E570 analysis report

An estimation of the yield of KHeX La

Analysis for each drift chamber and each coincidence condition

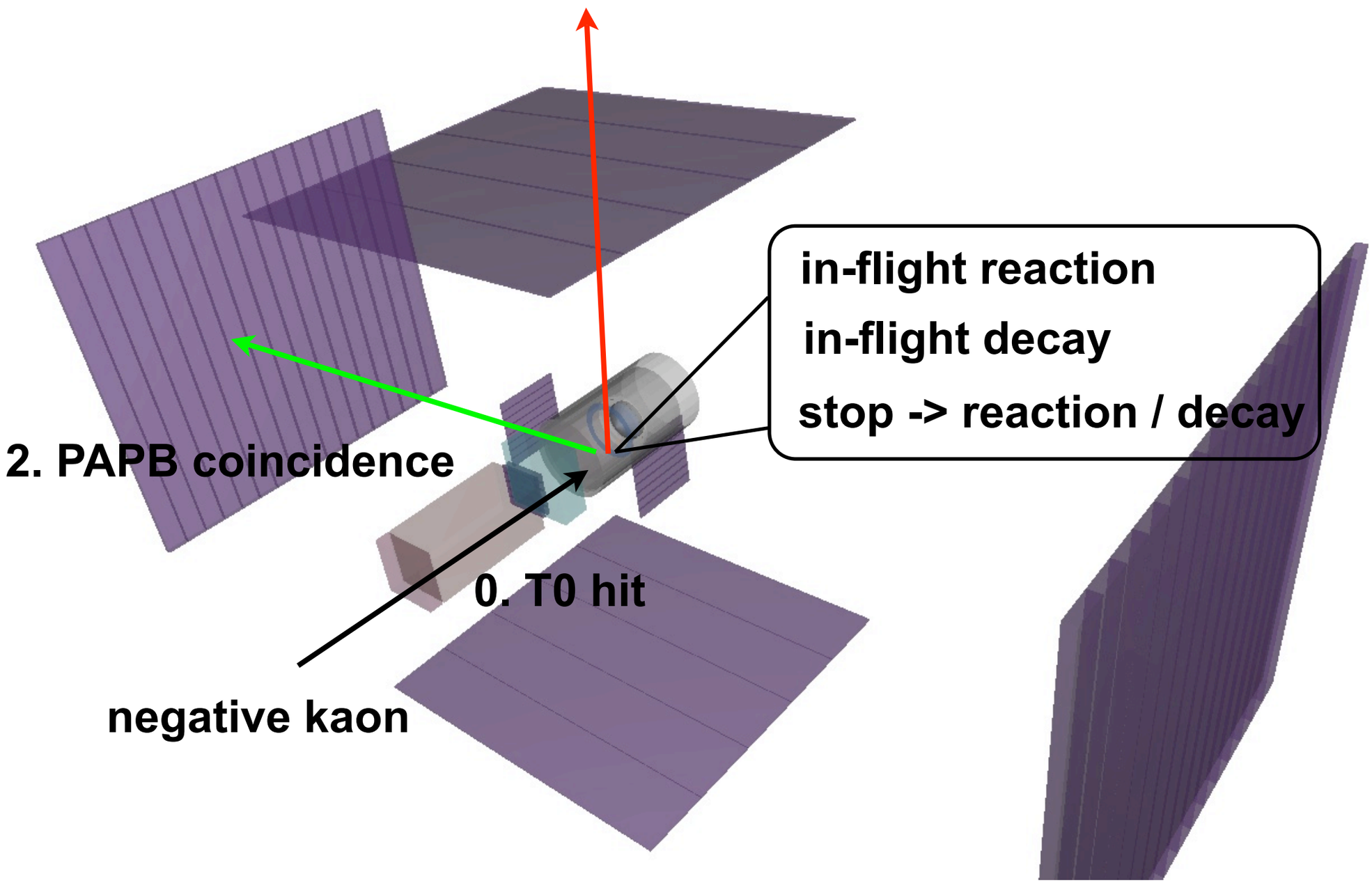
Estimation of in-flight contamination ratio

