

# KstopID spectrum fitting

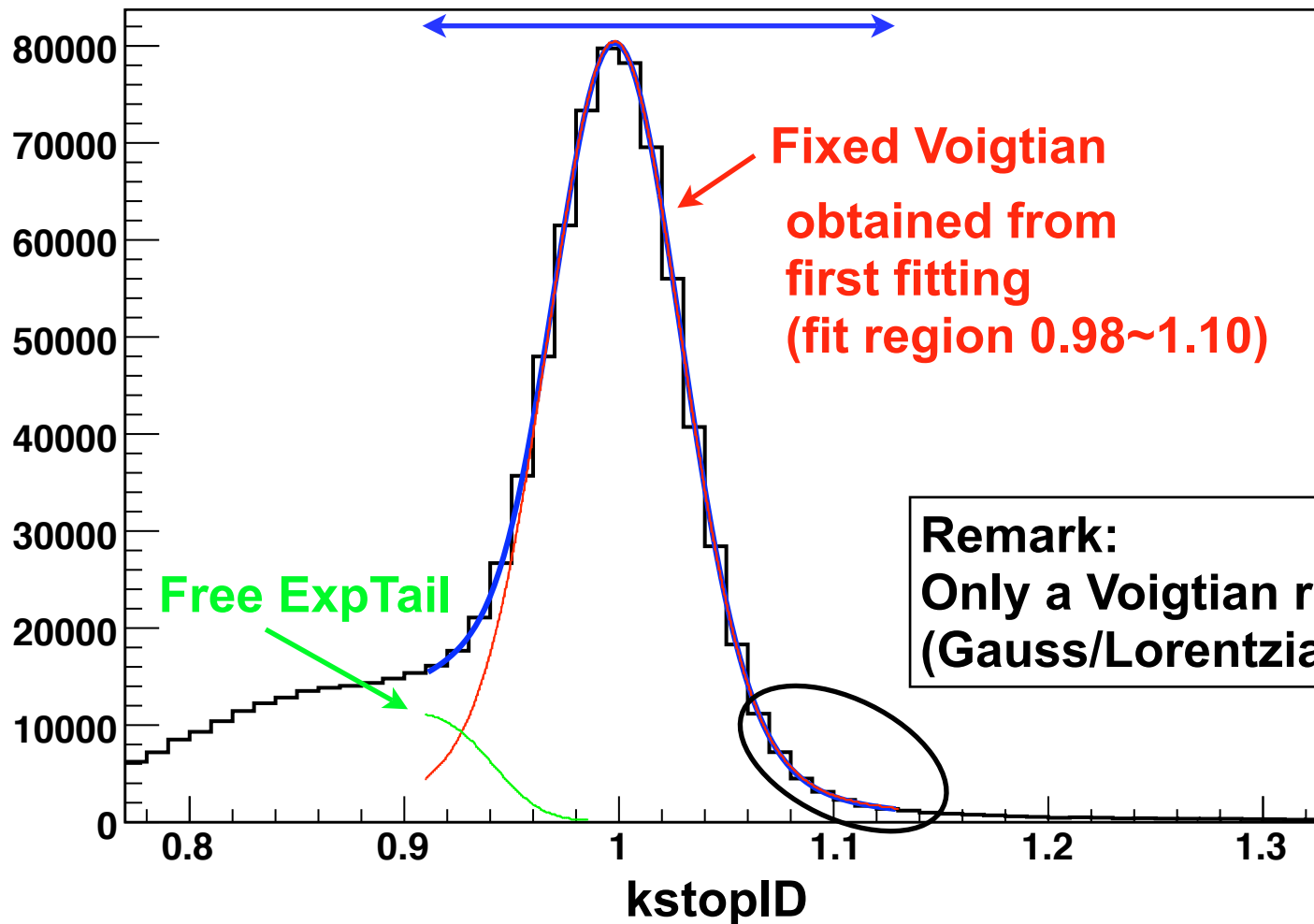
Voigtian + ExpTail

To get more reasonable ratio of  
in-flight events contamination

*Oct 17, 2007 H. Tatsuno*

**total t0ID (52 mm < z < 80 mm)**  
**(SDD hits not required)**

**fit region 0.91~1.13**



**Remark:**  
**Only a Voigtian reproduces this tail**  
**(Gauss/Lorentzian cannot)**

**contami-ratio 3.8%**

This shows the right-side shape  
(kstopID > 1) was completely fitted by  
a Voigtian

# Parameters of a fixed Voigtian

FCN=172.405 FROM MINOS STATUS=SUCCESSFUL 188 CALLS 456 TOTAL  
 EDM=2.73382e-06 STRATEGY= 1 ERROR MATRIX ACCURATE

| EXT PARAMETER |          | PARABOLIC   |             | MINOS ERRORS |             |
|---------------|----------|-------------|-------------|--------------|-------------|
| NO.           | NAME     | VALUE       | ERROR       | NEGATIVE     | POSITIVE    |
| 1             | V height | 1.01199e+05 | 5.94995e+02 | -5.94069e+02 | 6.03003e+02 |
| 2             | V mean   | 9.98048e-01 | 1.53915e-04 | -1.55222e-04 | 1.53420e-04 |
| 3             | V sigma  | 2.79053e-02 | 1.88861e-04 | -1.89849e-04 | 1.90300e-04 |
| 4             | V gamma  | 1.72953e-02 | 3.10871e-04 | -3.12303e-04 | 3.12858e-04 |
| 5             | V r      | 4.00000e+00 | fixed       |              |             |

