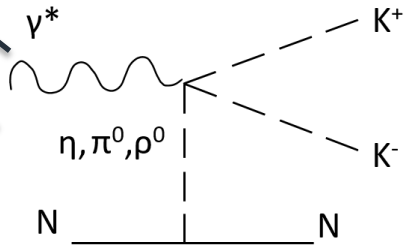


Resonances





Non-resonances



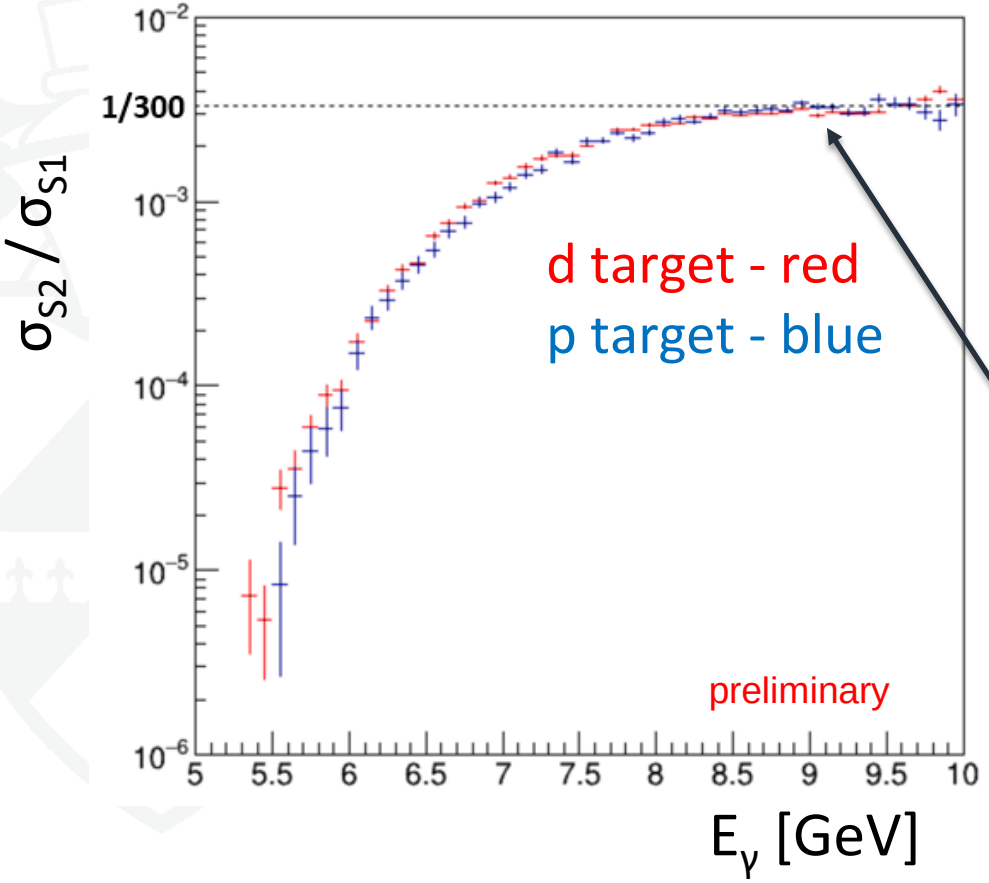
Total - Blue

Resonant region - red

Non-resonant region - green

Current Results

Strangeness Suppresion 2:1

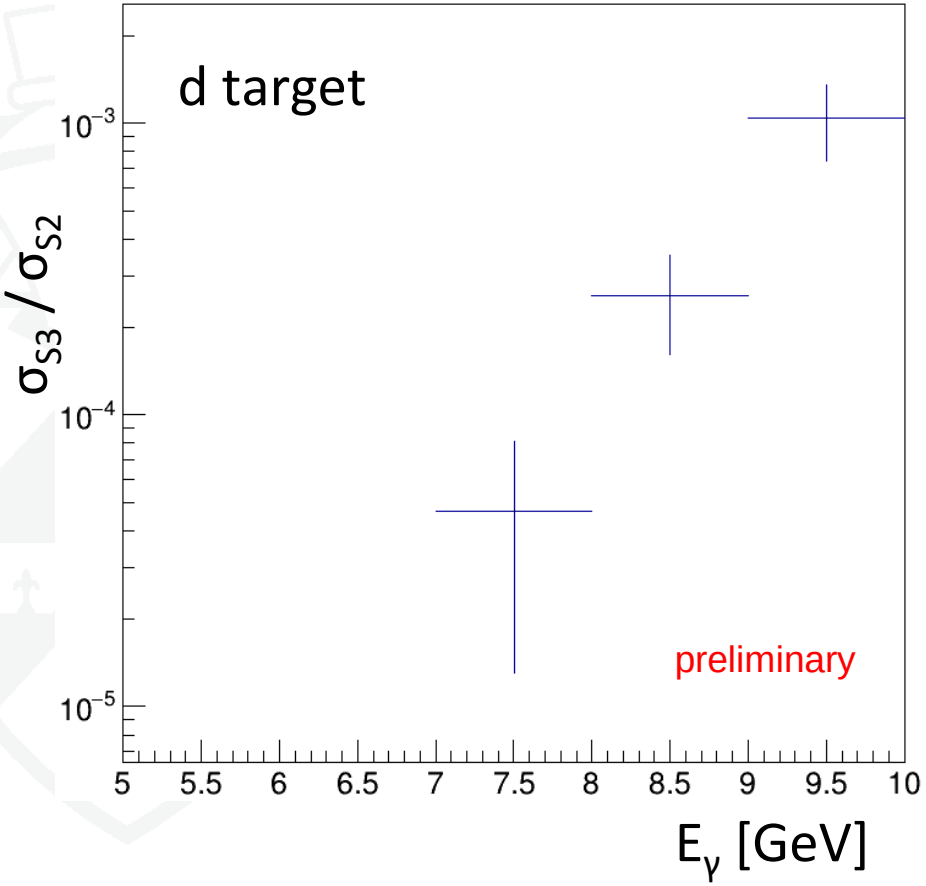


Smooth pattern