Considering systematic errors

2008 Feb 6, Hideyuki Tatsuno

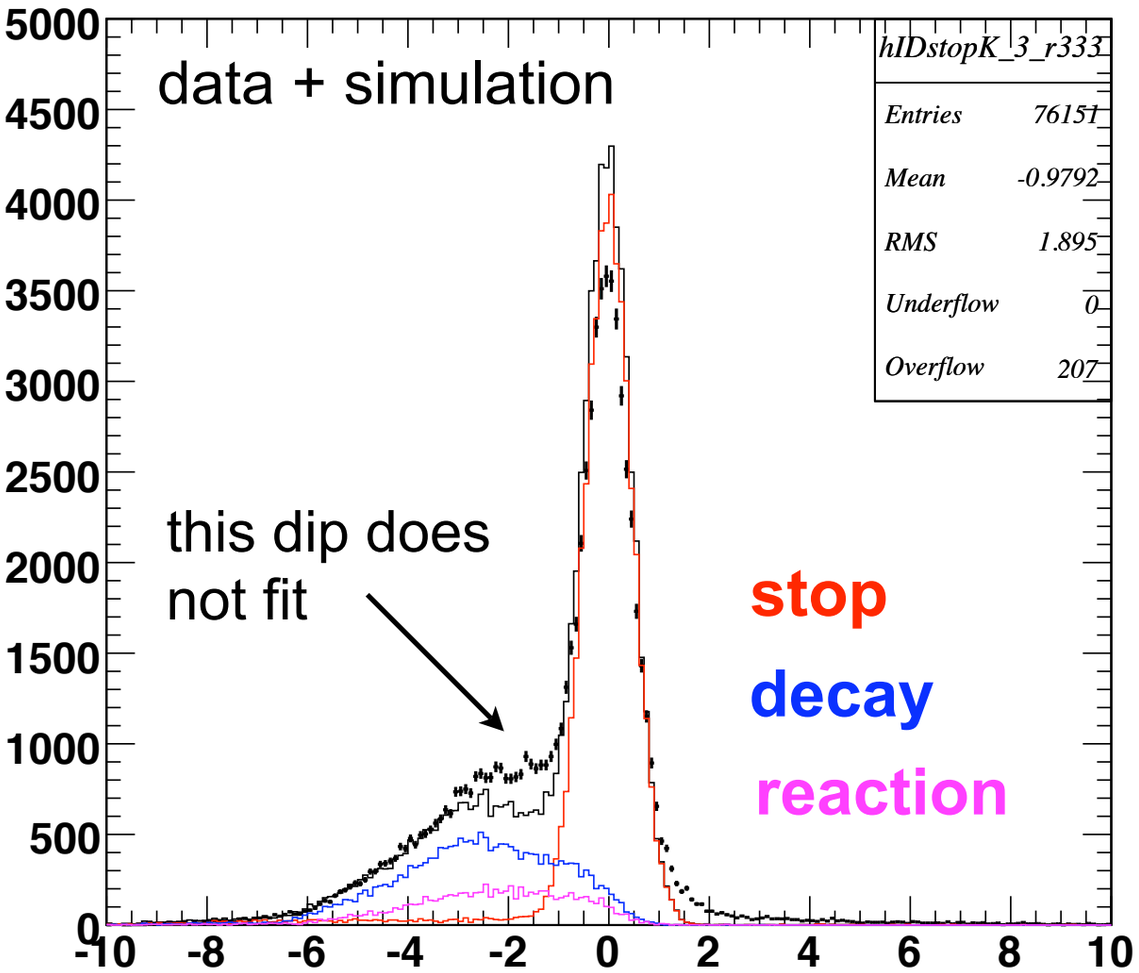
Monte Carlo simulation

To evaluate the ratio of in-flight contamination

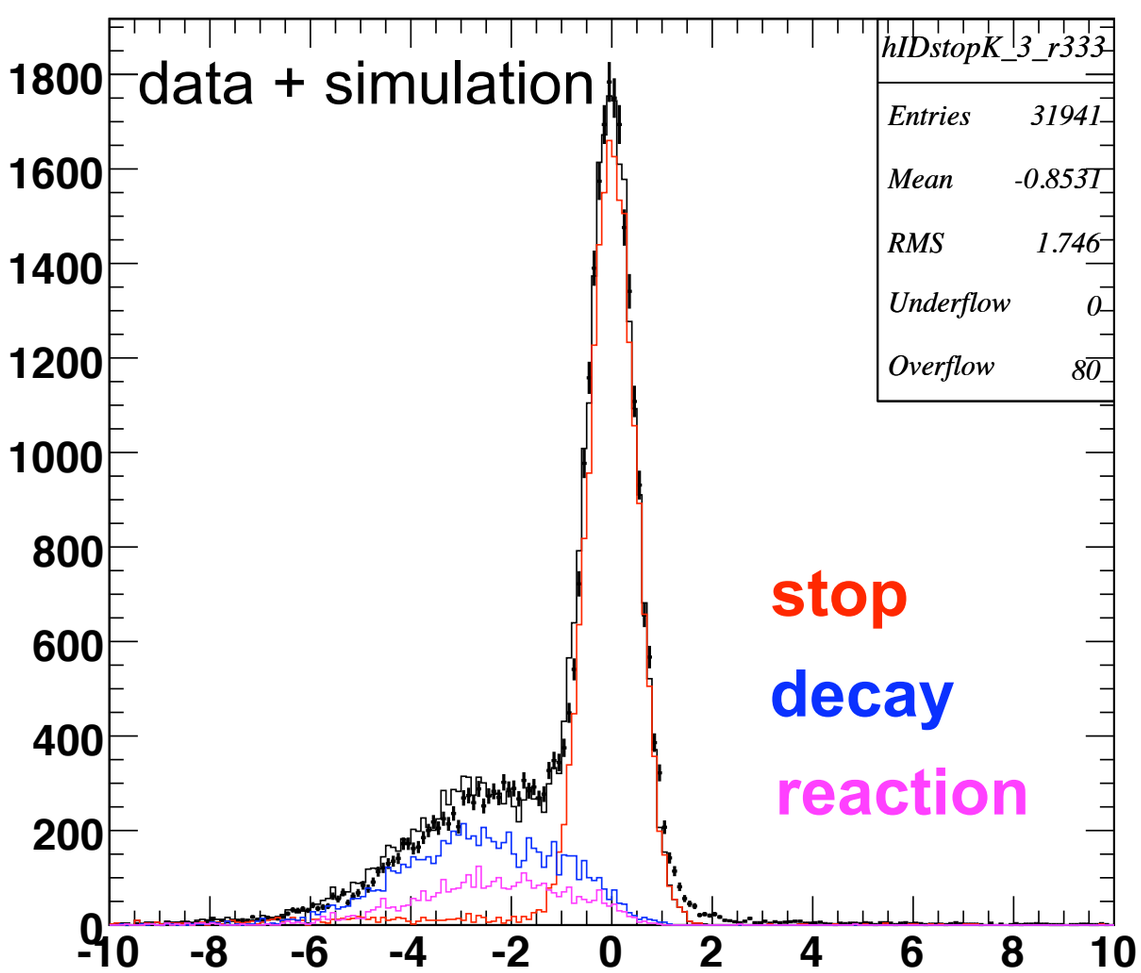


Normalized spectra of ID stopK

TC coin.



PAPB coin.

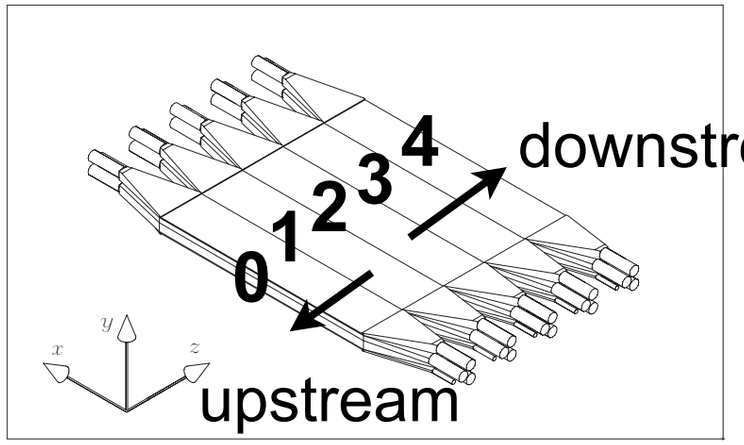


T0 energy resolution : $\frac{\Delta L}{L} = \frac{c}{\sqrt{L}}$ *ΔL : sigma of Gaussian*

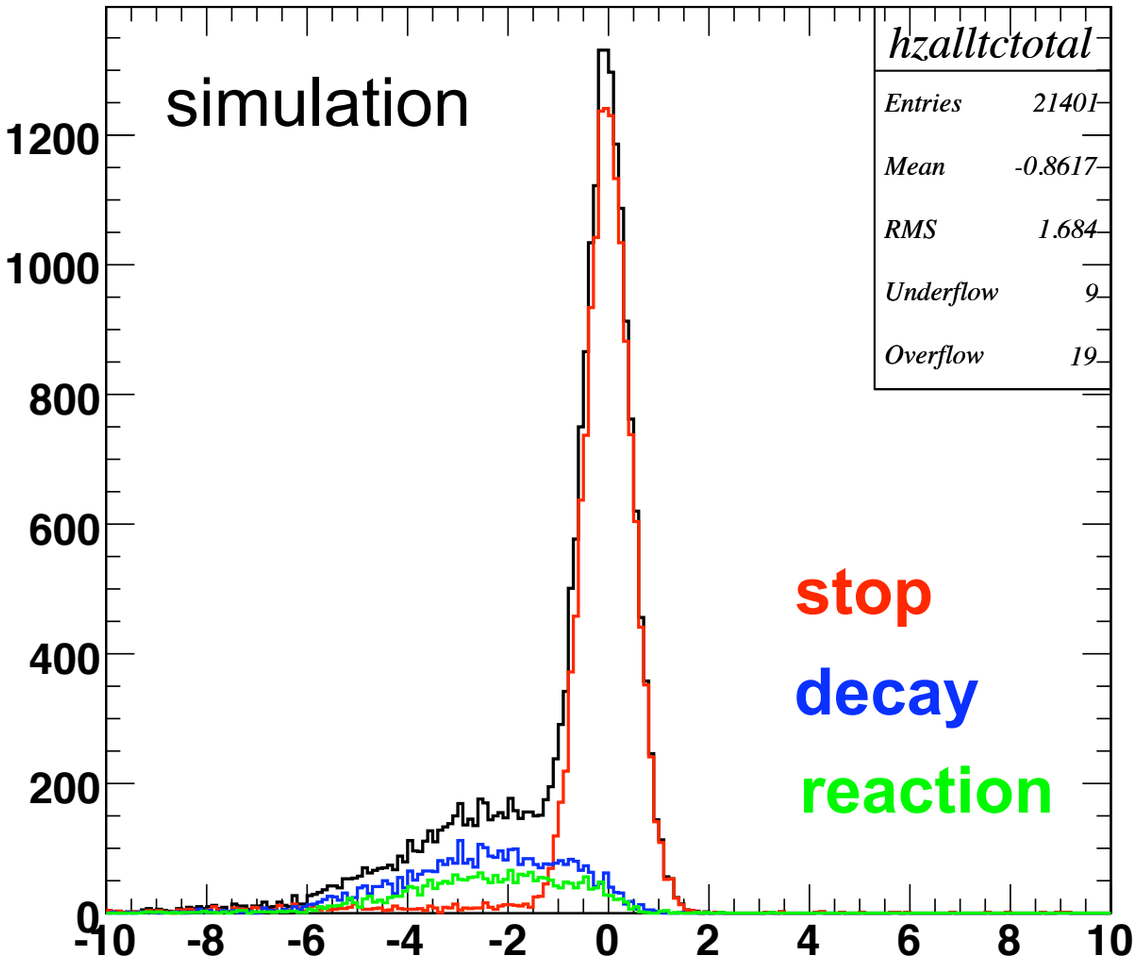
(c = 0.15)

