EAGLE array and conversion-electron spectrometers in nuclear structure studies at Heavy Ion Laboratory in Warsaw

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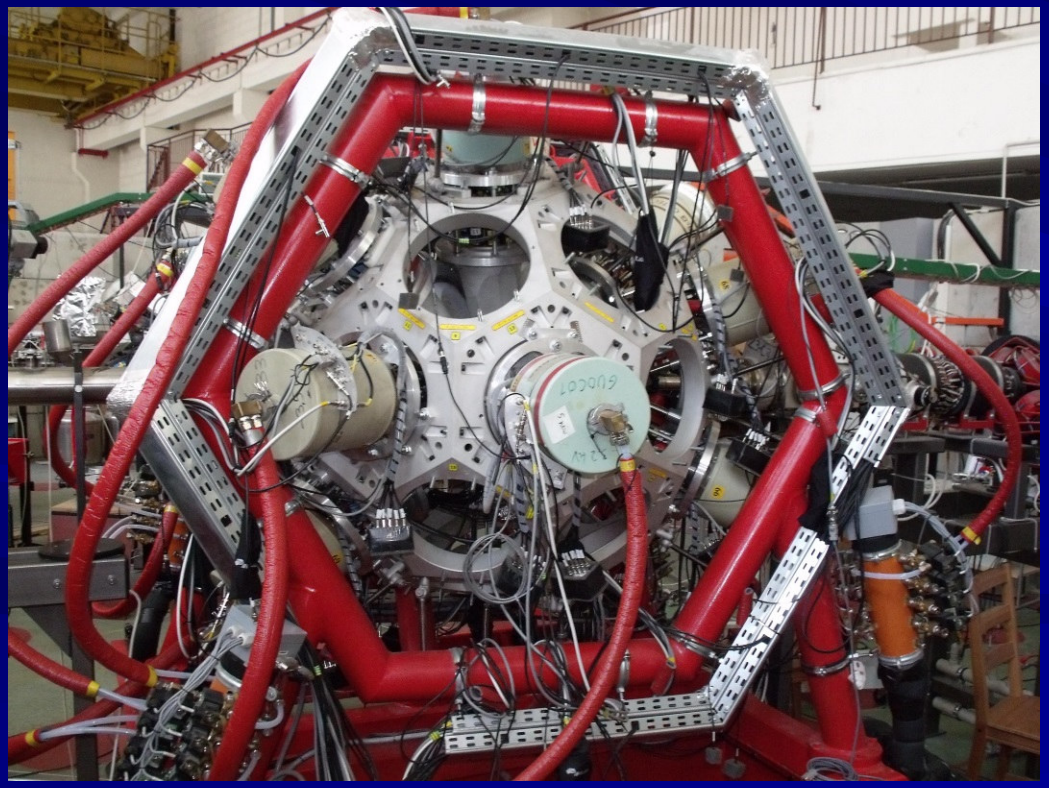

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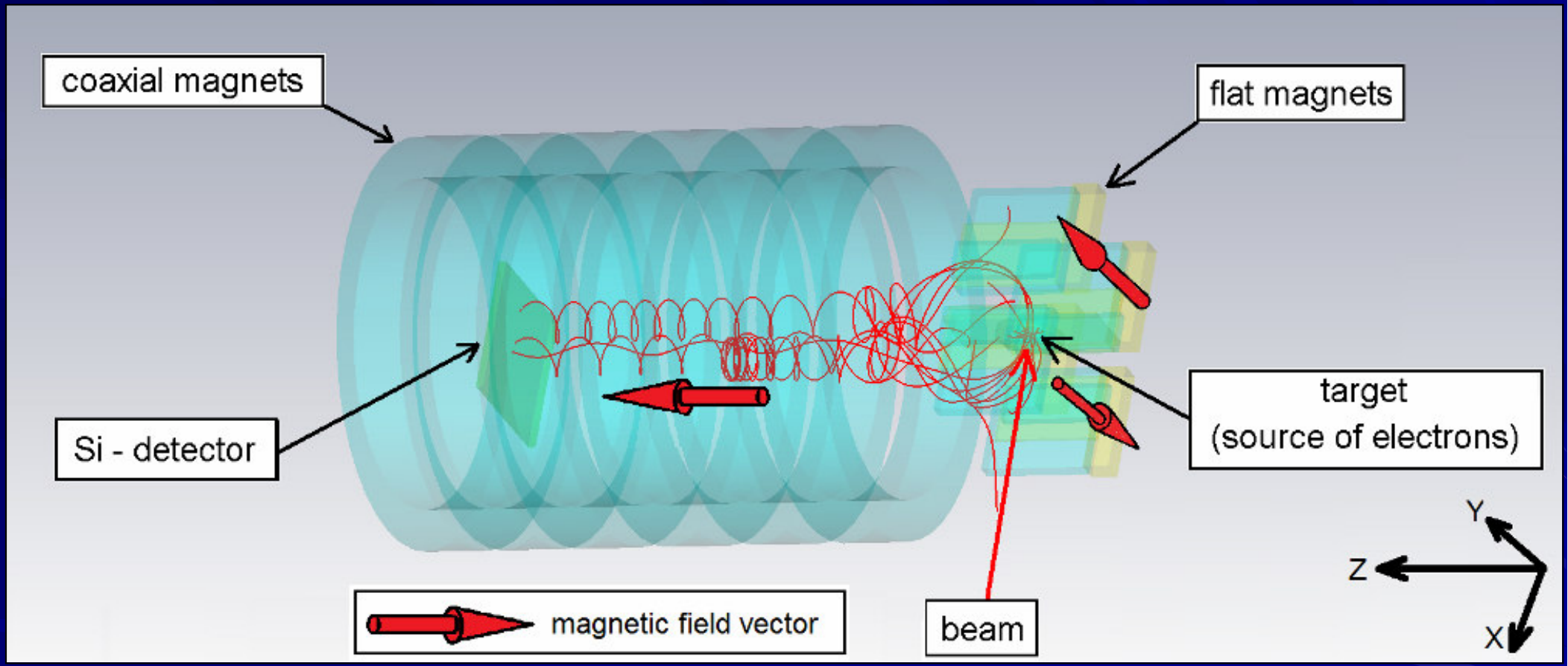
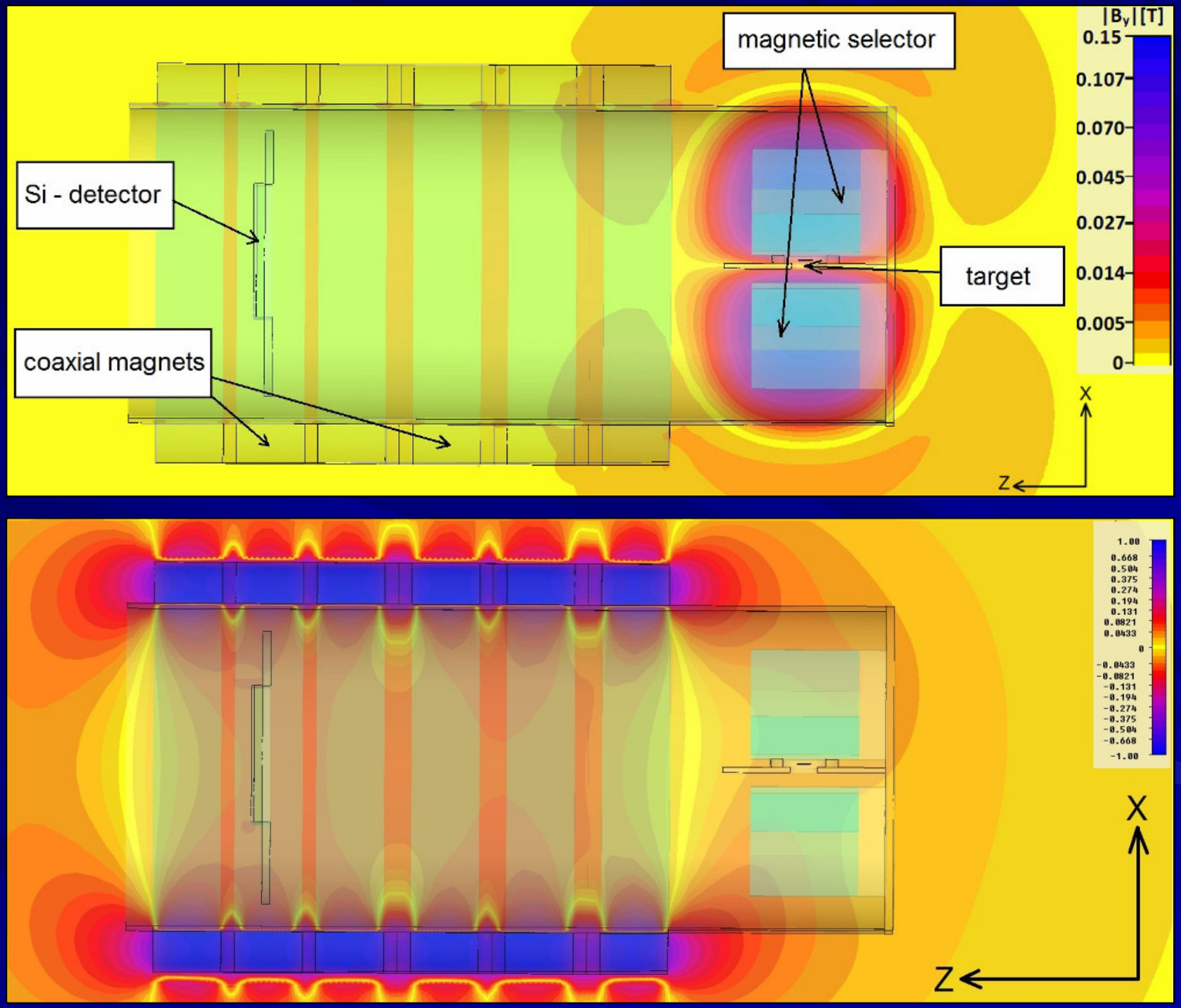
I. The conversion-electron spectrometer