FCN=295.631 FROM MIGRAD STATUS=CONVERGED 1057 CALLS 1058 TOTAL  
 EDM=0.000177827 STRATEGY= 1 ERROR MATRIX ACCURATE

| EXT PARAMETER |                   |             |             | STEP        | FIRST        |
|---------------|-------------------|-------------|-------------|-------------|--------------|
| NO.           | NAME              | VALUE       | ERROR       | SIZE        | DERIVATIVE   |
| 1             | V height          | 1.01199e+05 | fixed       |             |              |
| 2             | V mean            | 9.98048e-01 | fixed       |             |              |
| 3             | V sigma           | 2.79053e-02 | fixed       |             |              |
| 4             | V gamma           | 1.72953e-02 | fixed       |             |              |
| 5             | V r               | 4.00000e+00 | fixed       |             |              |
| 6             | GExpTail mean     | 9.41799e-01 | 8.01822e-04 | 2.91889e-06 | -3.15760e+00 |
| 7             | GExpTail sigma    | 1.76661e-02 | 9.63328e-04 | 4.23637e-06 | 5.13889e+00  |
| 8             | GExpTail D height | 5.70755e+03 | 1.39732e+02 | 3.82172e-01 | -8.28862e-05 |
| 9             | GExpTail D beta   | 1.28520e+03 | 6.91767e+04 | 4.84121e+01 | -2.67845e-07 |

***these values are reasonable ?***

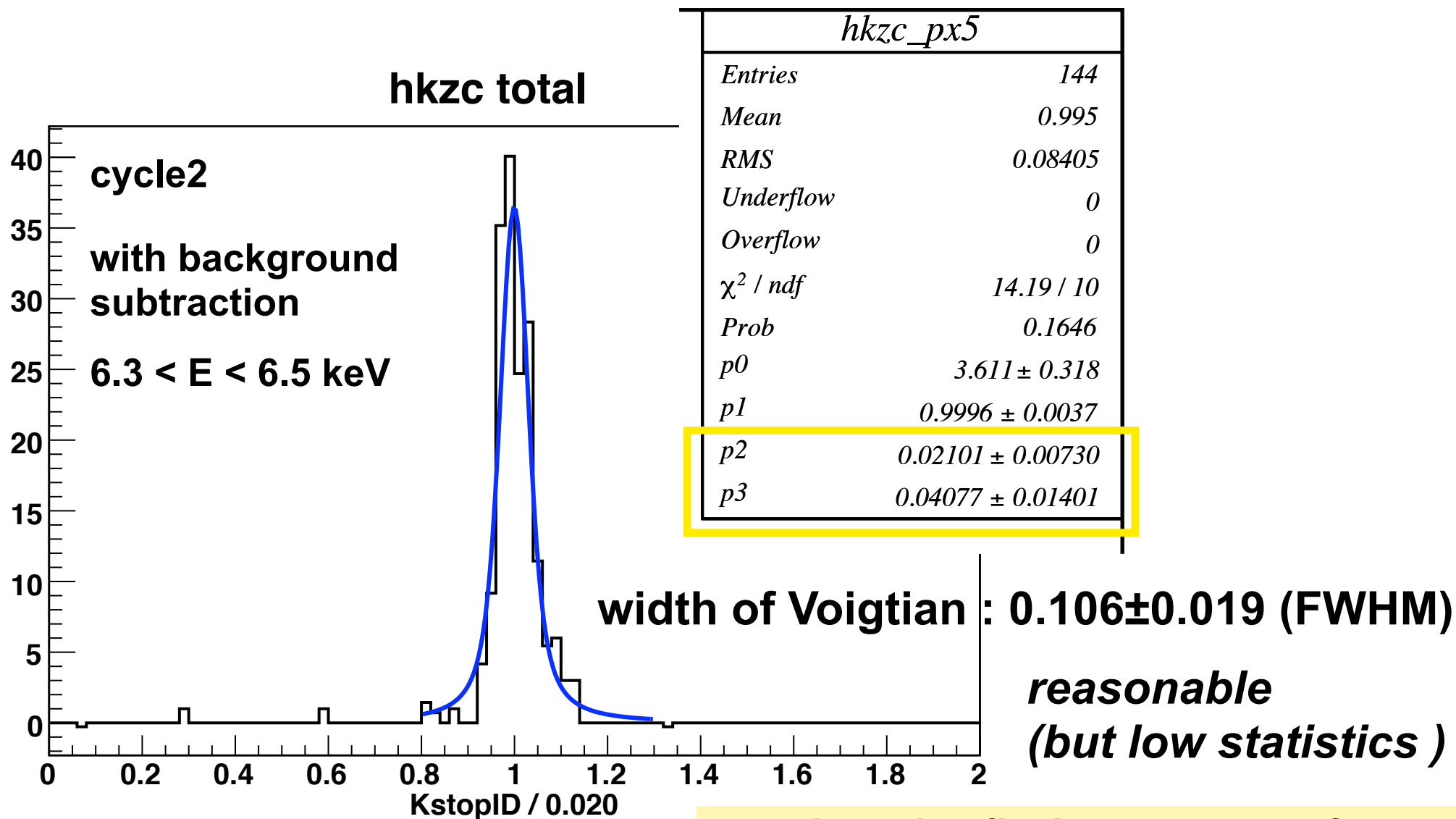
width of Voigtian : 0.08615(45) (FWHM)

