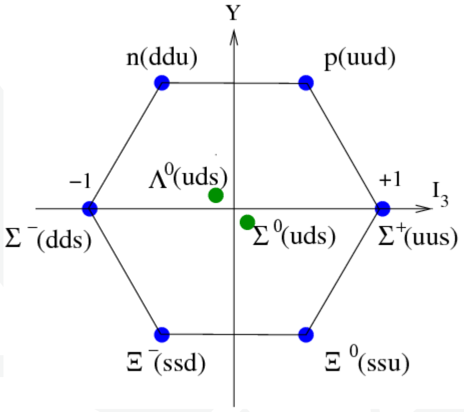
Hyperon spectroscopy at KLF

Mikhail Bashkanov

Outlook

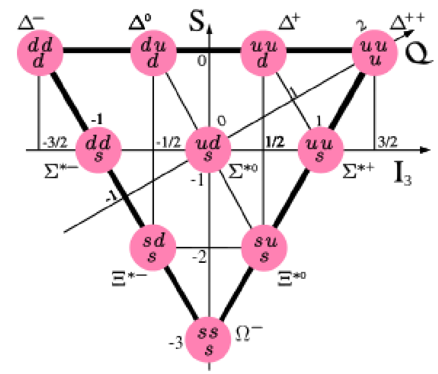
- WHY?
- BEAM-RELATED BACKGROUND
- KAON INDUCED REACTIONS
    - Simulation & reconstruction
- BEAM-RELATED BACKGROUND

Hyperons



Octet: N^*, $\boldsymbol{\Lambda}^*$, $\boldsymbol{\Sigma}^*$, $\boldsymbol{\Xi}^*$

Decuplet: Δ^*, $\boldsymbol{\Sigma}^*$, $\boldsymbol{\Xi}^*$, $\boldsymbol{\Omega}^*$



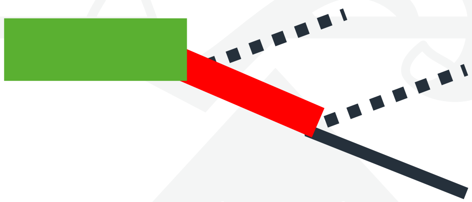
	Quark Models Predicted	"Observed", PDG
N^*	64	16
Δ^*	22	10
$\boldsymbol{\Lambda}^*$	17	14
$\boldsymbol{\Sigma}^*$	43	10
$\boldsymbol{\Xi}^*$	42	6
$\boldsymbol{\Omega}^*$	24	2

Theory limitations

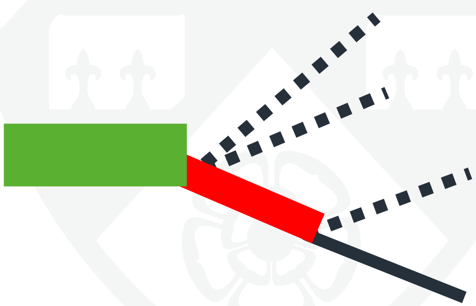
Kaon beam brings one unit of strangeness:

- No associated kaons for Λ^*, Σ^* production
- 1 associated kaon for Ξ^*
- 2 associated kaons for Ω^*

Good



Acceptable



Simplified,
model dependent analysis only

Questions

- Feasibility?
- Statistics?
- Systematics?

Hyperon analysis note:
https://wiki.jlab.org/klproject/images/0/08/KLF_Analysis_Report_%284%29.pdf

