UNIVERSITY of York

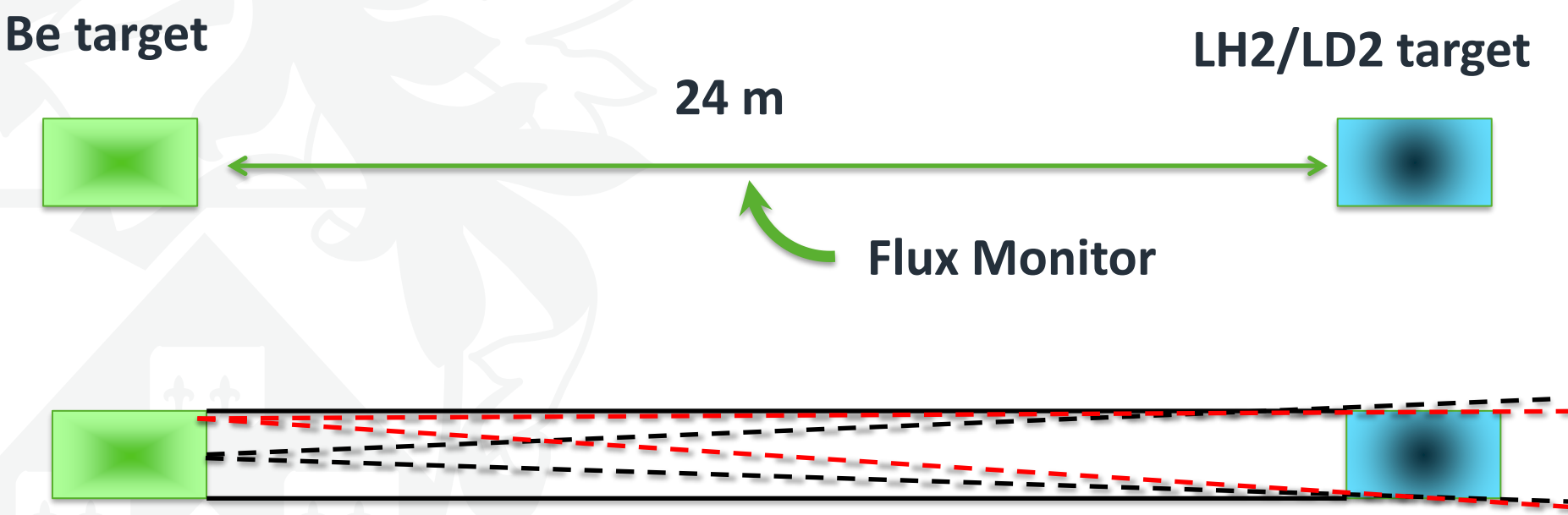
K_L Flux Monitor

Mikhail Bashkanov

Outlook

- Why?
  - K_L flux monitoring
- How?
  - Plan A
  - Plan B
  - Plan C

K_l flux monitor location

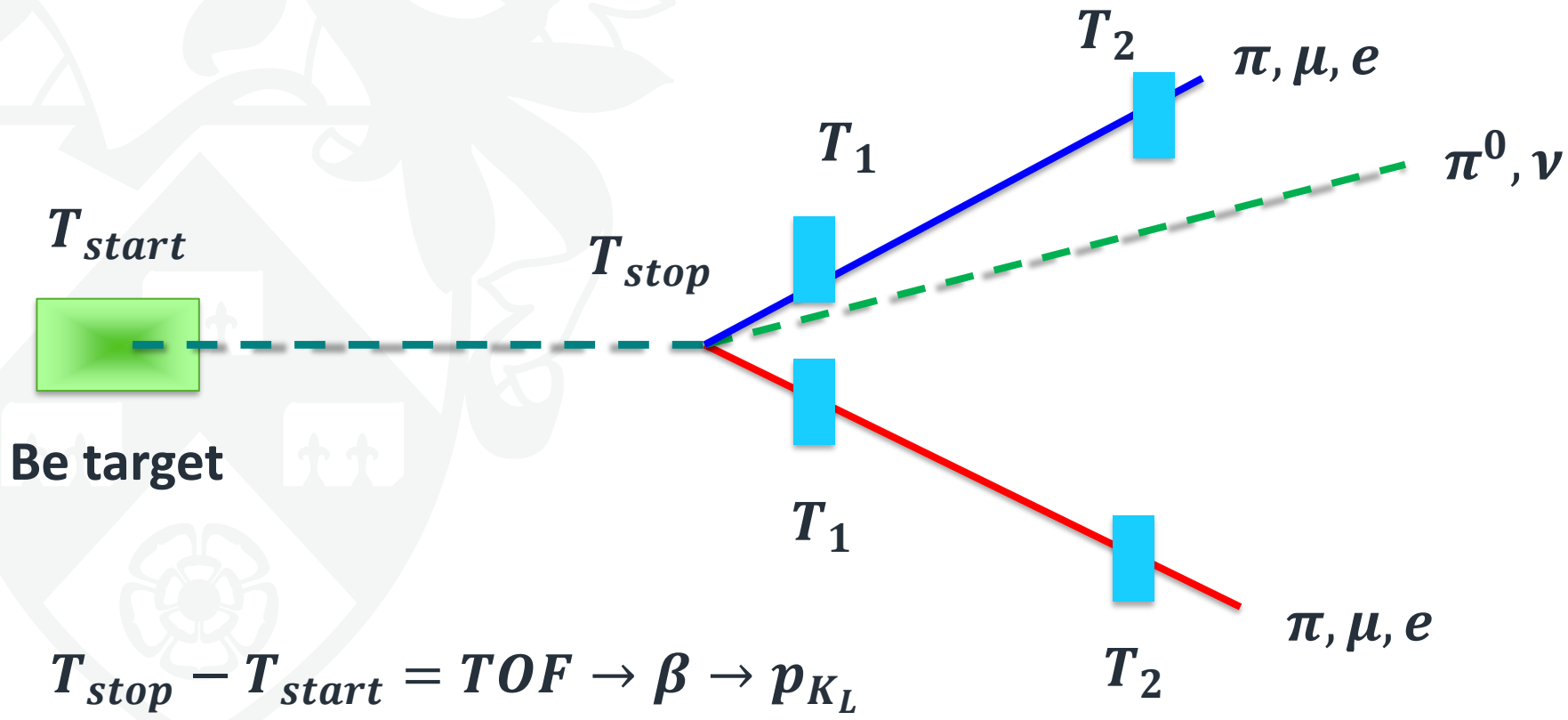


K_L decays

	Br, %
$K_l \to \pi^{\pm} e^{\mp} \nu_e$	40.55
$K_l \to \pi^{\pm} \mu^{\mp} \nu_\mu$	27.04
$K_l \to \pi^{+} \pi^{-} \pi^{0}$	12.54
$K_l \to \pi^{0} \pi^{0} \pi^{0}$	19.52