Difference between upstream and down stream

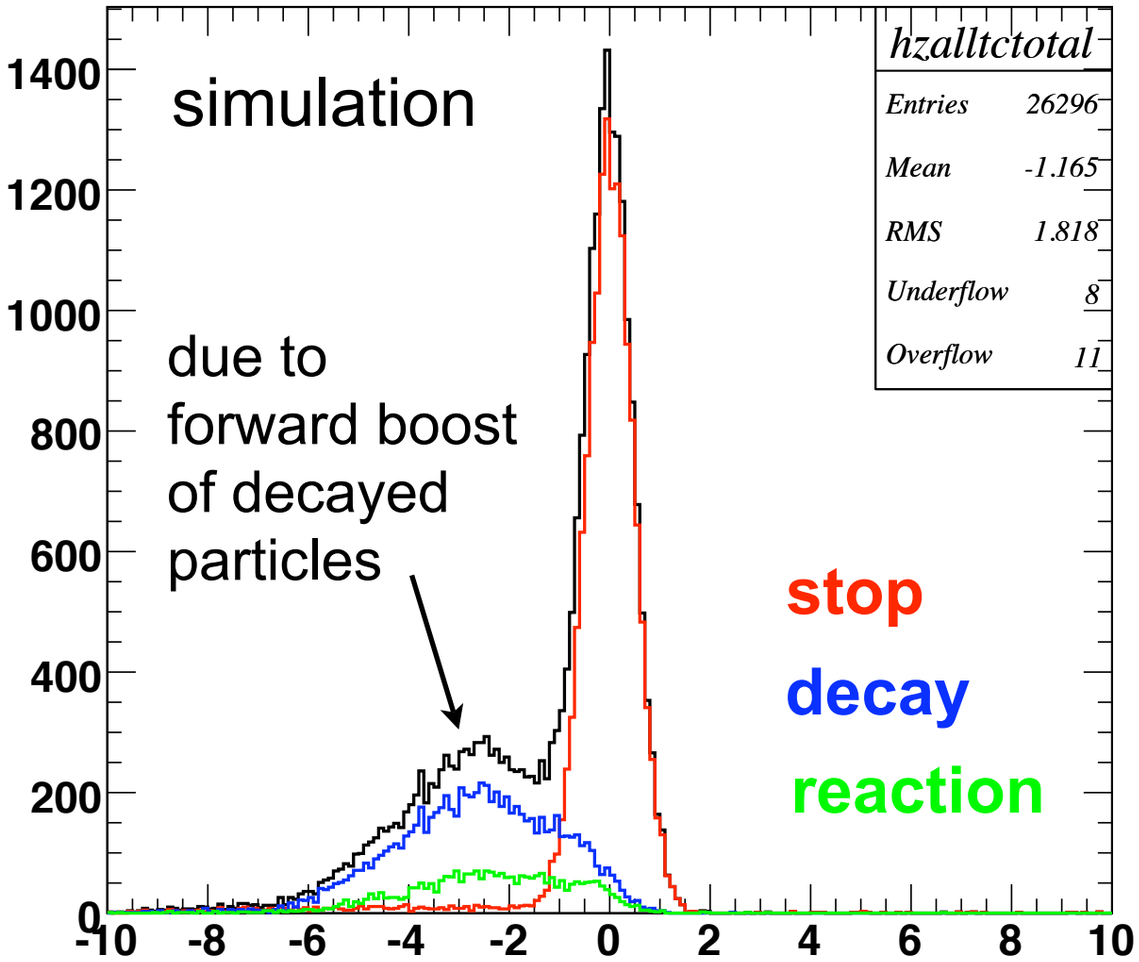
TC bottom



IDstopK TC upstream (id=0,1)

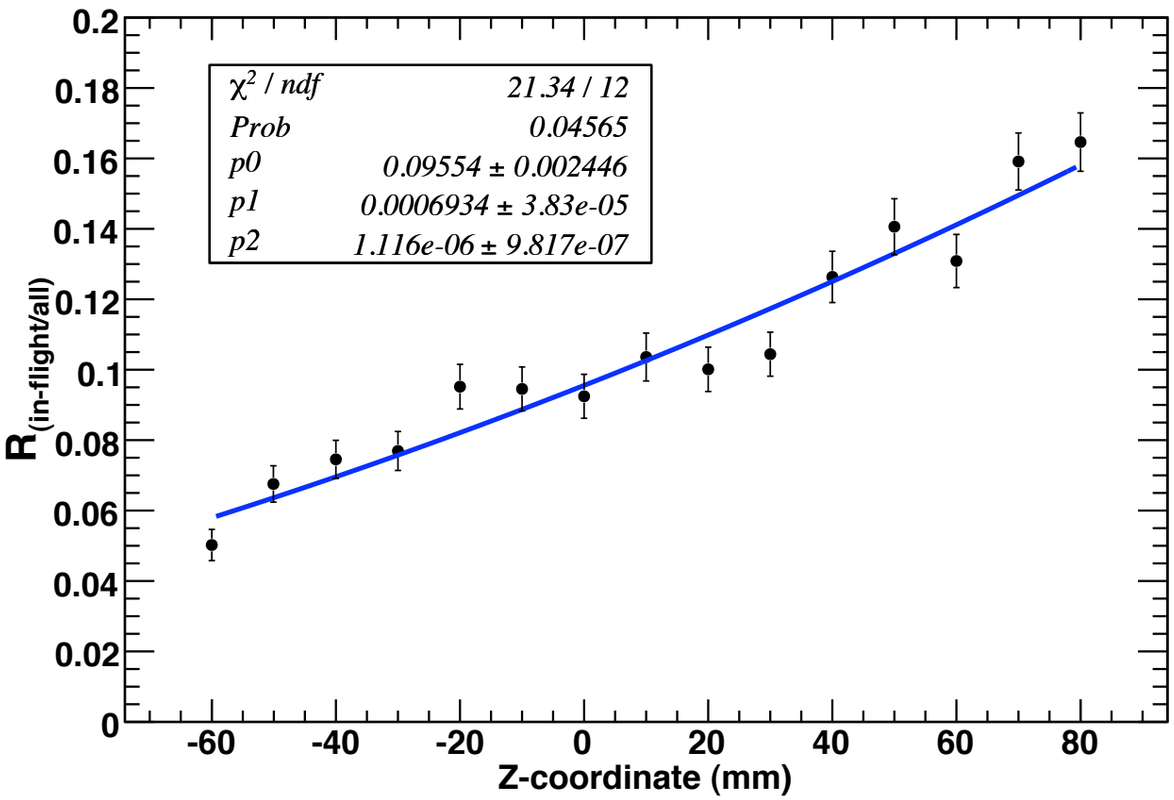


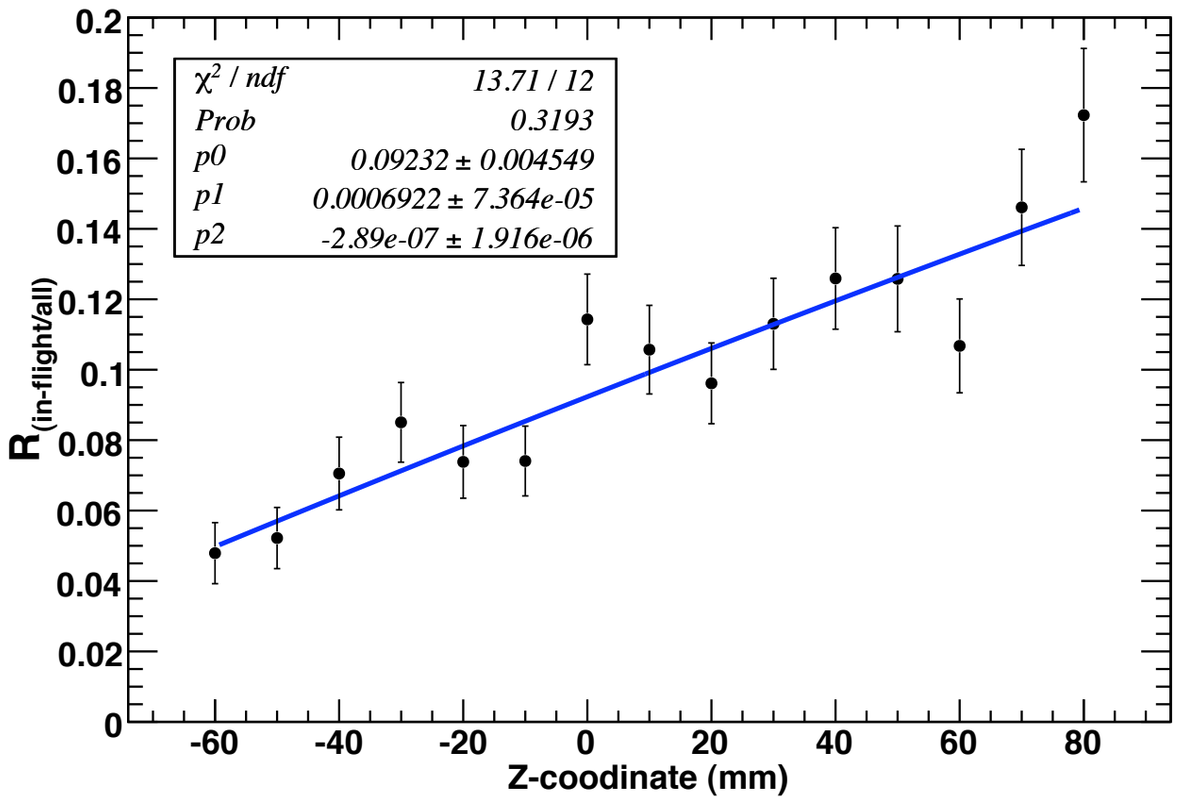
IDstopK TC downstream (id=3,4)