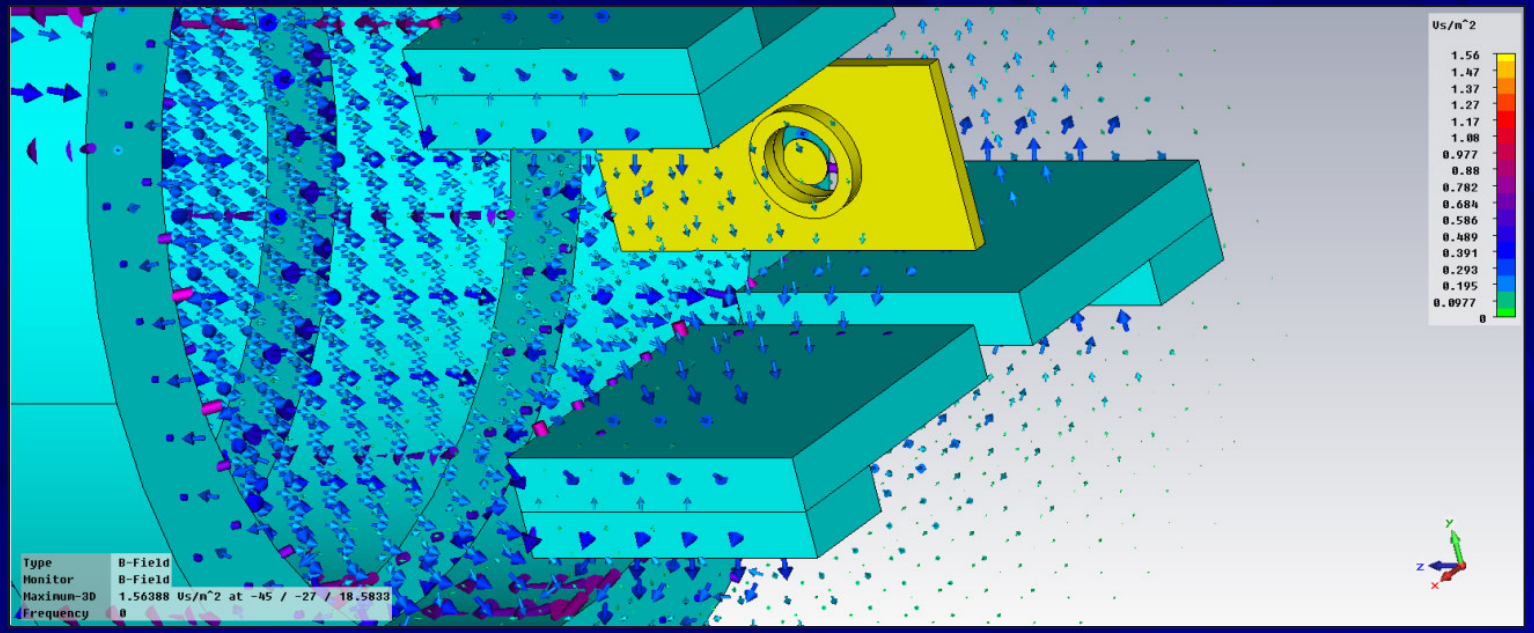
Principles of the project

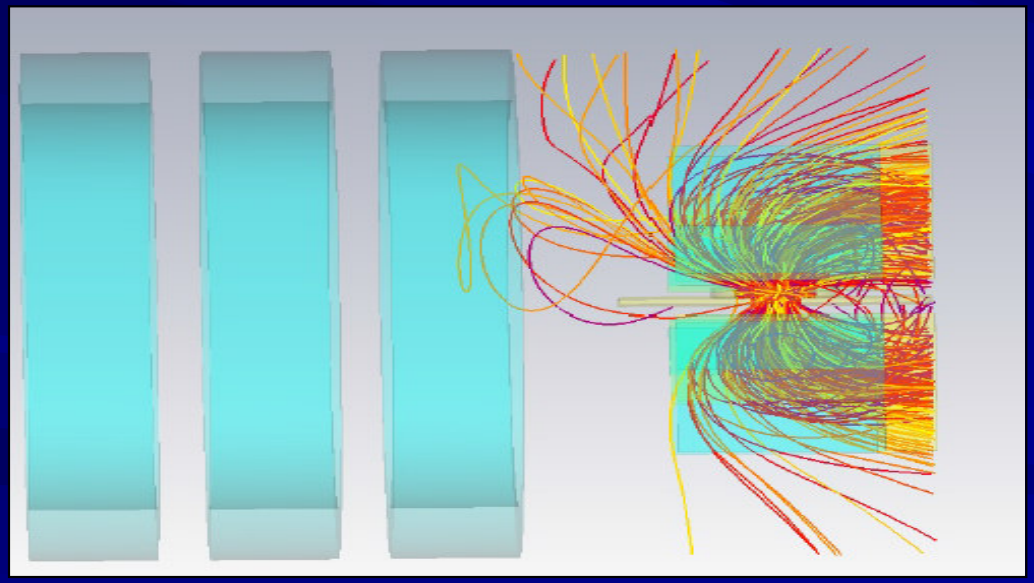


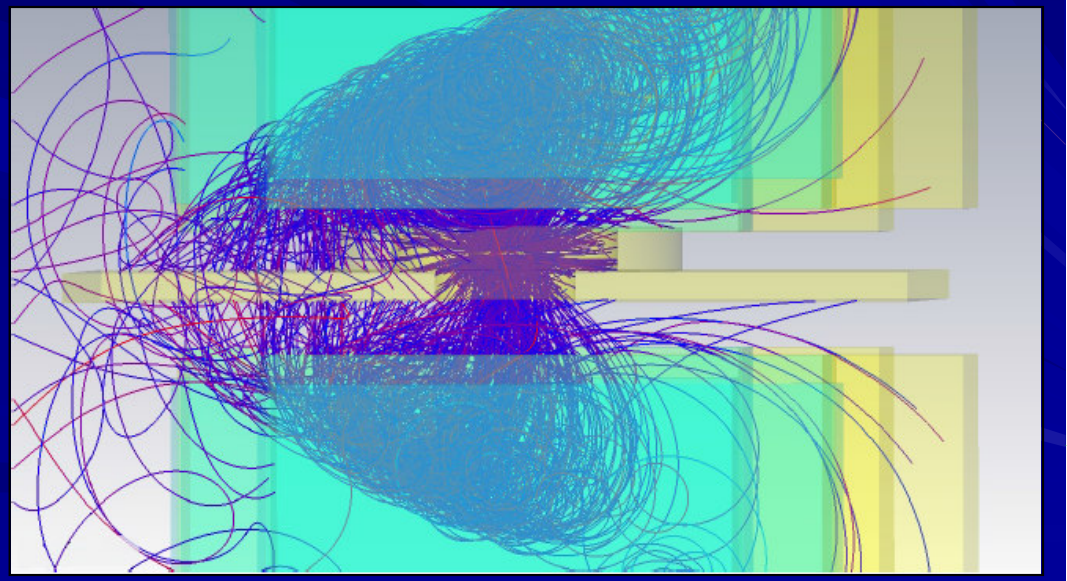
Principles of the project



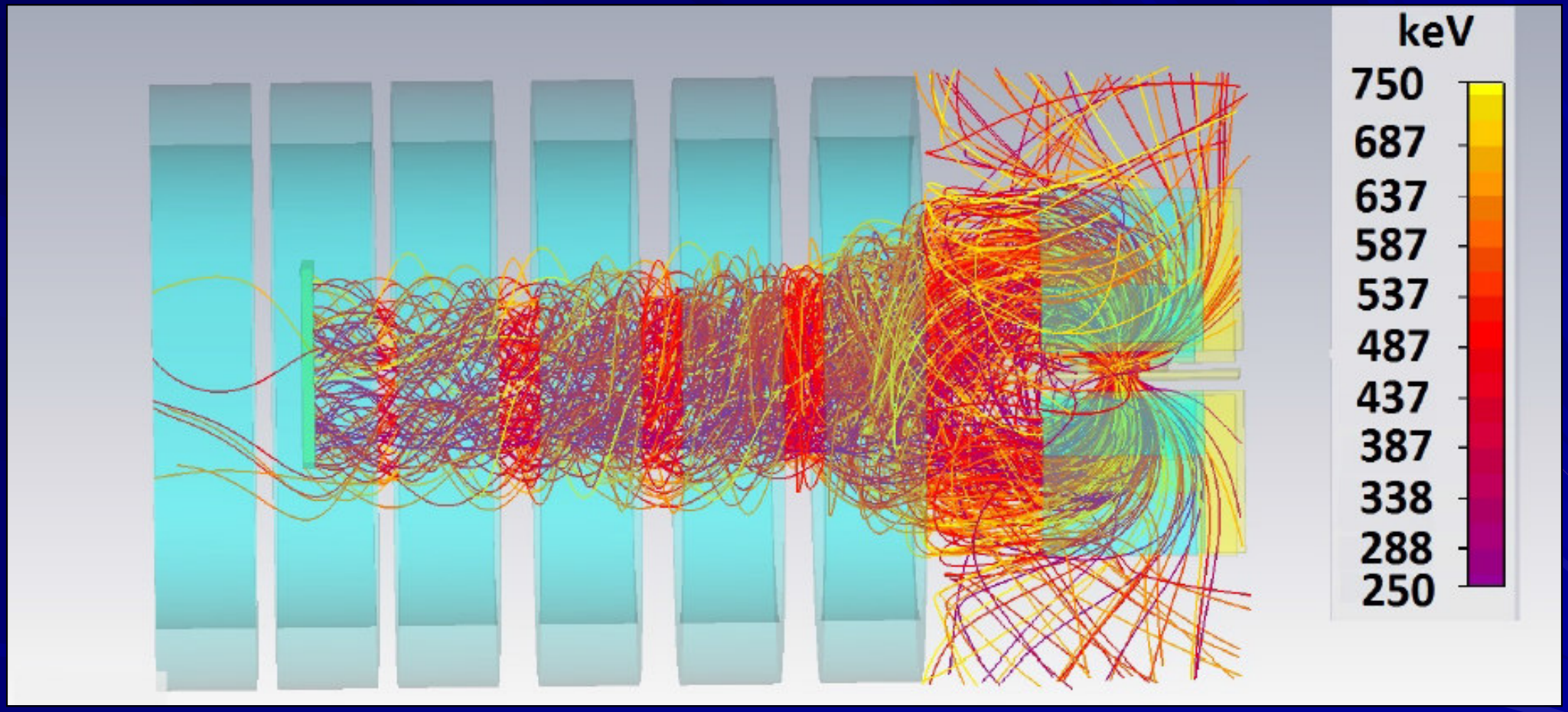
Principles of the project



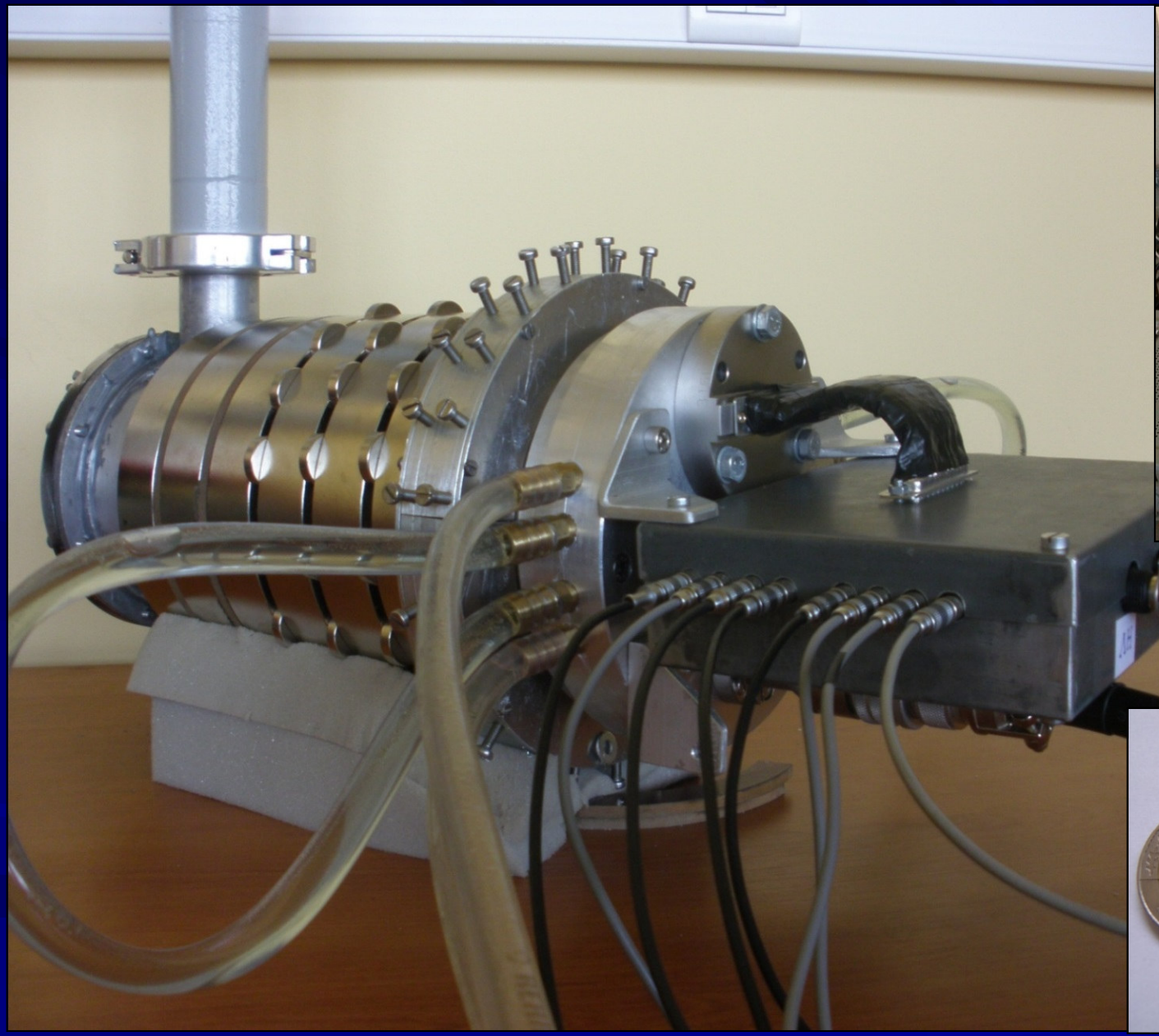


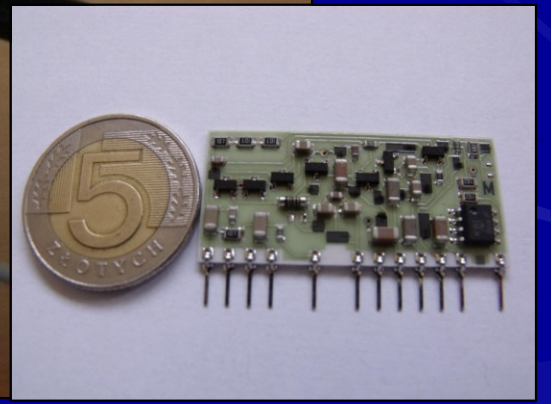


Principles of the project



ULESE (**U**niversity of **L**odz an **e**lectron **s**p**e**ctrometer)





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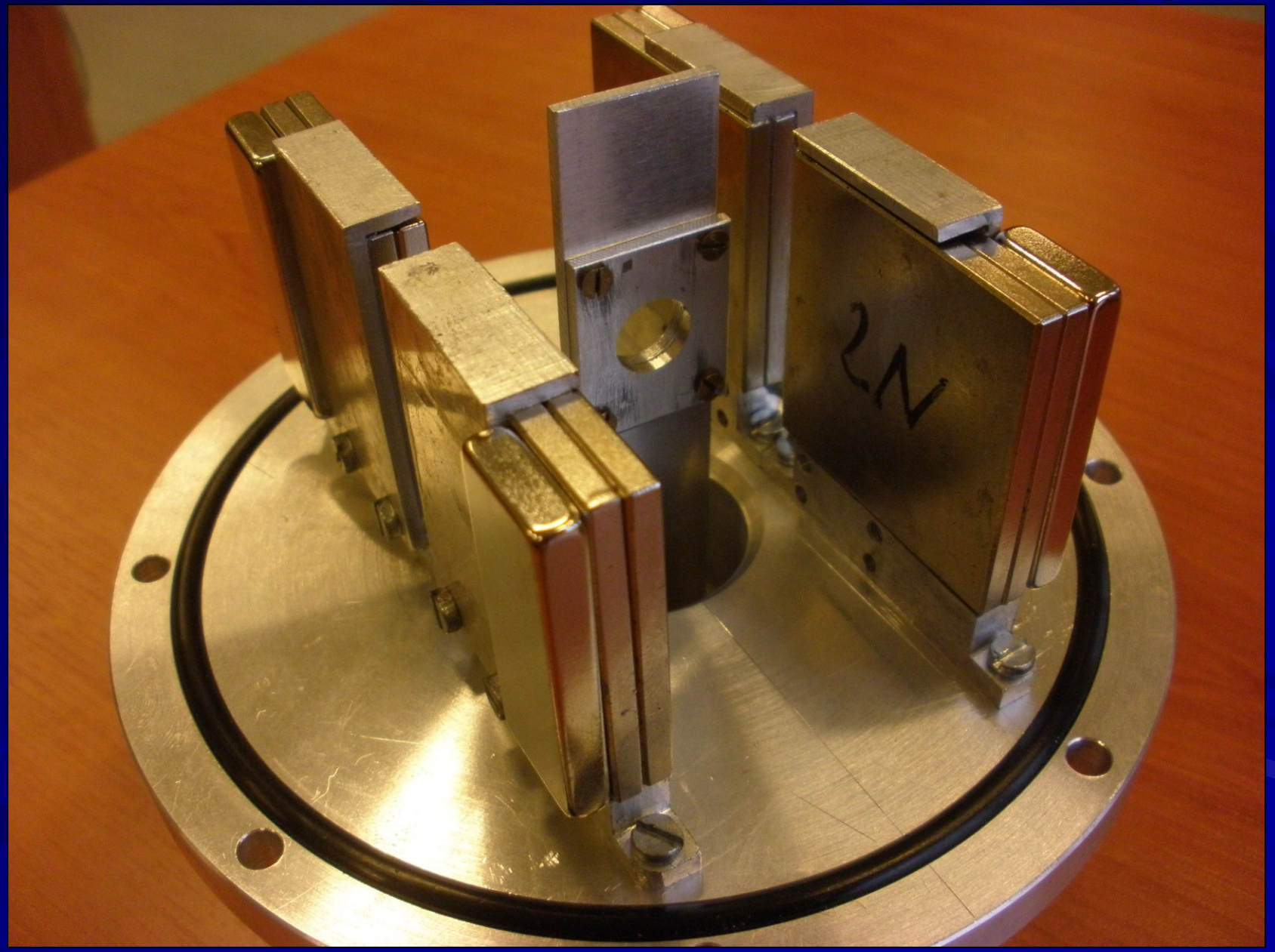