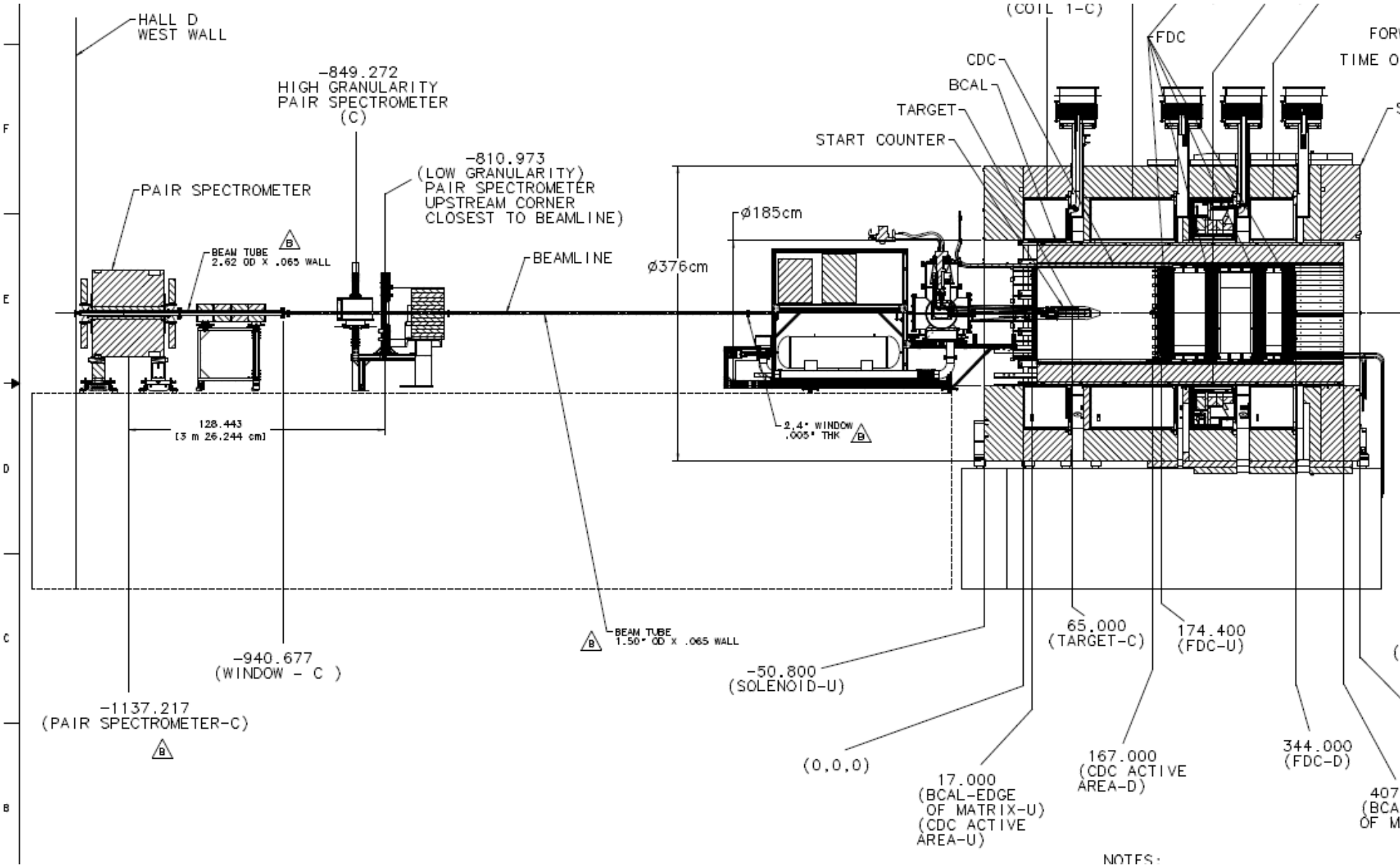
- **~ 21% of kaons decays in flight**
- **Any decay with charged particles can be used**

