Additional physics potential with K_LF

Mikhail Bashkanov

Outlook

- BEYOND KLF PROGRAM
  - K_L beta decay
  - Inversed Primakoff
  - Dark matter
  - Neutron reactions

Rare decays?

Rare decays

- Physics beyond SM
  - Rare final state
  - Precise calculations

K_L beta-decay

$$M(K_L) = 497.611\ MeV$$
$$M(K^{+/-}) = 493.696\ MeV$$
$$M(e^{+/-}) = 0.511\ MeV$$

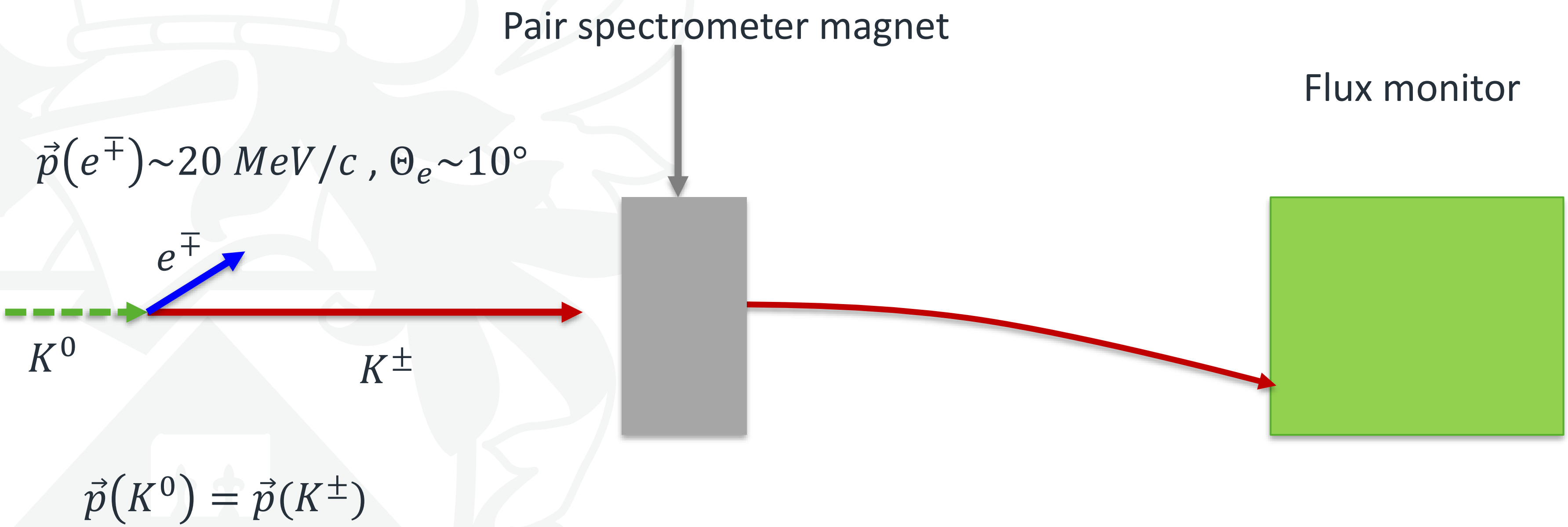
Available Phase Space $\mathbf{3.4\ MeV}$

$$K_L \to K^+ e^- \overline{\nu_e}$$
$$K_L \to K^- e^+ \nu_e$$

BUT!!!

- In flight decay (boosted)
- Can build dedicated detector
- Br$\left(K^0 \to K^{\pm} e^{\mp}\ \nu\right) \sim 10^{-9}$ (N.N. Shishov, Yad. Phyz. 82, 86, (2019))
- ~50 decays per beamtime