$$f_V \sim 0.5346 f_L + \sqrt{0.2166 f_L^2 + f_G^2}$$

JQSRT 17, P233  
 accuracy of 0.02%

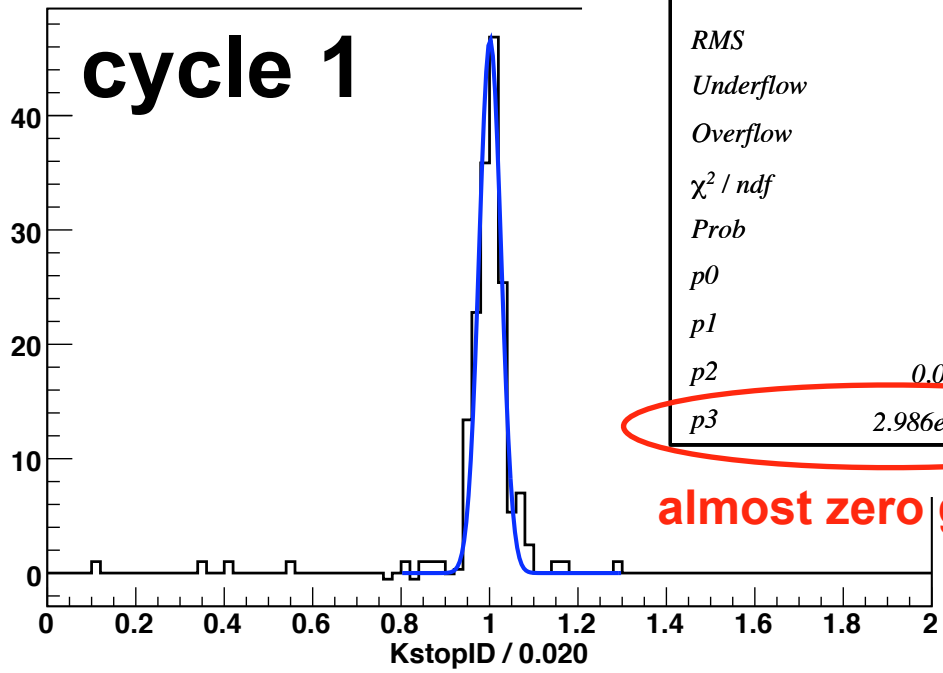
# “pure” stopped K events

(SDD hits required and L $\alpha$  peak selected)



***not adapted to fix the parameters from these values***

hkzc total



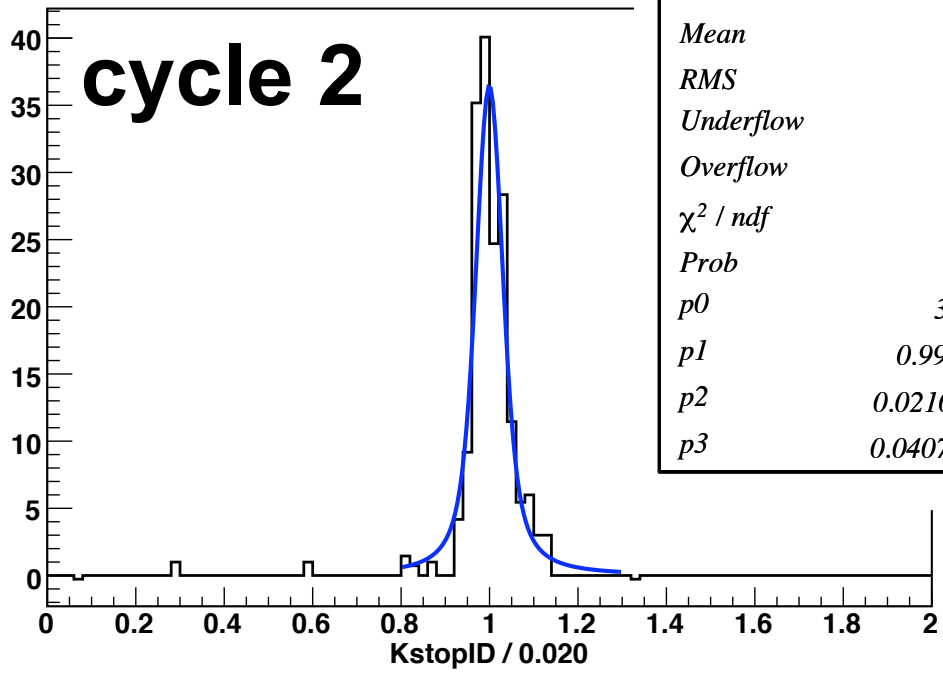
| <i>hkzc_px5</i>  |                       |
|------------------|-----------------------|
| <i>Entries</i>   | 153                   |
| <i>Mean</i>      | 0.9867                |
| <i>RMS</i>       | 0.1039                |
| <i>Underflow</i> | 0                     |
| <i>Overflow</i>  | 0                     |
| $\chi^2 / ndf$   | 22.05 / 14            |
| <i>Prob</i>      | 0.0775                |
| <i>p0</i>        | 2.902 ± 0.242         |
| <i>p1</i>        | 1.001 ± 0.002         |
| <i>p2</i>        | 0.02482 ± 0.00183     |
| <i>p3</i>        | 2.986e-11 ± 6.890e-02 |

almost zero gamma

# Remark

Furthermore, sometimes the “pure” stopped-K shape can be fitted not only by Voigtian but also by Gaussian due to its low statistics (?).