K_L monitoring

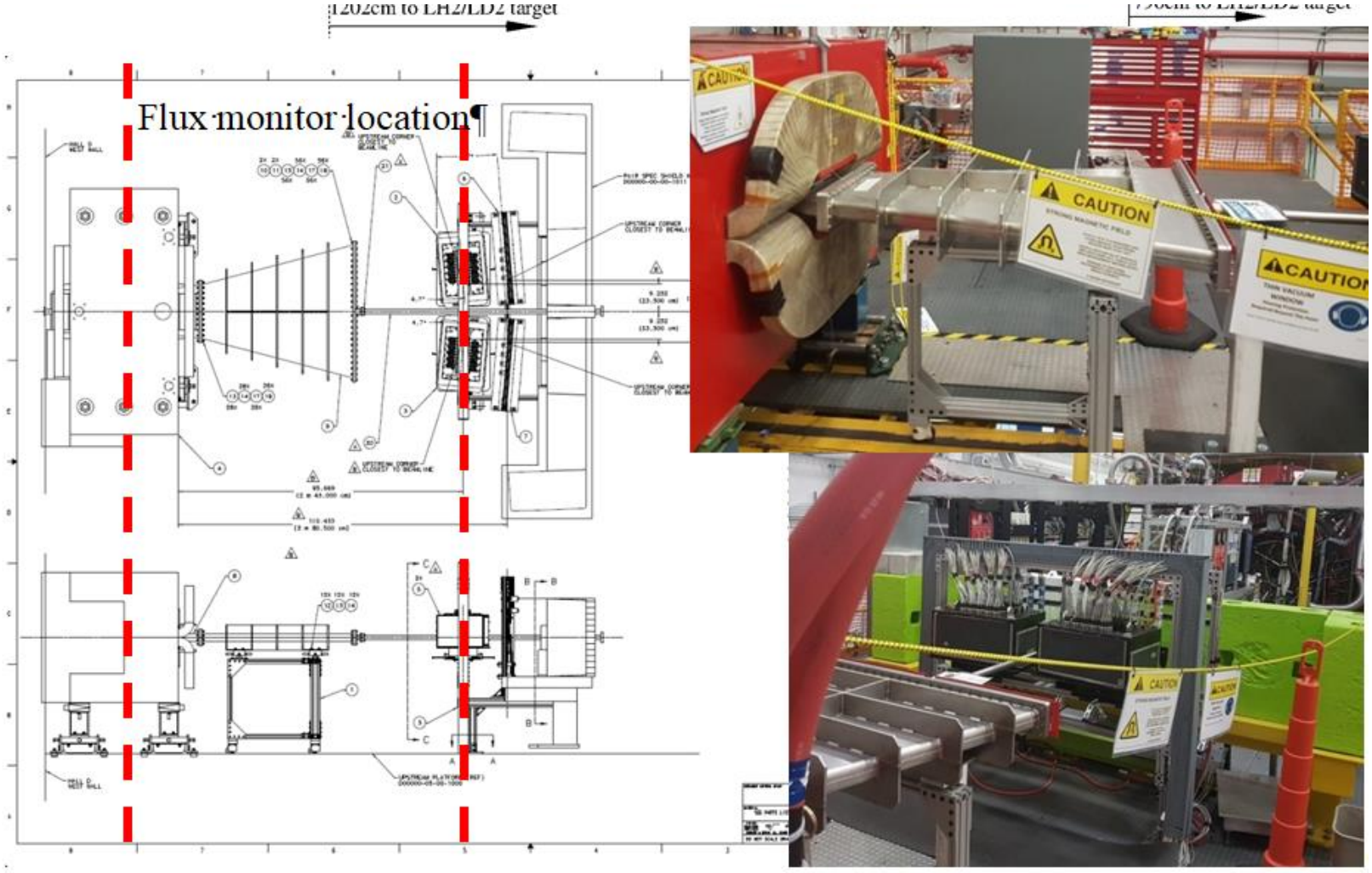


$$T_{stop} - T_{start} = TOF \rightarrow \beta \rightarrow p_{K_L}$$

K_l flux monitor location

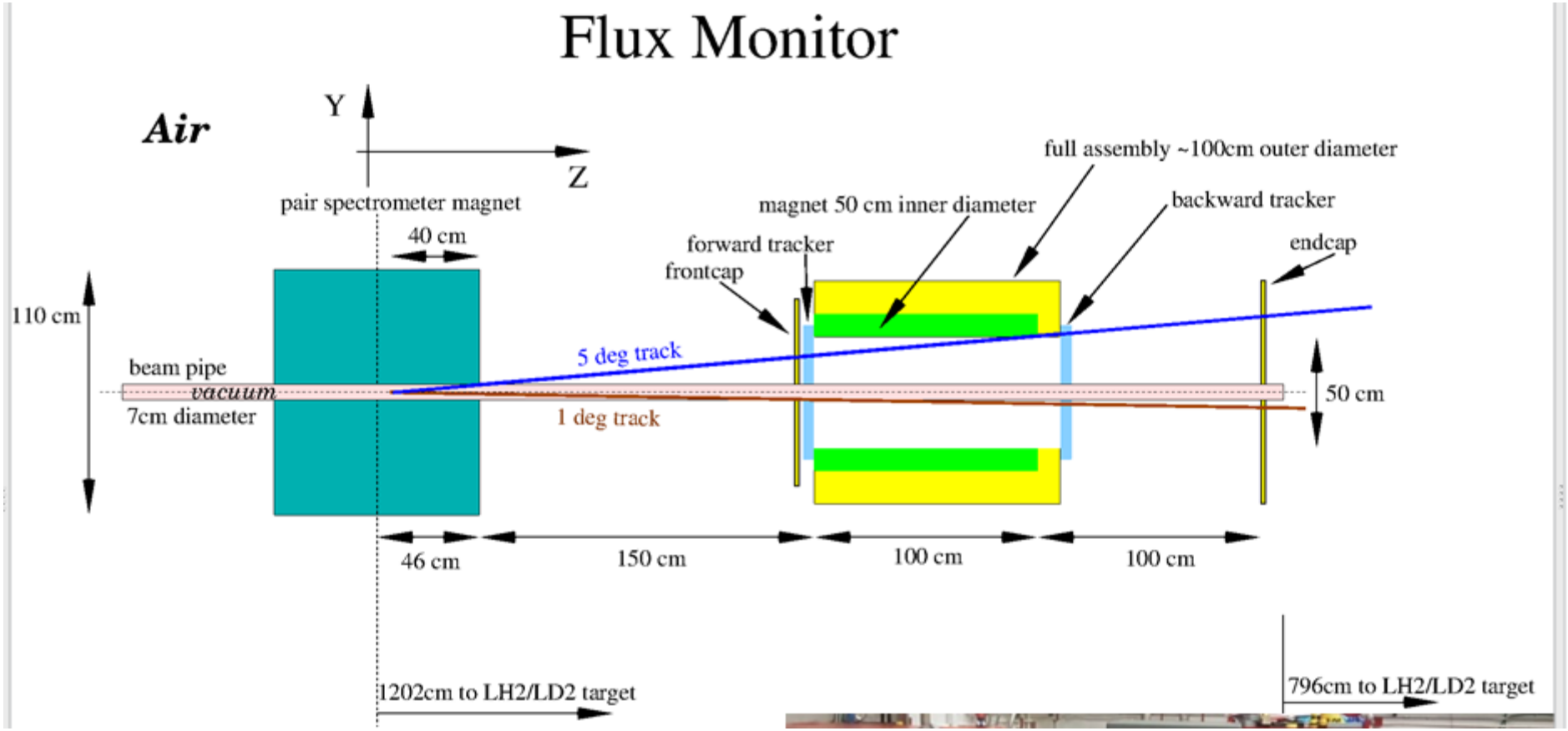


Flux monitor location

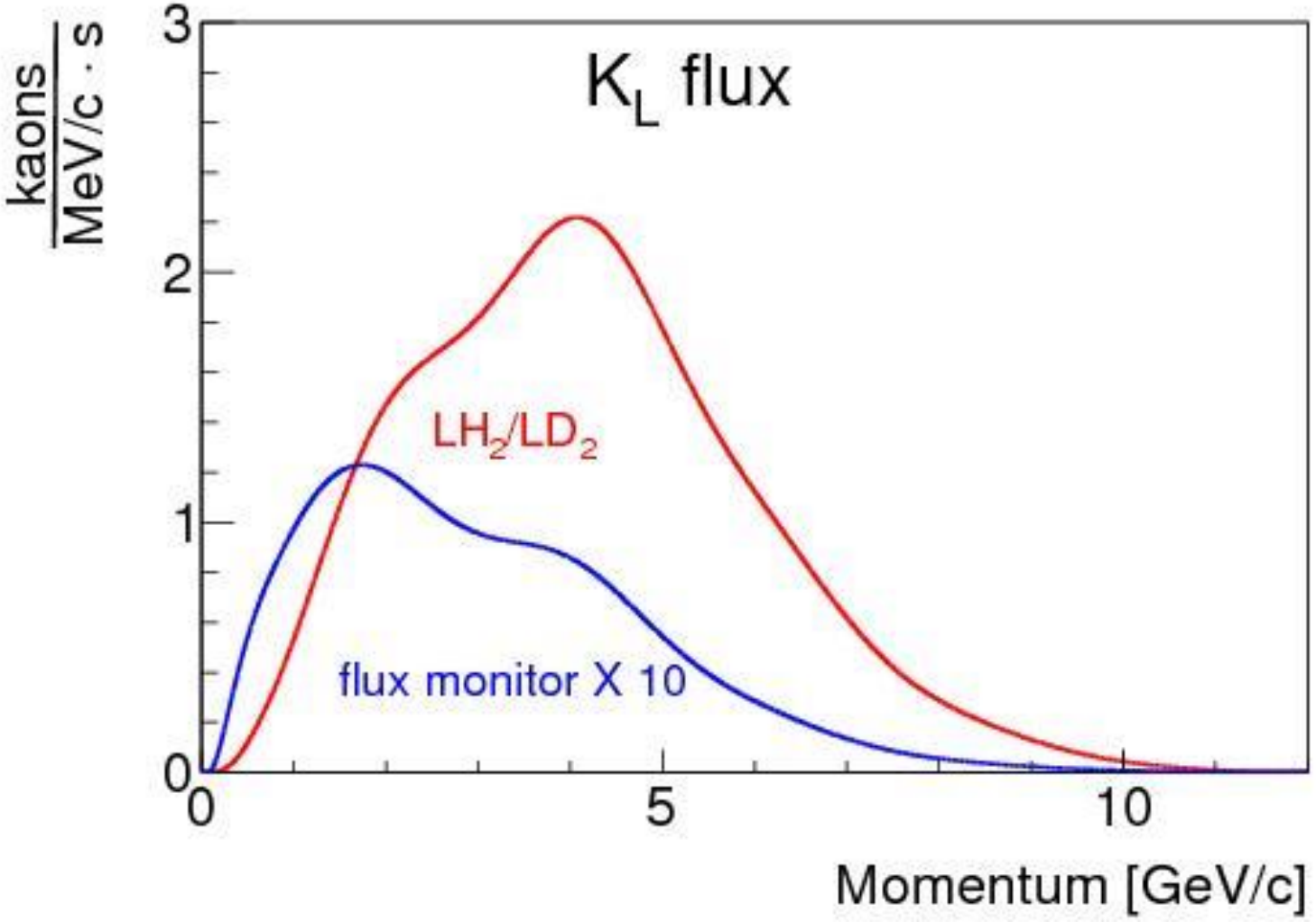


$K_l F$ Monitor

Magnet, 1m long, 50 cm diameter

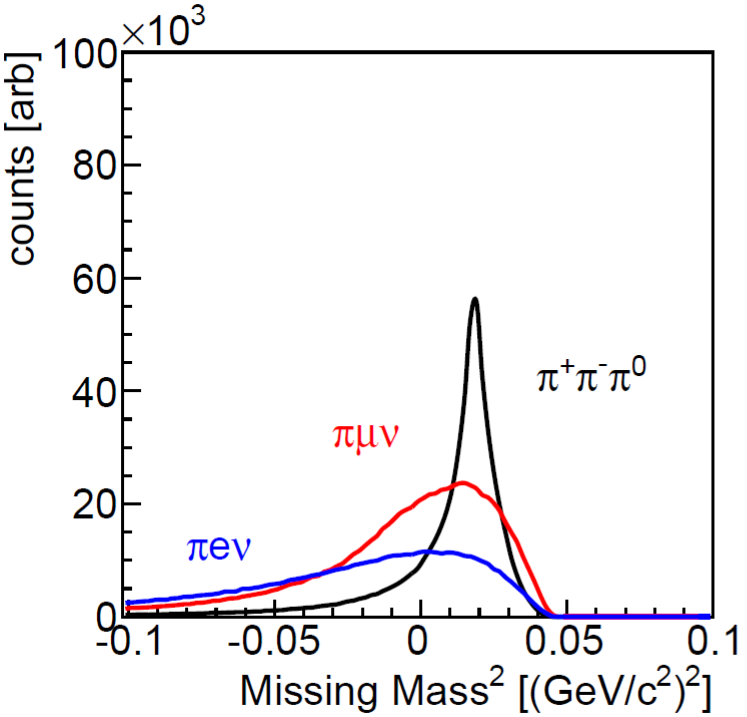


K_L spectrum

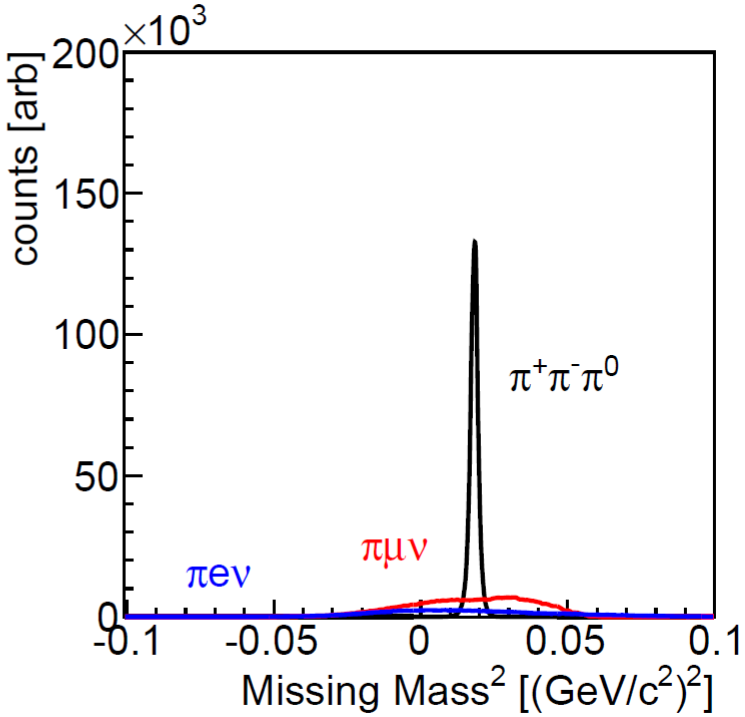

K_L flux
kaons / MeV/c · s
LH2/LD2
flux monitor X 10
0
1
2
3
0
5
10
Momentum [GeV/c]

