

Comparison of methods for calculating efficiencies

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Counting efficiency

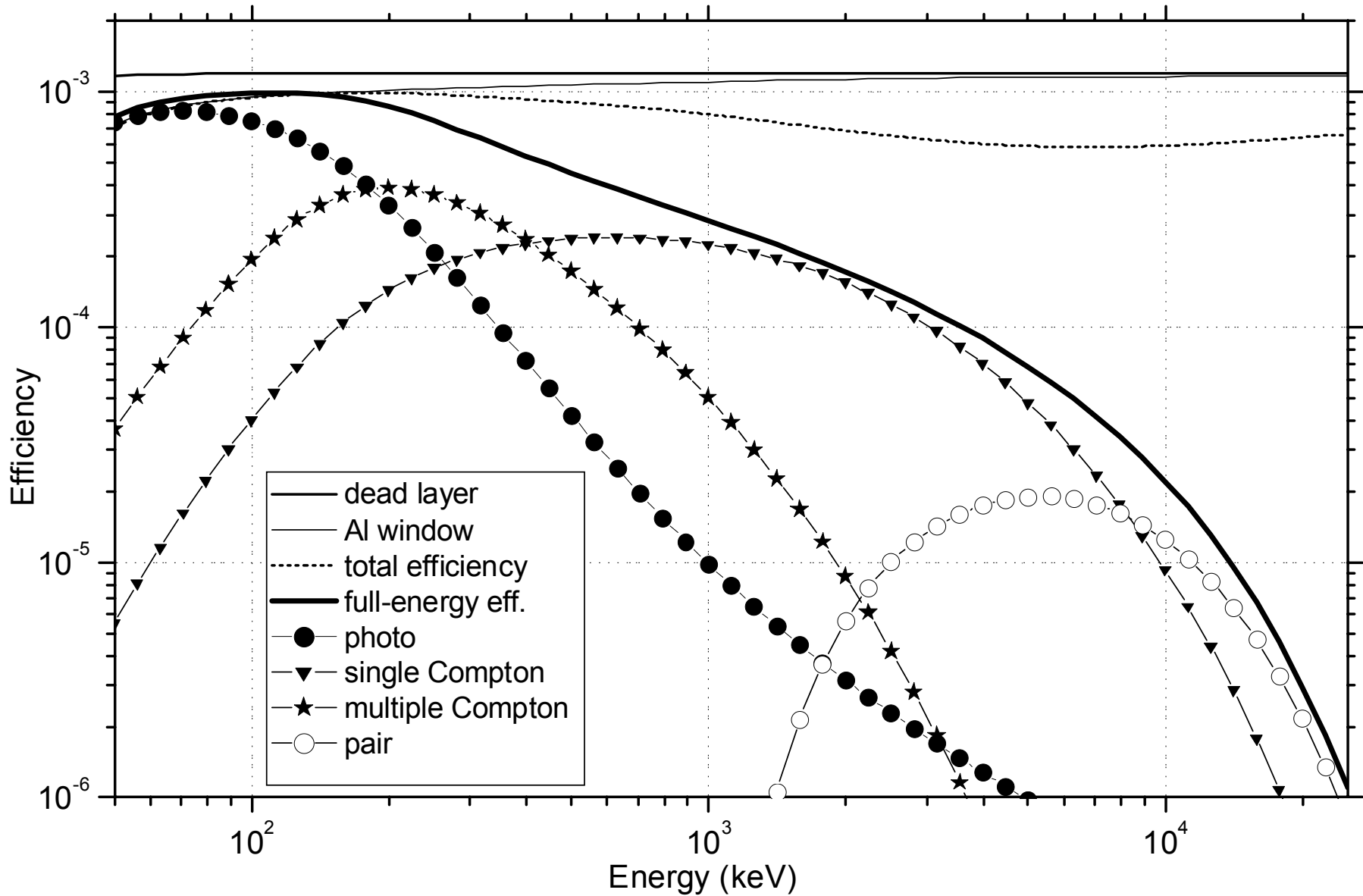
- Efficiency for full energy peaks
- Single event
 - Photo effect
- Multiple events
 - Single Compton scattering + PE
 - Multiple Compton scattering + PE
 - Pair production + PE

Description of efficiency function

- Semiempirical
- Fitting to measured data
 - Free fit (any parameters can be found)
 - Constrained fit (a range for the parameters are allowed based on our knowledge)
- Functions
 - 1 polynomial
 - More polynomials
 - spline

Semiempirical

- Absorption in the Al window
- Absorption in the dead layer
- Total efficiency (close to geometric)
- Photo effect
- Compton scattering
 - Single
 - Multiple
- Pair production



