K_L Flux Monitor
- Status Report

KLF Collaboration Meeting

Image: University of York/Alex Holland
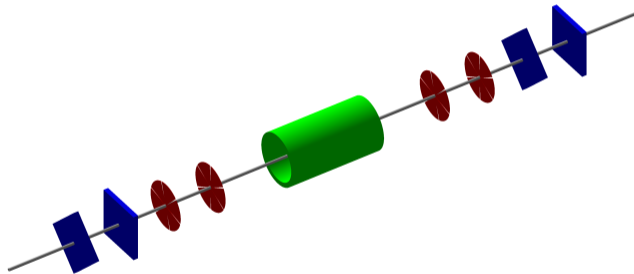
Stuart Fegan

University of York

December 9th, 2020

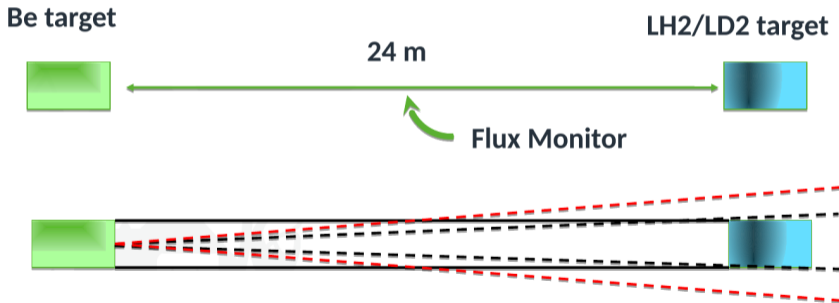UNIVERSITY
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Jefferson Lab

Outline

- K_L flux monitoring
    - Overview
    - K_L decays
    - TOF/Phi Displacement
- K_L flux monitor design
    - TOF Prototype
    - Location
    - Expected Performance
- Conclusions and Outlook

Measuring K_L Flux

- Full flux of diverging K_L beam can be measured by careful choice of flux monitor location
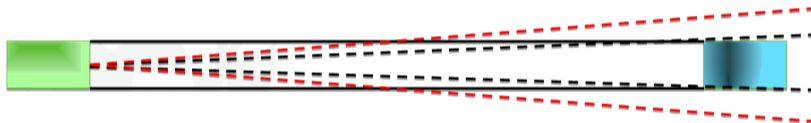
Measuring K_L Flux

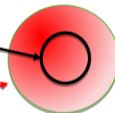■ Flux at target can be inferred when no information lost in beampipe
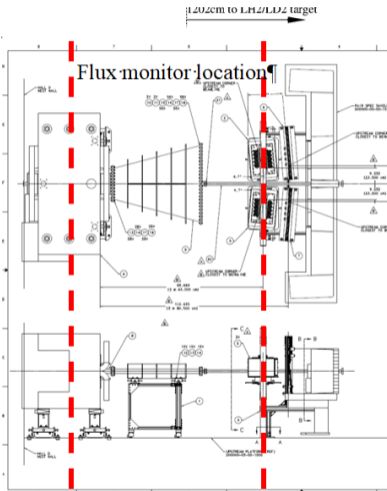

Be target

LH2/LD2 target

Kaon flux on LH2/LD2 target

Kaon flux measured by Flux Monitor

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Installation Location in Hall D

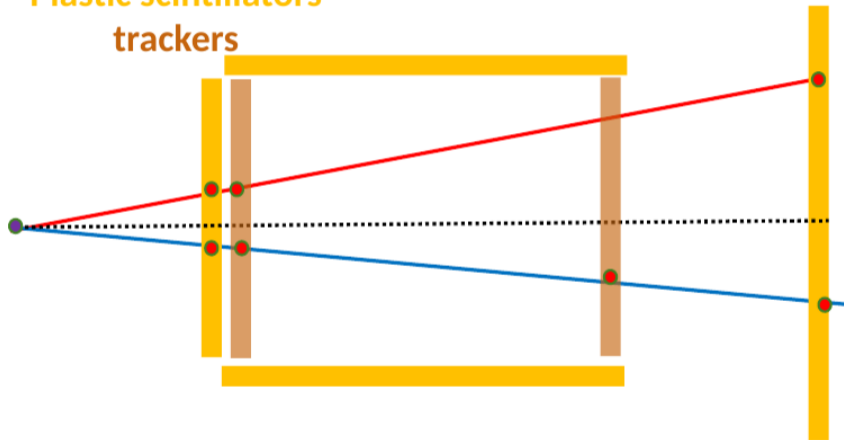## K_L Decays

Decay	BR (%)
$K_L \rightarrow \pi^{\pm} e^{\mp} \nu_e$	40.55
$K_L \rightarrow \pi^{\pm} \mu^{\mp} \nu_{\mu}$	27.04
$K_L \rightarrow \pi^+ \pi^- \pi^0$	12.54
$K_L \rightarrow \pi^0 \pi^0 \pi^0$	19.52