Rare decays



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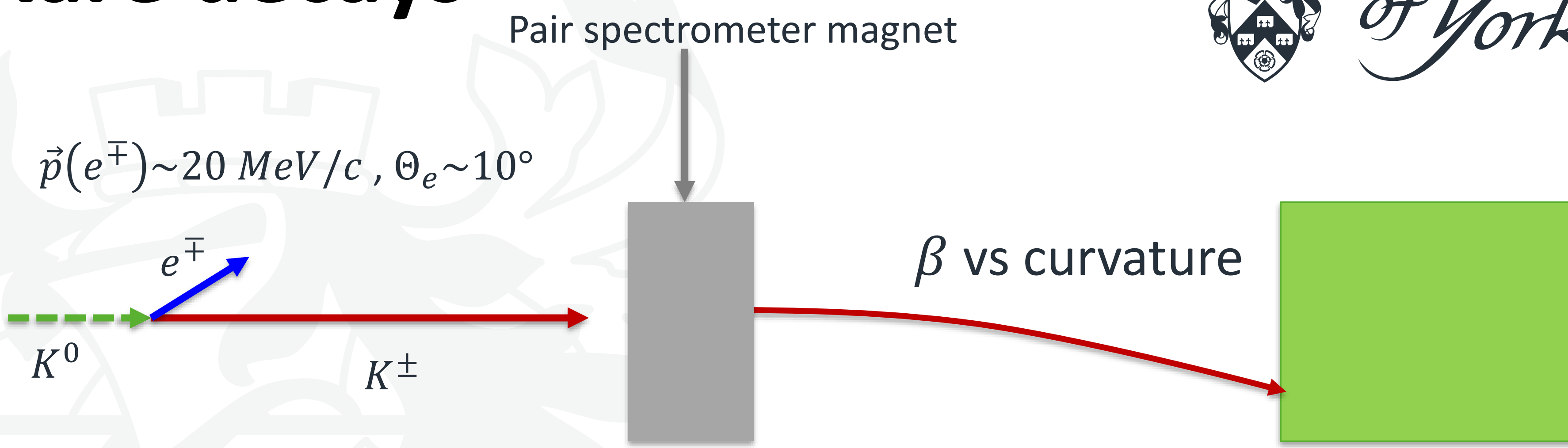
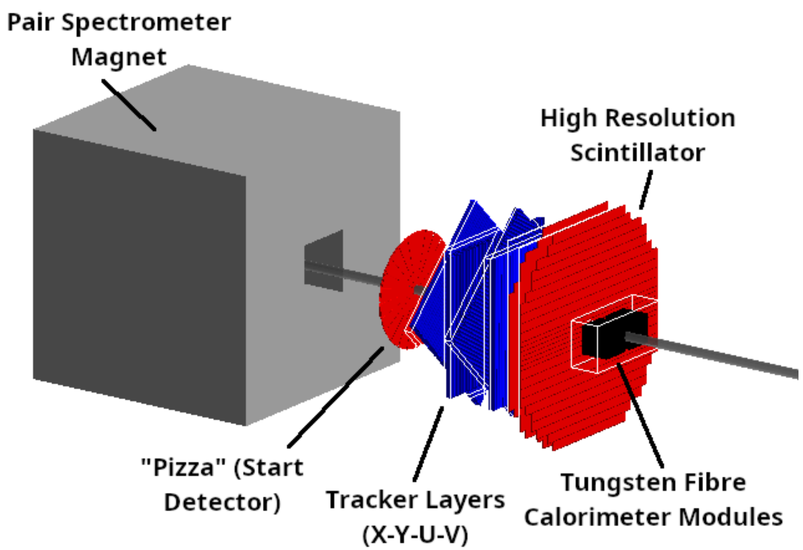
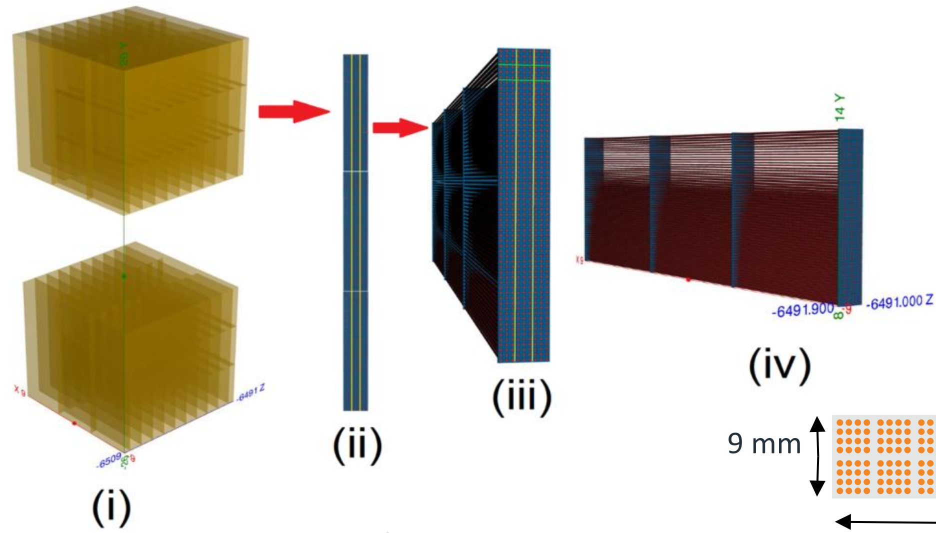




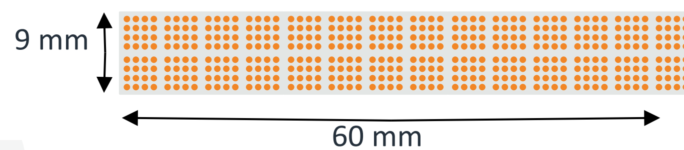
York EIC luminosity calorimeter at KLF

EIC spaghetti calorimeter

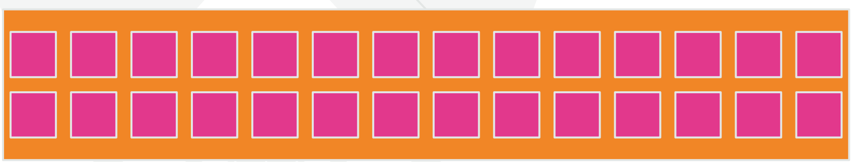


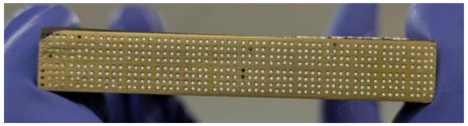
Density	9 g cm-3
Moliere Radius	15 mm
Mass	~ 60 kg