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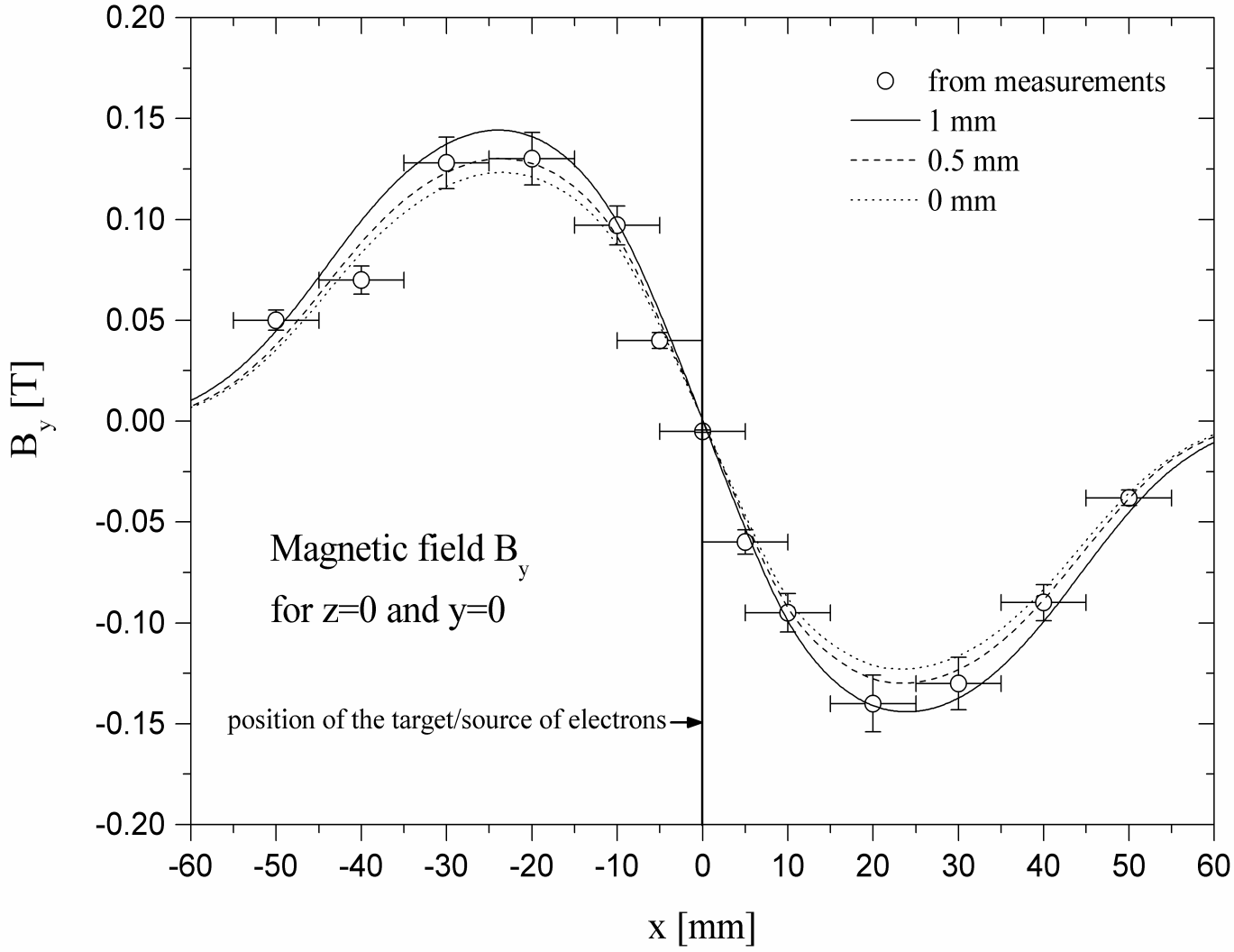

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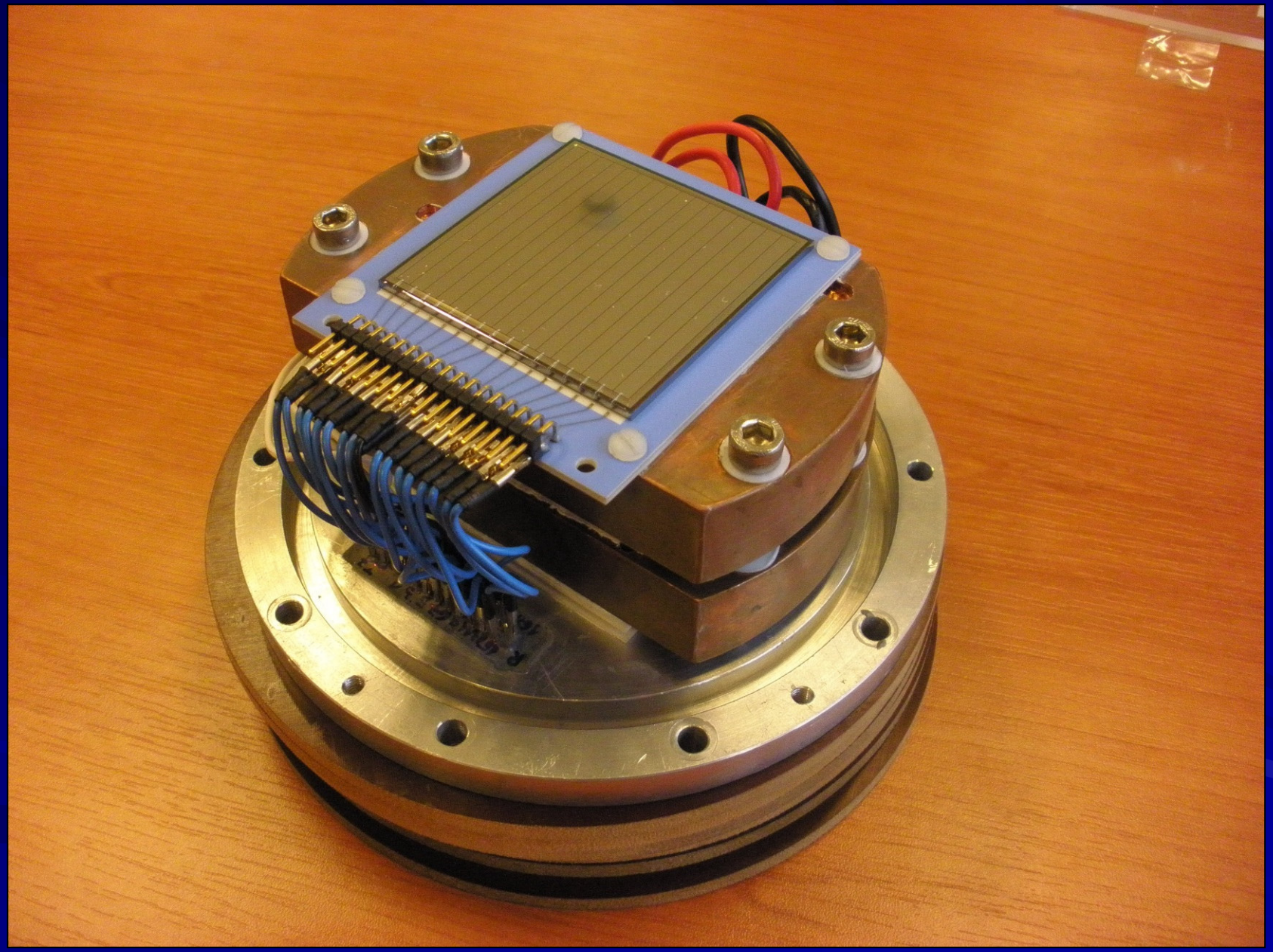
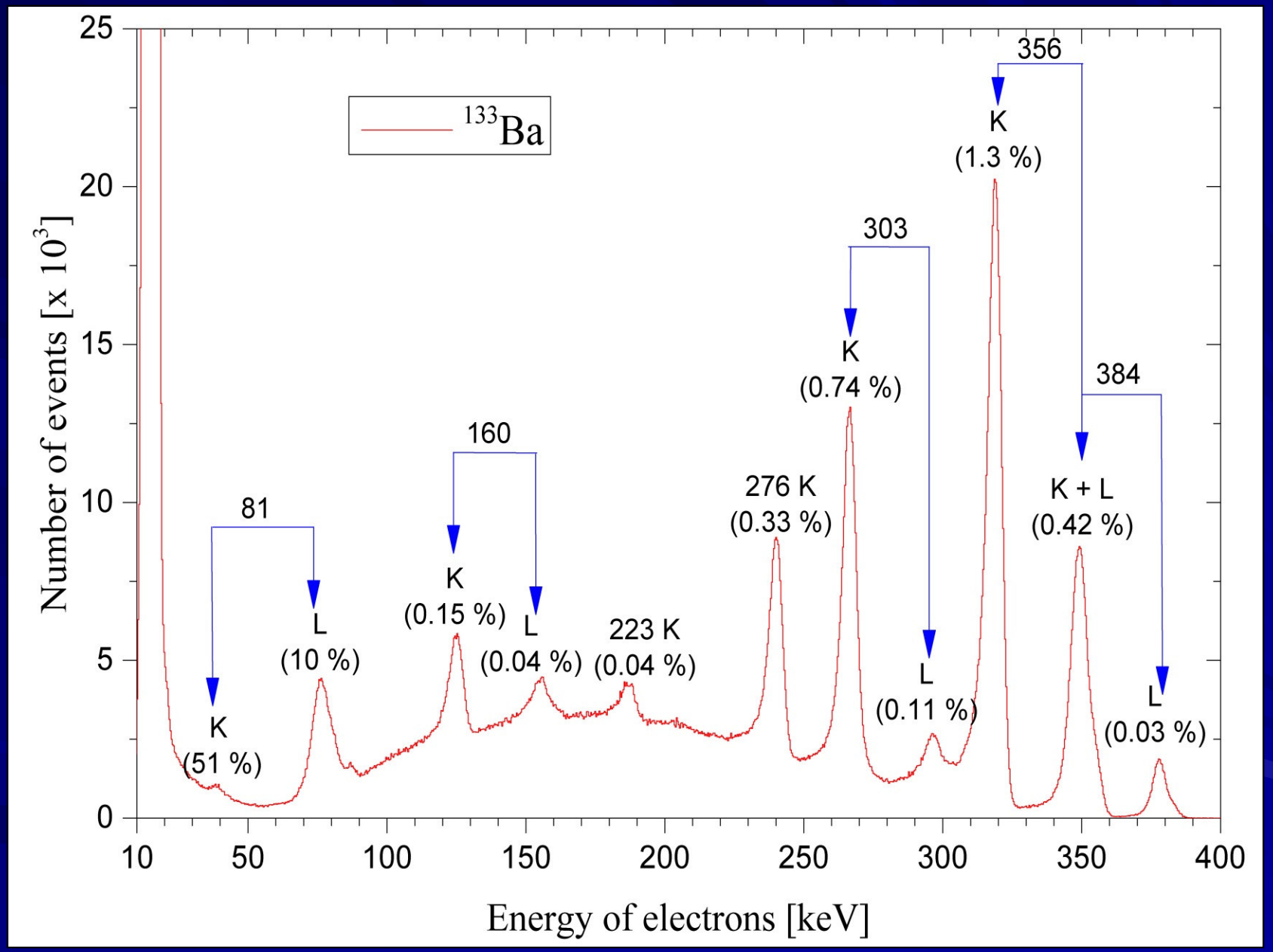


Characteristics of the electrons spectrometer



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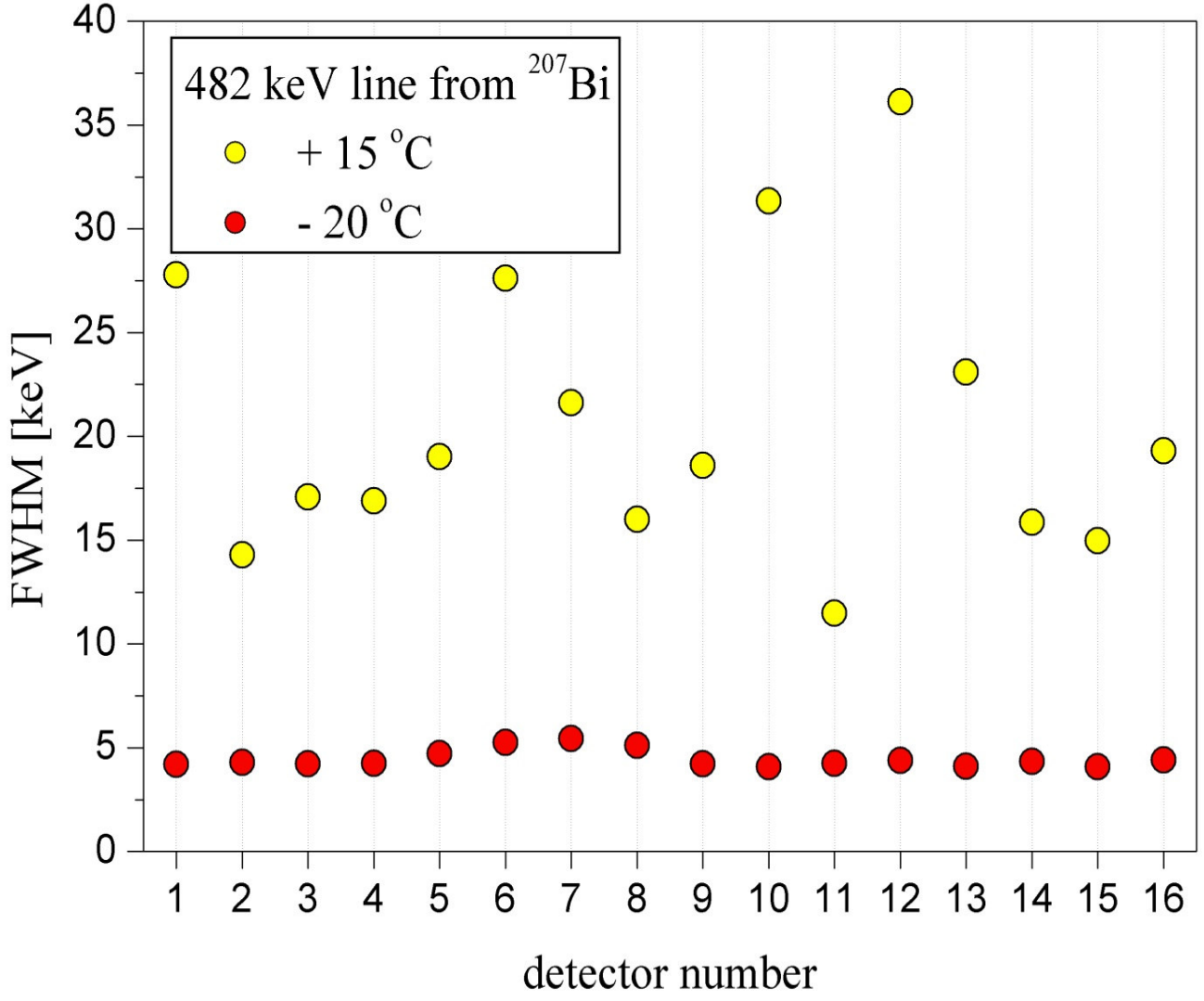