Reactions of interest

$K_L p \to K_s p$
$K_L p \to \pi^+ \Lambda$
$K_L p \to K^+ \Xi^0$

2 Body Final state
Pure Σ^* channels

$K_L n \to K^+ \Xi^-$

Measurement on neutron target
Σ^*, Λ^* interplay

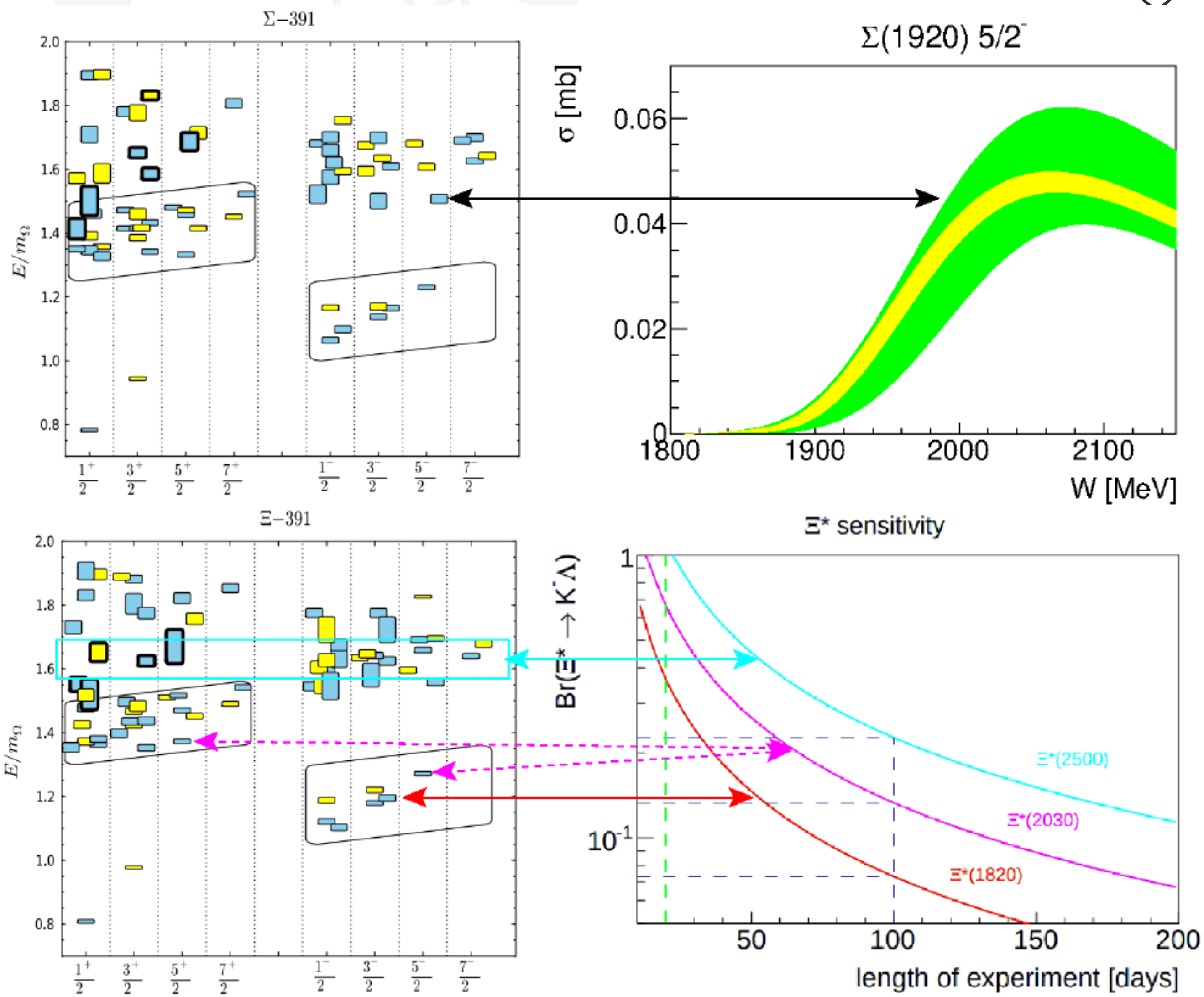
$K_L n \to K^+ \Xi^{*-}$