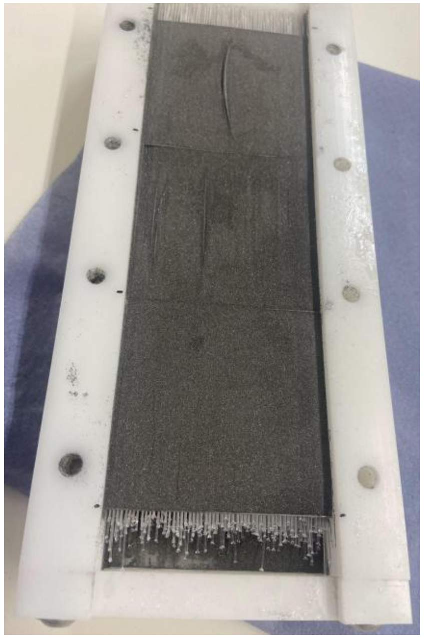
X-Y-Z position resolution



Populated PCB

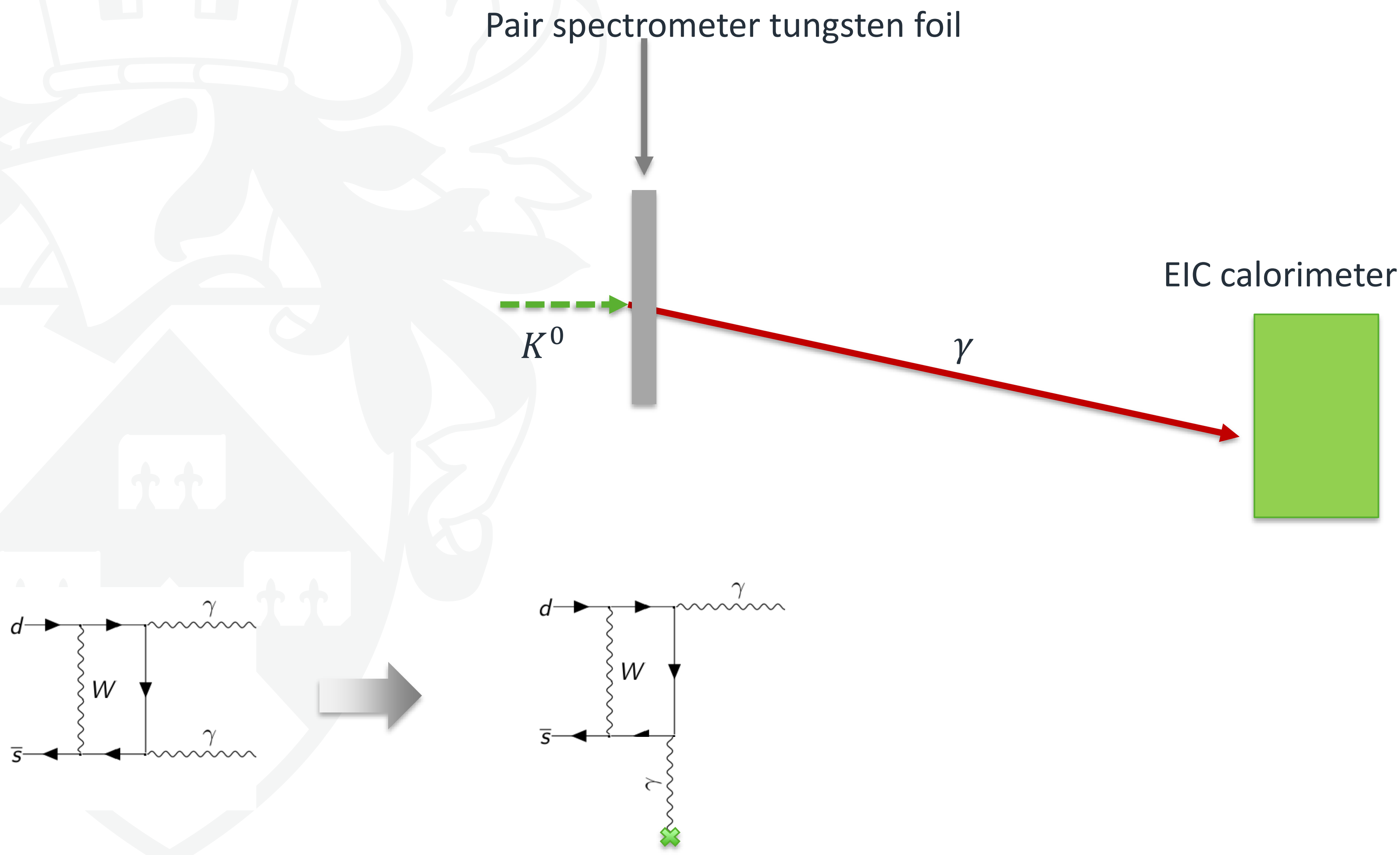






Alex Smith

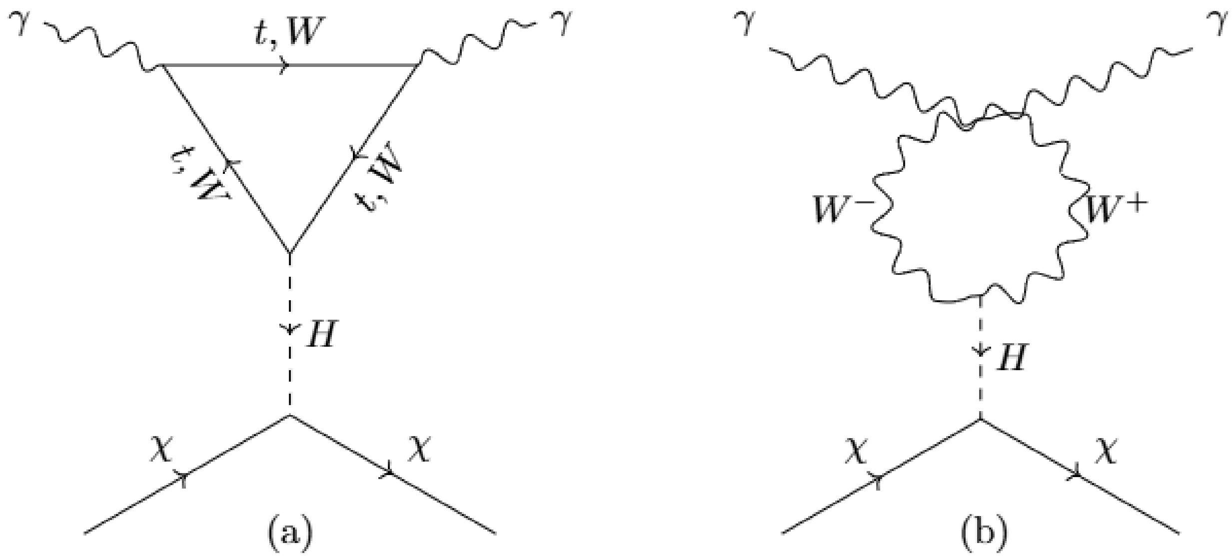
Inversed Primakoff



Dark Matter at KLF?

Asli Acar, Mikhail Bashkanov, Dan Watts

WIMP – light interactions



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Physics Letters B

Volume 870, November 2025, 139920

Letter

Dark matter: Red or blue?