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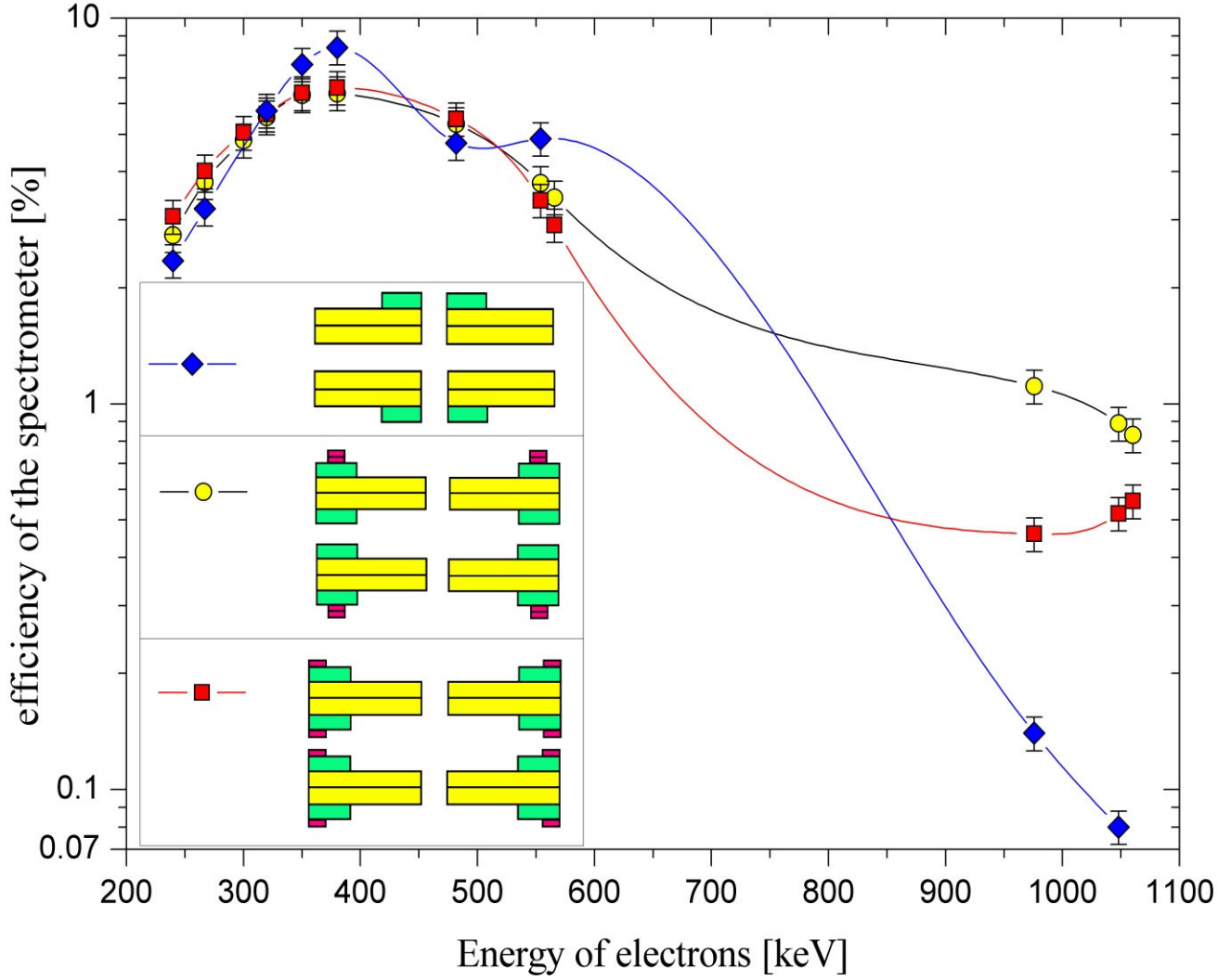

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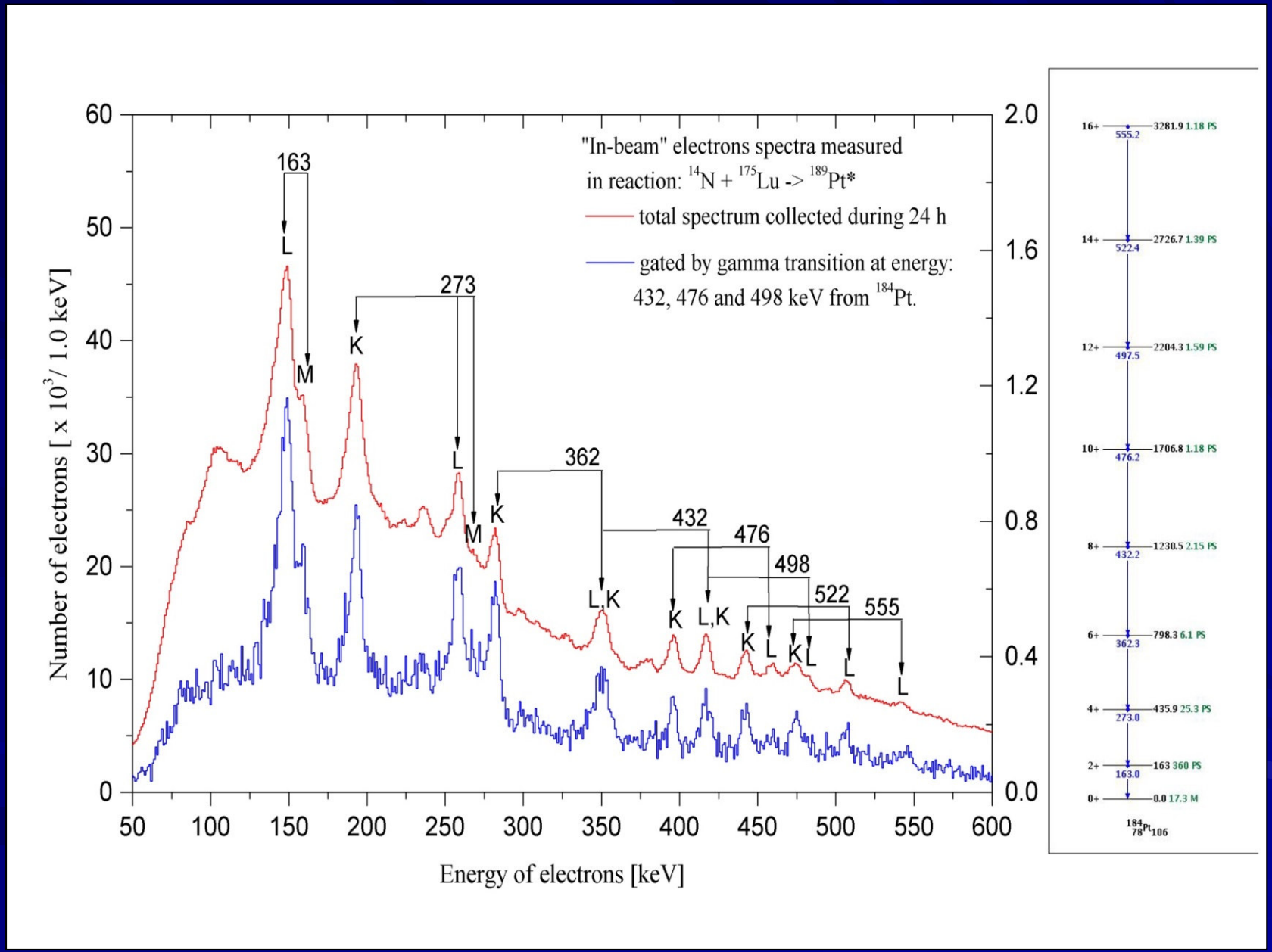

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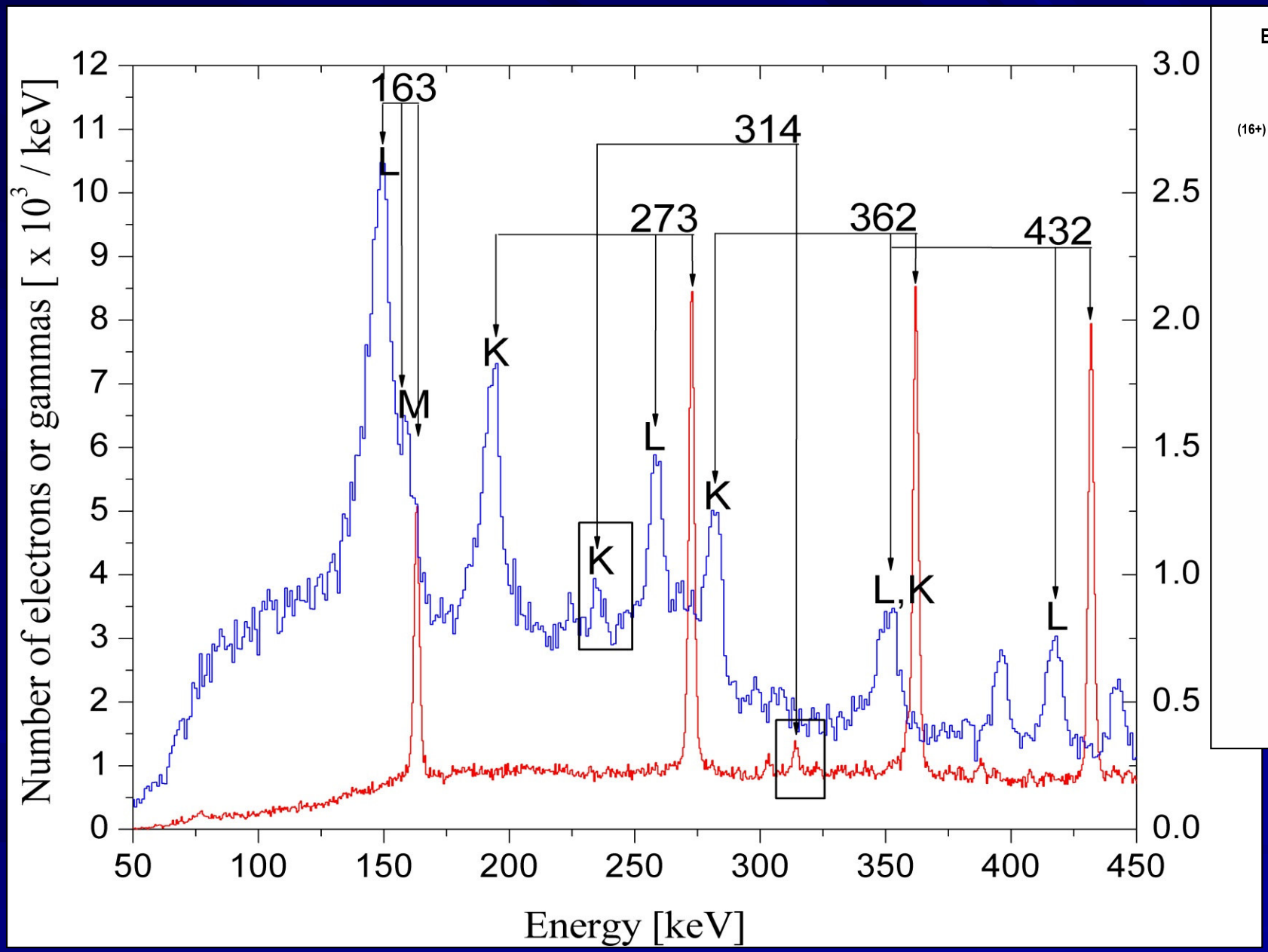
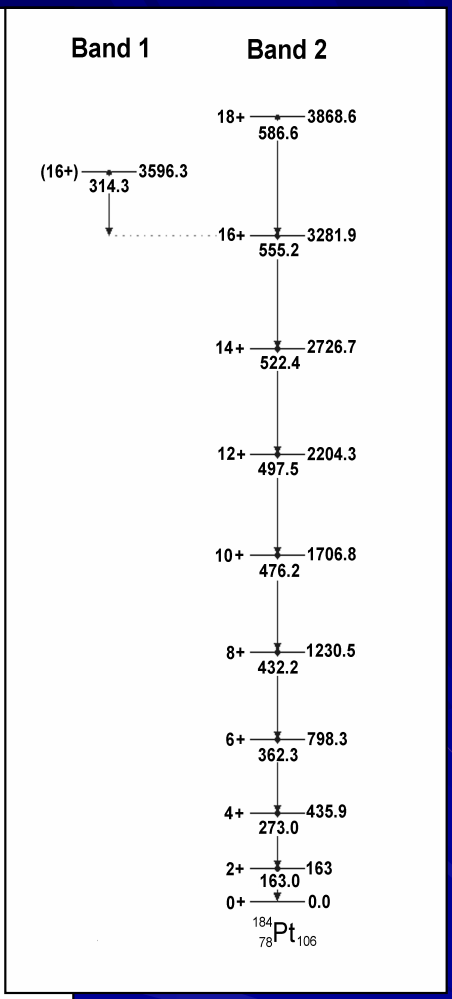




Characteristics of the electrons spectrometer

- Perpendicular symmetry of axis of the spectrometer to an axis of beam,
- Registration of electrons emitted forward and backward directions from the target,
- Elimination of positrons,
- Minimization of delta electrons with using the magnet selector (flat magnets) and special shape of the target holder,
- Increasing of efficiency of the spectrometer by coaxial magnets,
- Compact form,
- Photon background minimized by special shape of the target holder,
- Using the 16 segmented Si detector at active area 25 cm^2 at thickness 1.5 mm,
- Cooling down the detector by the system of two Peltier modules (267 W each).