Excited Ξ^*, associated production

$K_L p \to K^+ n$

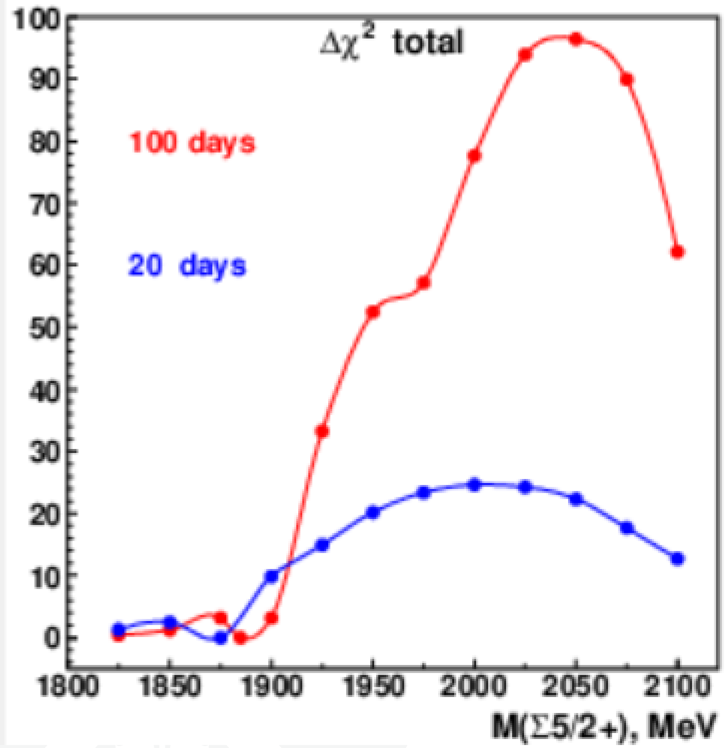
Non-resonant background

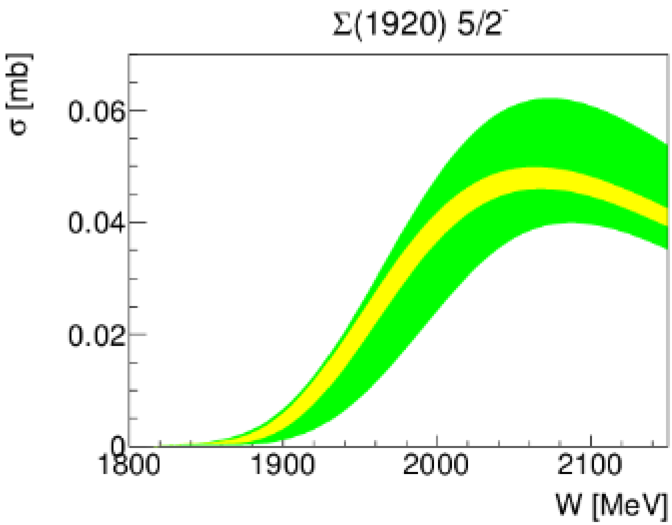
Results



Σ−391
E/m_Ω
Σ(1920) 5/2⁻
σ [mb]
W [MeV]
Ξ−391
Ξ* sensitivity
Br(Ξ* → K⁻Λ)
Ξ*(2500)
Ξ*(2030)
Ξ*(1820)
length of experiment [days]