A. Acar, C. Isaacson, M. Bashkanov, D.P. Watts

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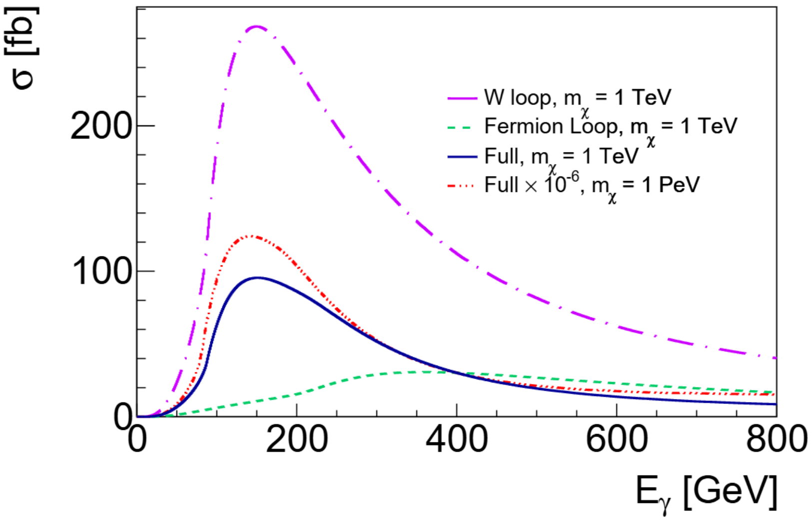
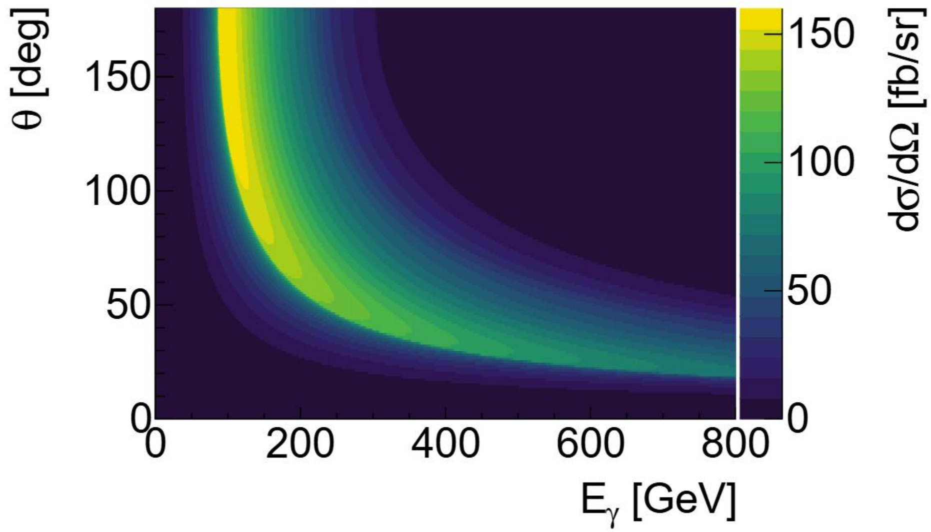
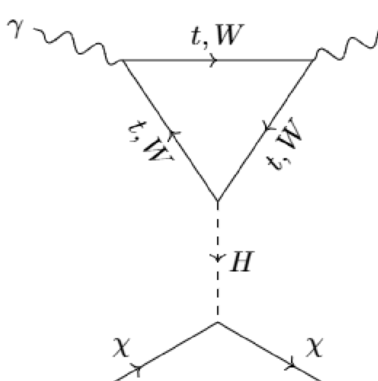
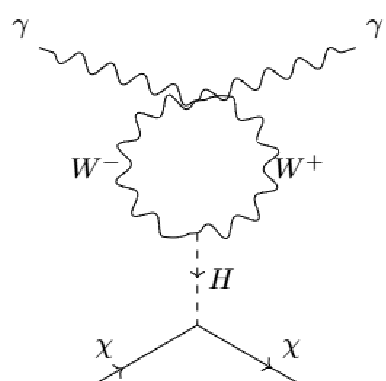
WIMP – light interactions





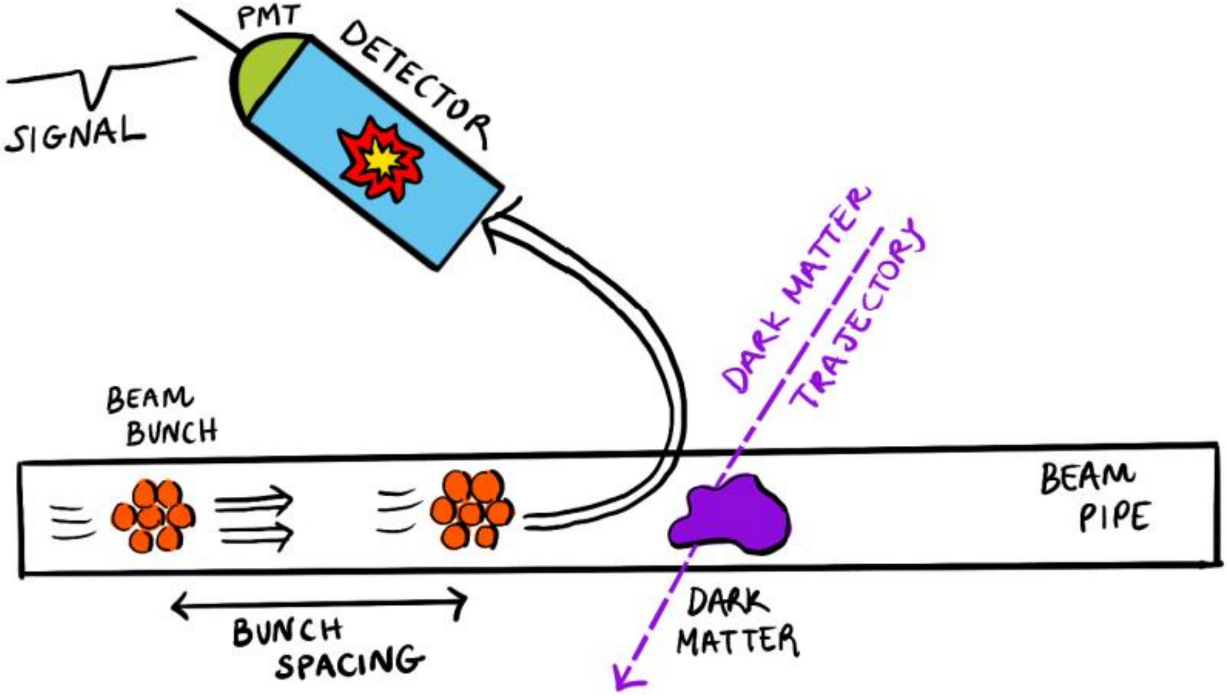


(a)