II. Study of $K^{\pi}=8^{-}$ isomers for N=74 and N=106

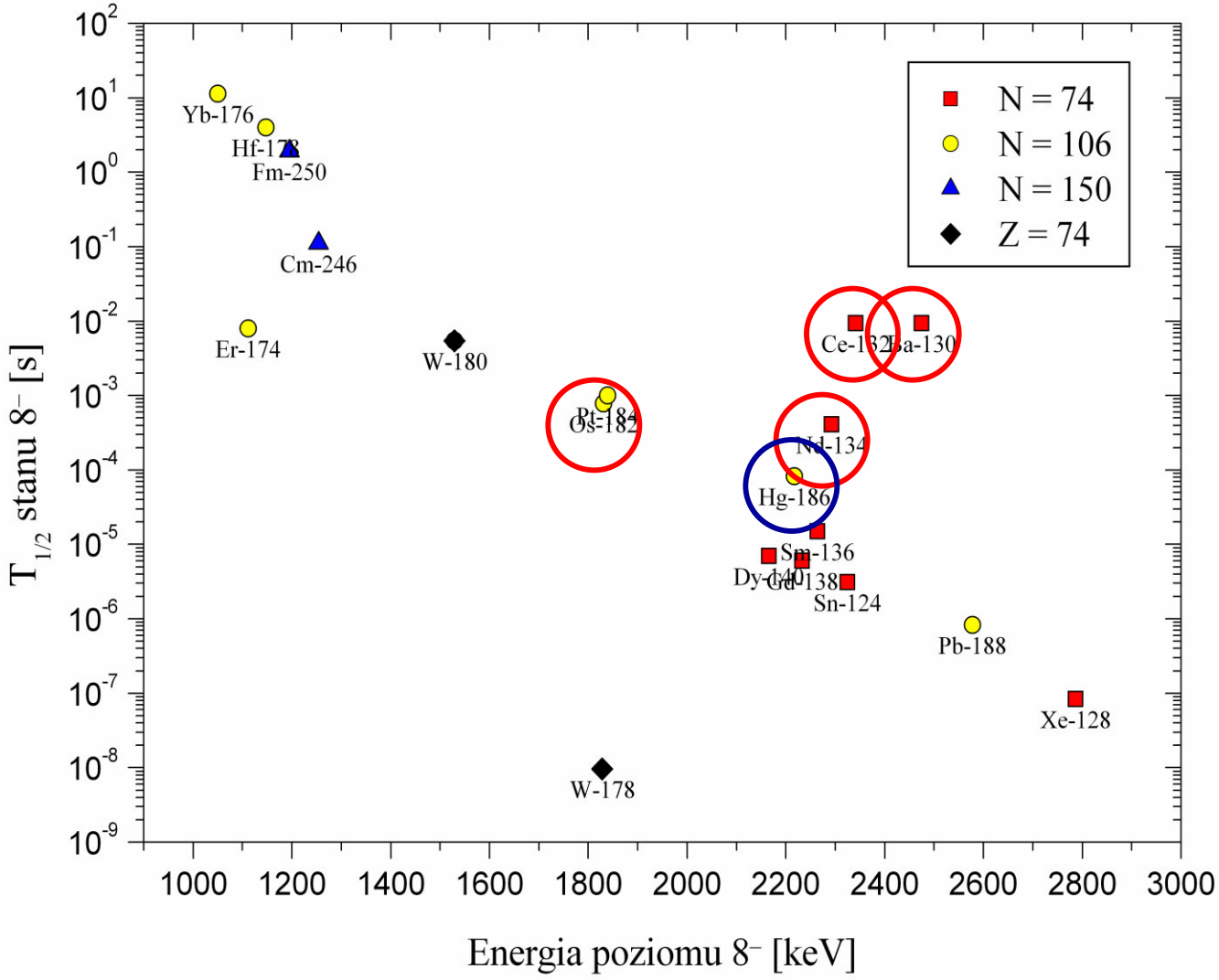
Motivation

The problem of the K selection rule violation for electromagnetic transitions in nuclei is not yet well understood.

Possible explanations of this phenomenon are:

- The Coriolis mixing of states with different *K* values,
- The orientation of the angular momentum represents a new degree of freedom. Decay modes involving large *K* differences represent large changes of the orientation,
- The tunneling motion in the γ-deformation is degree of freedom. This mechanism is important for γ-soft nuclei.

Motivation


N = 74
N = 106
N = 150
Z = 74
Yb-176
Hf-178
Fm-250
Cm-246
Er-174
W-180
Os-182
Ce-132
Ba-130
Nd-134
Hg-186
Sm-136
Dy-140
Gd-138
Sn-124
Pb-188
Xe-128
W-178
$T_{1/2}$ stanu 8^- [s]
Energia poziomu 8^- [keV]

Motivation

The interpretation of the $K^{\pi}=8^{-}$ isomeric state.

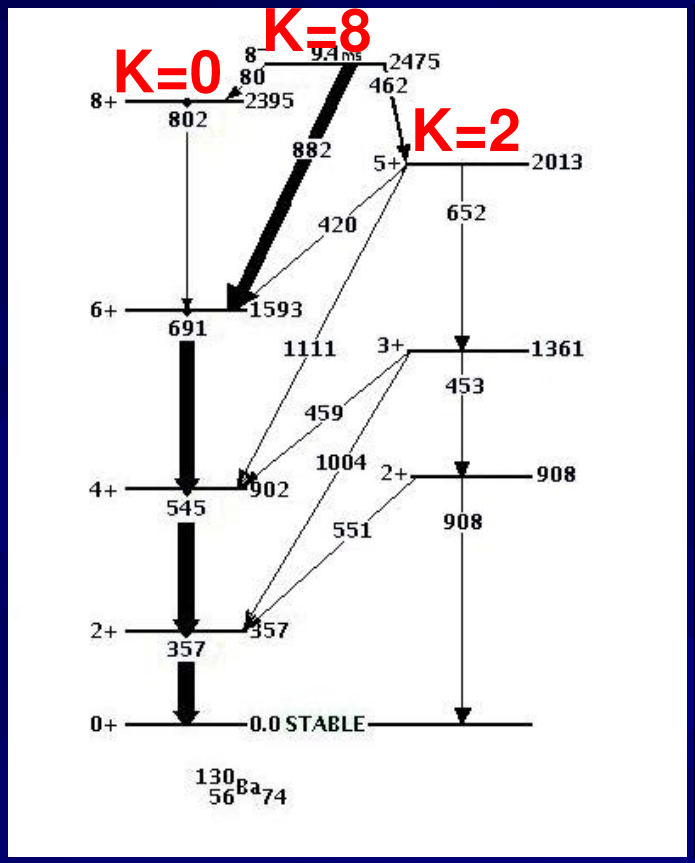
N = 74, (50 + 24) → **$\nu 7/2^{-}[404] \otimes \nu 9/2^{-}[514]$**

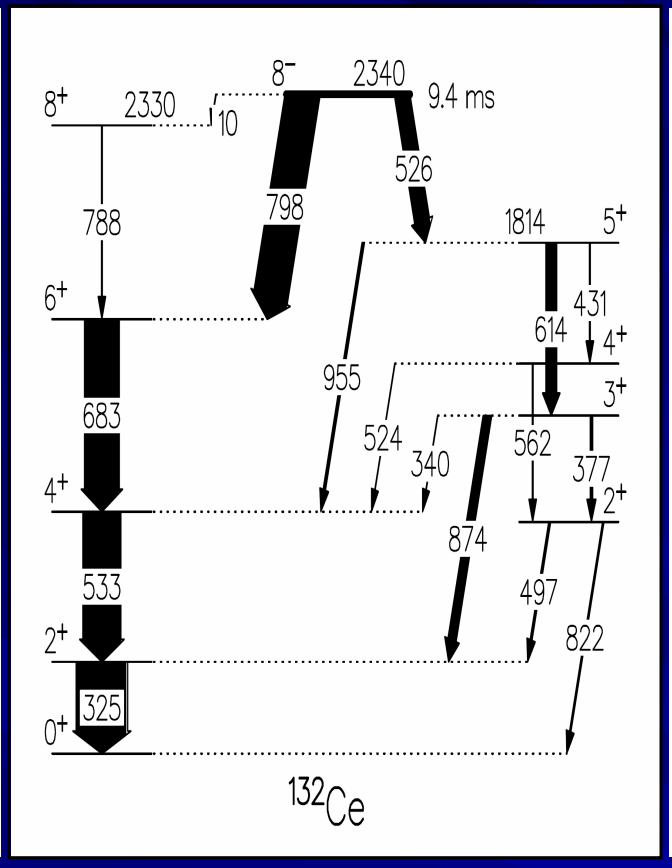
N = 106, (82 + 24) → **$\nu 7/2^{-}[514] \otimes \nu 9/2^{+}[624]$**

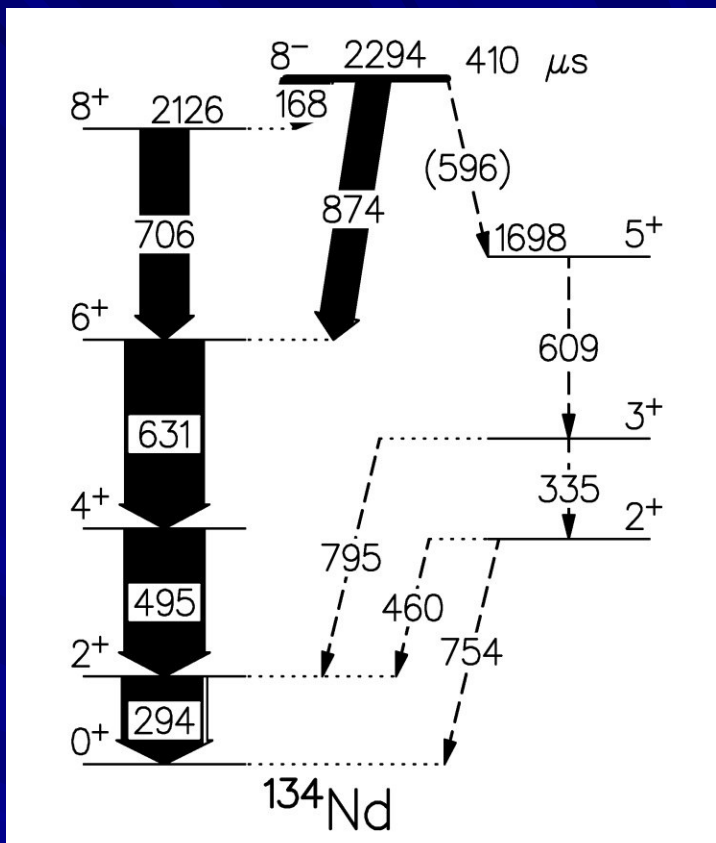
N = 150, (126 + 24) → **$\nu 7/2^{-}[624] \otimes \nu 9/2^{-}[734]$**

where: $\Omega[N\Lambda n_z]$

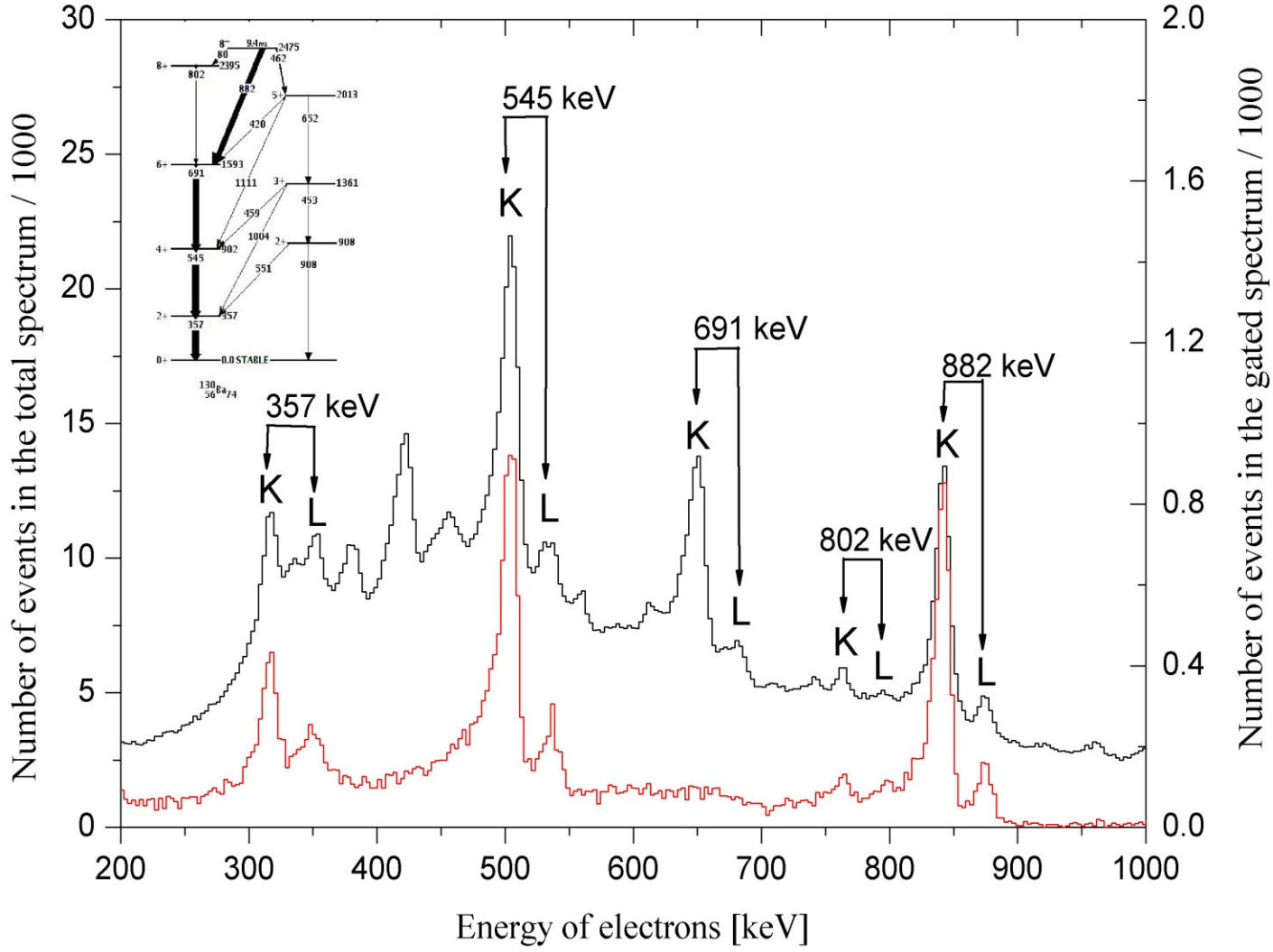
Motivation


K=8
K=0
K=2
8−
9.4ns
2475
80
462
8+
2395
802
882
5+
2013
652
420
6+
1593
691
1111
3+
1361
453
459
1004
2+
908
4+
902
545
908
551
2+
357
357
0+
0.0 STABLE
130 56Ba74