Major contributions

- Low energy
 - Al window
 - Dead layer
- Medium energy
 - Photo effect
 - Multiple Compton scattering
- High energy
 - Single Compton scattering
- (above 6—8 MeV: pair prod)

Polynomials

- n-th order polynomial in log-log scale:

$$\log \varepsilon = \sum a_i \log E^i$$

p^i – i-th order polynomial

op^i -- i-th order orthonormal polynomial

Data provided

- Measured peak areas with unc-s
- Energy, emission probability values (unc-s)
- Activities (unc-s)

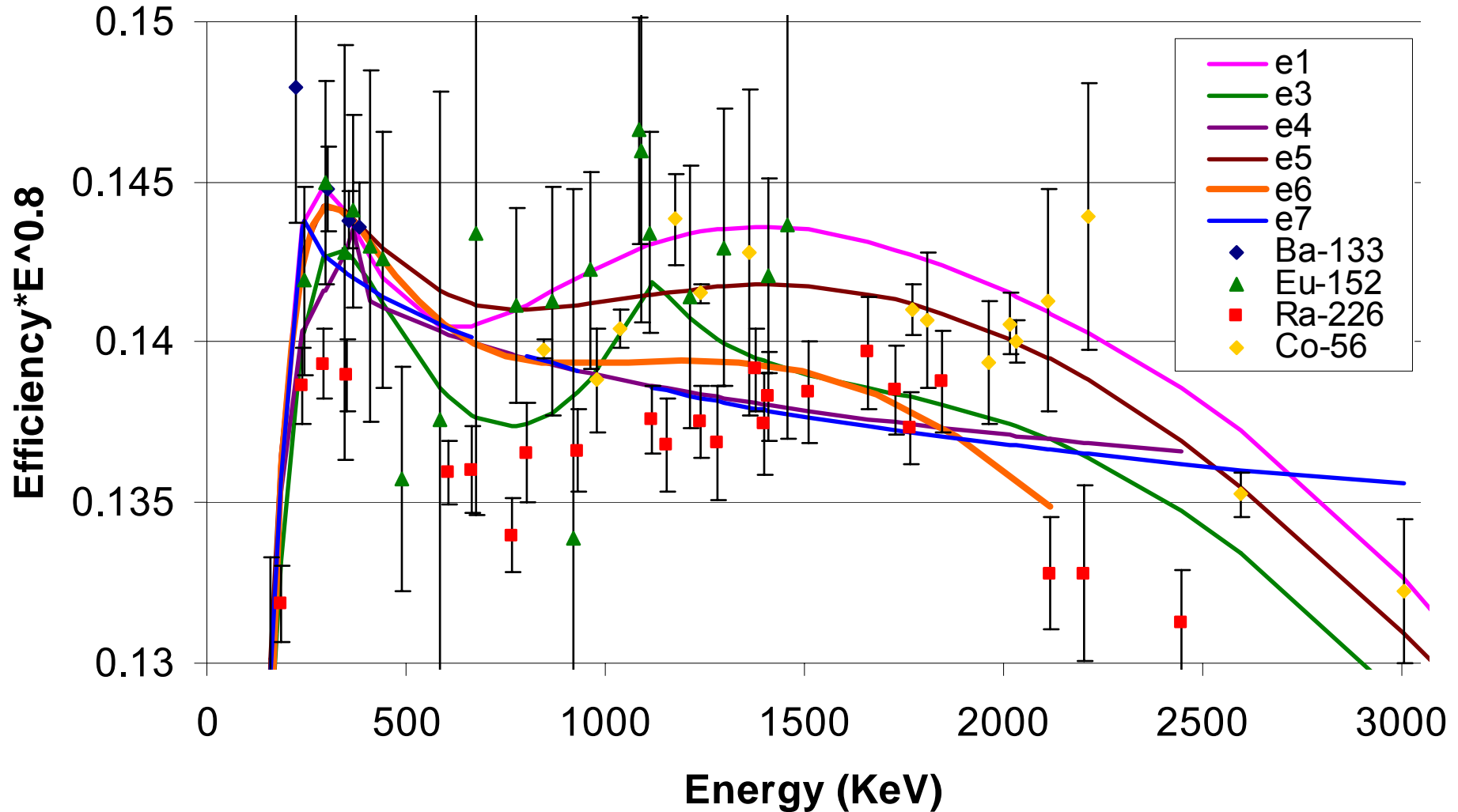
for

- Ba-133 (53—384 keV) absolute source
- Eu-152 (121—1458 keV) abs
- Ra-226 (186—2447 keV) abs
- [Co-56 (847—3273 keV) relative, optional]