hkzc total



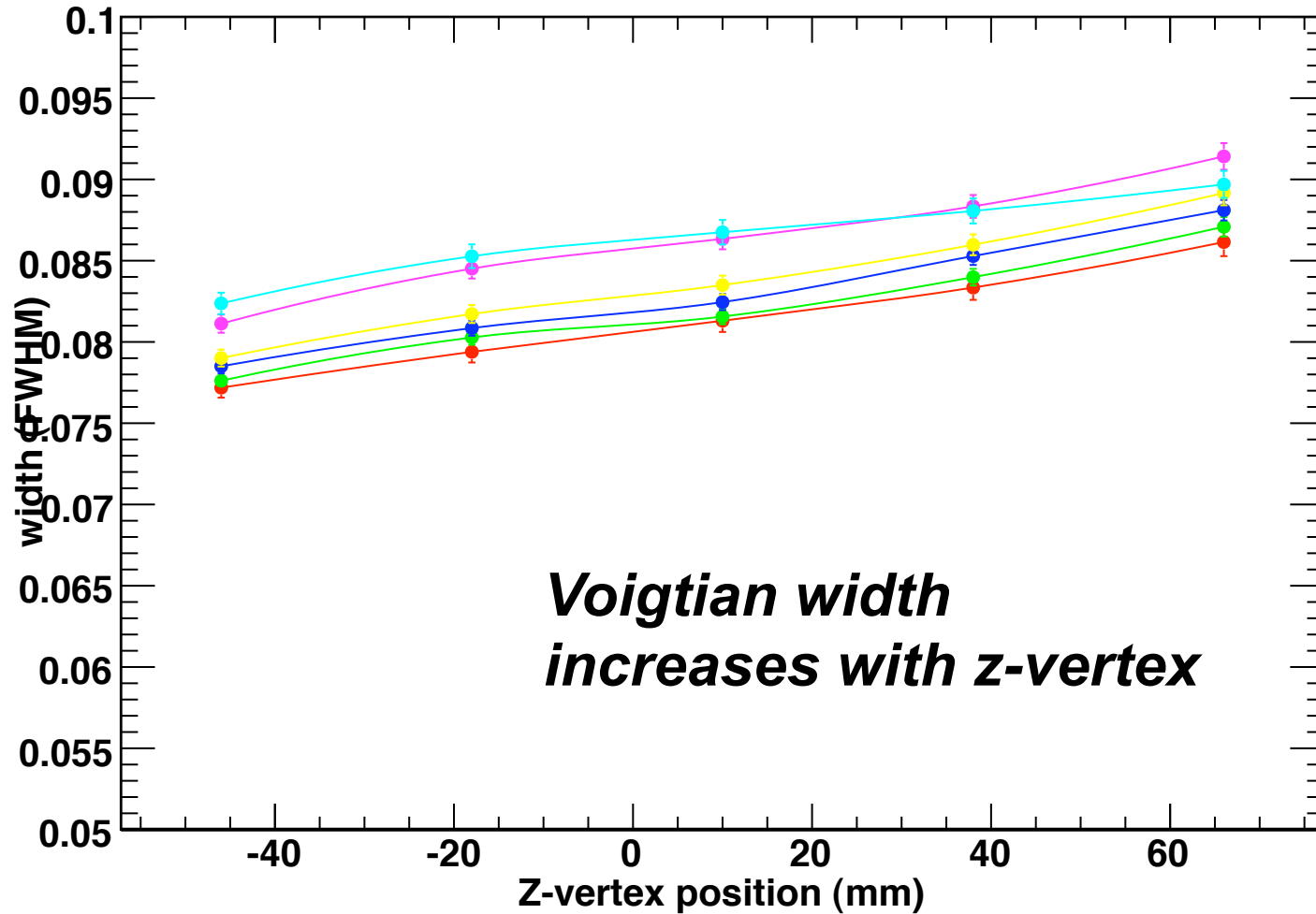
| <i>hkzc_px5</i>  |                   |
|------------------|-------------------|
| <i>Entries</i>   | 144               |
| <i>Mean</i>      | 0.995             |
| <i>RMS</i>       | 0.08405           |
| <i>Underflow</i> | 0                 |
| <i>Overflow</i>  | 0                 |
| $\chi^2 / ndf$   | 14.19 / 10        |
| <i>Prob</i>      | 0.1646            |
| <i>p0</i>        | 3.611 ± 0.318     |
| <i>p1</i>        | 0.9996 ± 0.0037   |
| <i>p2</i>        | 0.02101 ± 0.00730 |
| <i>p3</i>        | 0.04077 ± 0.01401 |

On the other hand, the raw KstopID shape is fit to only a Voigtian.

