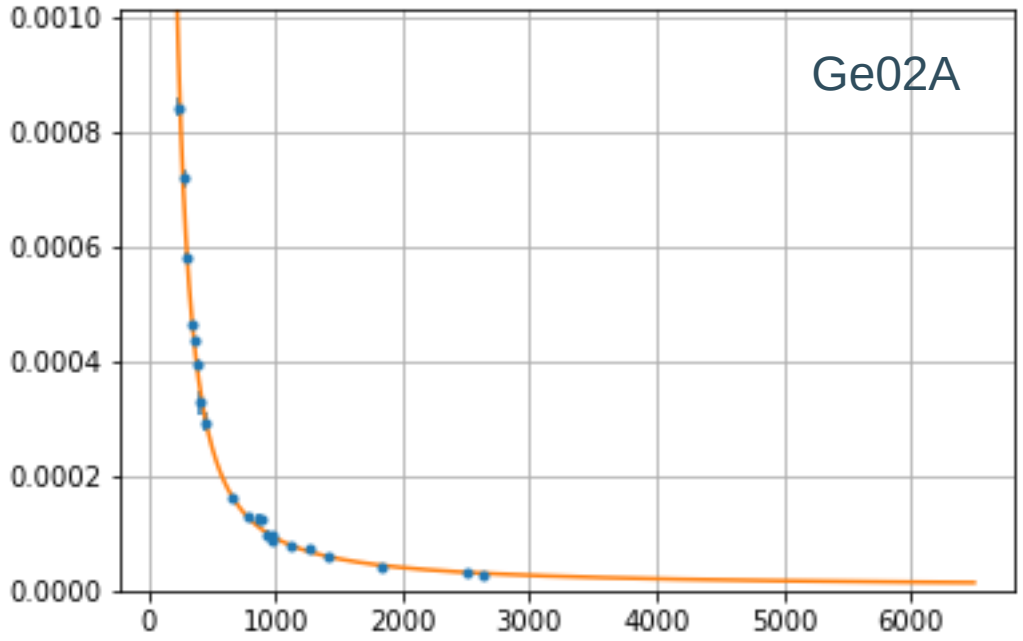
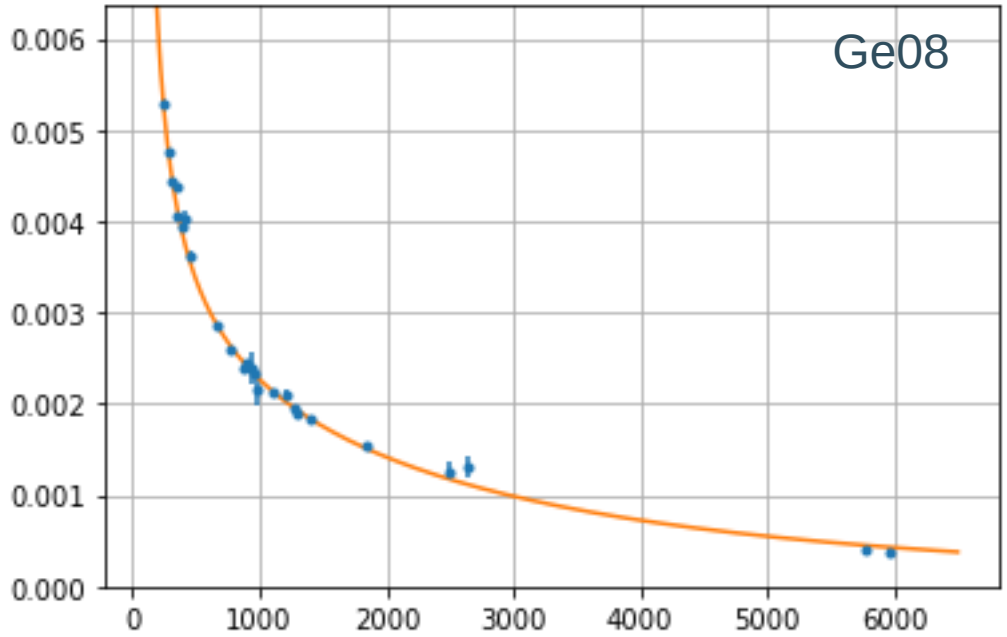
KU LEUVEN