Ratio of in-flight contamination

stop K definition = IDstopK > -1.0





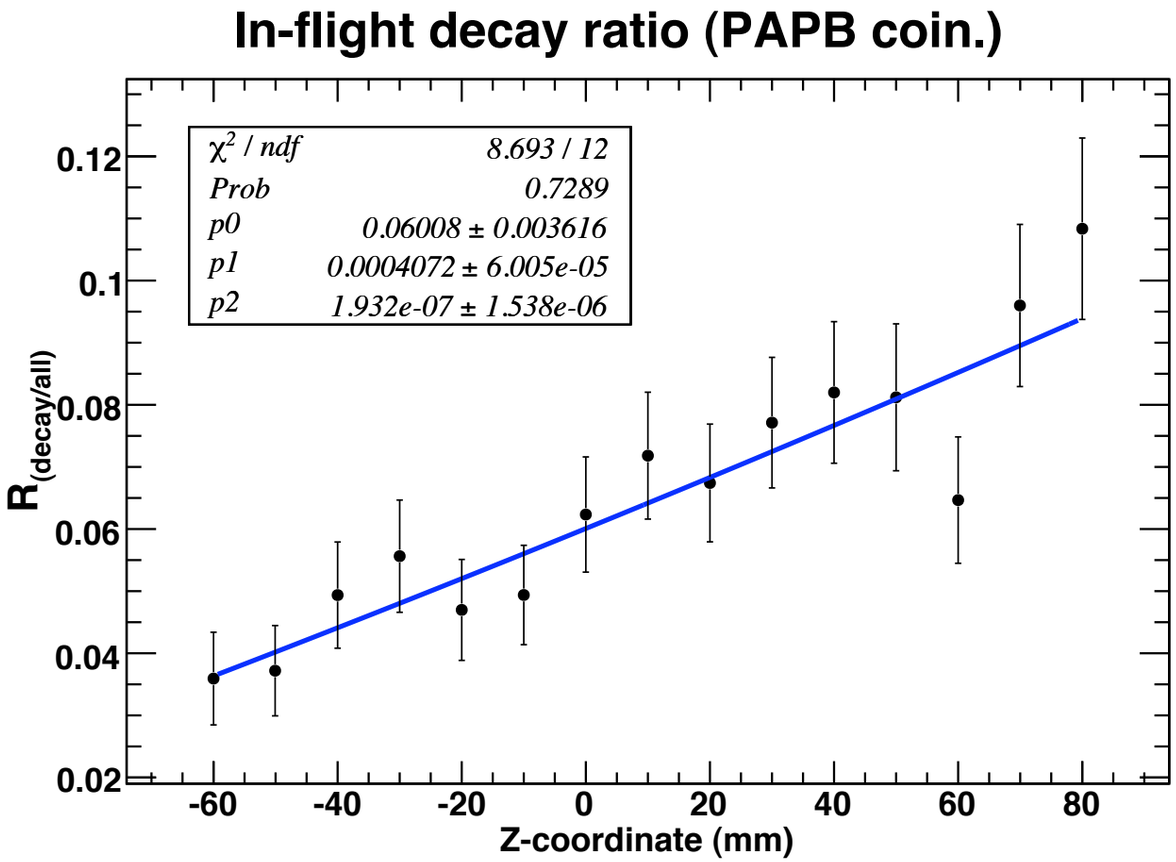
Clearly see a z-position dependence of the ratio

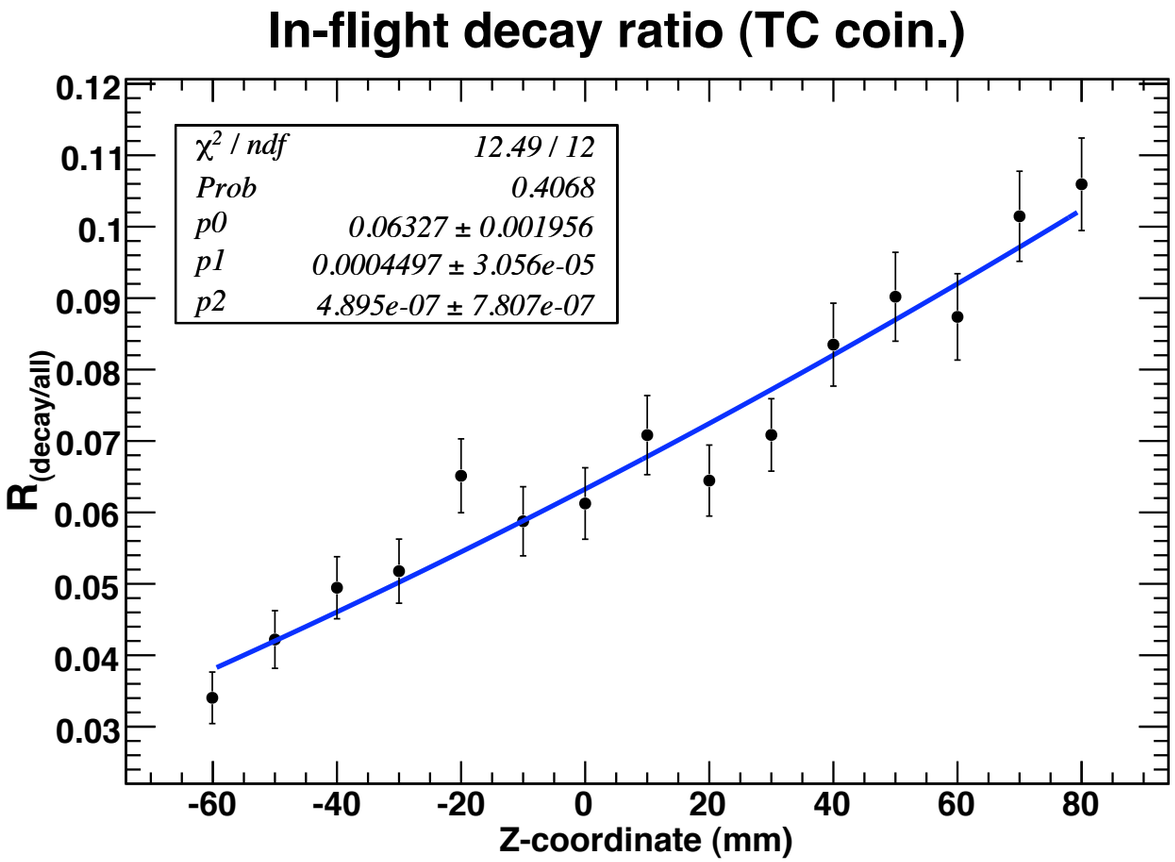
Fit with a 2nd-order polynomial function

Subtract the contamination from reconstructed vertices

Use the corrected stopped-K distribution as input of a MC simulation for evaluating efficiencies of SDDs

For comparison : in-flight decayed events

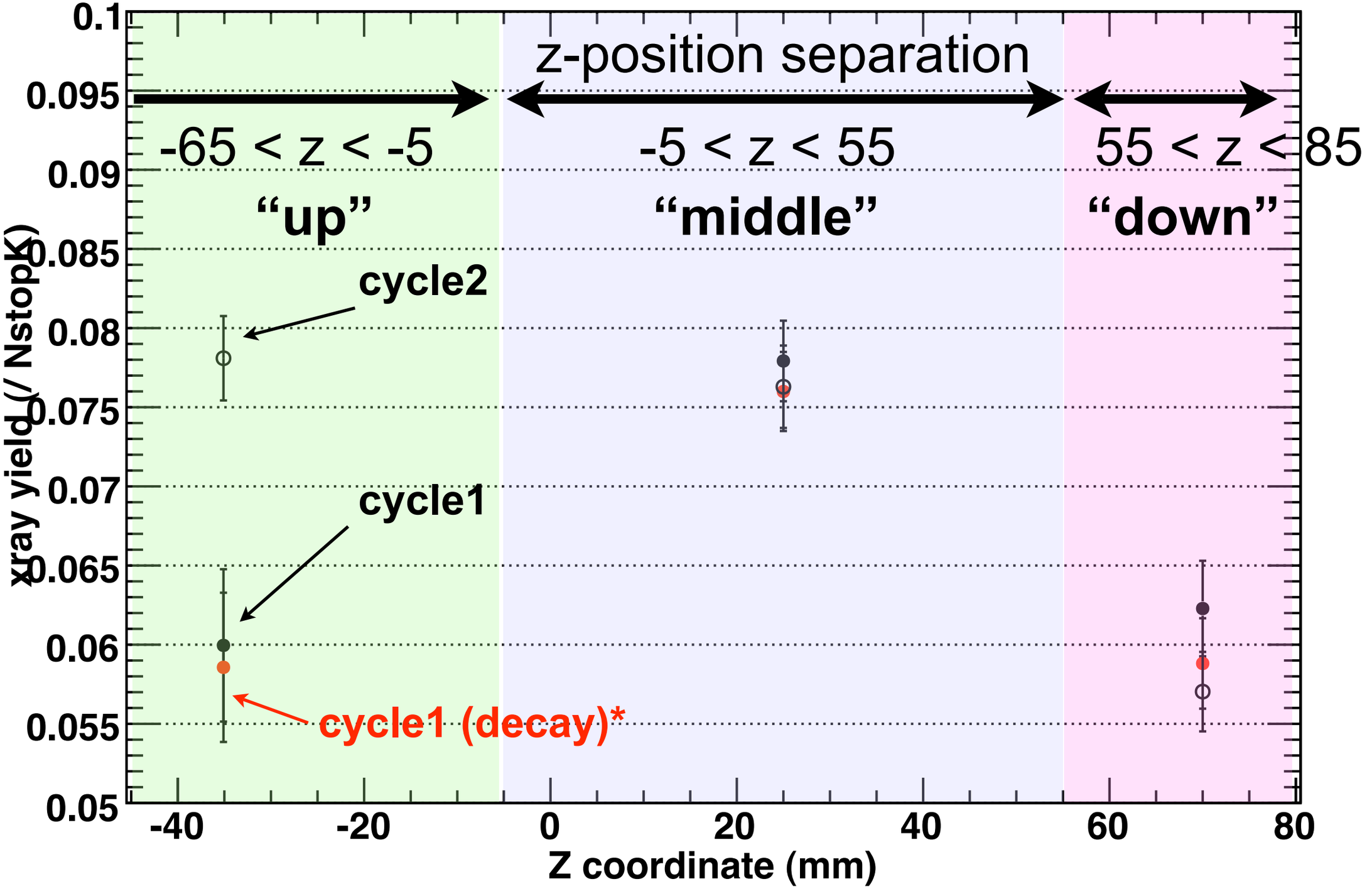




To check the contribution of decayed events, the reacted events were removed from “in-flight events”.