- Roughtly 21% of Kaons decay in flight
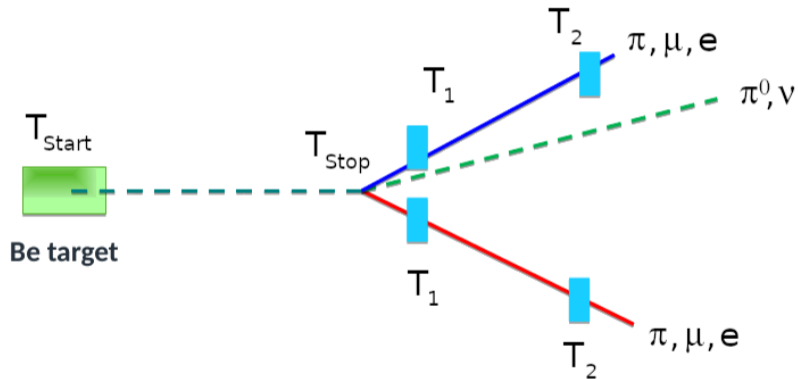- Any decay with charged particles can be used

K_L Monitor Concept

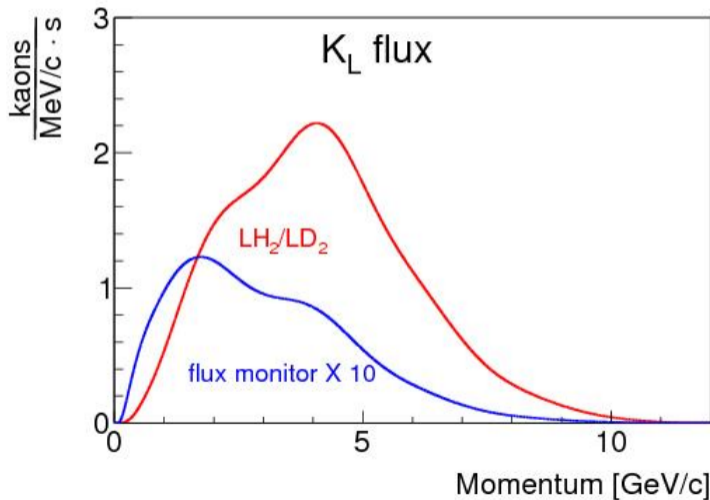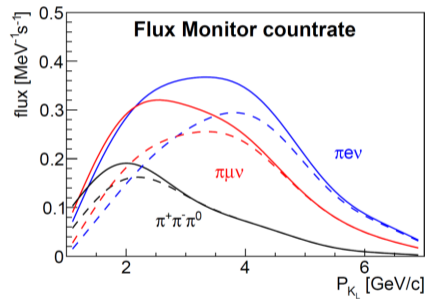
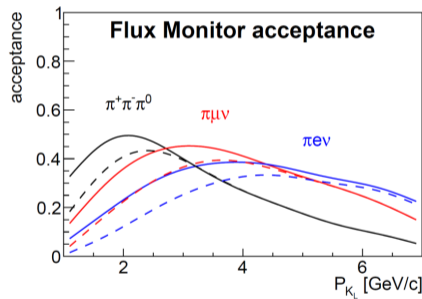**Plastic scintillators trackers**

K_L Reconstruction

$$T_{Stop} - T_{Start} = TOF \rightarrow \beta \rightarrow p_{K_L}$$

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K_L Spectrum

K_L Monitor
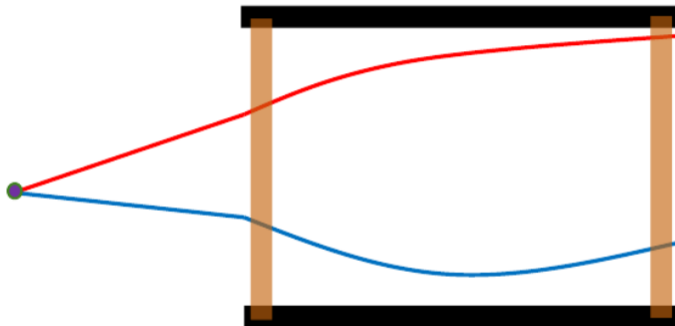
Phi Displacement

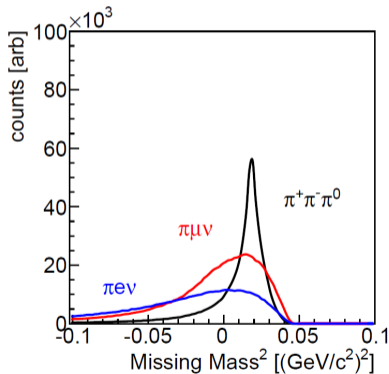
$$\phi' = 0.5 \frac{l \cdot z \cdot 0.3 \cdot B}{p \cdot cos(\Theta)}; \; l \sim 1 \text{ m}; \; |z| = 1; \; B = 1$$