K_l FM resolution

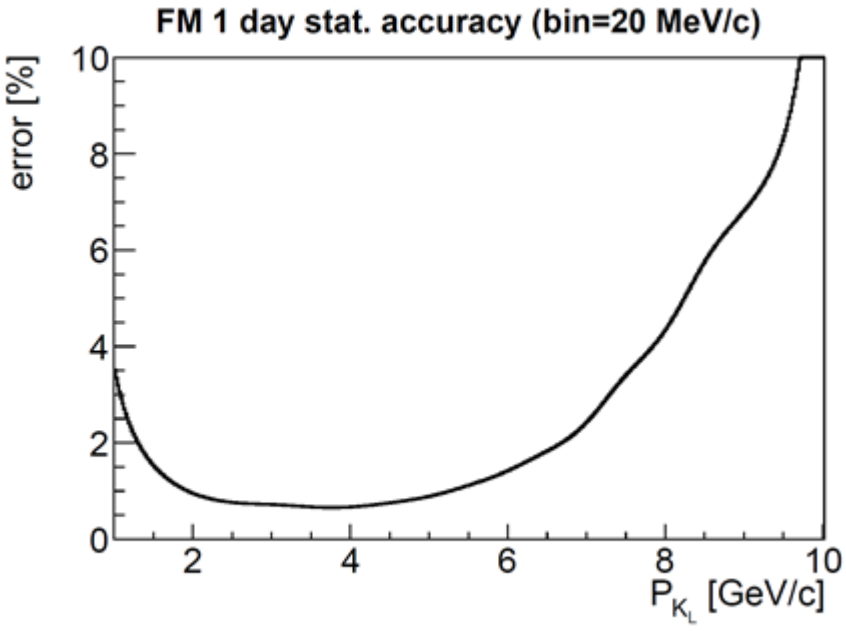
TOF reconstruction

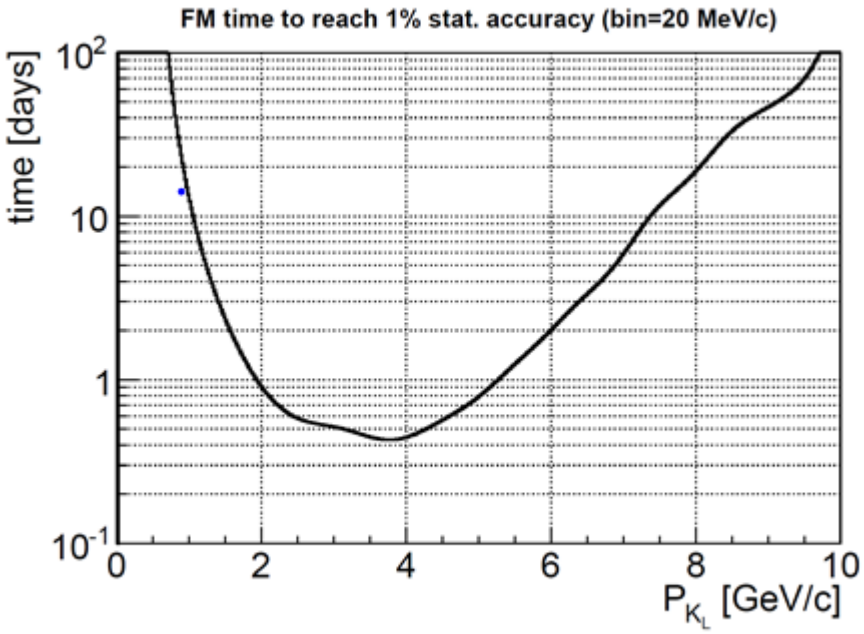


Magnetic reconstruction



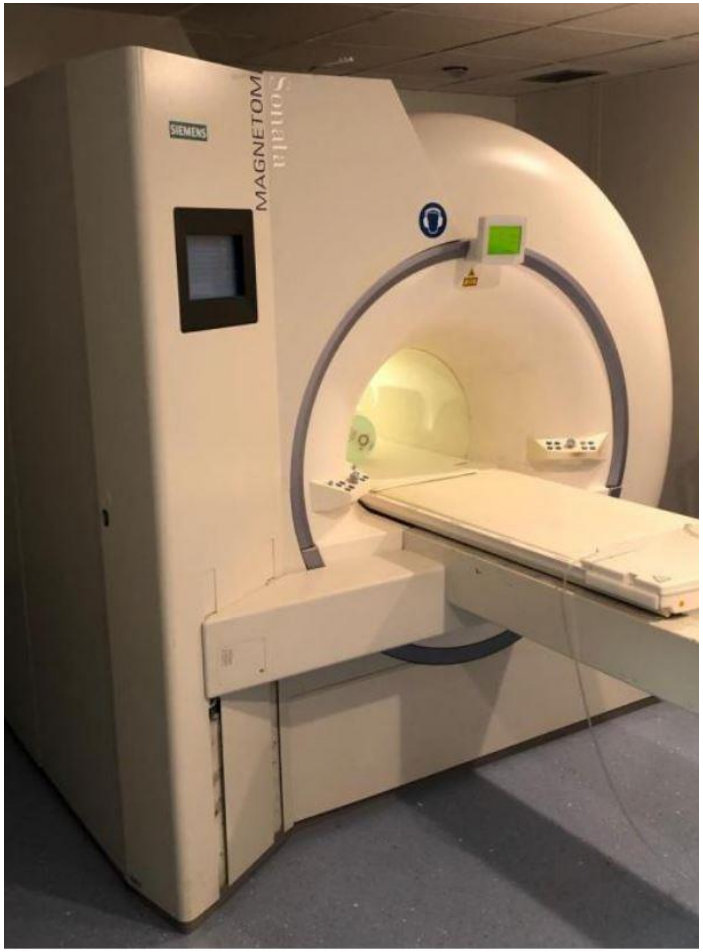
Expected stat accuracy





Plan A’