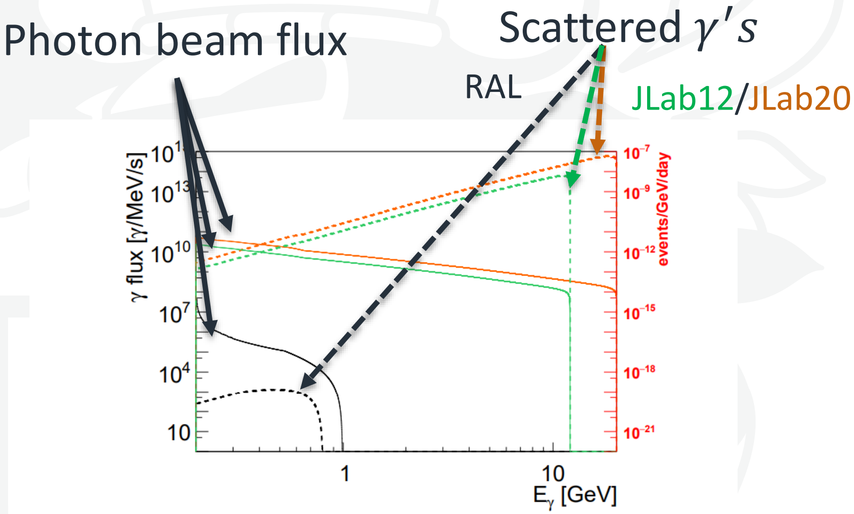
(b)