So, it is not adapted to fix the Voigtian parameters by the values of “pure” stopped-K events.

# Results

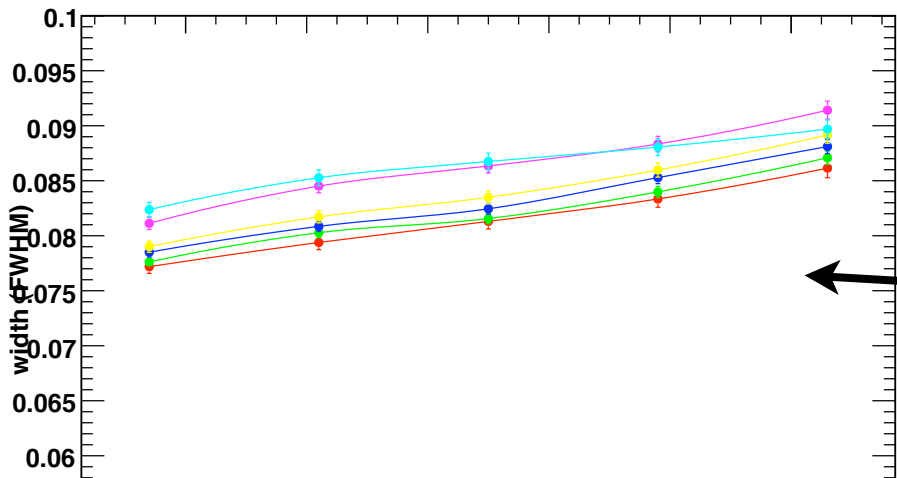
## Voigtian width (total)



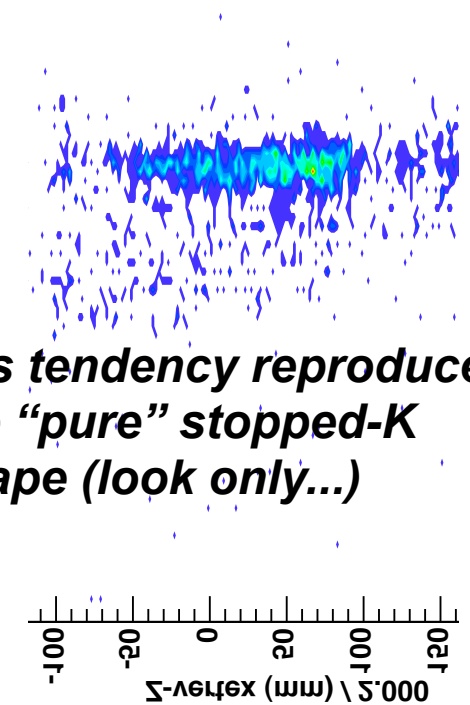
cycle 1 run 37-100  
run 101-200  
run 201-300  
run 301-386

cycle 2 run 419-500  
run 500-600

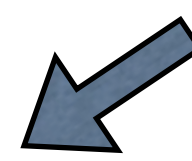
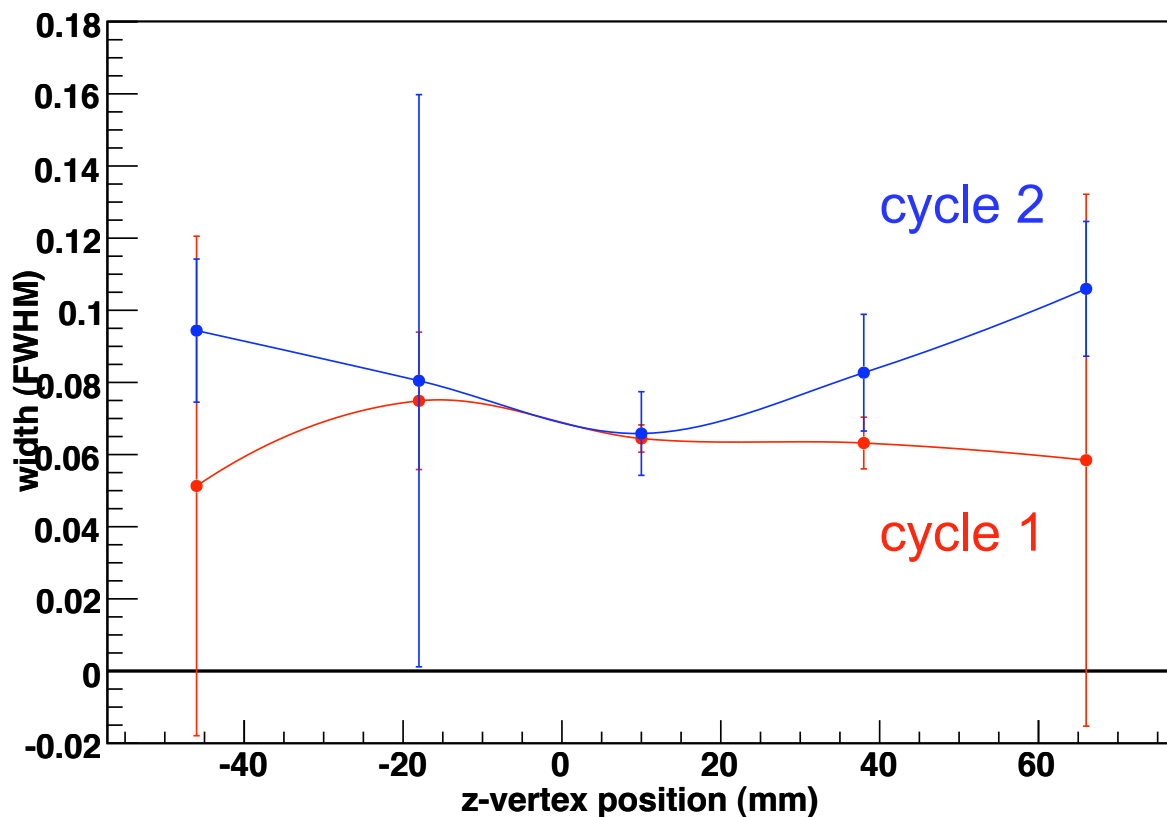
Voigtian width (total)