Possible magnet



Siemens Magnetom 1.5T used MRI

Table 4: Magnet specification

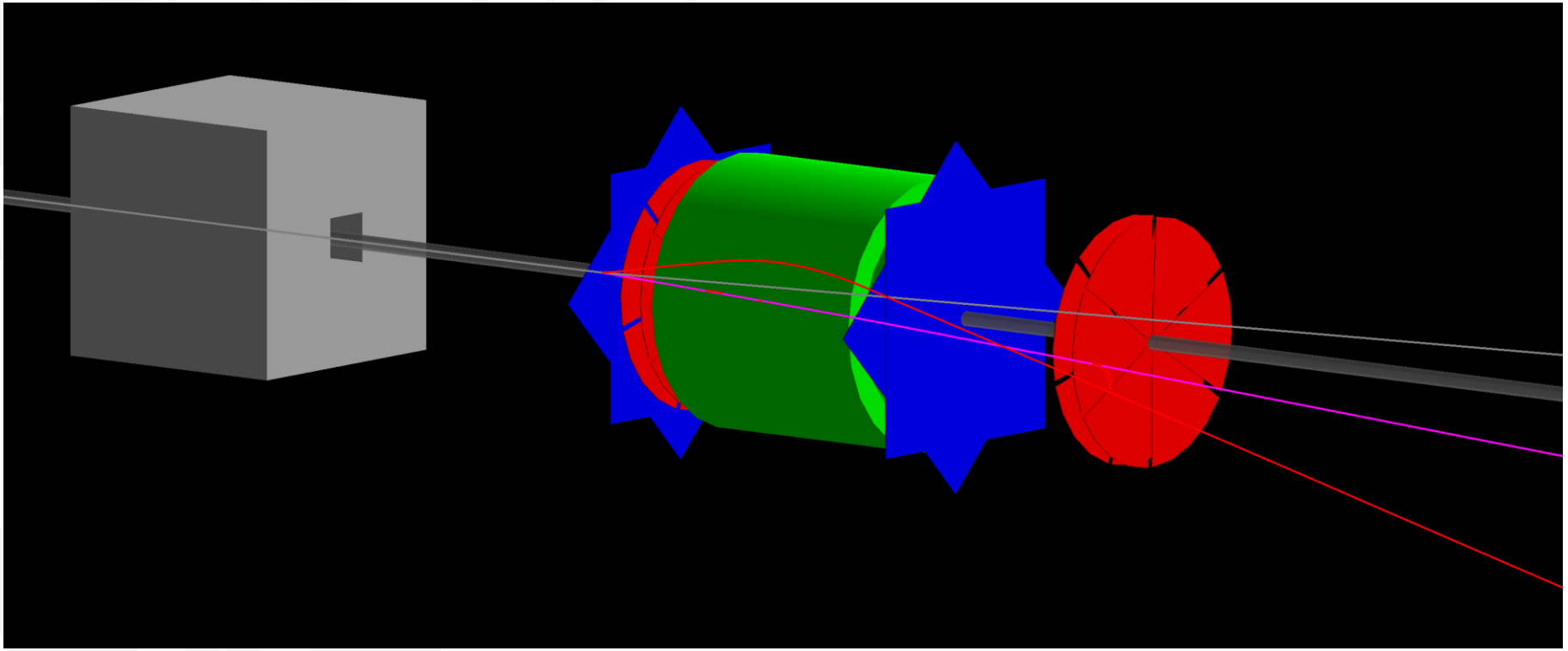
Parameter	Siemens
RF frequency MHz	63.6
Shielding	Passive and active
Homogeneity (VRMS) 40 cm DSV ppm	0.2 (typically)
Field stability ppm/hr	< 0.1
Number of measurement planes	24
Number of measurement points	20
Cooling system	Liquid helium only
Boil-off rate l/hr	0
Helium refill	10 years maximum (approximately)

Table 7: Installation details

Overall scanner dimensions	Siemens
Mass: magnet only tonnes	3.55 ± 8(including helium)
Mass: assembly tonnes	5.5
Depth with covers (z) cm	160
Width with covers (x) cm	230
Height with covers (y) cm	230

~70kEuro+delivery

Simulations



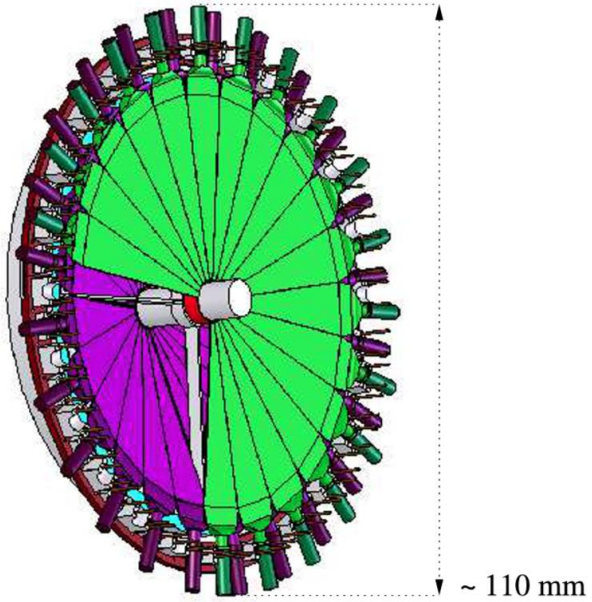
Less background with dipole “ON”

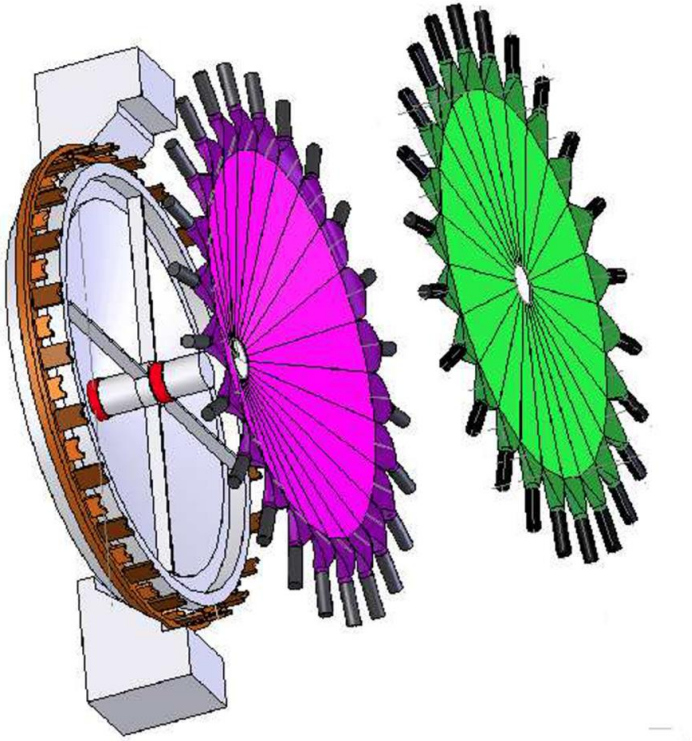
Status

- Applied for the equipment grant STFC UK
  - Stage 1 – OK
  - Stage 2 – submitted – 17Oct2022
- Prototyping fast TOF (together with Chem. UoY)
  - Fast plastic scintillators
  - Liquid scintillators
  - Cherenkov as TOF (reference)