DM vs intense beams

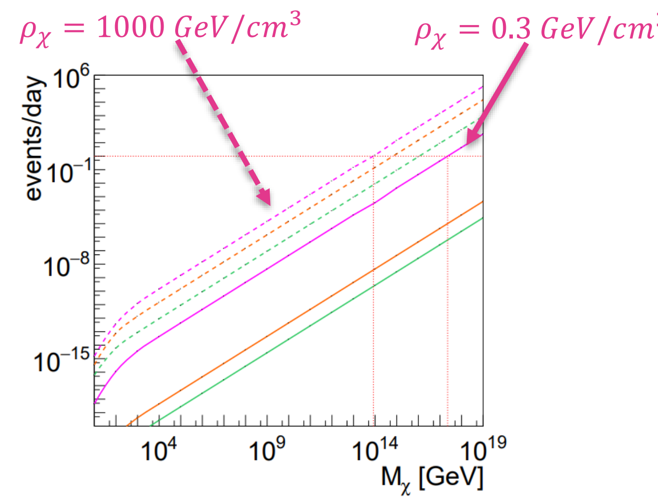


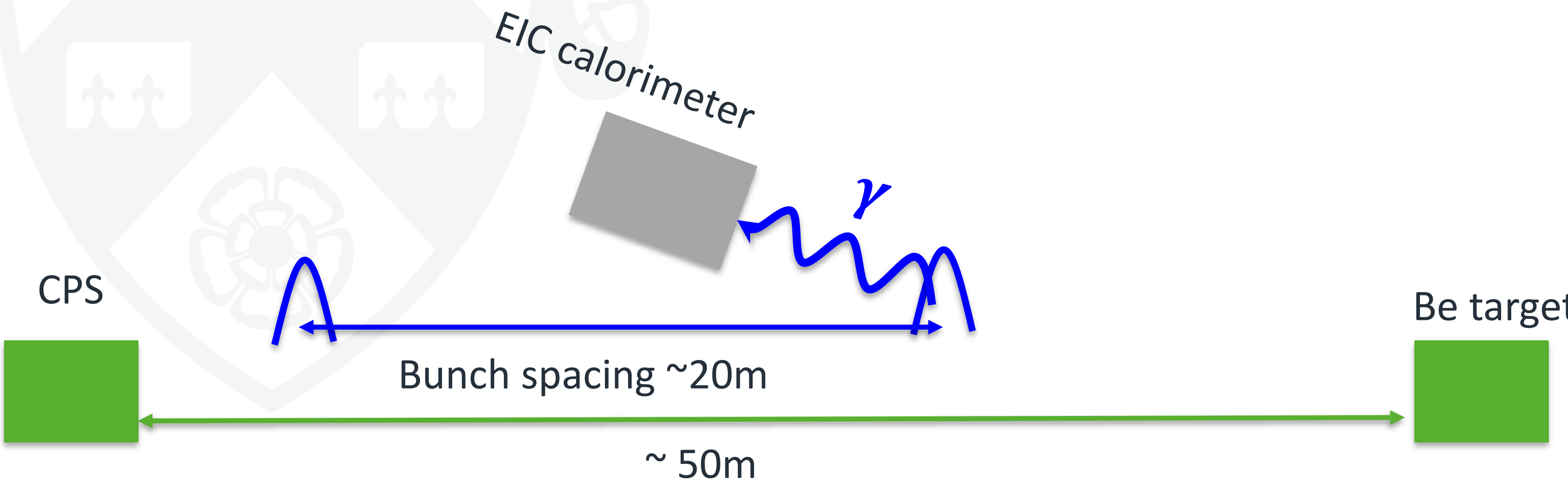
arXiv: 2603.03011

WIMP's at accelerators



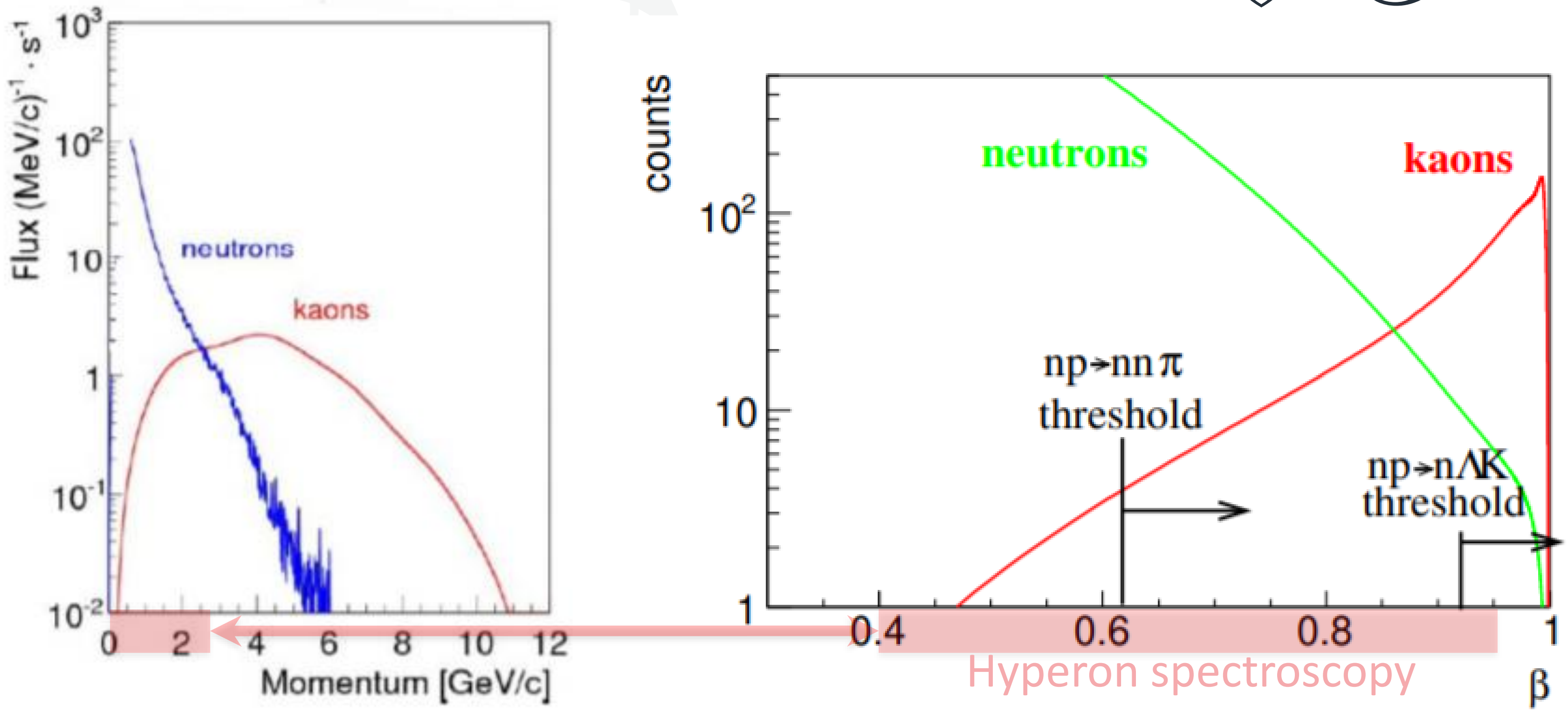
Muon collider





Neutron beams?

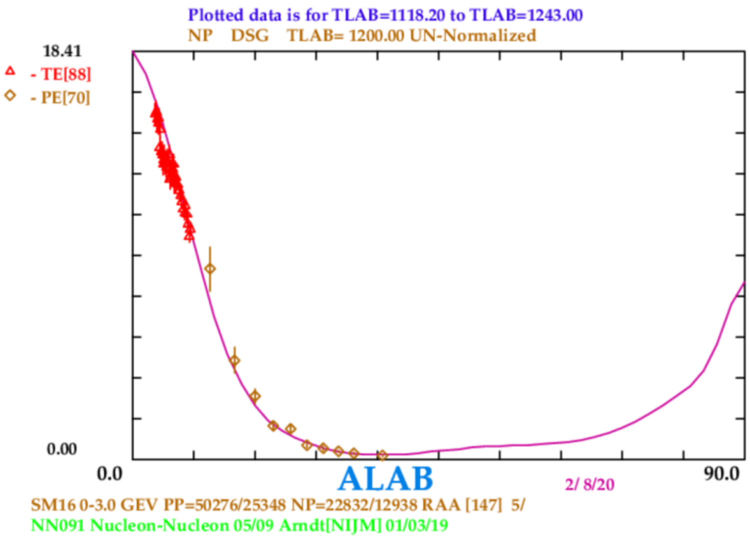
Neutron Background



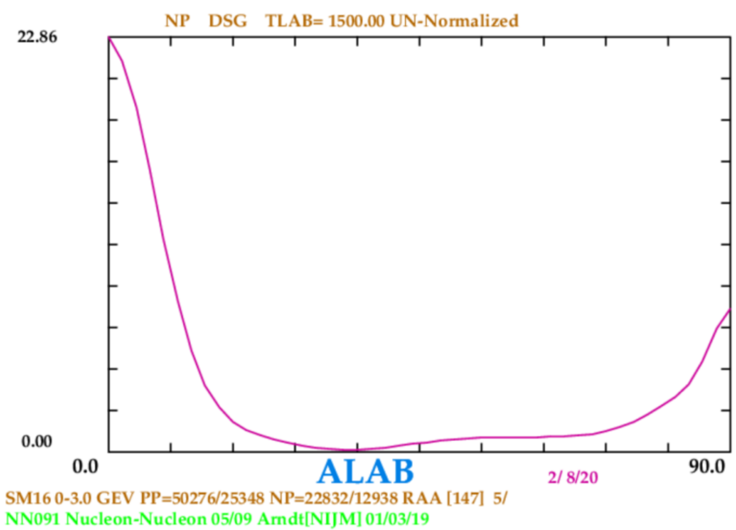
- $E_n > 1.6\ GeV$ (strangeness threshold)~ 1% of neutron flux
- $0.3 < E_n < 1.6\ GeV$ (above pion threshold)~ 5% of neutron flux
- $E_n < 0.3\ GeV$ ~ 94% of neutron flux – do not contribute