*this tendency reproduces the "pure" stopped-K shape (look only...)*



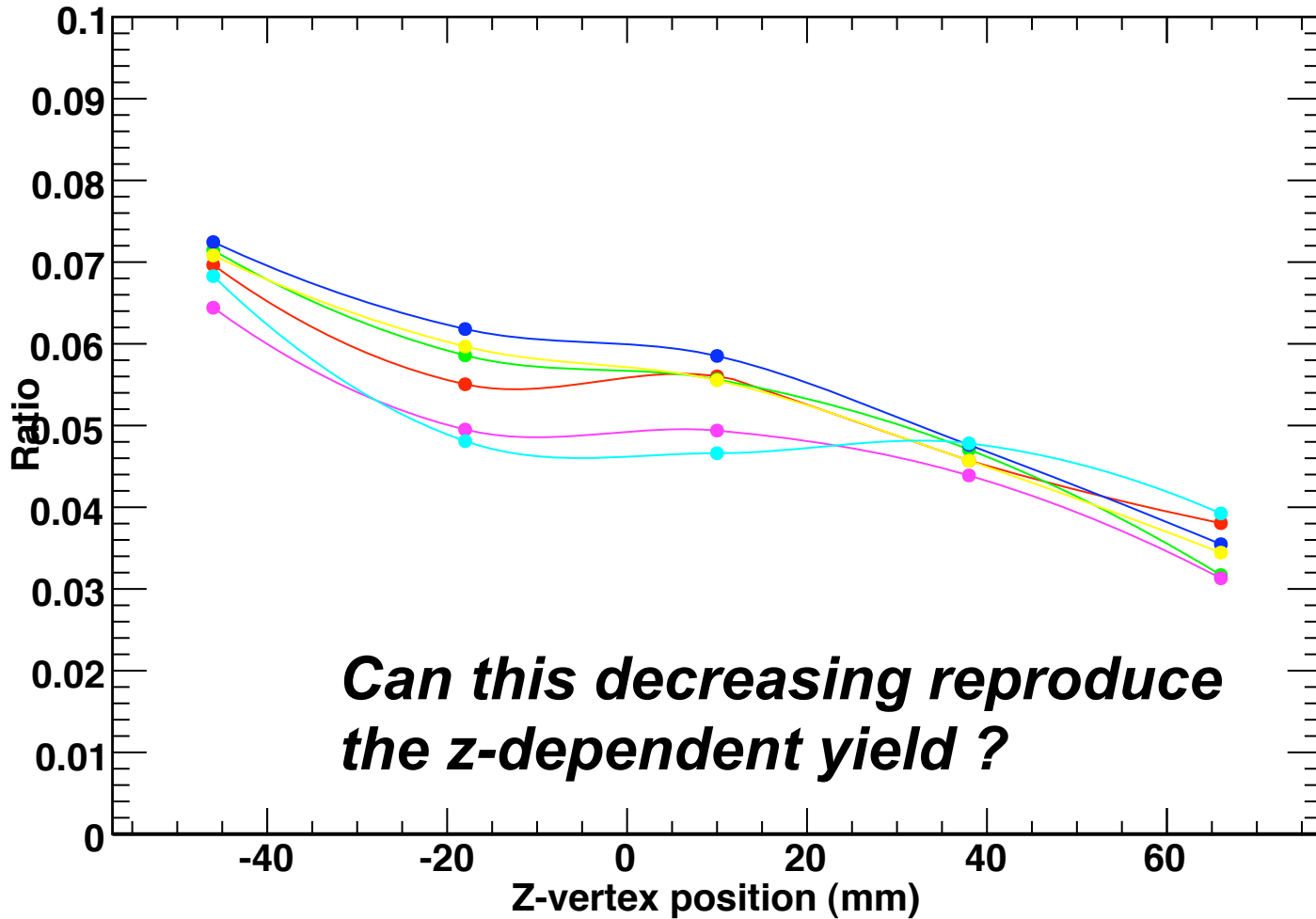
Voigtian width (FWHM) of stopped-K events