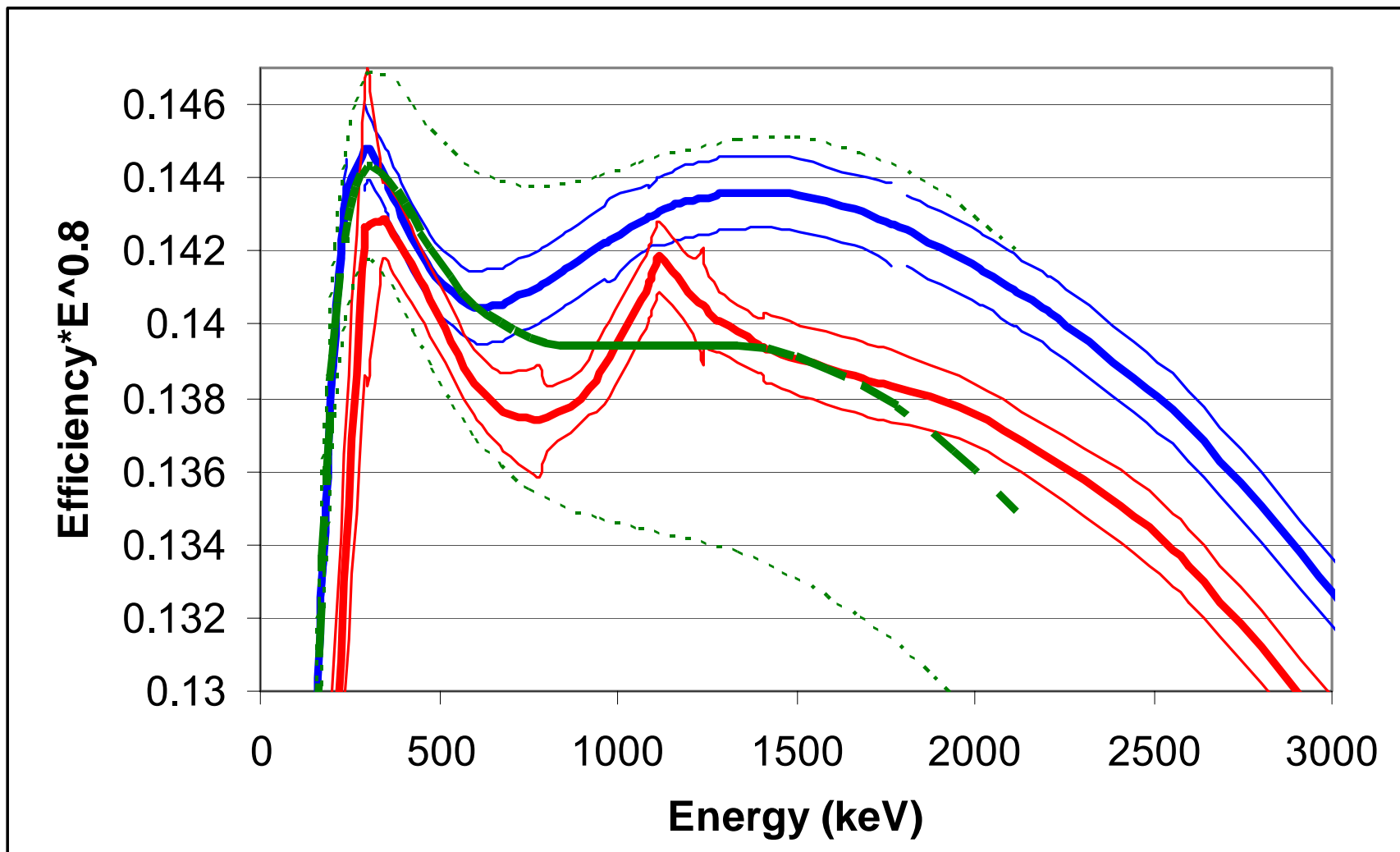
Methods

- 1 – op^8 (IKI) – 1 absolute source
- 2 – op^8 (IKI) – 2 absolute source
- 3 – (50-248): p^4 + (-1127): p^4 + (-3300): p^3
- 4 – (40-400): p^4 + (350-2500): p^1 + (2400-3500): p^1
- 5 – p^5
- 6 – (50-2100) p^4
- 7 – (50-250): p^3 + (250-3000): p^1

Details (measured values + fits)



Fitted functions and confidence intervals



χ^2 values

- 1 4.1
- (2 28.7)
- 3 1.5
- 4 6.5
- 5 5.3
- 6
- 7 6.7

Conclusions

- Literature data are not accurate enough
- Fitted functions do not follow any physically reasonable shape
- More fitted parameters – better fit
- Mid energy reange cannot be fitted with a straight line
- Discrepancies in the percent level