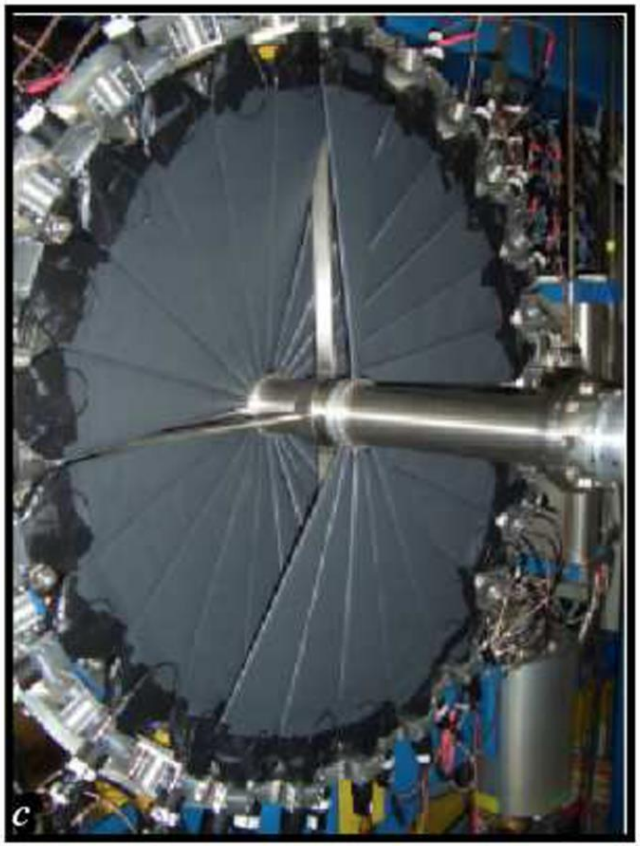
Plan B

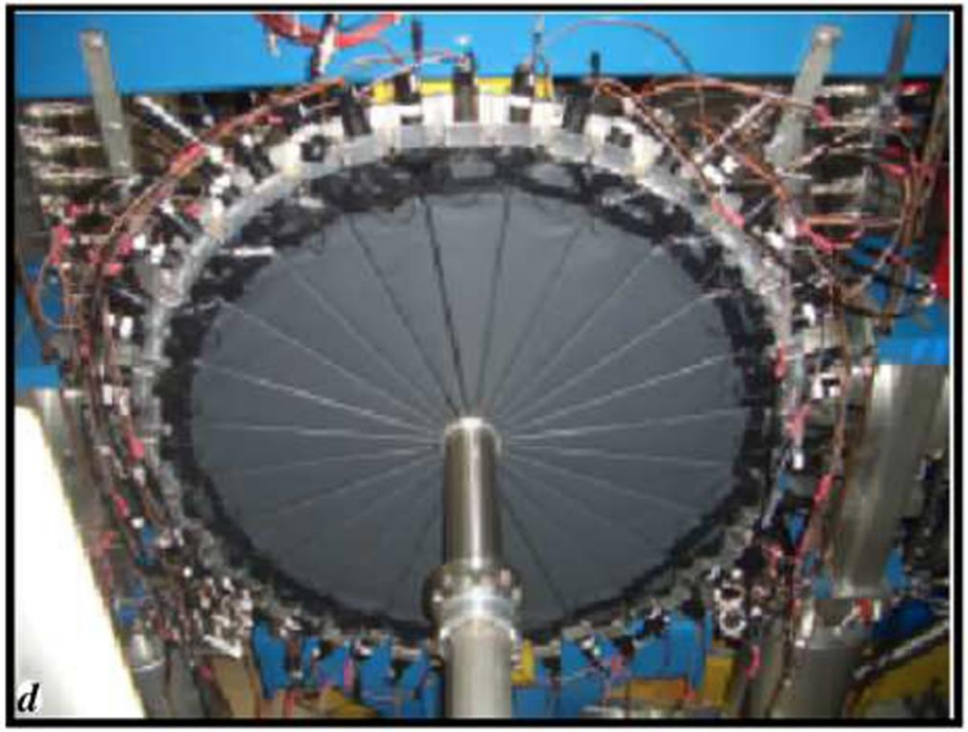
Wasa detectors



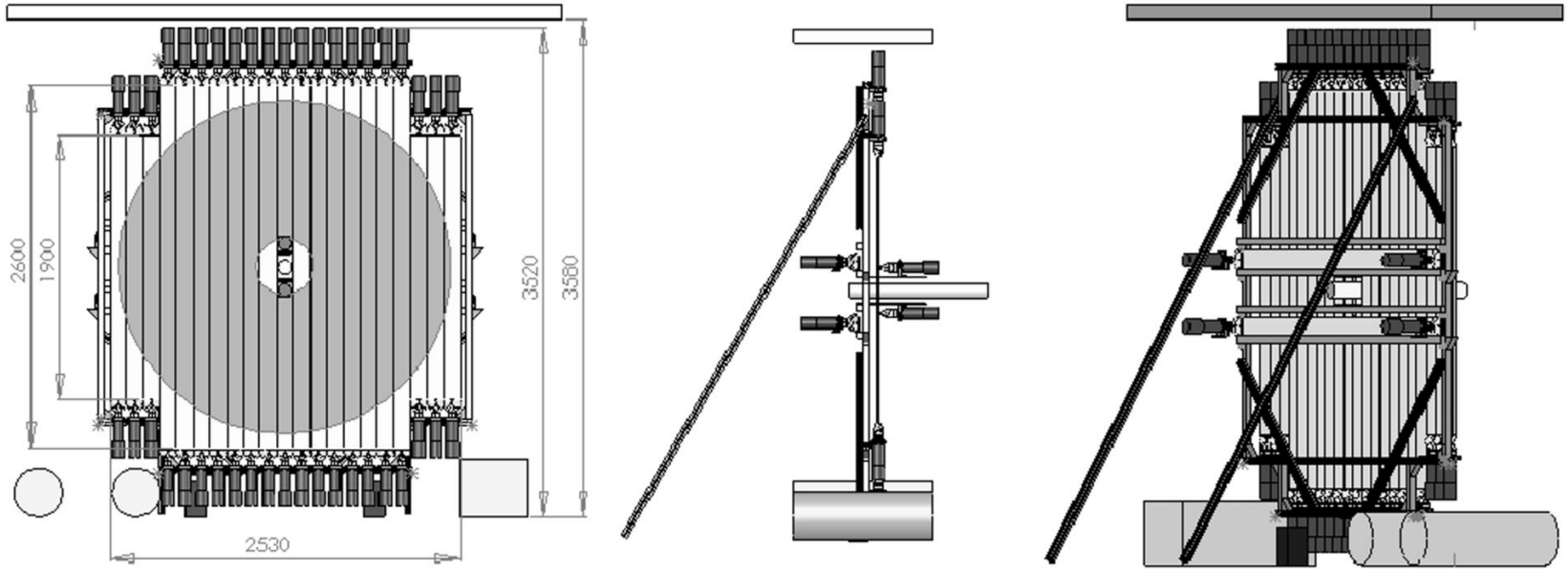


Wasa detectors

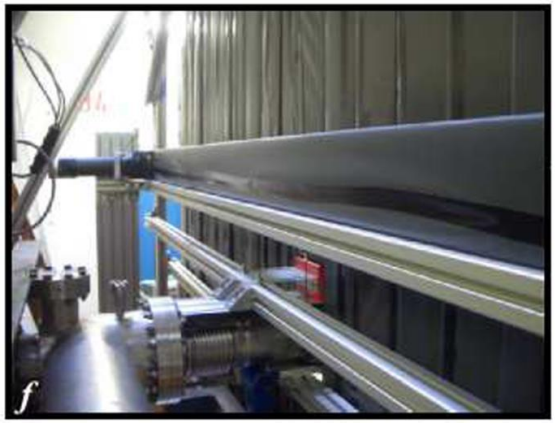




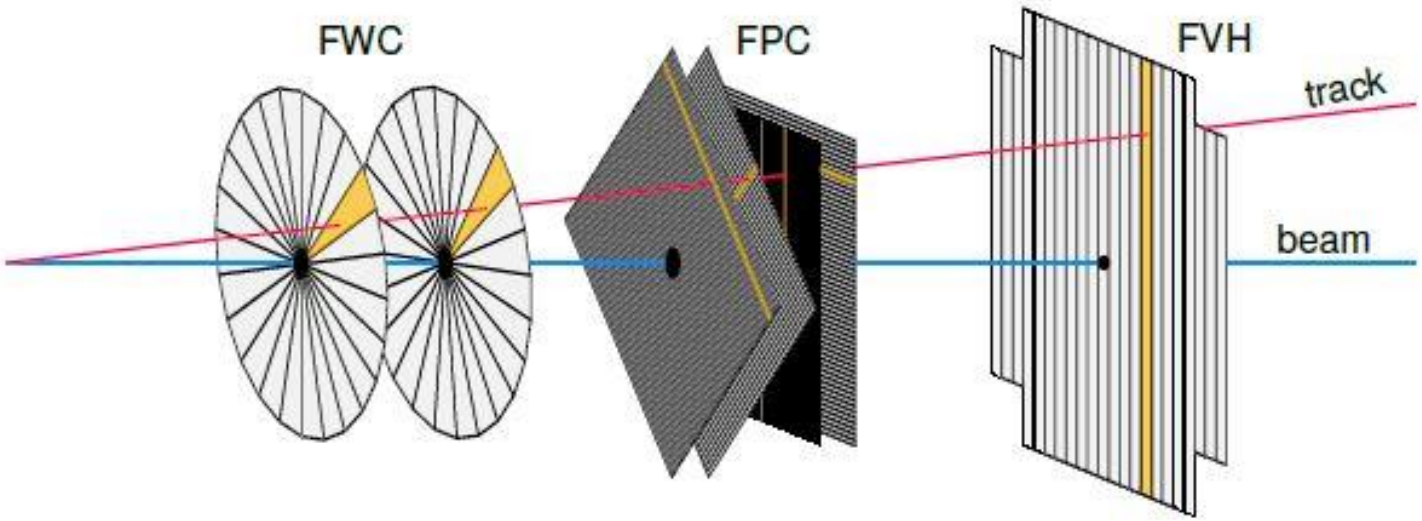
Wasa detectors



Wasa detectors

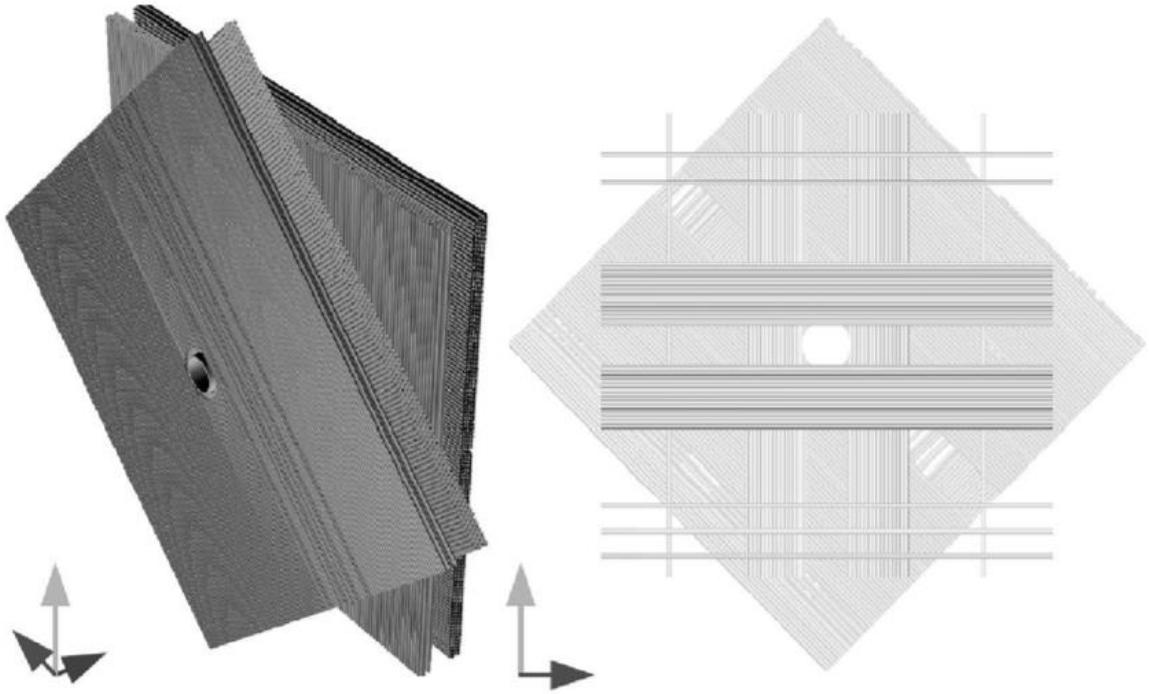


Wasa detectors