Systematics





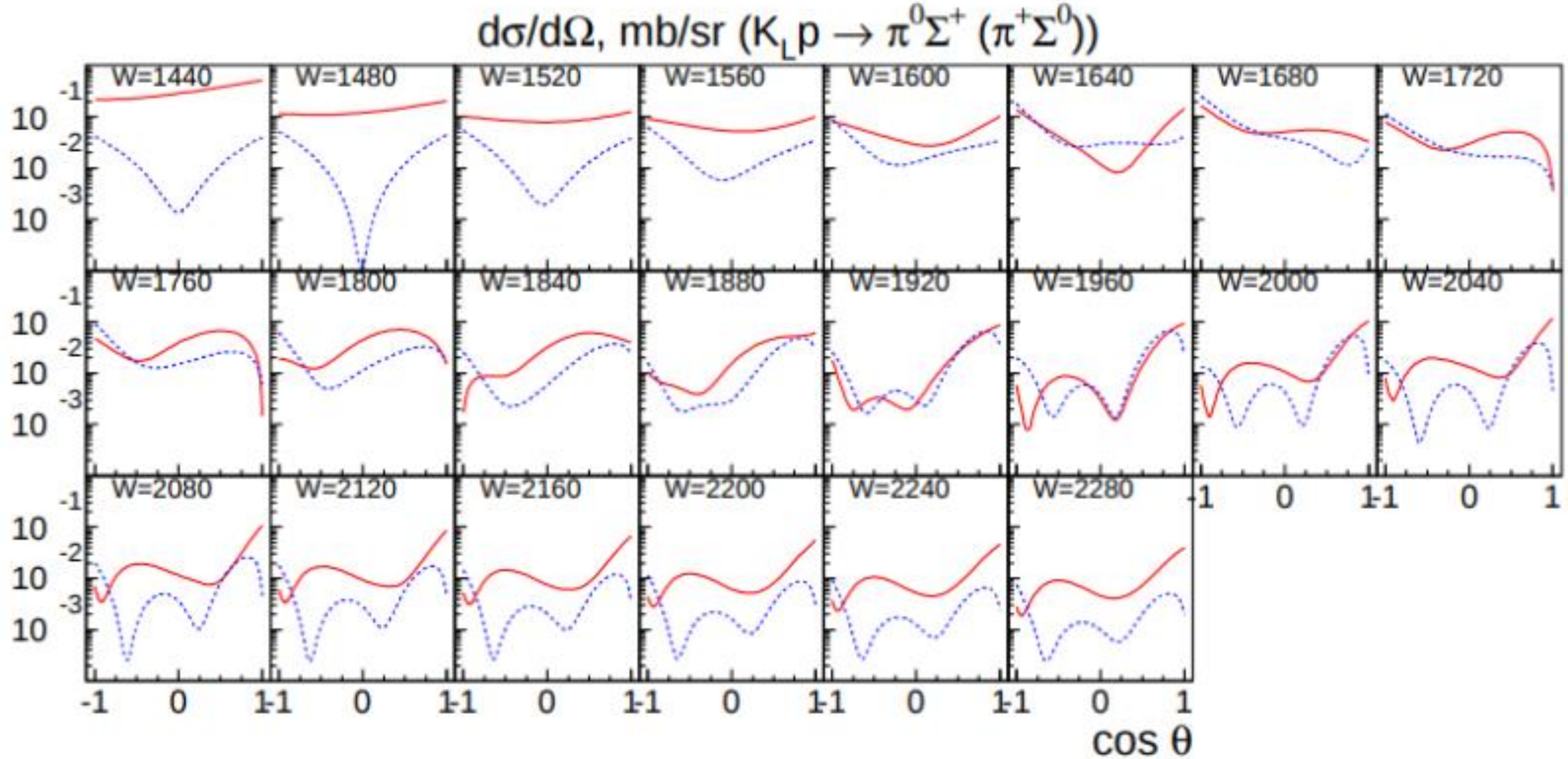
New findings: $\pi\Lambda/\pi\Sigma$

Isospin amplitudes

$$|A(K^-p)|^2 = \frac{1}{2}(|A_1|^2 + |A_0|^2 + 2Re(A_1A_0^*))$$

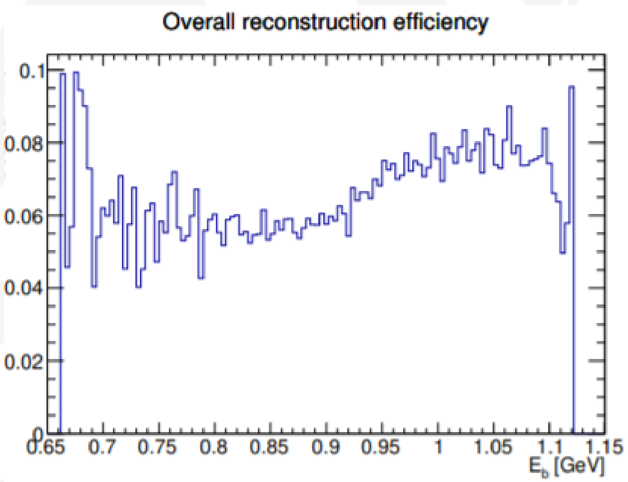
$$|A(K^0n)|^2 = \frac{1}{2}(|A_1|^2 + |A_0|^2 - 2Re(A_1A_0^*))$$