Levels off at higher momenta

Additional K^+ suppresses by a factor of ~ 1/300

Strangeness Suppresion 3:2



Approaches same level as 2:1

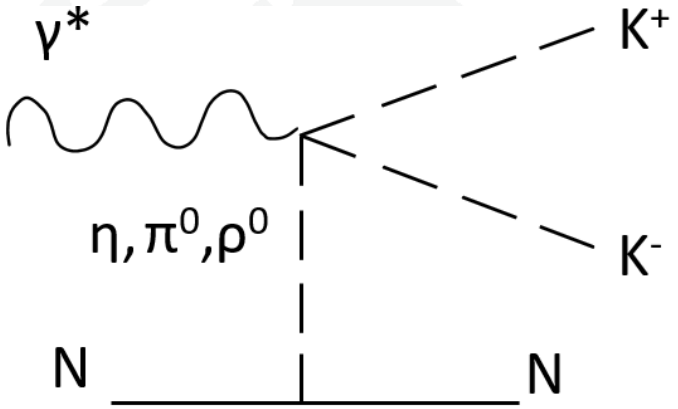
Higher E_γ needed

Strange Exotic Production

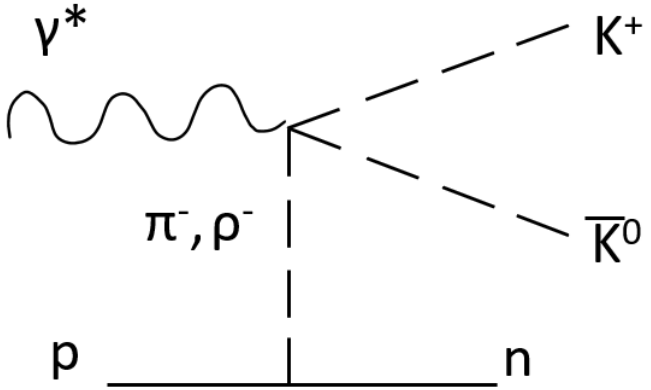
Non-resonant