np-elastic scattering

$E_n = 1.25$ GeV

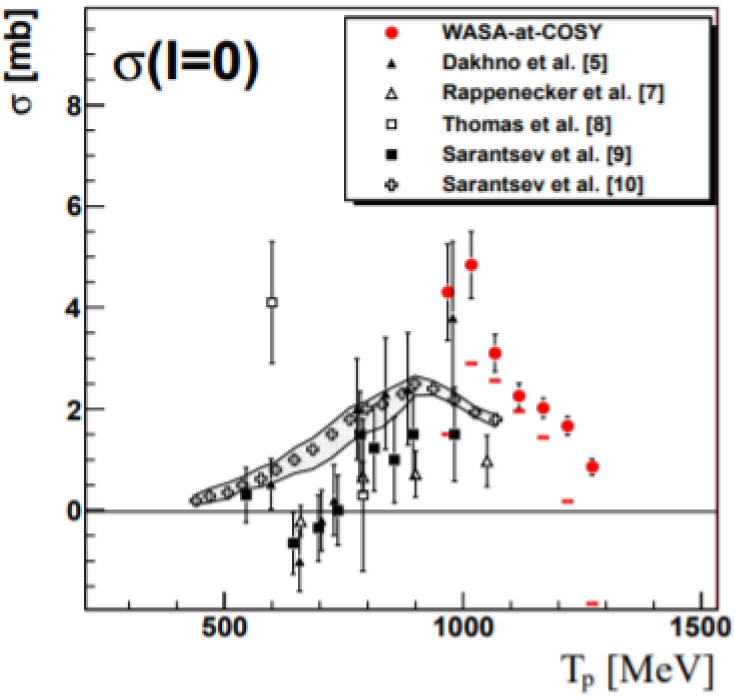


$E_n = 1.5$ GeV



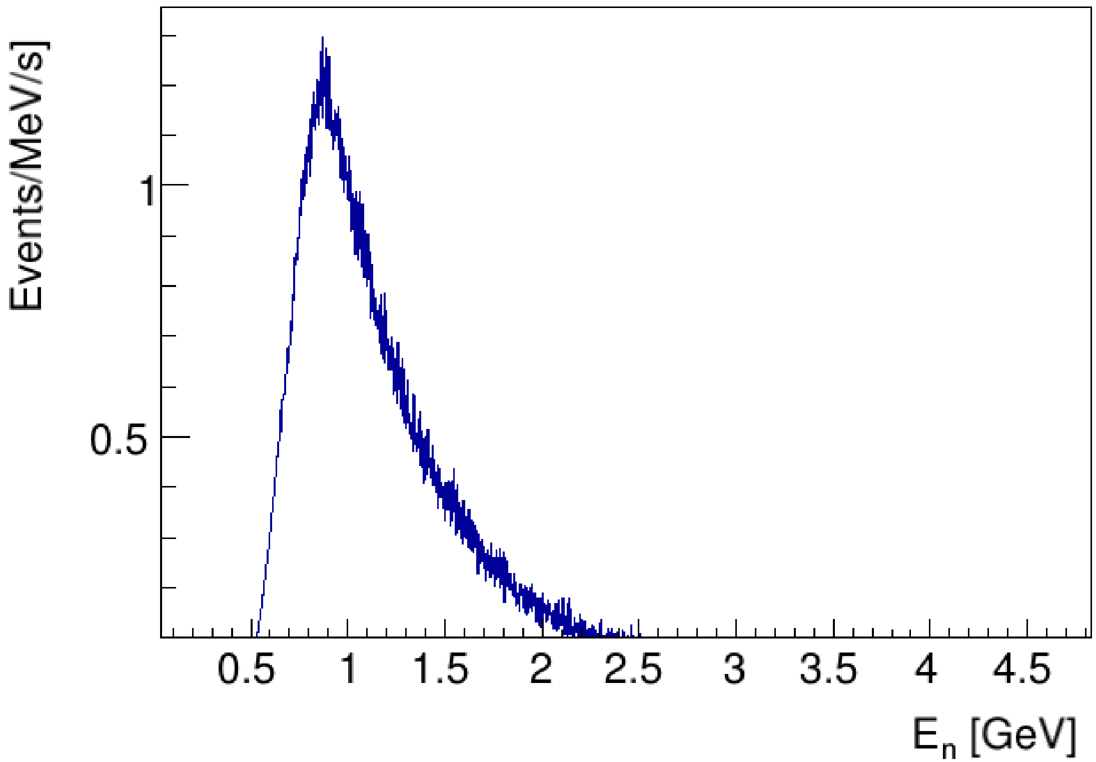
np-single pion production

Isoscalar contribution



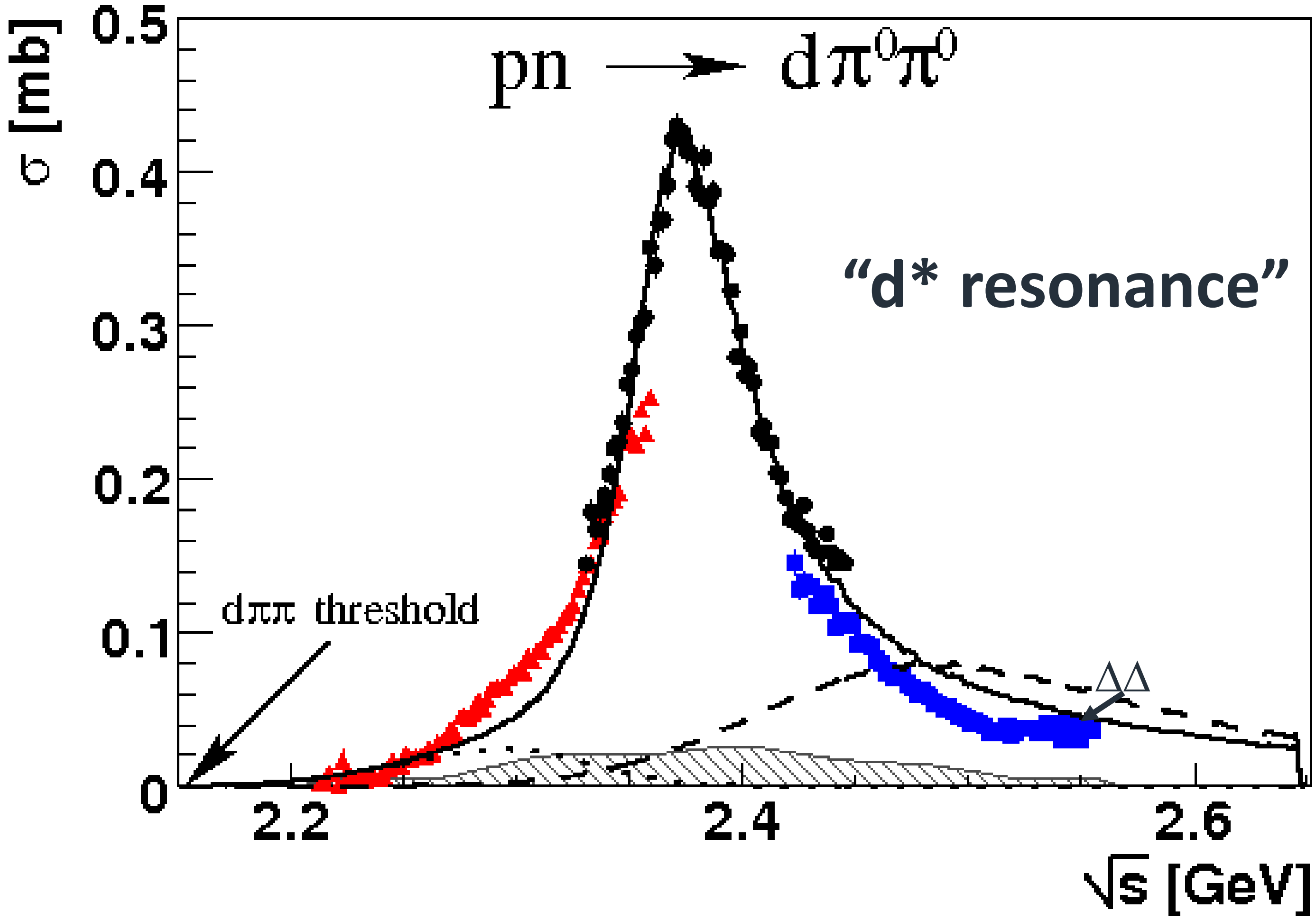
$$\sigma(NN \rightarrow NN\pi)[I=0] = 3\{2\sigma(np \rightarrow pp\pi^-) - \sigma(pp \rightarrow pp\pi^0)\}$$