$$|A(K^0p)|^2 = |A_1|^2.$$



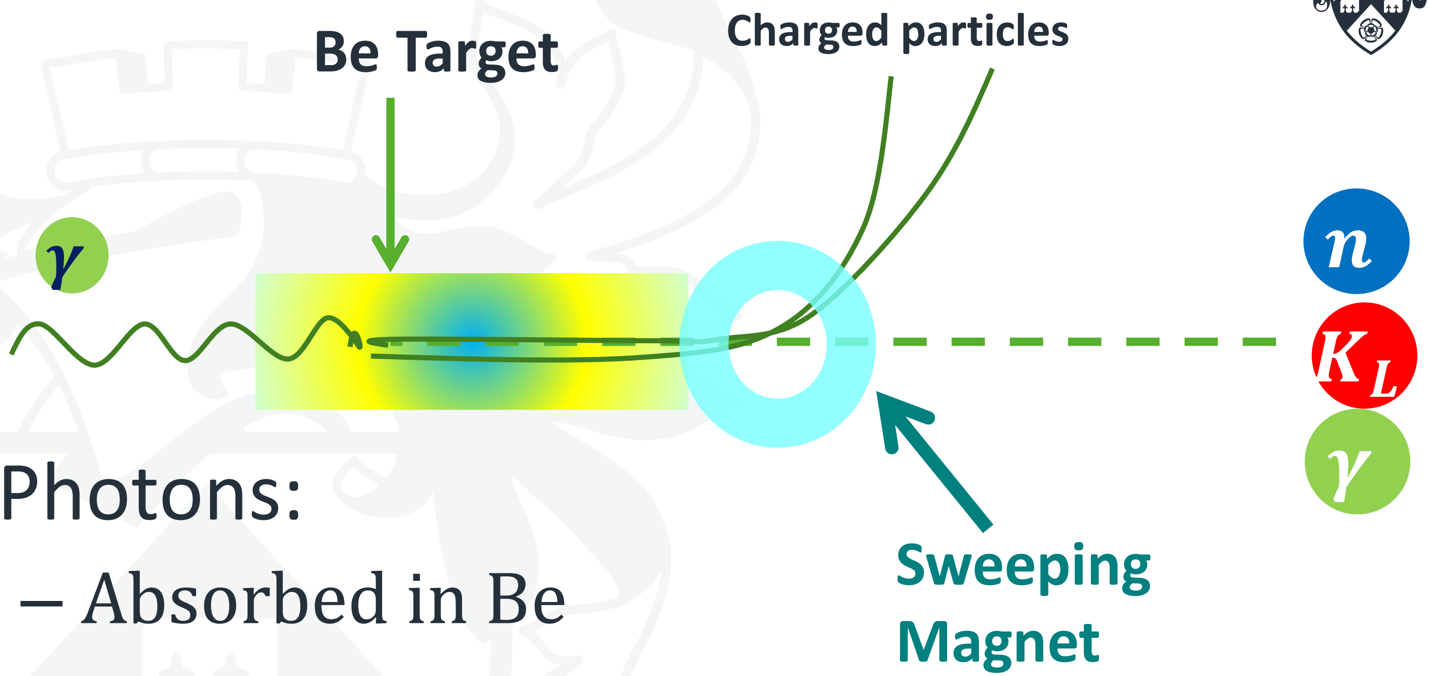
Further studies

$$K_L p \rightarrow \Sigma(1670) \rightarrow \Lambda\pi^+,\ \Lambda\gamma,\ \Lambda e^+ e^-$$



Backgrounds

Possible Backgrounds

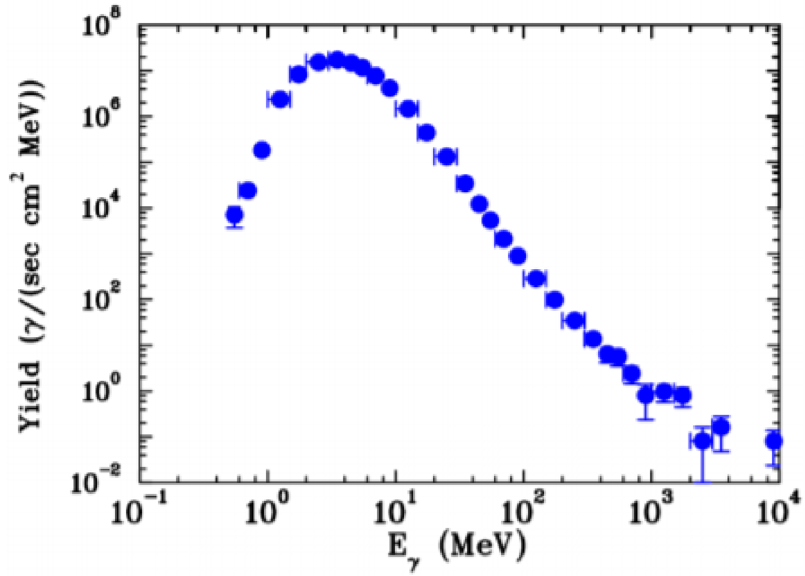


- Photons:
  - Absorbed in Be
  - $v = c$
  - Small x-section
- Neutrons:
  - $v_n \ll v_{K_L}$
  - Different kinematics