Update muX meeting 16/06

Michael Heines

Fit rescaled efficiency – individual detectors

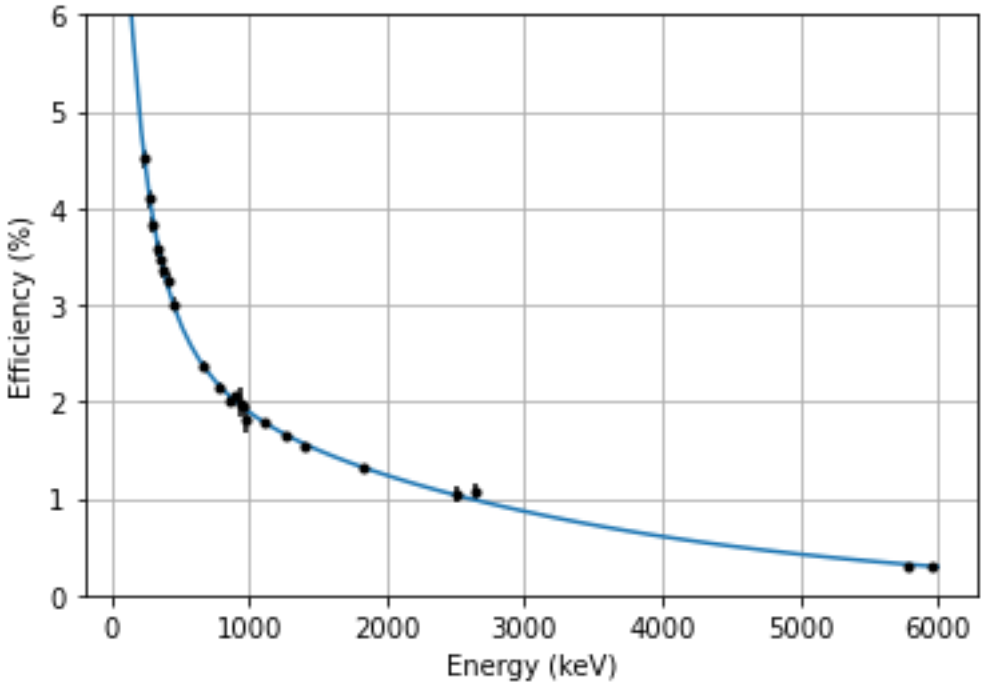




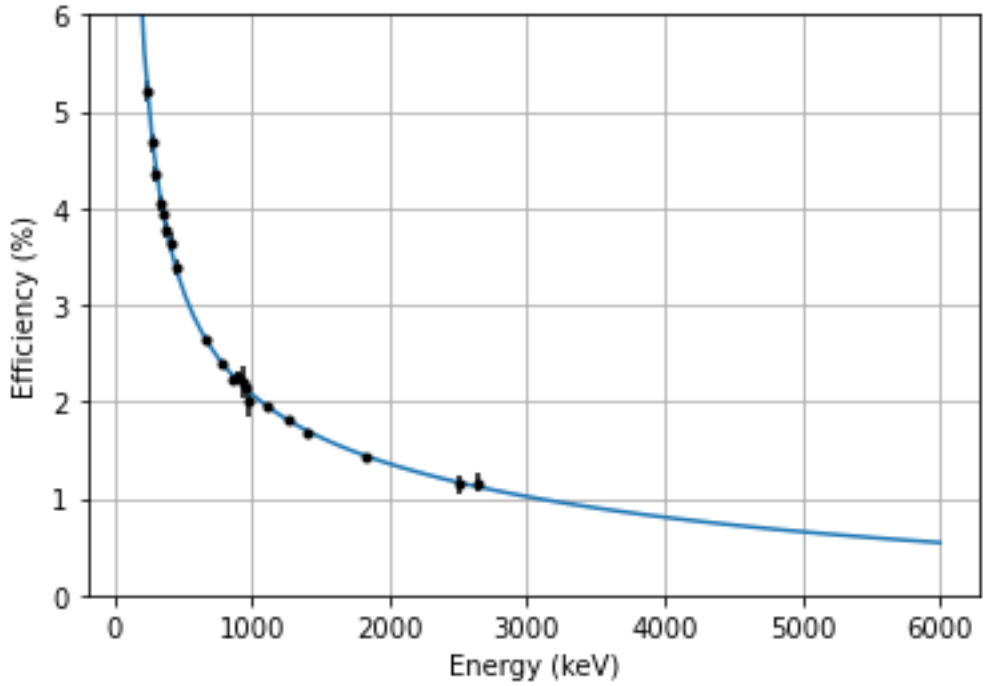
For individual fits, efficiency at 6 MeV tends to be overestimated

Fit rescaled efficiency – All detectors

All detectors that reach 6 MeV



All detectors



Estimating errors

- Standard lmfit method:

```
[[Variables]]
    a0: -50.3964715 +/- 17.0457141 (33.82%) (init = -1)
    a1:  32.4348745 +/- 10.0372420 (30.95%) (init = 0.01)
    a2: -8.01965565 +/- 2.20147080 (27.45%) (init = 0)
    a3:  0.85773288 +/- 0.21308737 (24.84%) (init = 0)
    a4: -0.03411285 +/- 0.00767716 (22.51%) (init = 0)
```