*unstable fitting !*

# Results

## In-flight ratio (total)



cycle 1 run 37-100  
run 101-200  
run 201-300  
run 301-386

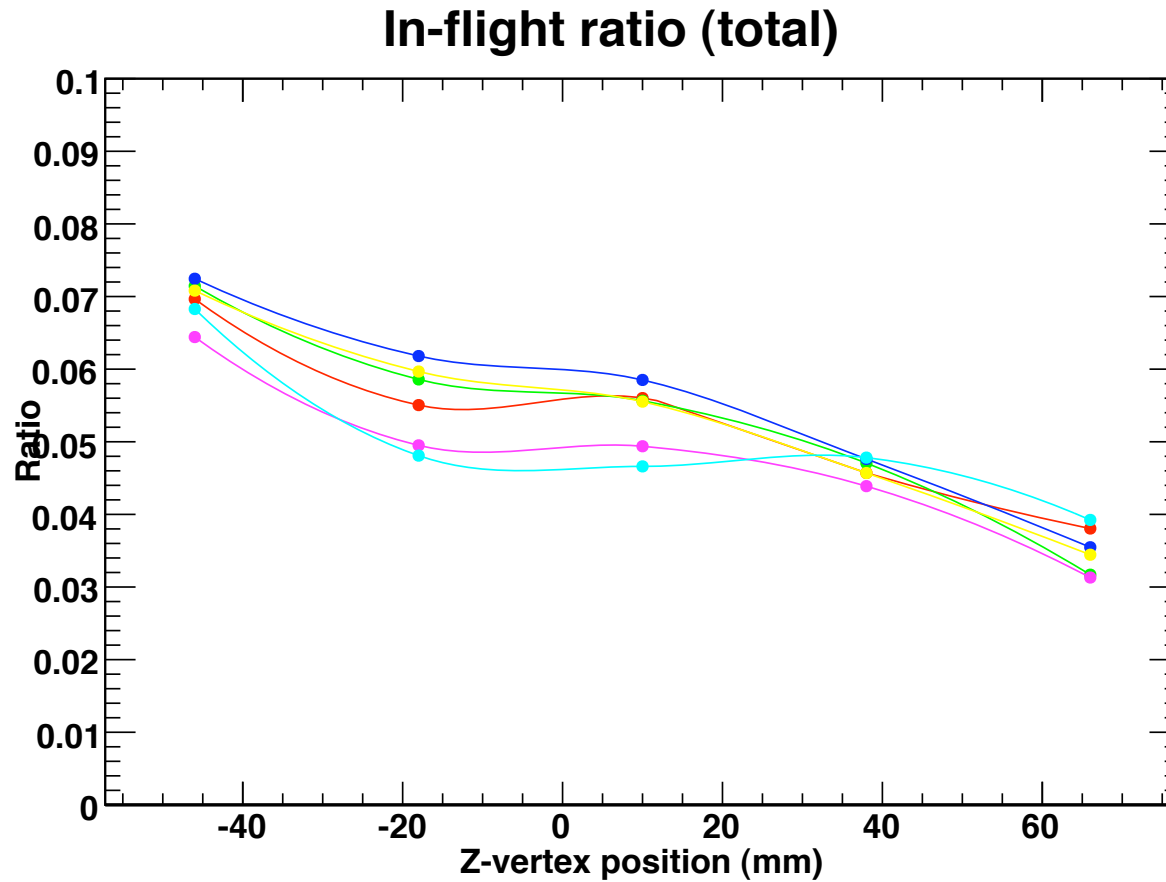
cycle 2 run 419-500  
run 500-600

*naively think : opposite tendency ?*



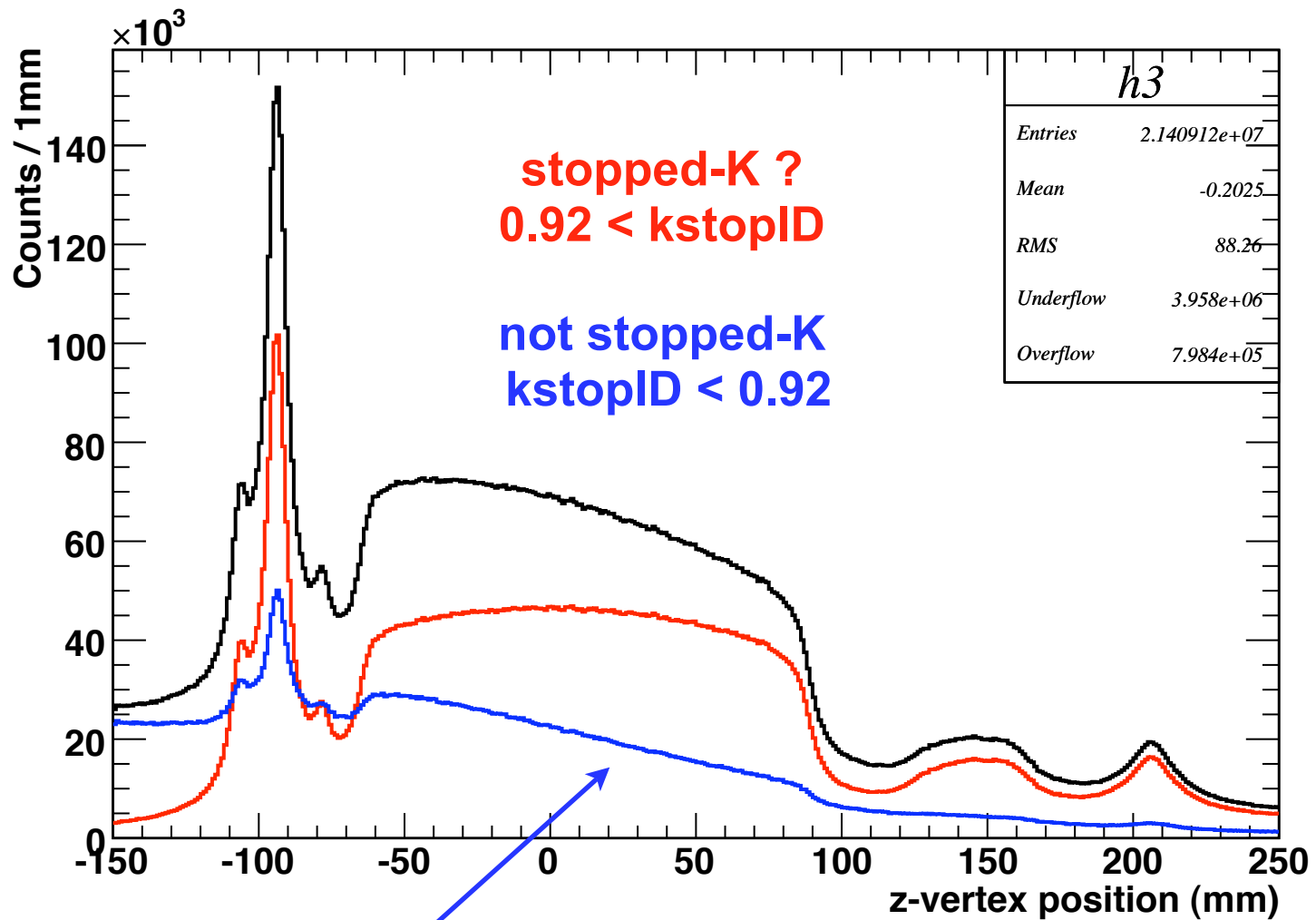
(Continue)