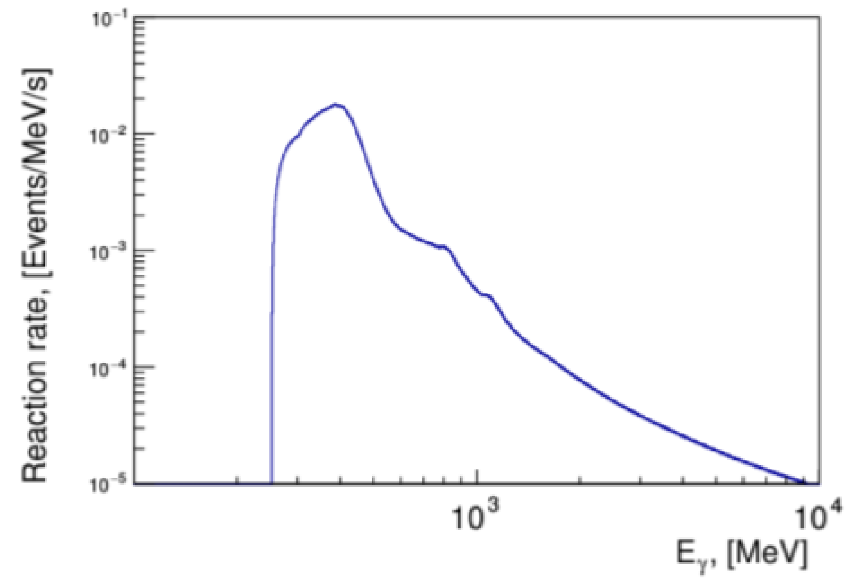
94%of neutrons associated with **T < 300**MeV