Good fit for detector → Massive uncertainty

Energy (keV)	Efficiency (%)	Absolute uncertainty (%)
700	2.3	1.7e+14
1000	1.9	4.7e+15
6000	0.29	6.0e+23

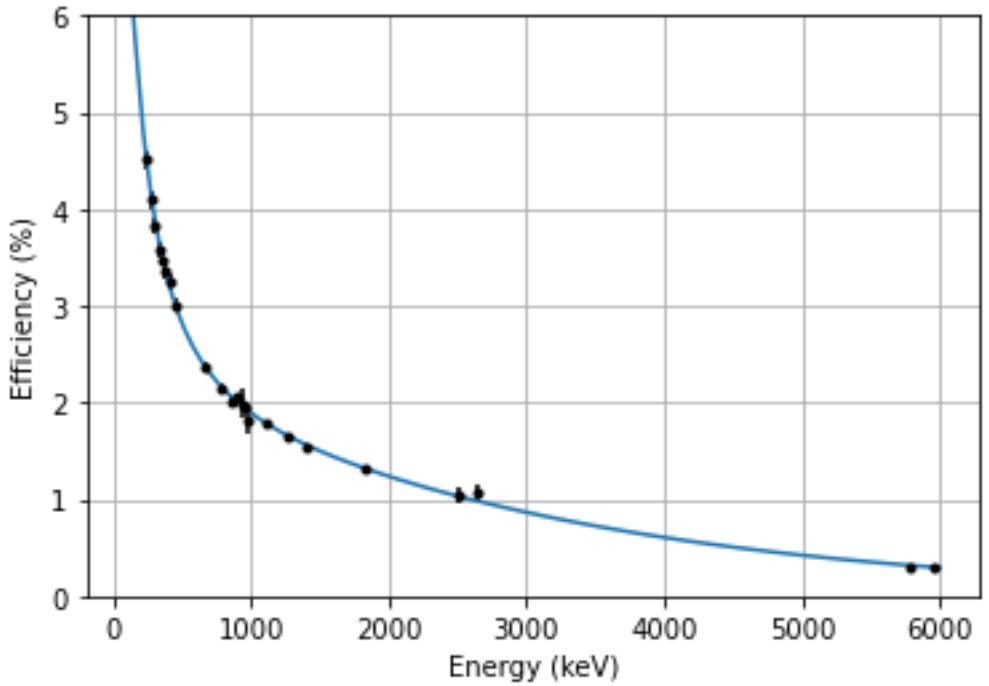
- Heavy correlation → Try to solve with covariance matrix

```
[ 2.906e+02 -1.710e+02  3.746e+01 -3.619e+00  1.300e-01]
[-1.710e+02  1.007e+02 -2.209e+01  2.135e+00 -7.678e-02]
[ 3.746e+01 -2.209e+01  4.846e+00 -4.689e-01  1.687e-02]
[-3.619e+00  2.135e+00 -4.689e-01  4.541e-02 -1.635e-03]
[ 1.300e-01 -7.678e-02  1.687e-02 -1.635e-03  5.894e-05]
```

Very large negative covariances!

$$\sigma_t^2 = \begin{bmatrix} \frac{\partial t}{\partial X} & \frac{\partial t}{\partial Y} \end{bmatrix} \begin{bmatrix} \sigma_X^2 & cov(X,Y) \\ cov(X,Y) & \sigma_Y^2 \end{bmatrix} \begin{bmatrix} \frac{\partial t}{\partial X} \\ \frac{\partial t}{\partial Y} \end{bmatrix}$$

Uncertainty estimation



Detectors	1 MeV	6 MeV
All	2.0792(10)%	/
No Ge06	1.936(9)%	/
high E	1.893(10)%	0.293(10)%
high E, No Ge06	1.750(8)%	0.272(11)%

What about systematics? Hard to quantify…

Planning

- Main issues:
  - Muon stopping range in the order of 1-5 mm
  - Enriched material is expensive

- Ordering:
  - ^{39}K: 500 mg (K mass) of enriched KCl with a purity > 99.97%
  - ^{41}K: 100 mg (K mass) of enriched KCl with a purity > 98.80%

- iThemba wrapping up their developments on the separator
  - Most likely start implanting ^{40}K mid-July
  - Need minimum 8 µAh of ^{40}K (ideally more)

- Tests on 200 mg KOH (roughly same muon stopping) during MIXE?

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