Deuteron -> 3 production modes
Proton -> 2 production modes

→ Expect ratio of 3/2



Proton & neutron



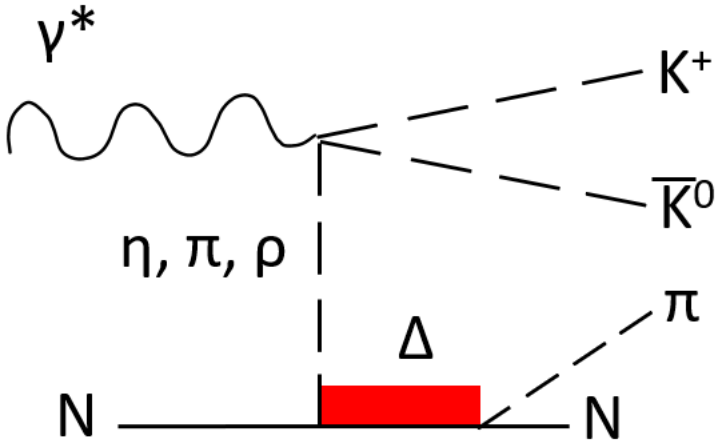
Proton only

Strange Exotic Production

Deck contribution

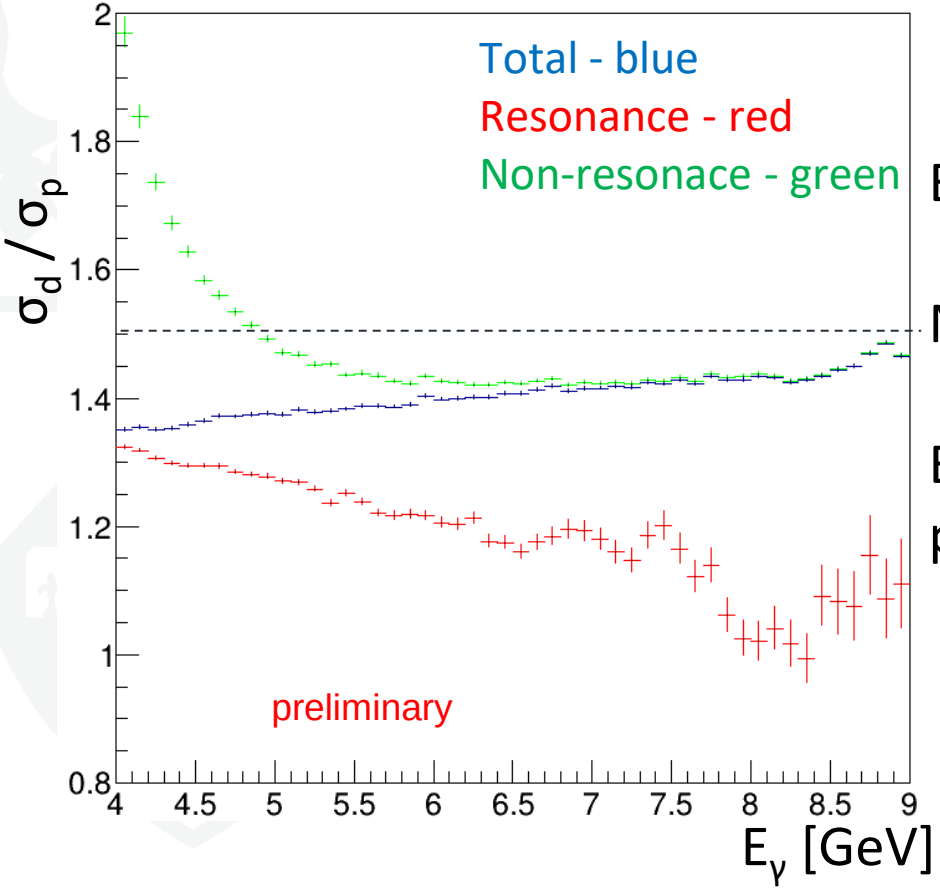
Deuteron -> 2 production modes
Proton -> 1 production modes