$$\phi'[rad] = \frac{0.15}{p[GeV/c] \cdot cos(\Theta)}$$

Phi Displacement

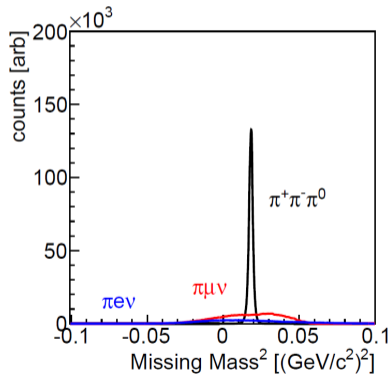TOF reconstruction   Magnetic reconstruction
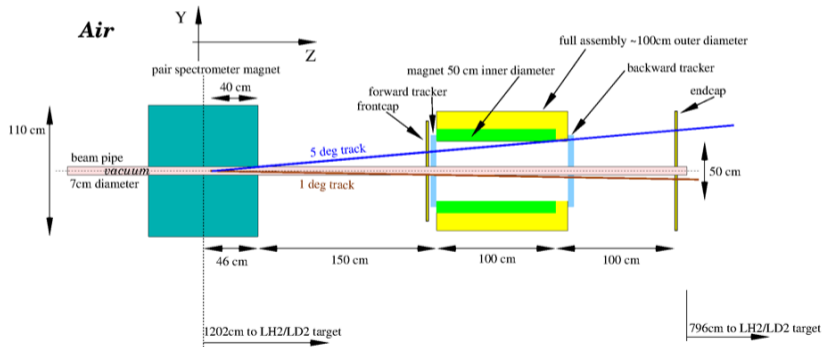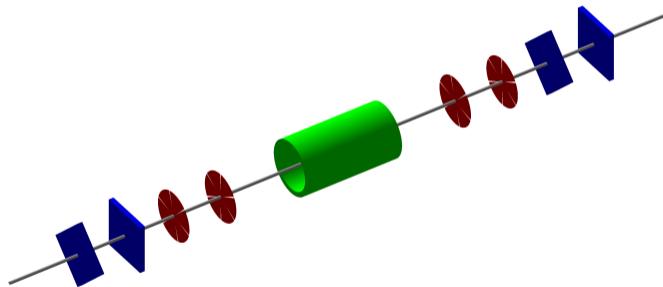
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Design Overview

- Magnet, 1 m long, 50 cm diameter

Flux Monitor

Design Overview

- Straw tube tracker prototypes under evaluation
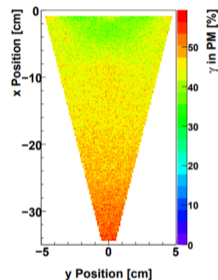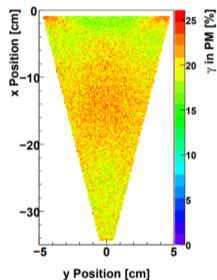- TOF prototypes to be built in York

Possible Magnet

- The ISOLDE Experiment at CERN used a retired MRI scanner magnet
- Many such magnets exist, awaiting scrappage
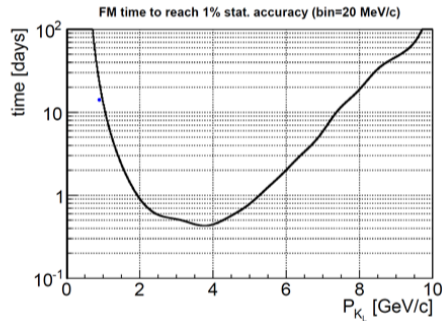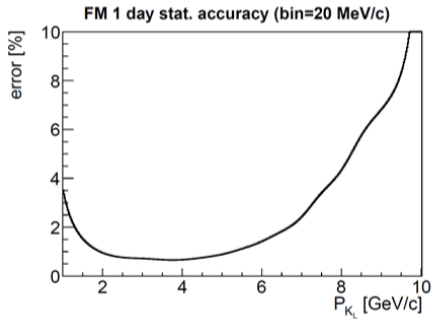- ISOLDE acquired theirs for a nominal sum ($1)

TOF Prototype

- Double layer fast scintillator
- "Pizza slice" design
- Readout at outer edge via twisted lightguide, coupled to PMTs
- SiPMs at inner edge

- Funding for prototypes requested from STFC
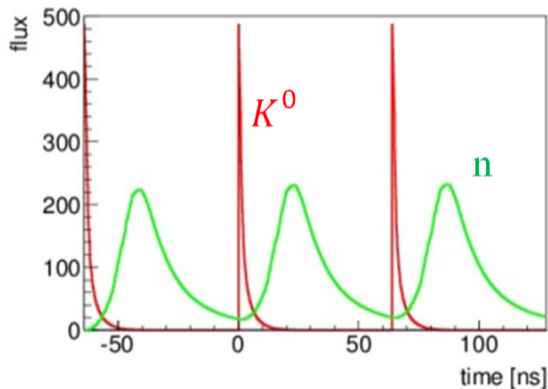- Beamline tests with these prototypes envisaged at JLab

Expected Performance

Time Structure of K_L Beam

- Different timing structure of K_L and neutrons
- Neutron background in K_L beam is small

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Conclusions and Outlook

- Kaon flux can be monitored
- Preliminary design of a flux monitor is being optimised
- Funding requested for TOF prototyping in York (STFC, UK)