This tendency is not reasonable ?



# Counts

## run 419-500

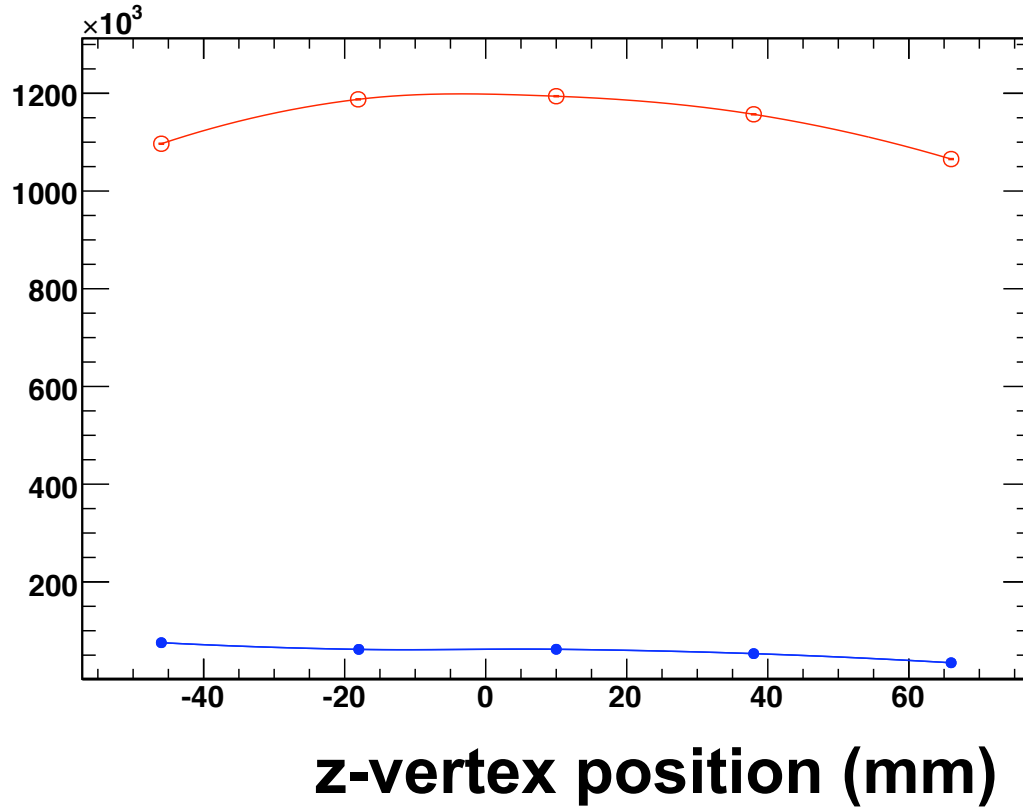


in-flight reaction + decay  
events has a negative slope

# Counts

run 419-500

$0.92 < kstopID < 1.1$



this negative slope is a reasonable possibility (how about simulation...?)