→ Expect ratio of 2/1



Proton & neutron

Strangeness 1 d:p

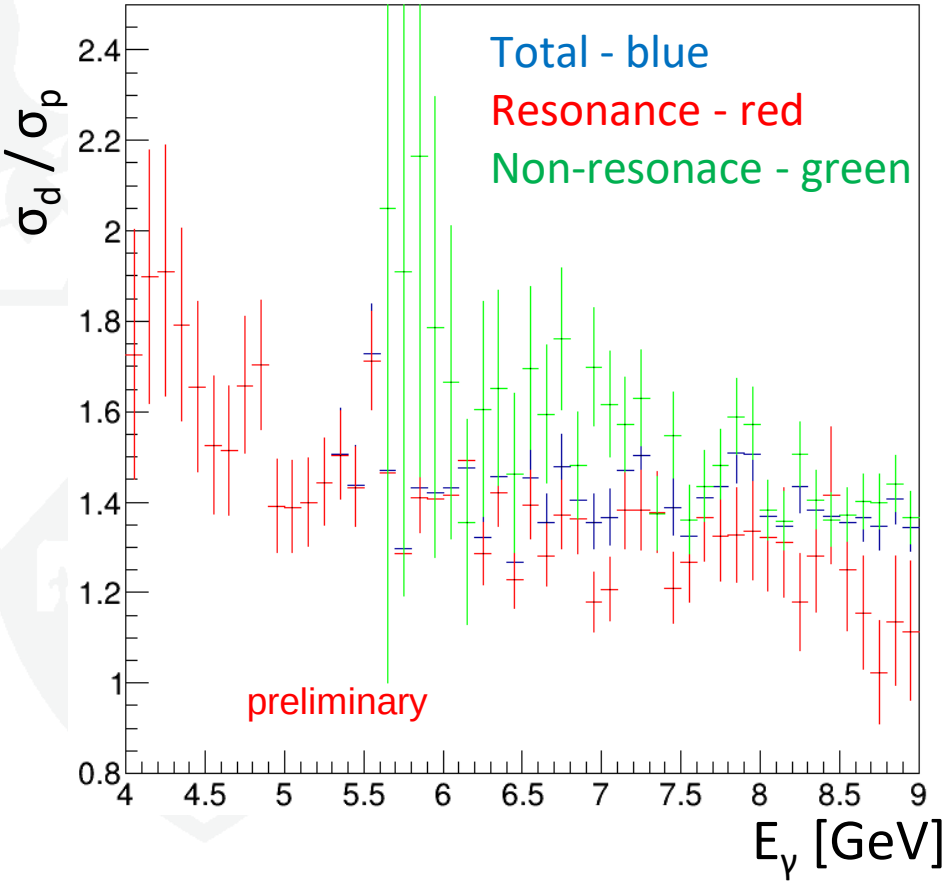


Expected between 1.5 - 2

Non-resonant scaling ~ 1.5

Enhancements for resonant production on deuteron

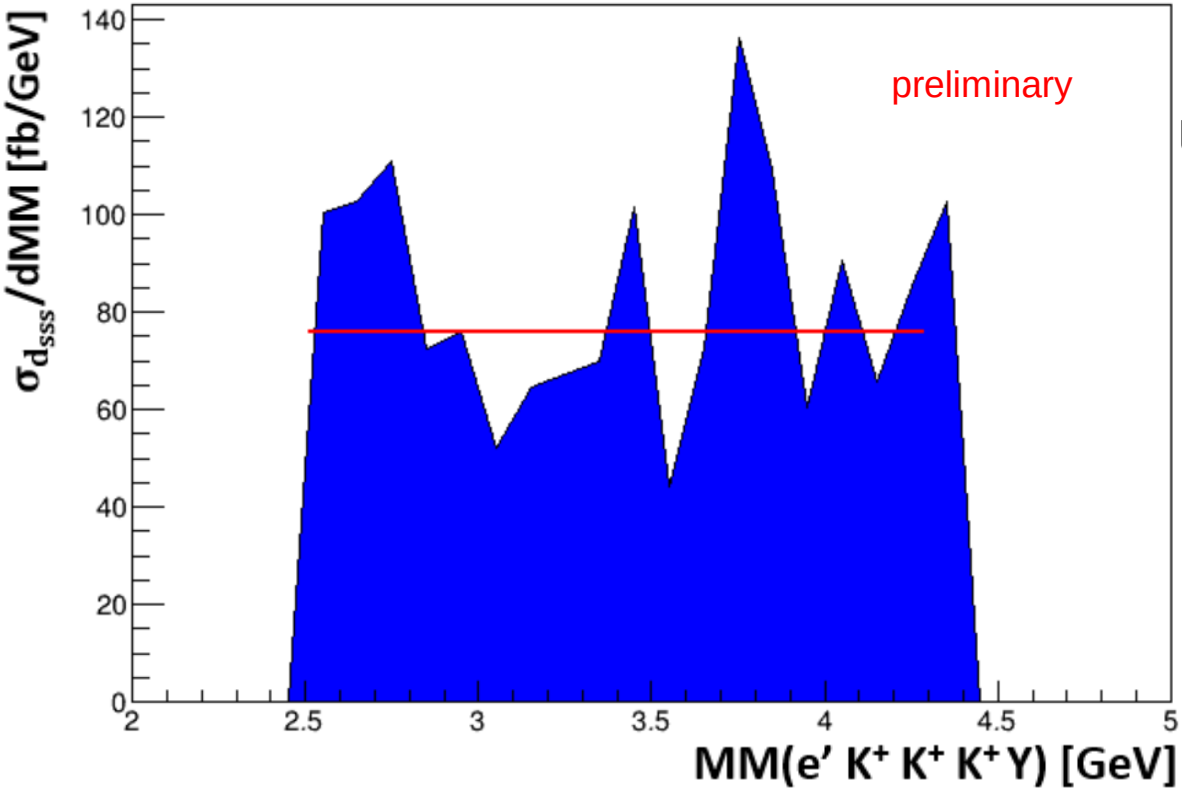
Strangeness 2 d:p