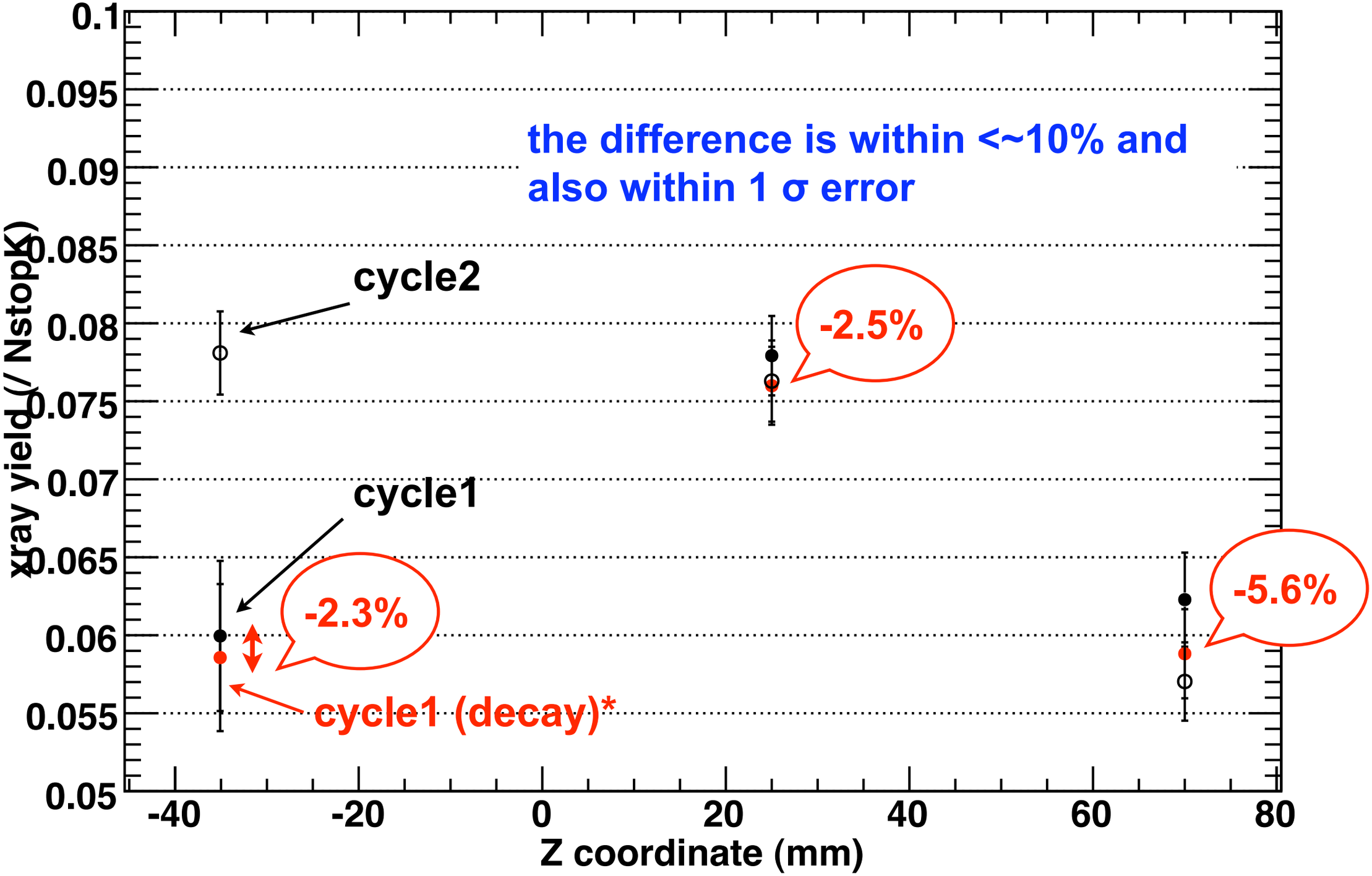
This is a “lower limit” of the ratio.

KHeX La yield per NstopK (VDC)



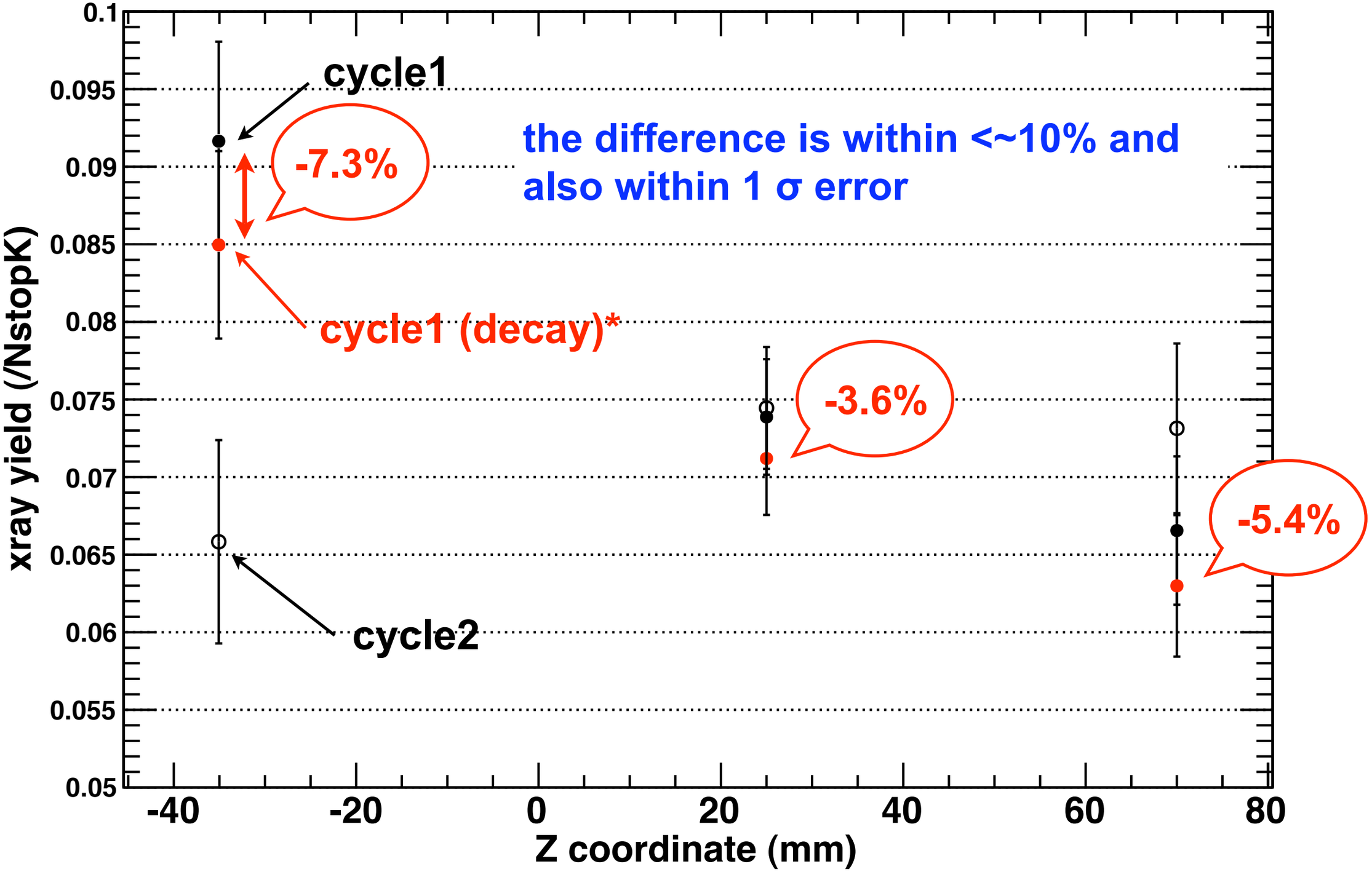
* in-flight reaction events were not included

KHeX La yield per NstopK (VDC)