12

Photon background



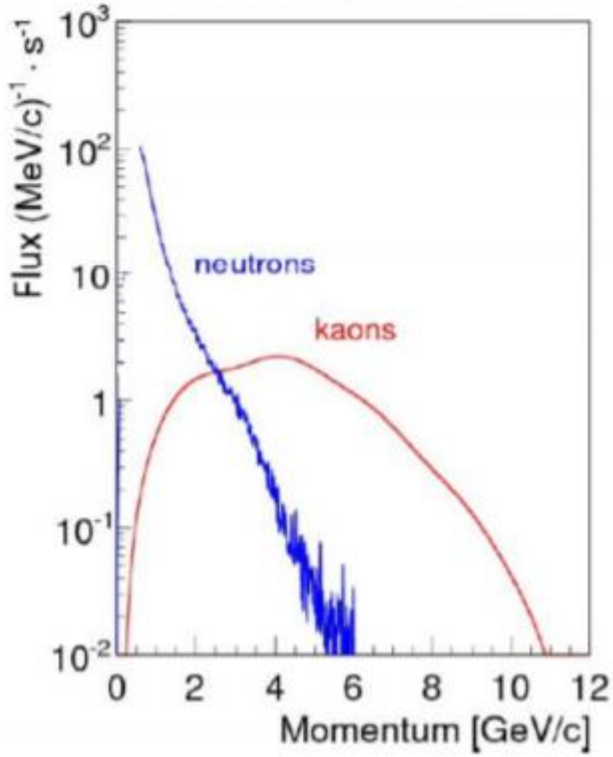
Photon flux at LH2/LD2

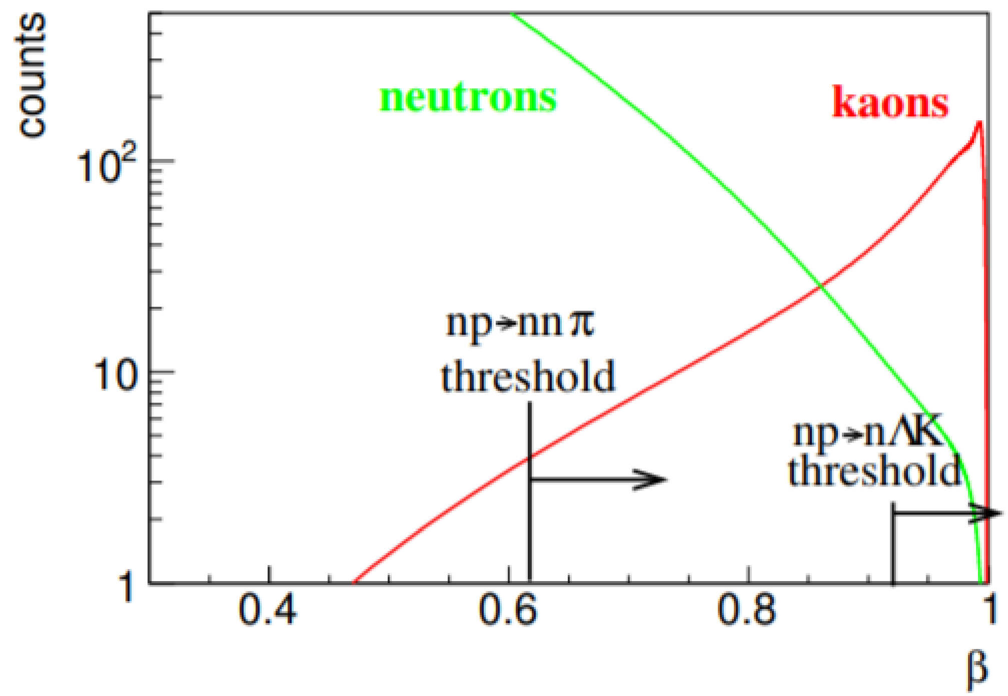


Photoinduced reaction rate

Photoinduced reaction rate < 4Hz

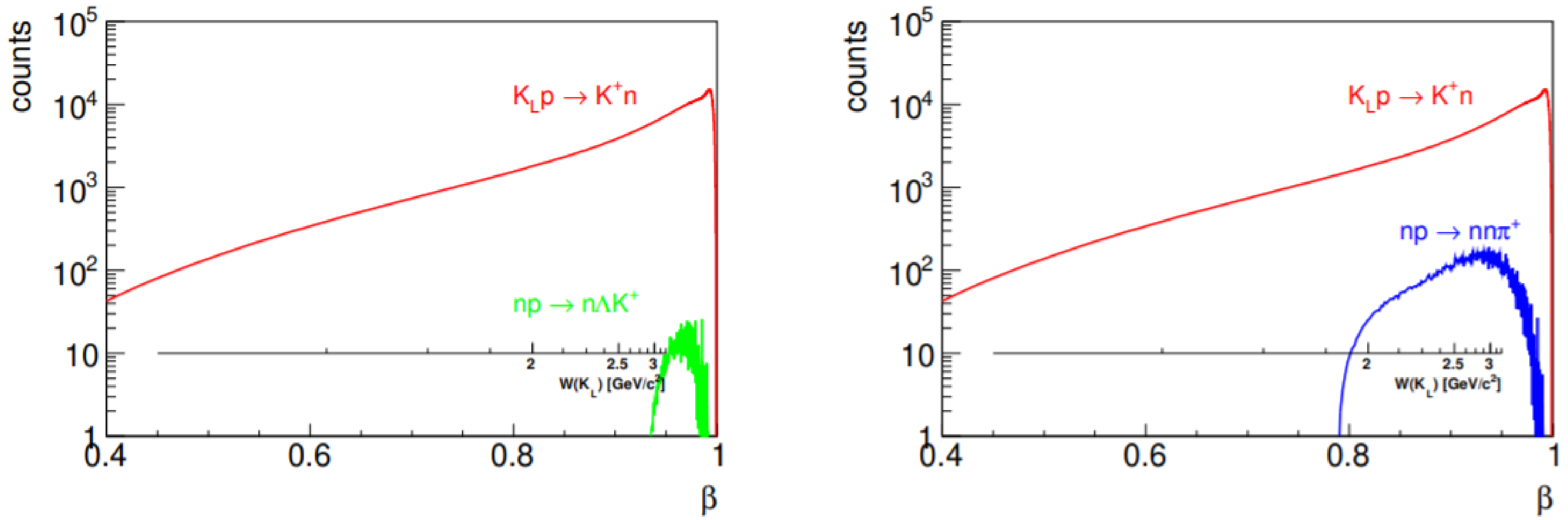
Neutron Background





- $E_n > 1.6\ GeV$ (strangeness threshold)~ 1% of neutron flux
- $0.3 < E_n < 1.6\ GeV$ (above pion threshold)~ 5% of neutron flux
- $E_n < 0.3\ GeV$ ~ 94% of neutron flux – do not contribute

Neutron Background



Other sources of n-induced background

- $np \rightarrow K^{+}X$ *– NOT A PROBLEM*
  - the x-section and a flux is too small to be a problem.
- $np \rightarrow \pi^{+}X$ *– NOT A PROBLEM*
  - very different kinematics
  - exclusivity

Conclusion

- Hyperon spectroscopy programme is under control
- Good progress
- Nice results (statistics/systematics/background)