n-induced reaction countrate



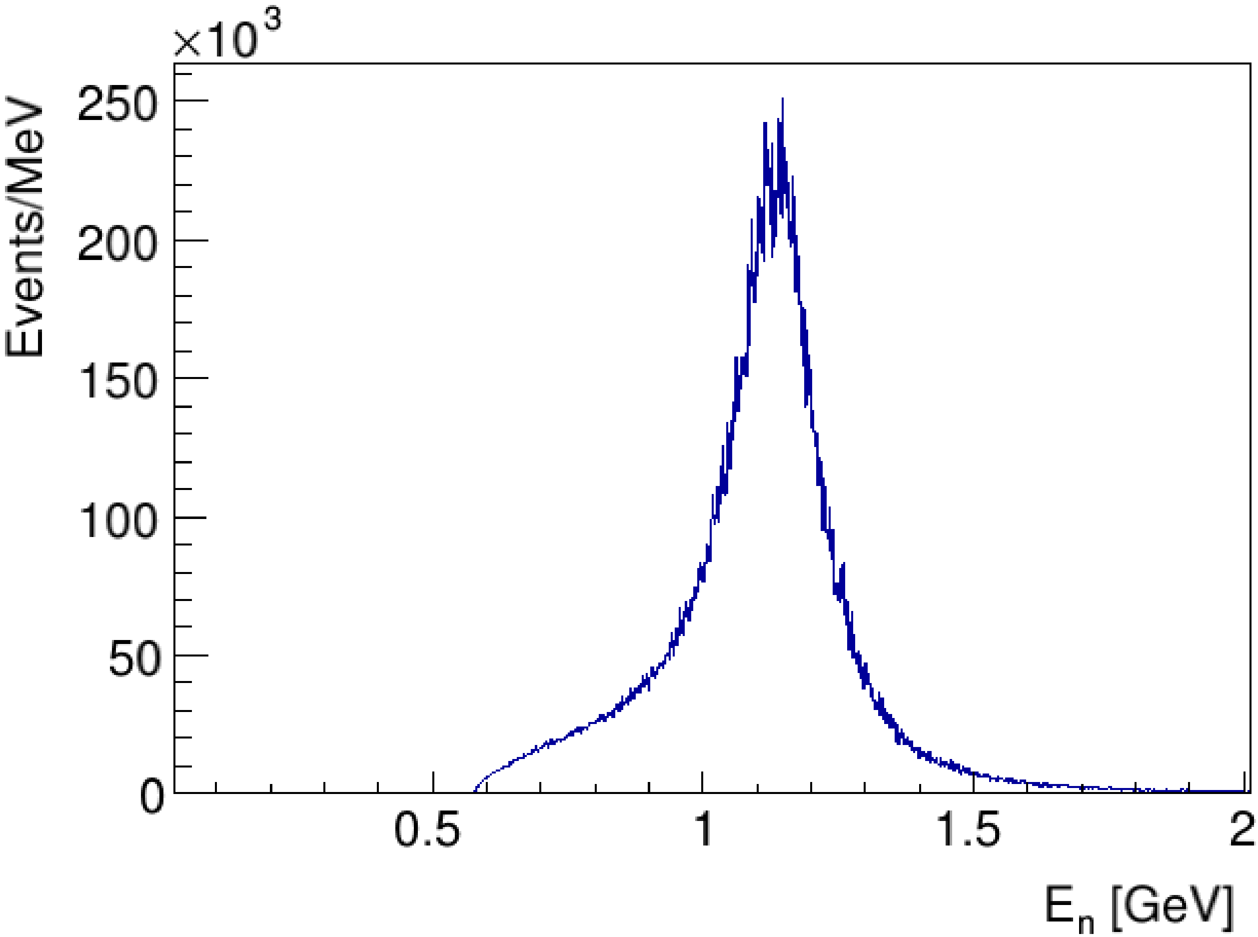
X-sections from SAID database

Total cross section
$pn \to d\pi^0\pi^0$



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

d^*-at KLF



$\sim 10^7$ events in 100 days beamtime

Conclusion

UNIVERSITY of York

- A lot of possible side-projects at KLF
  - Rare KL decays
  - Neutron beams
    - Elastic x-section
    - Isoscalar cross-section (link to heavy ions)
    - Single pion production
    - d*(2380) line shape
  - Dark matter
  - …..