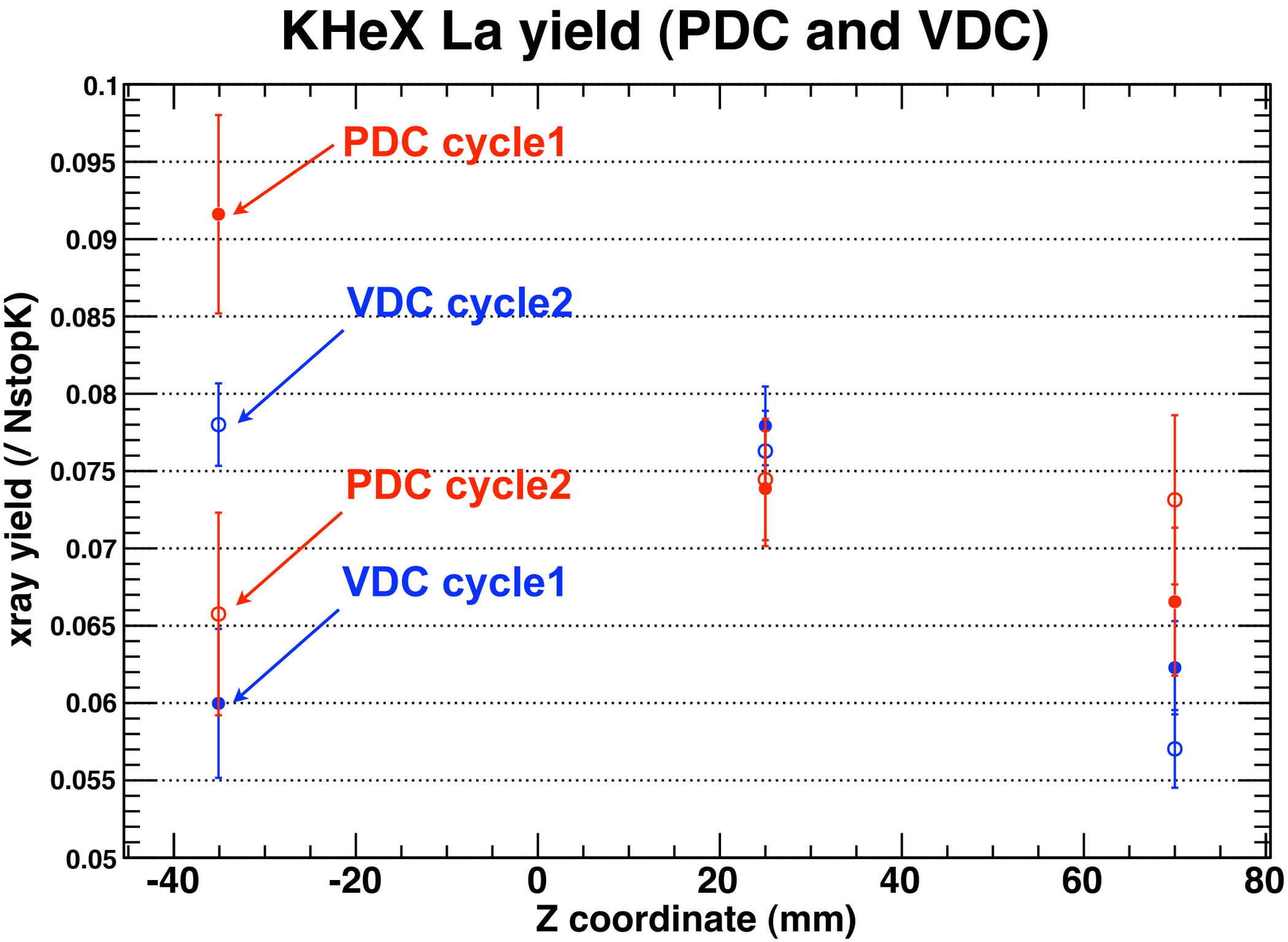
* in-flight reaction events were not included

KHeX La yield per NstopK (PDC)