Similar behaviour & scaling

Further studies will be performed

d_{sss} Upper Limit



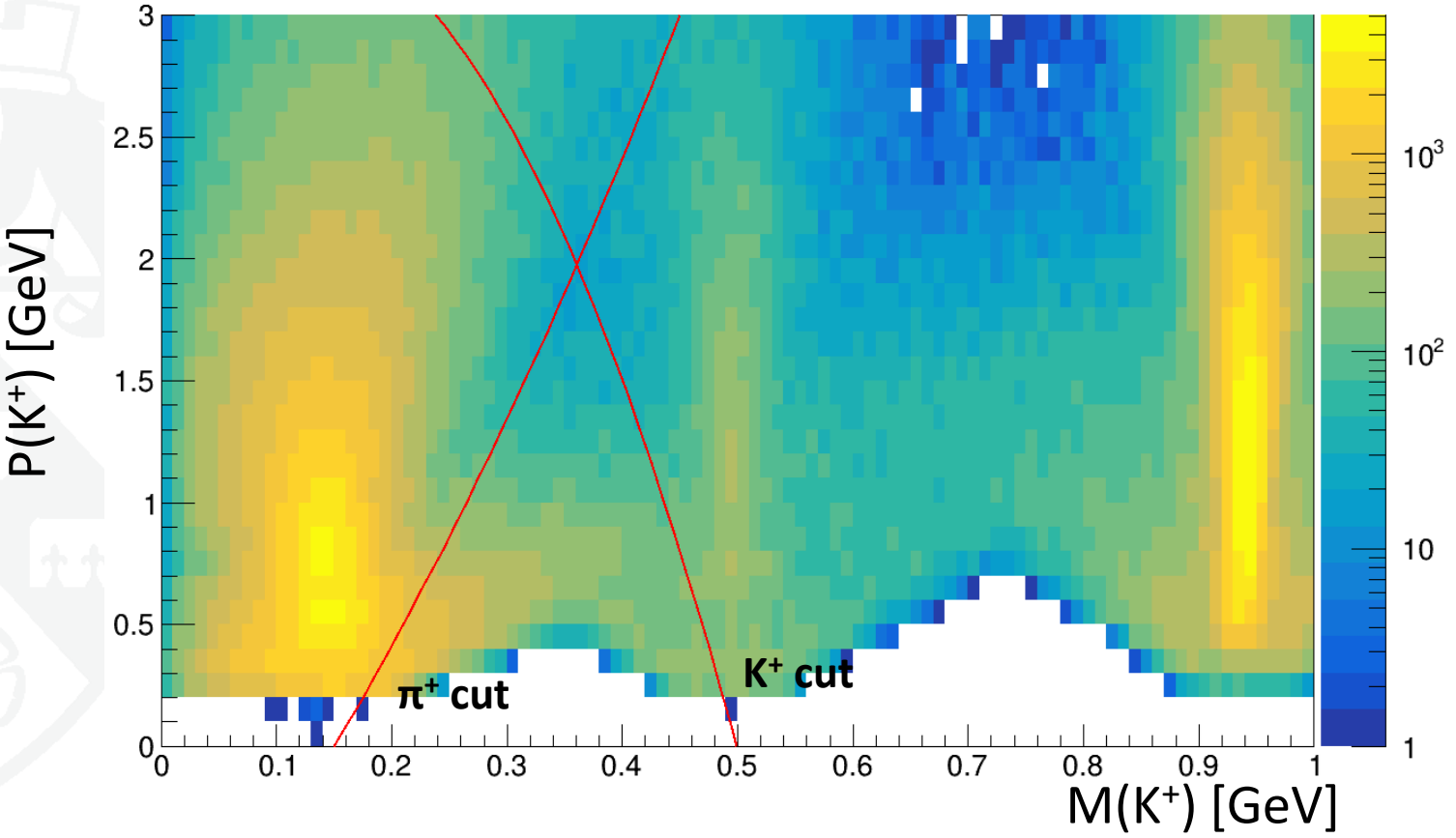
Upper limit is 76 +/- 2 fb/GeV

Summary

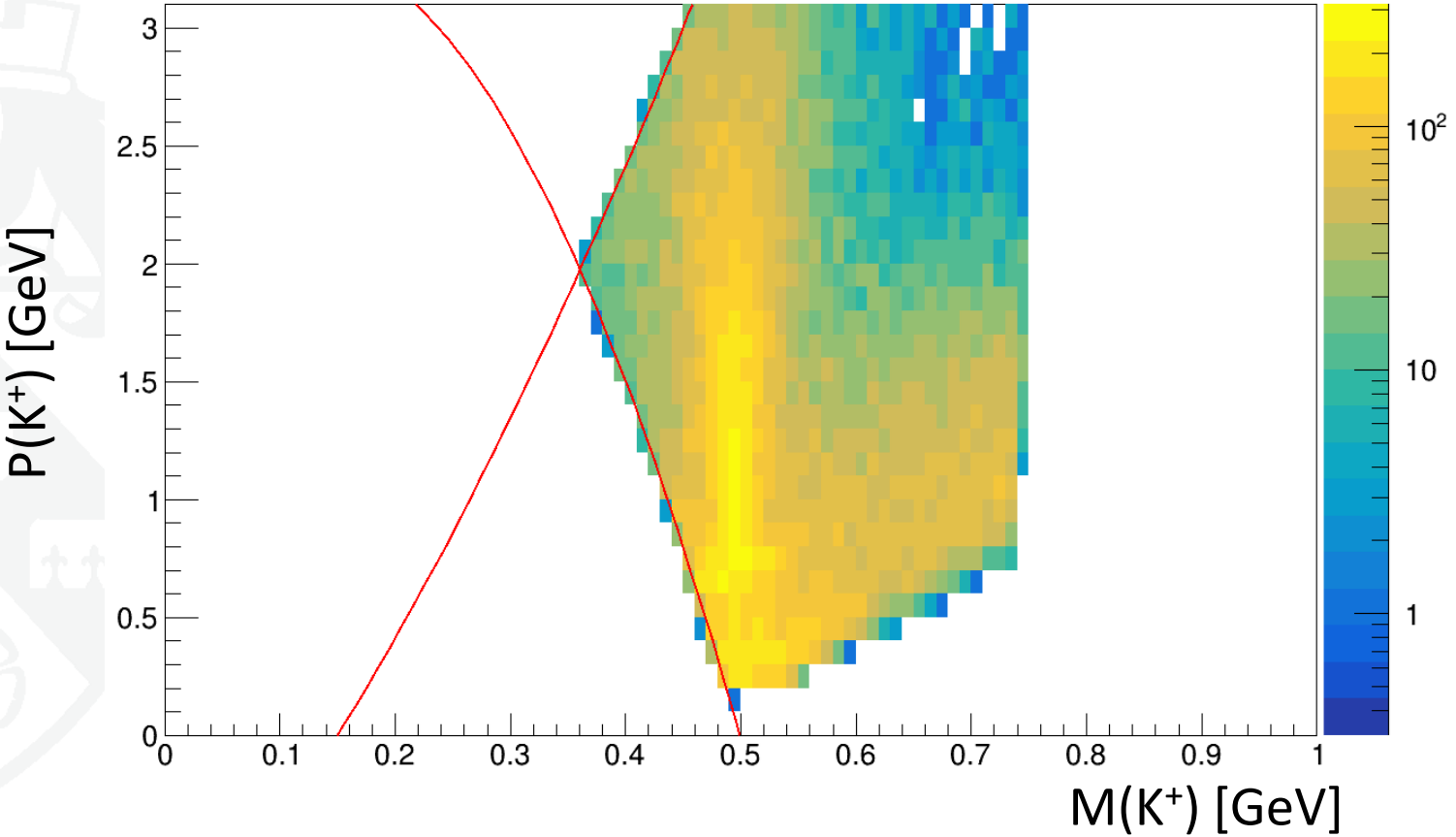
- **First ever** scaling behaviour for strangeness
- Initial estimates at strangeness suppression factors -> 1/300
- Strange resonant production enhancements on deuteron
- d_{sss} cross section upper limit

Additional Slides

Kaon Requirements



Kaon Requirements



Data

- RGA
- Fall2018
- dst
- Inbending
- 174 runs

- RGB
- Spring2019
- dst
- Inbending
- 249 runs

- File Path:

Fall 2018 In:
/cache/clas12/rg-a/production/recon/fall2018/torus-1/pass1/v0/dst/recon/
RGB Spring 2019 In:
/cache/clas12/rg-b/production/recon/spring2019/torus-1/pass1/v0/dst/recon/