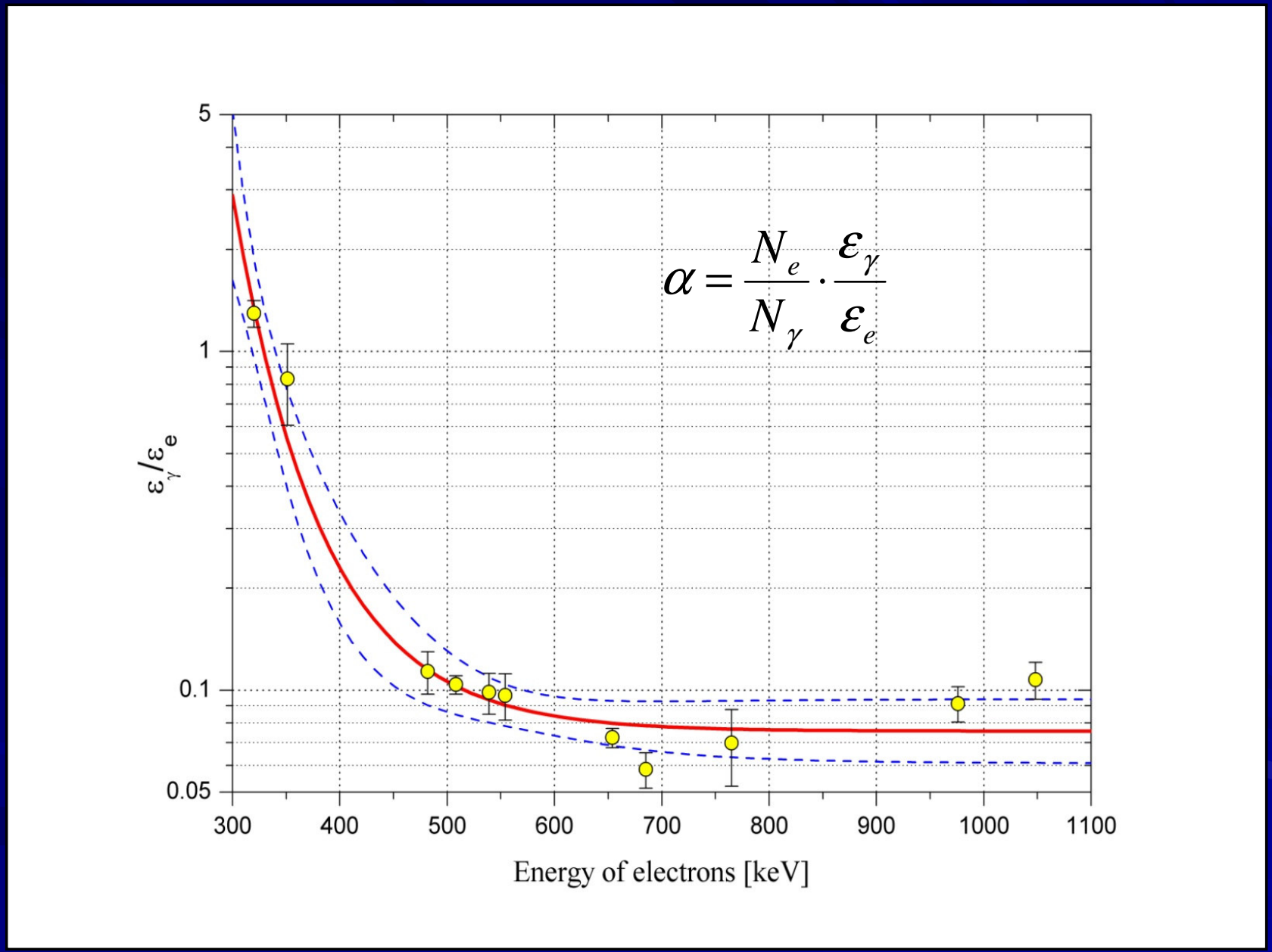

8+
2330
10
8−
2340
9.4 ms
526
798
788
1814
5+
431
614
4+
955
3+
683
524
340
562
377
4+
2+
874
533
497
2+
822
325
0+
132Ce


8−
2294
410 μs
8+
2126
168
(596)
874
706
1698
5+
6+
609
3+
631
335
4+
2+
795
495
460
754
2+
294
0+
134Nd