Used in TOF mode for the isospin violating $dd \rightarrow {}^{4}He\pi^{0}$ experiment

Wasa detectors



(b) *Forward Proportional Chamber FPC*

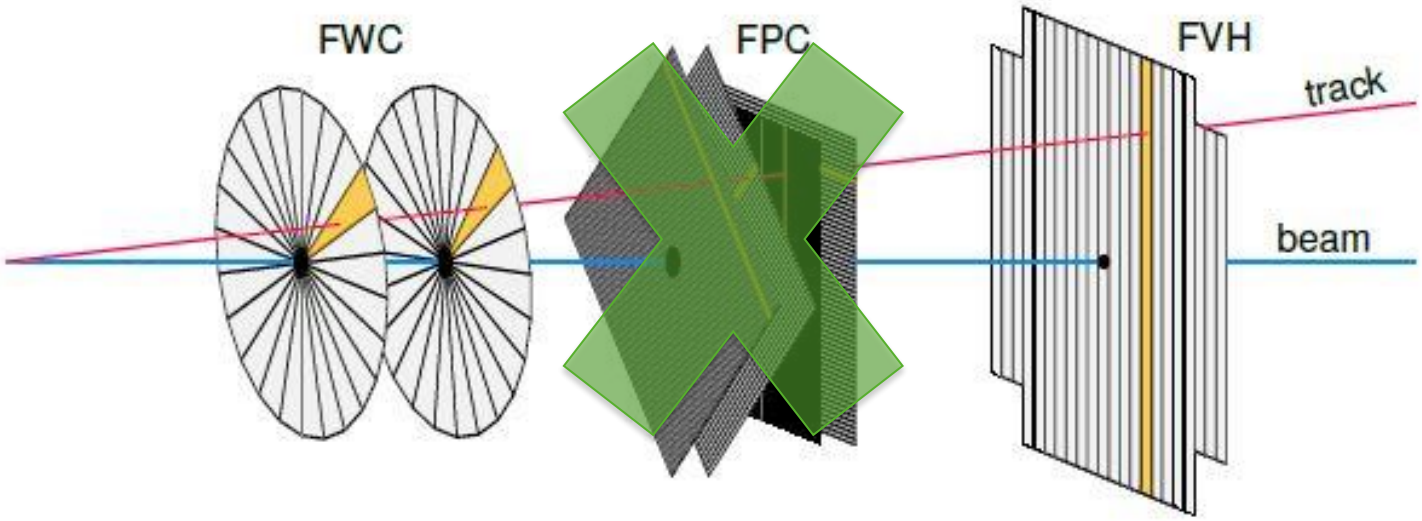
Status

- FWC (TOF start) and FVH (TOF stop)
  - Agreed on use
  - Available from 2024
- Tracker
  - Agreed on use (Uppsala, TJ)
  - Available from 2024

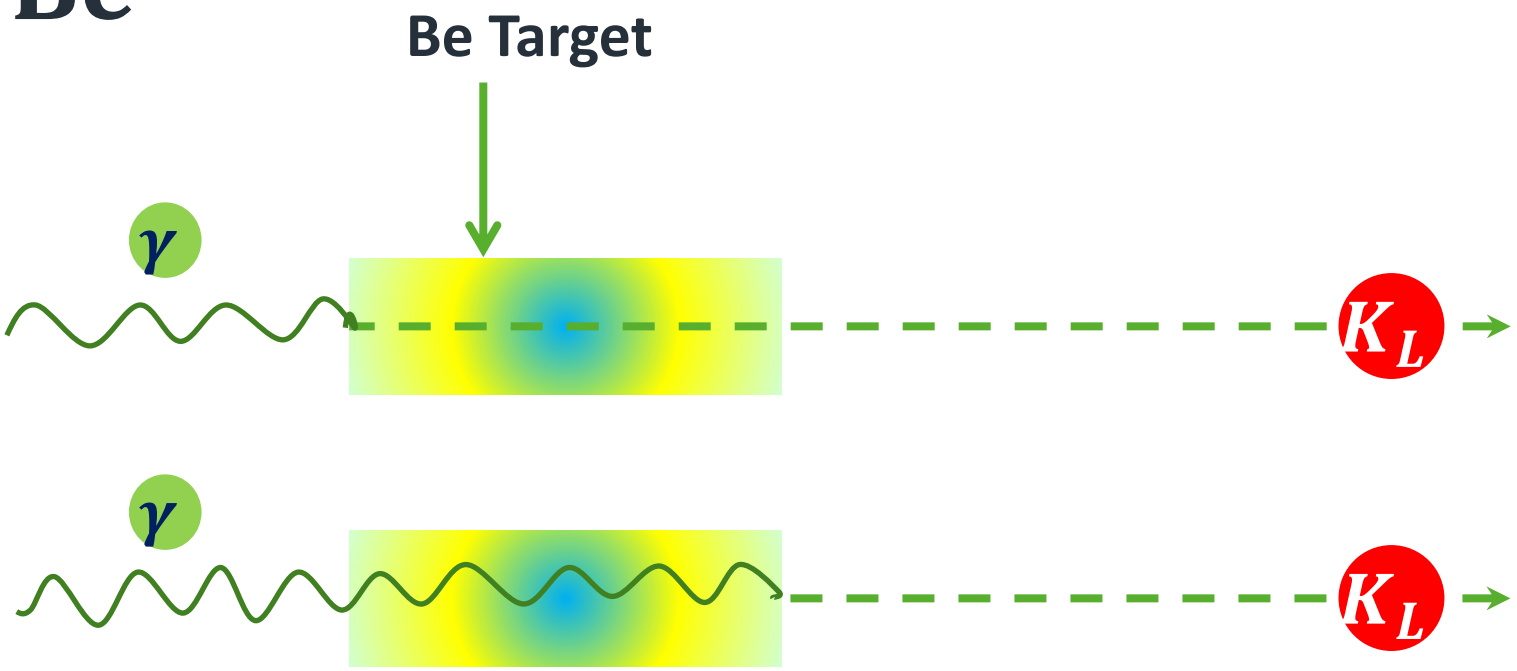
Plan C

DO WE NEED A TRACKER?