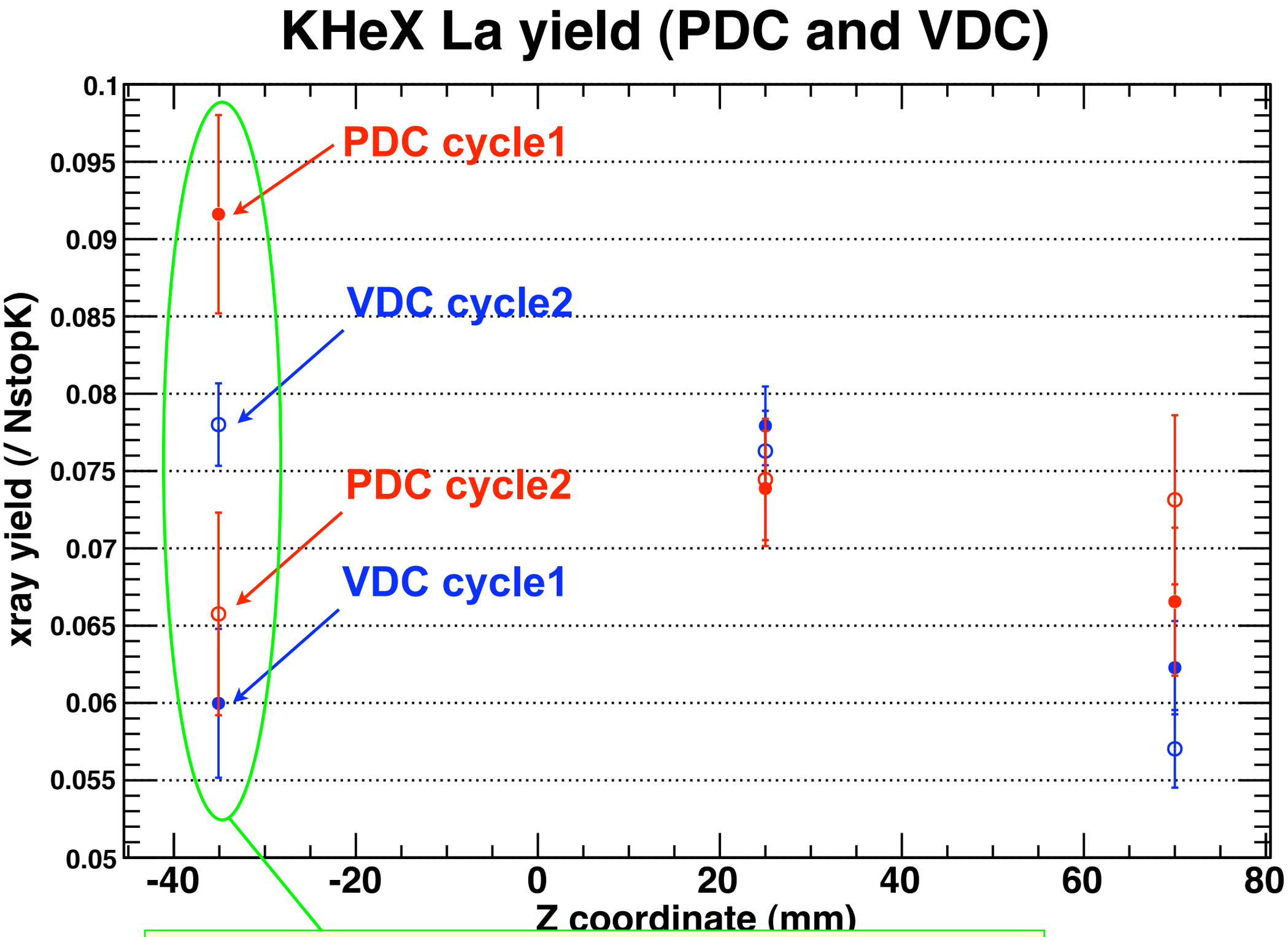


* in-flight reaction events were not included

All of results

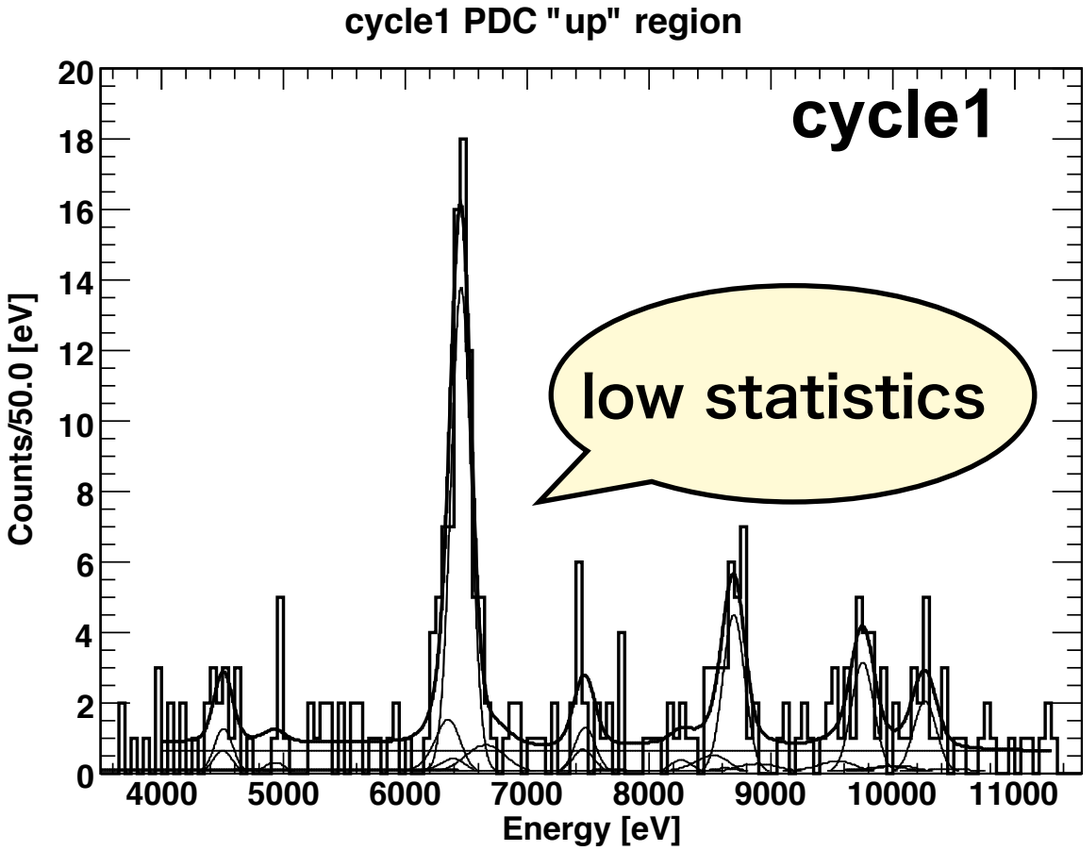


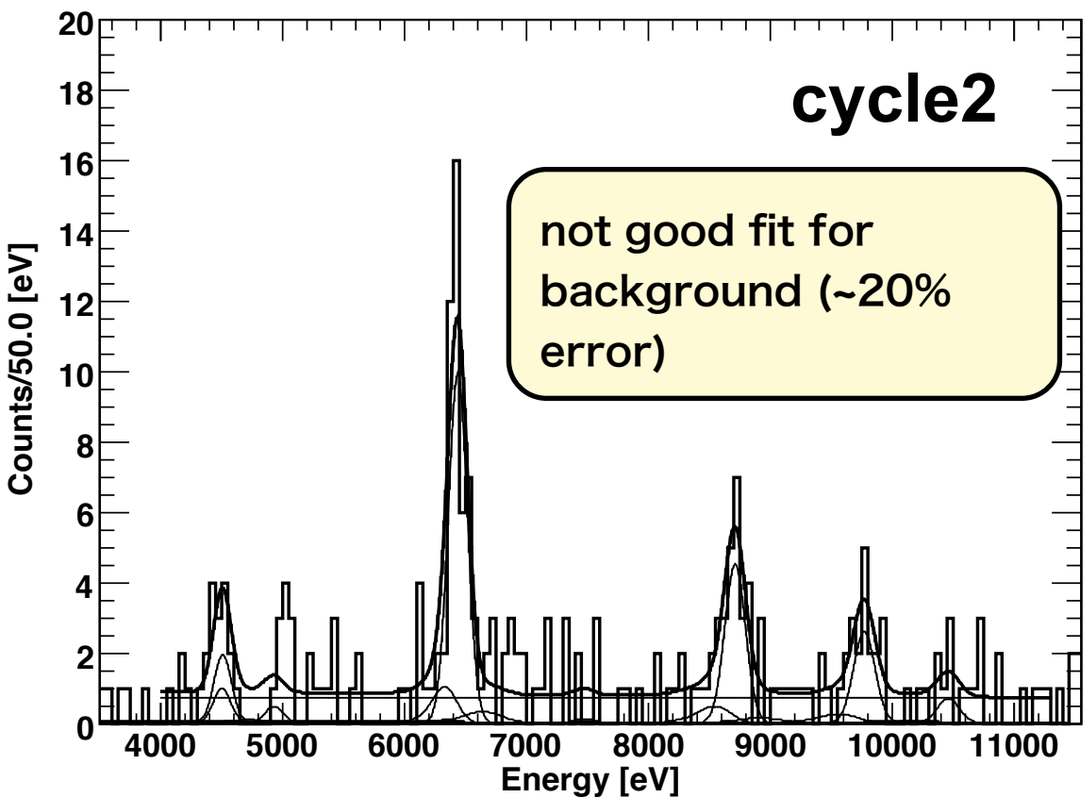
All of results



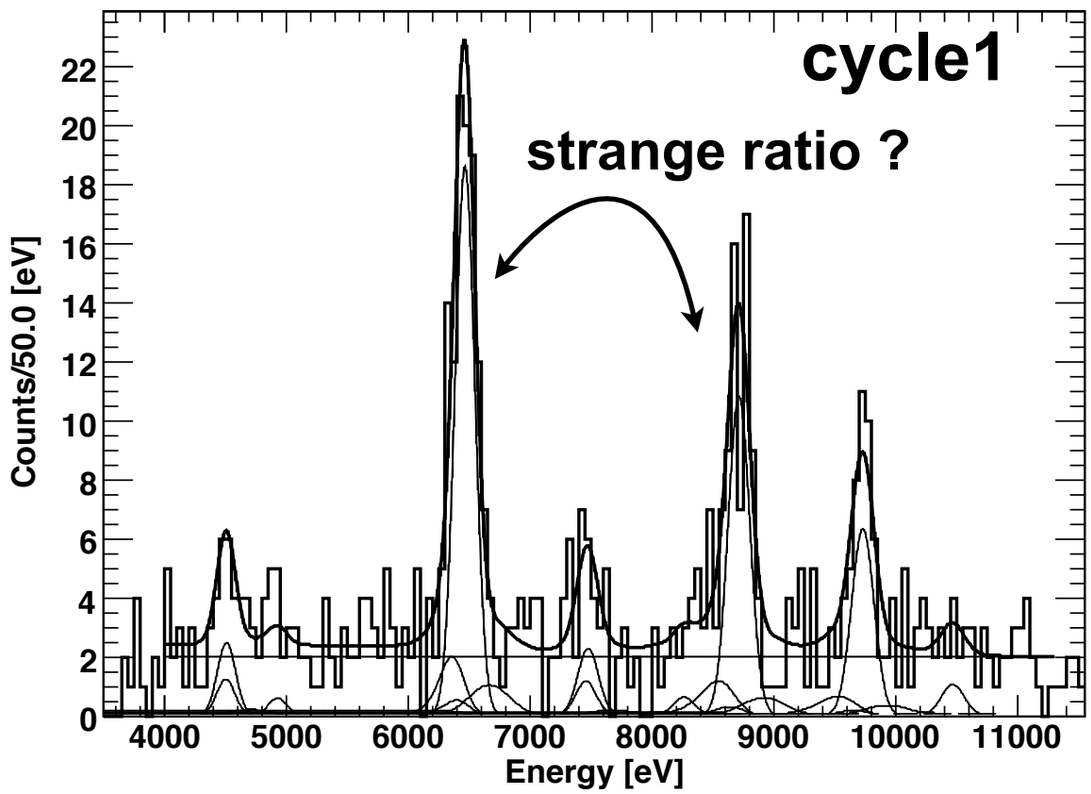
Are the “up” results inconsistent ?

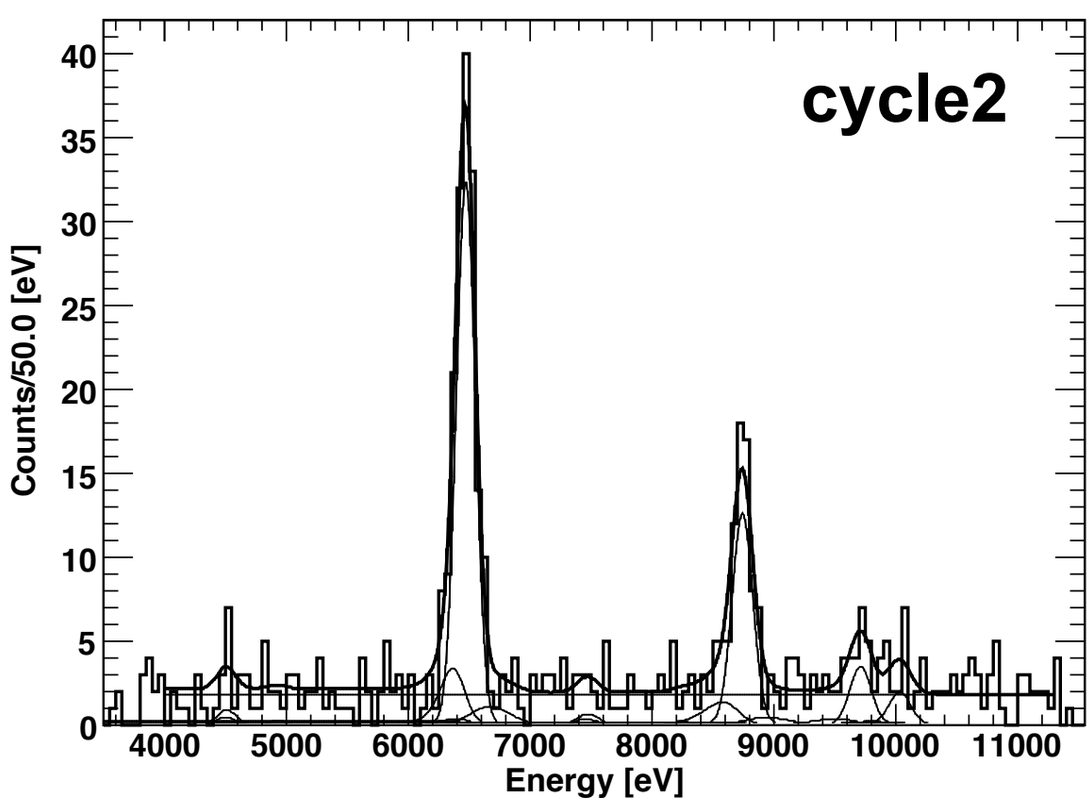
PDC “up”


cycle1 PDC "up" region
cycle1
low statistics
Counts/50.0 [eV]
Energy [eV]


cycle2
not good fit for background (~20% error)
Counts/50.0 [eV]
Energy [eV]

VDC “up”


cycle1
strange ratio ?
Counts/50.0 [eV]
Energy [eV]


cycle2
Counts/50.0 [eV]
Energy [eV]

1. Think of the “up” results as a statistical fluctuation
2. Take into account the systematics at each z region

systematic errors (% of center values)

	VDC			**PDC**		
	“up”	“middle”	“down”	“up”	“middle”	“down”
in-flight ratio correction	±0.27%	±0.52%	±1.2%	±0.50%	±0.98%	±2.3%
counts of KHeX La*	±~3%	±~3%	±~3%	±~3%	±~3%	±~3%
in-flight reaction	-2.3%	-2.5%	-5.6%	-7.3%	-3.6%	-5.4%
total	+3.3/-5.6%	+3.5/-6.0%	+4.2/-9.8%	+3.5/-10.8%	+4.0/-7.6%	+5.3/-10.7%
cf. statistical error (cycle1)	±8.0%	±3.3%	±4.8%	±7.0%	±5.0%	±7.2%

* is described in next page

* systematics for number of x-ray counts

i) Fit functions (Compton, LE tail, pileup and shelf) → **~2% uncertainty**
ii) Mylar thickness -> transmission rate → **negligible**
iii) Aluminized insulator thickness -> transmission rate → **negligible**
iv) Target density -> transmission rate → **negligible**
V) Relative position between target and SDD -> averaged efficiency of SDD → **~1% for KHeX La**
vi) SDD's thickness -> averaged efficiency → **negligible**

In total ~3%

How to include the systematic errors ?