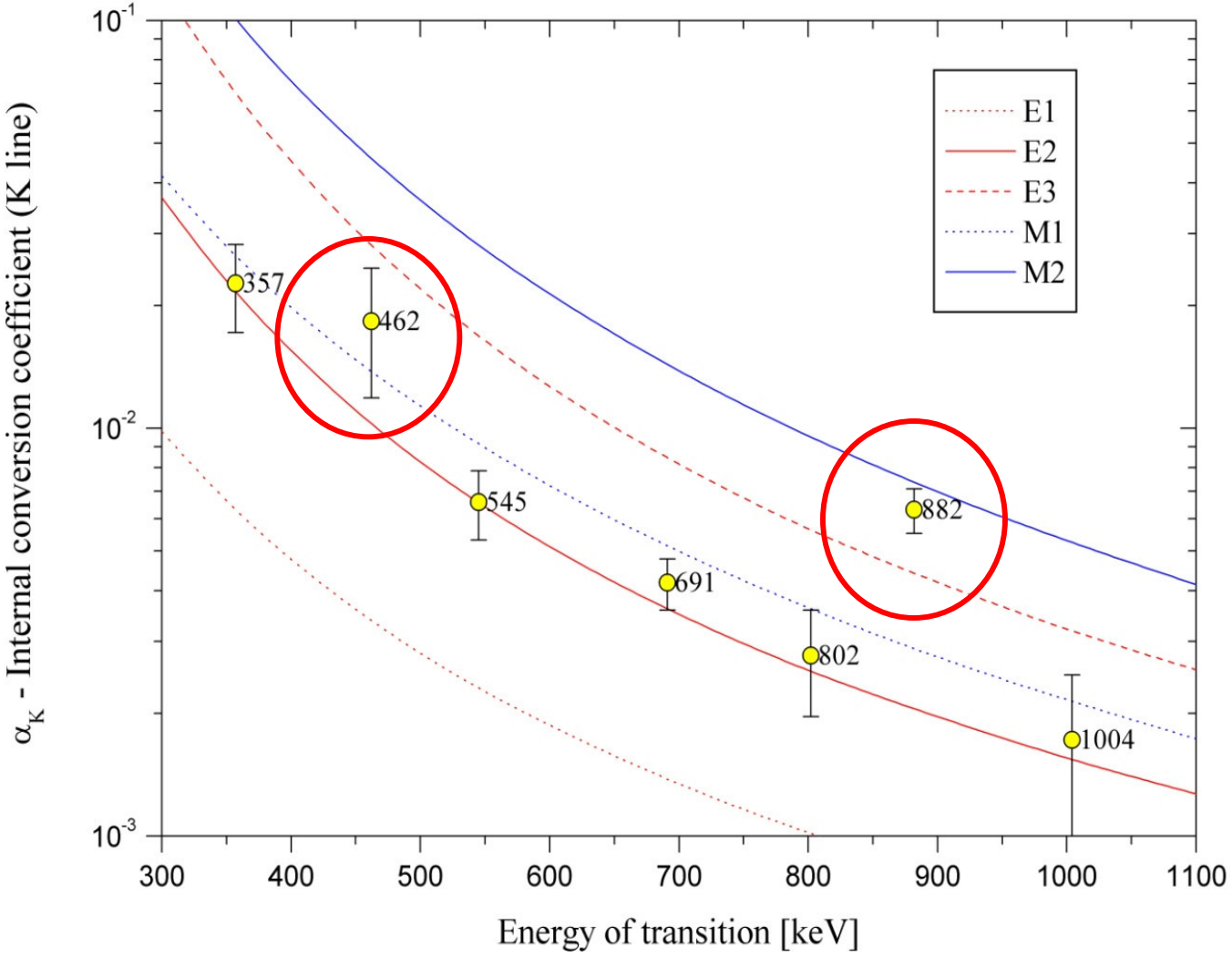
Results for ^{130}Ba



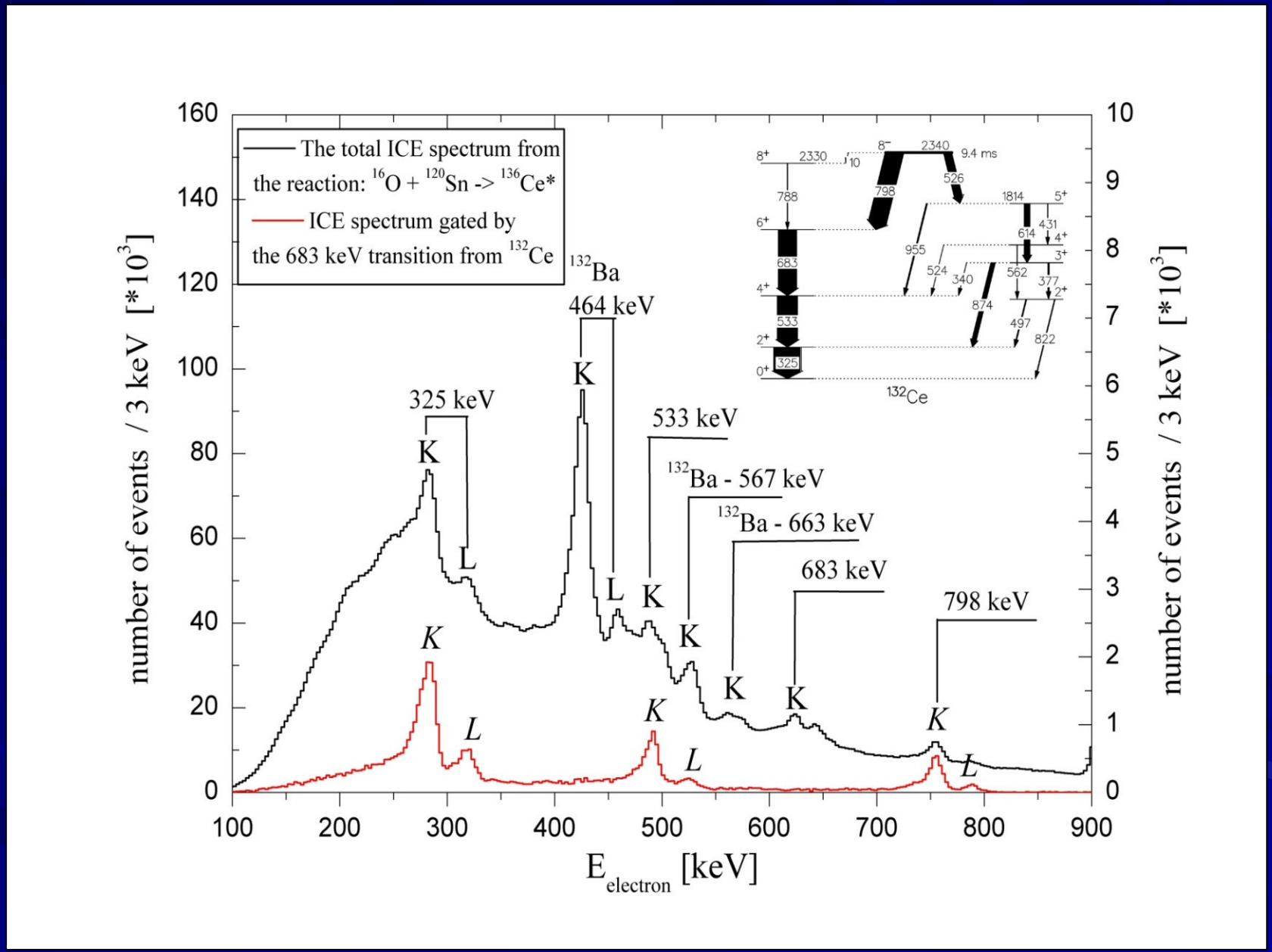
Results for ^{130}Ba



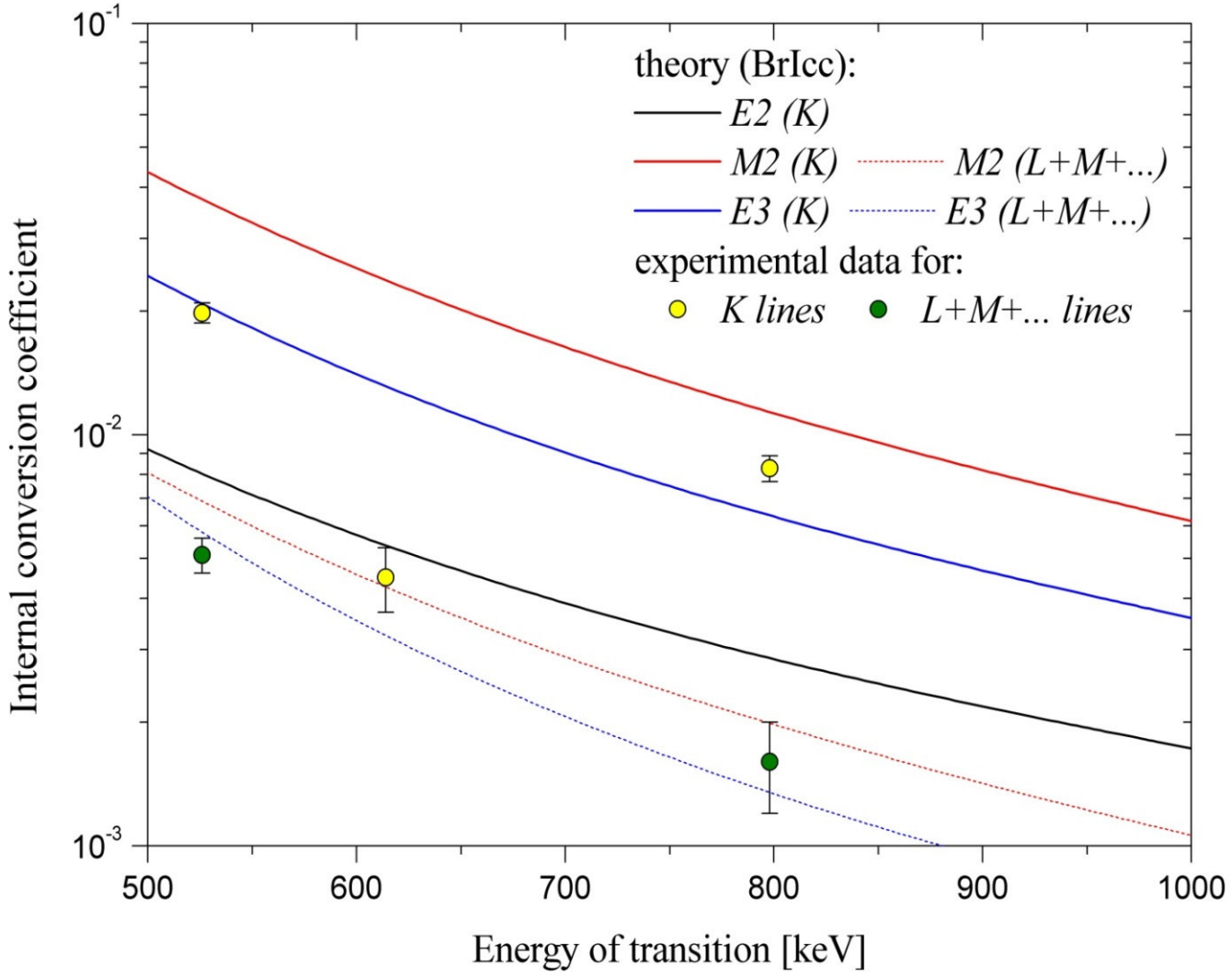
Results for ^{130}Ba



Results for ^{132}Ce

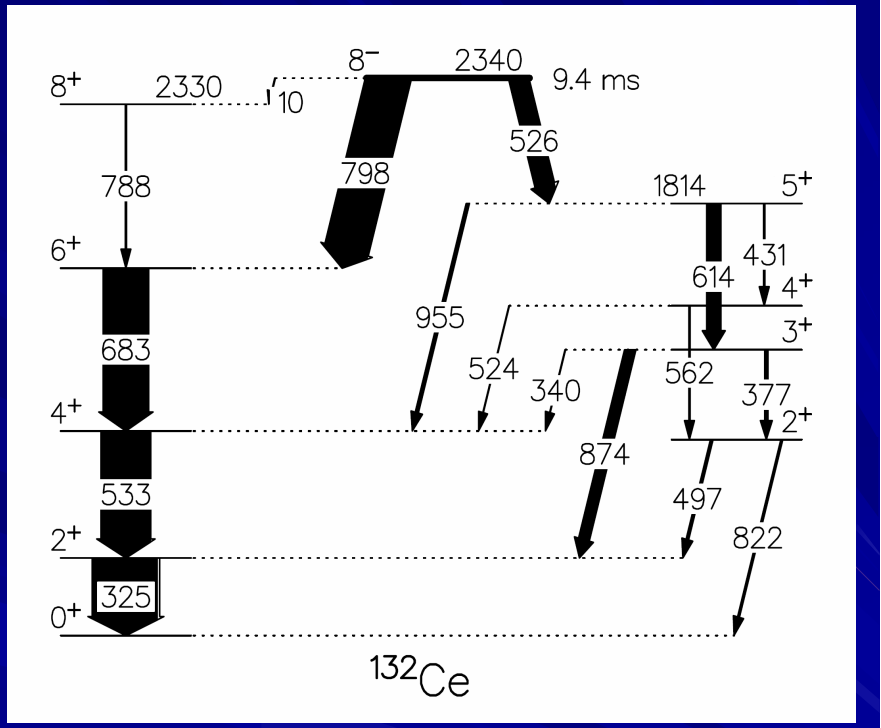


Results for ^{132}Ce

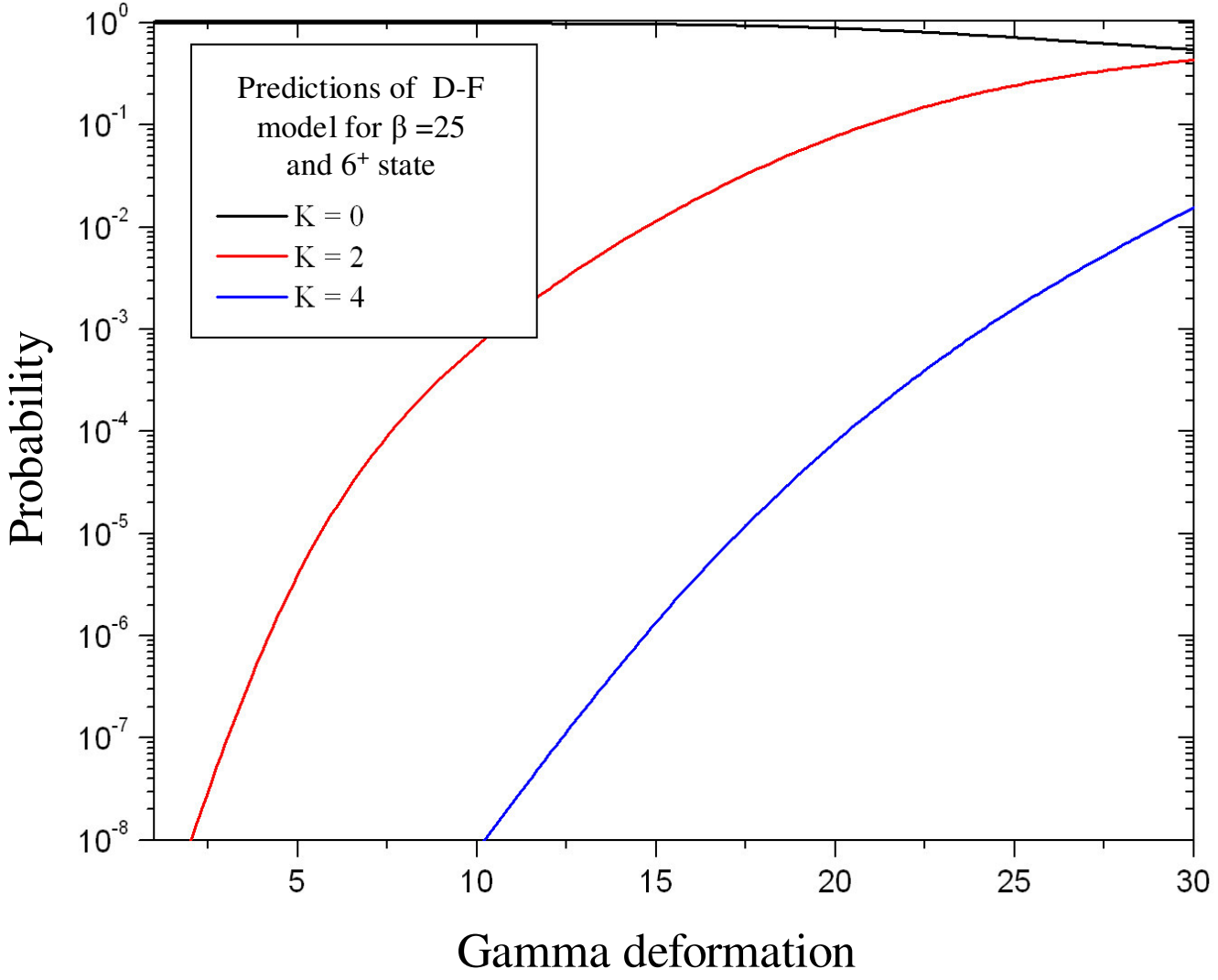


Results for ^{132}Ce

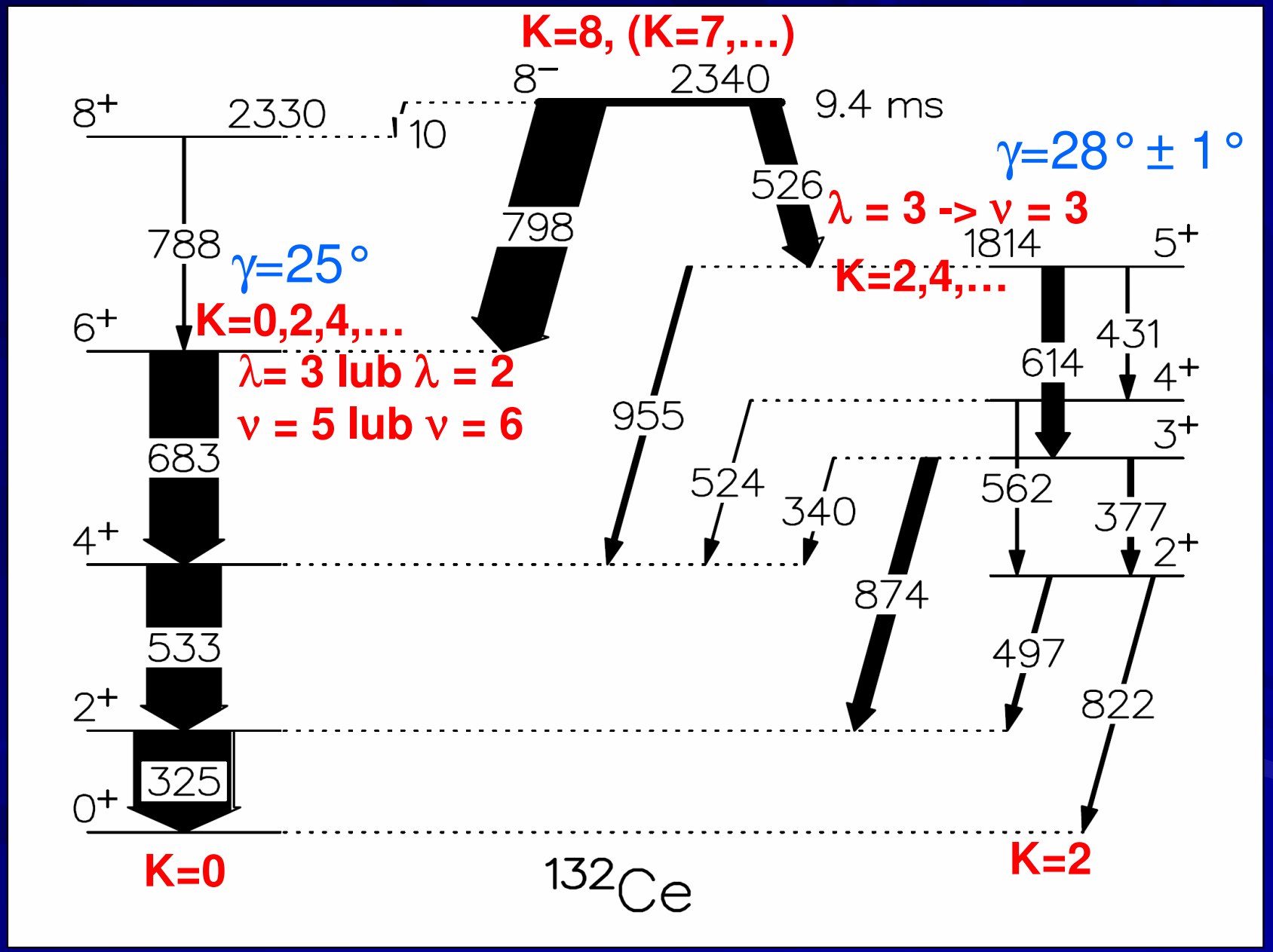
transition energy [keV]	526	798
intensity I_γ	30	68
multipolarity - λ	E3	65(9) % E3 35(9) % M2
reduced hindrance factor f_ν	6.7(3)	5.2(2) – E3 14.9(7) – M2