Wasa detectors



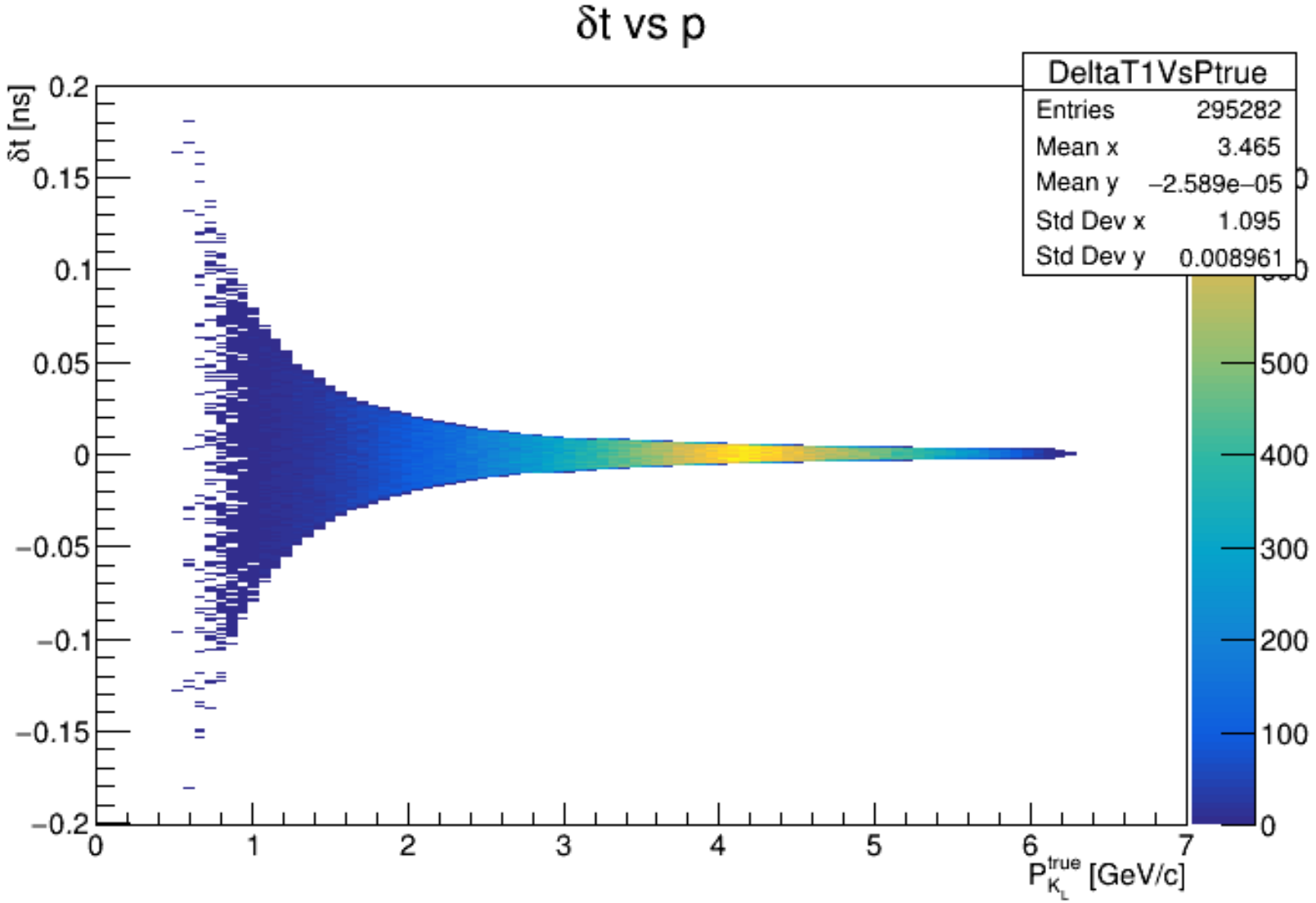
K_l time resolution due to position in Be



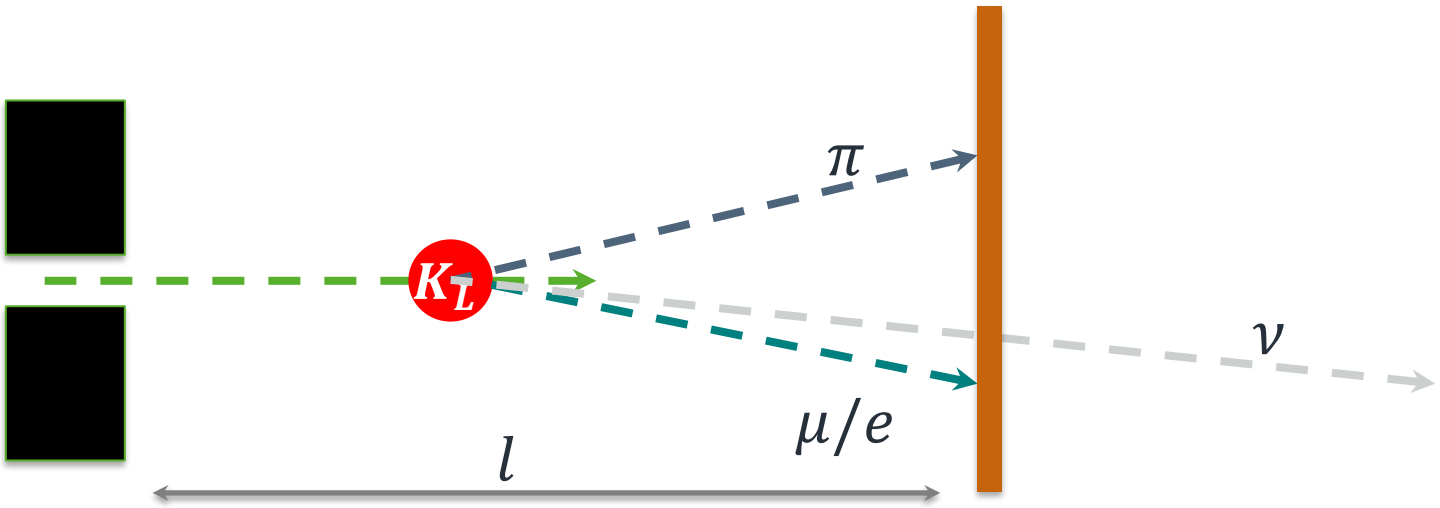
$$\Delta t = \frac{L}{c\beta_{K_l}} - \frac{L}{c} = \frac{L}{c}\left(\frac{1}{\beta_{K_l}} - 1\right)$$

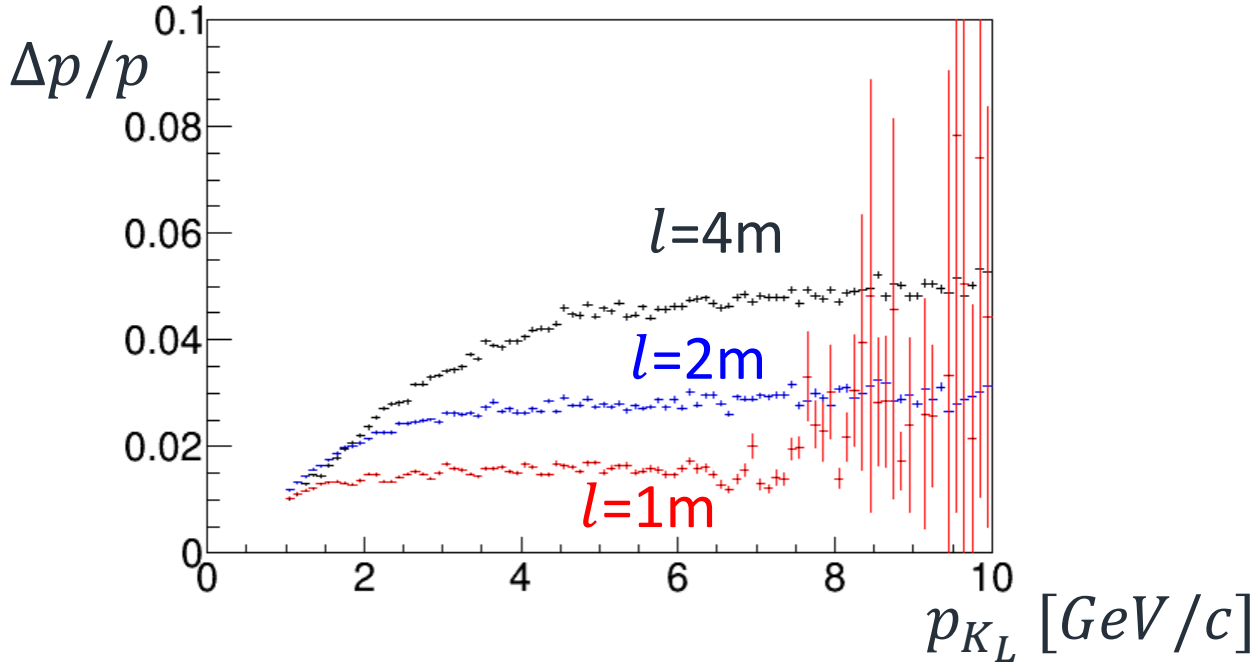
For L=40cm and $p_{K_l} > 800 MeV/c, \Delta t < 150 ps$

K_l time resolution due to position in Be



"No tracker" K_l time resolution





Status

- 3 options for the Flux monitor
  - Price
  - Performance
  - Byproduct research (rare decays)
  - Background suppression

Conclusion