- **Fit statistical results and then add the largest systematic error**

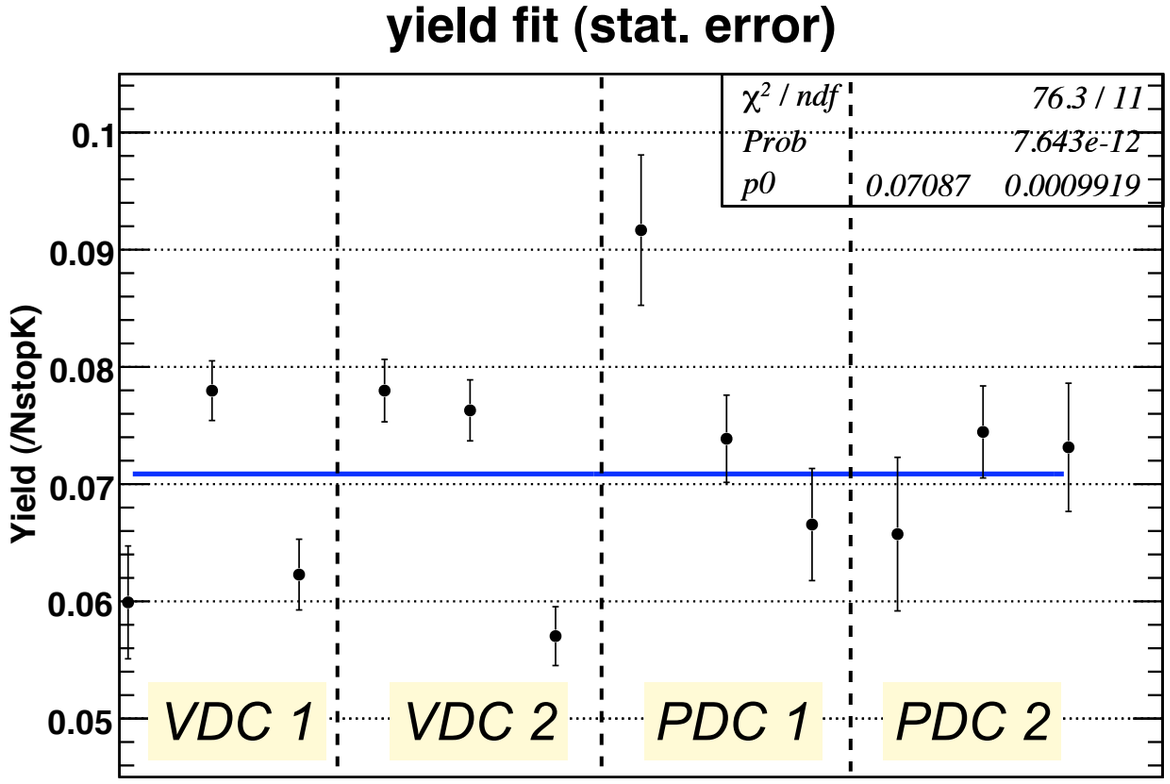
  because the center values shift to same direction for all points
  (VDC and PDC; up, middle and down)

- **Combine statistic and systematic errors and then fit**

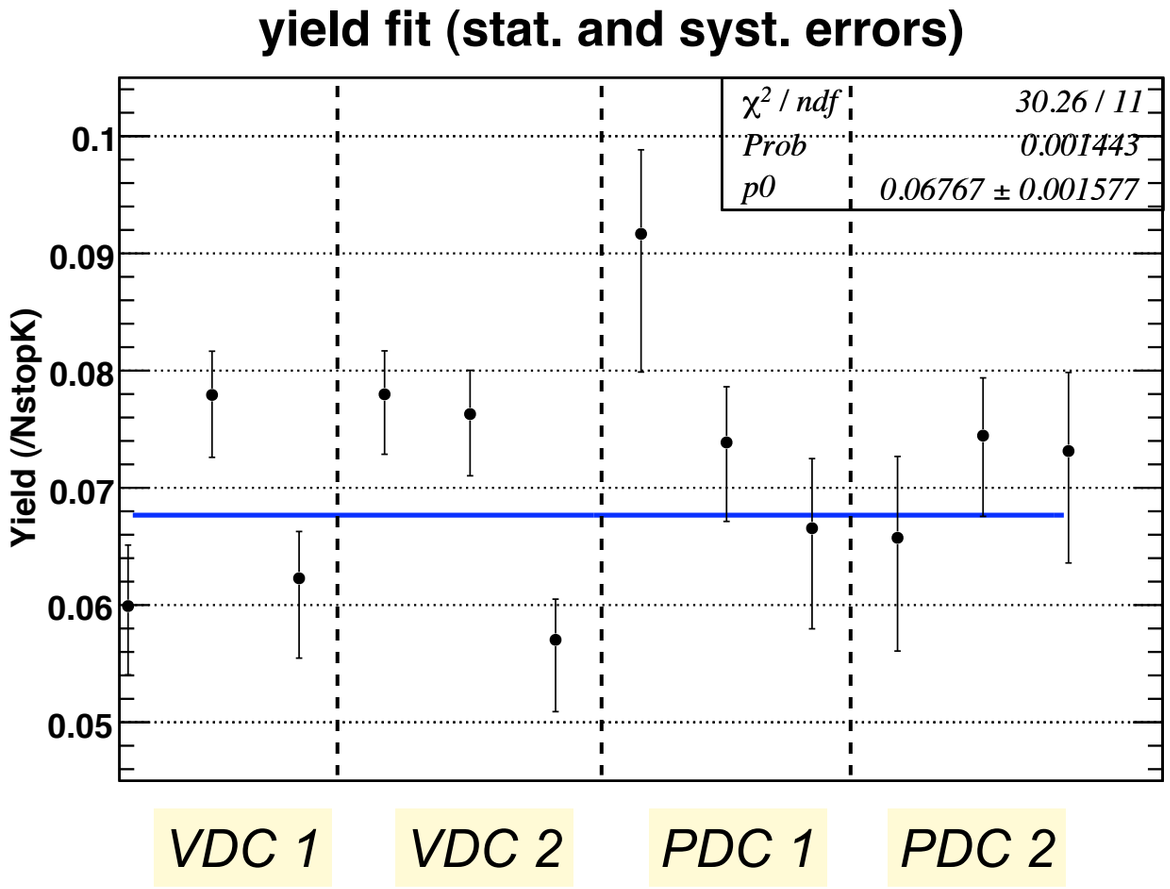
$$\sigma_{\mathrm{total}} = \sqrt{\sigma^2_{\mathrm{stat.}} + \sigma^2_{\mathrm{syst.}}}$$

this results in a smaller error due to weighted average ....

KHeX La



yield = 7.1 ± 0.1(stat.)
+0.3/-0.8 (syst.) %



$$\sigma_{\text{total}} = \sqrt{\sigma^2_{\text{stat.}} + \sigma^2_{\text{syst.}}}$$

yield = 6.8 ± 0.2 %

this method decreases the systematic error due to weighted average

Result

KHeX La yield = 7.1 ± 0.1(stat.)
+0.3/-0.8 (syst.) %

The most dominant term of the systematic error is the uncertainty of correction of the “in-flight reaction”

But this is an over estimation for the lower side error, because of the bold assumption of removing all in-flight reacted events when calculating the contamination ratio.

The systematic error of x-ray counts is about a half of the “in-flight reaction” one.

Summary

I tried the analysis, each drift chamber and each coincidence condition (TC / PAPB), to evaluate the x-ray yield per number of stopped kaons.

The in-flight contamination ratio was calculated by a MC simulation including the coincidence condition.

The corrected stopped-K distribution was used for calculating SDD's efficiency.

Results of three target region ("up, middle and down") have individual statistic and systematic errors.

Conservatively added the systematic errors.

The result of KHeX La is 7.1 ± 0.1(stat.) +0.3/-0.8 (syst.) %