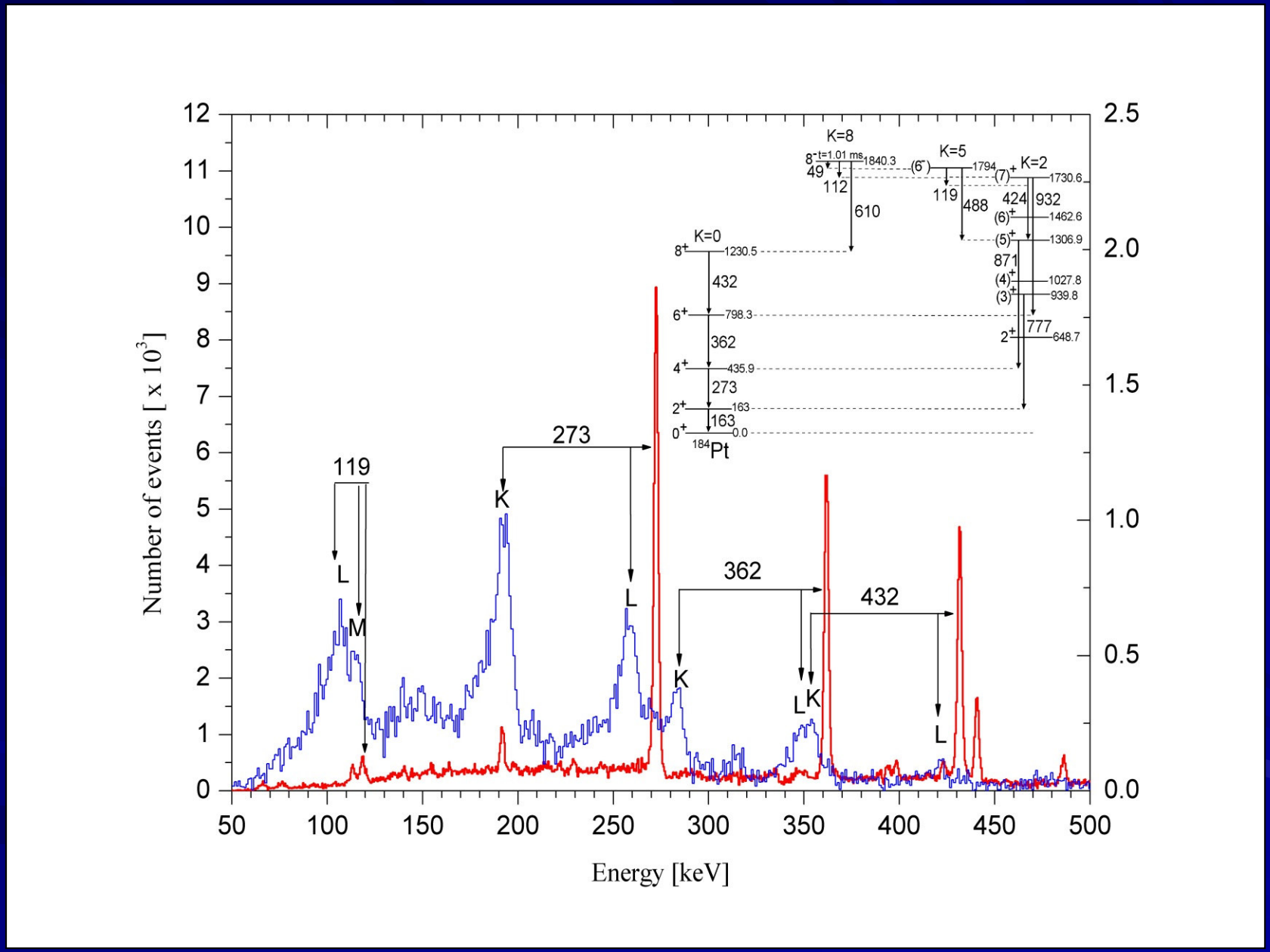
Results for ^{132}Ce



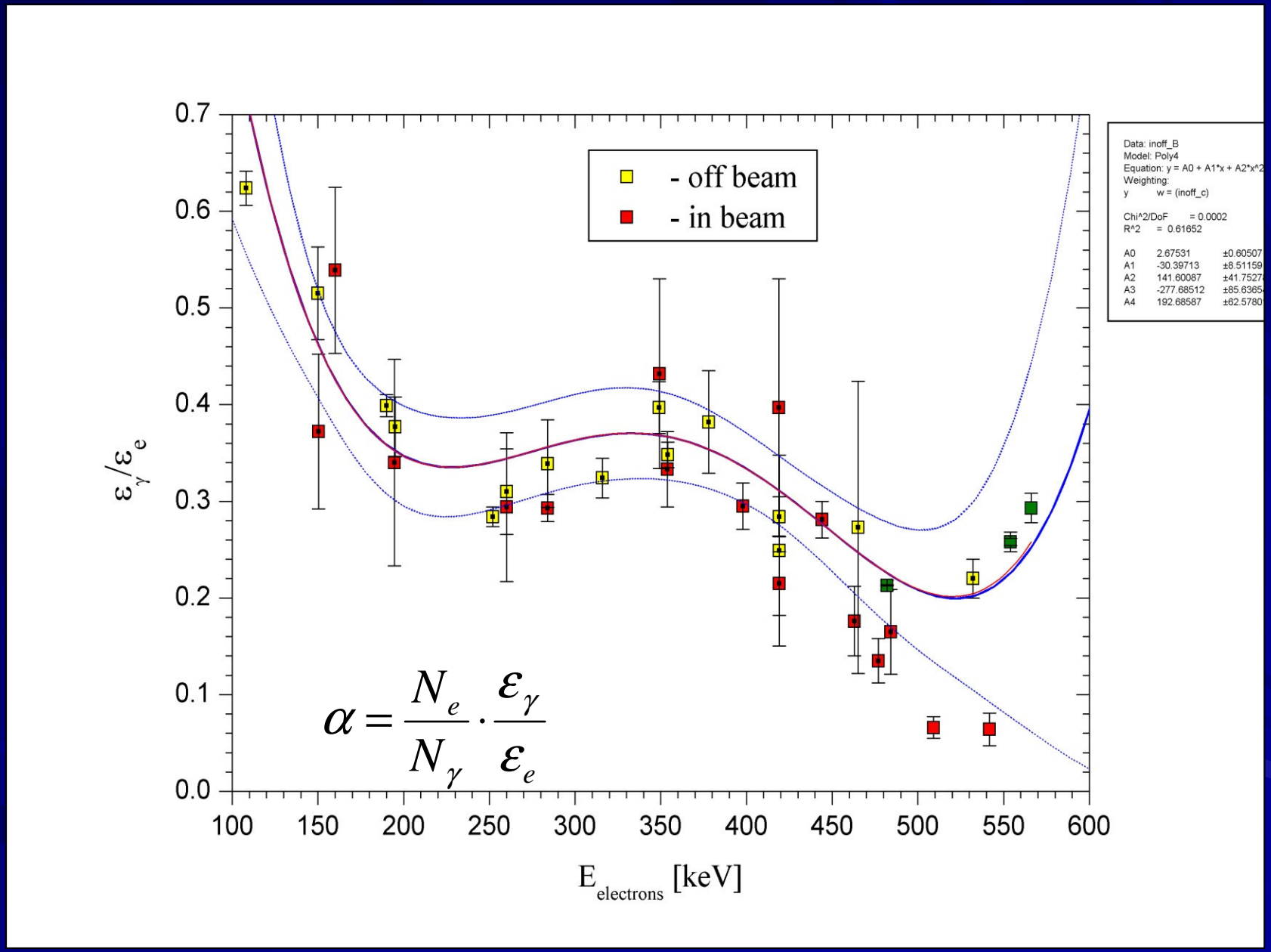
Results for ^{132}Ce



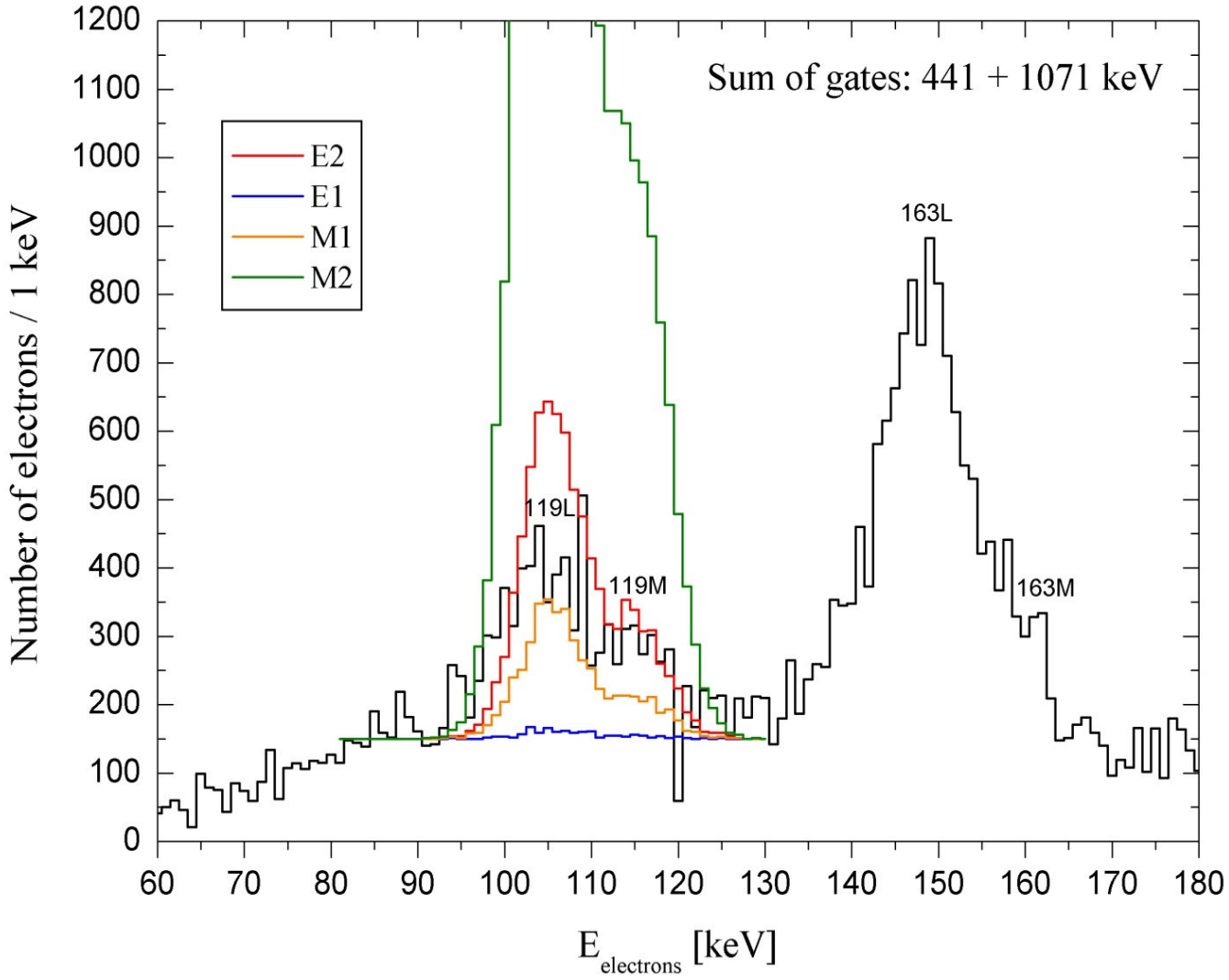
Measurements for ^{184}Pt



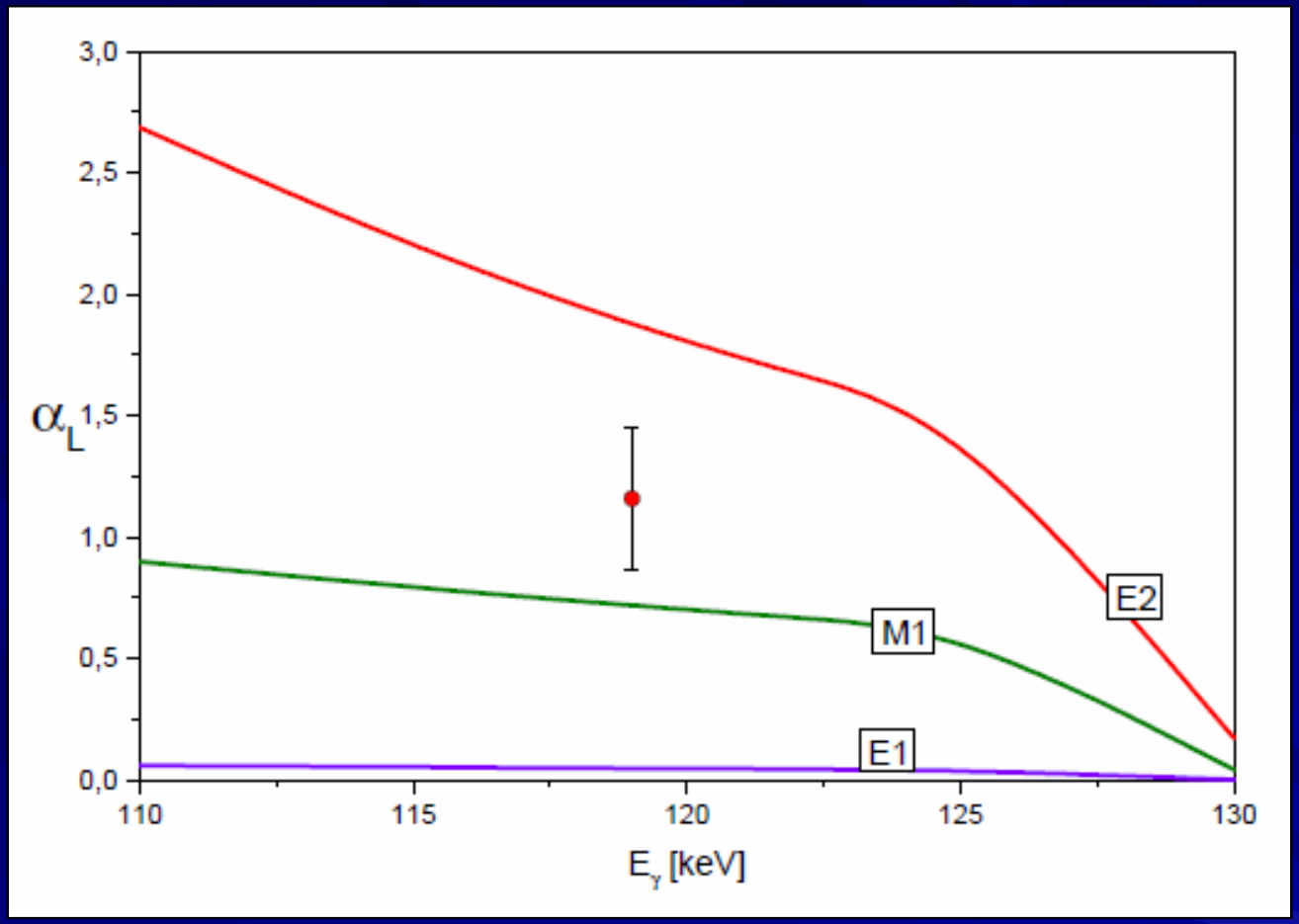
Measurements for ^{184}Pt



Measurements for ^{184}Pt



Measurements for ^{184}Pt

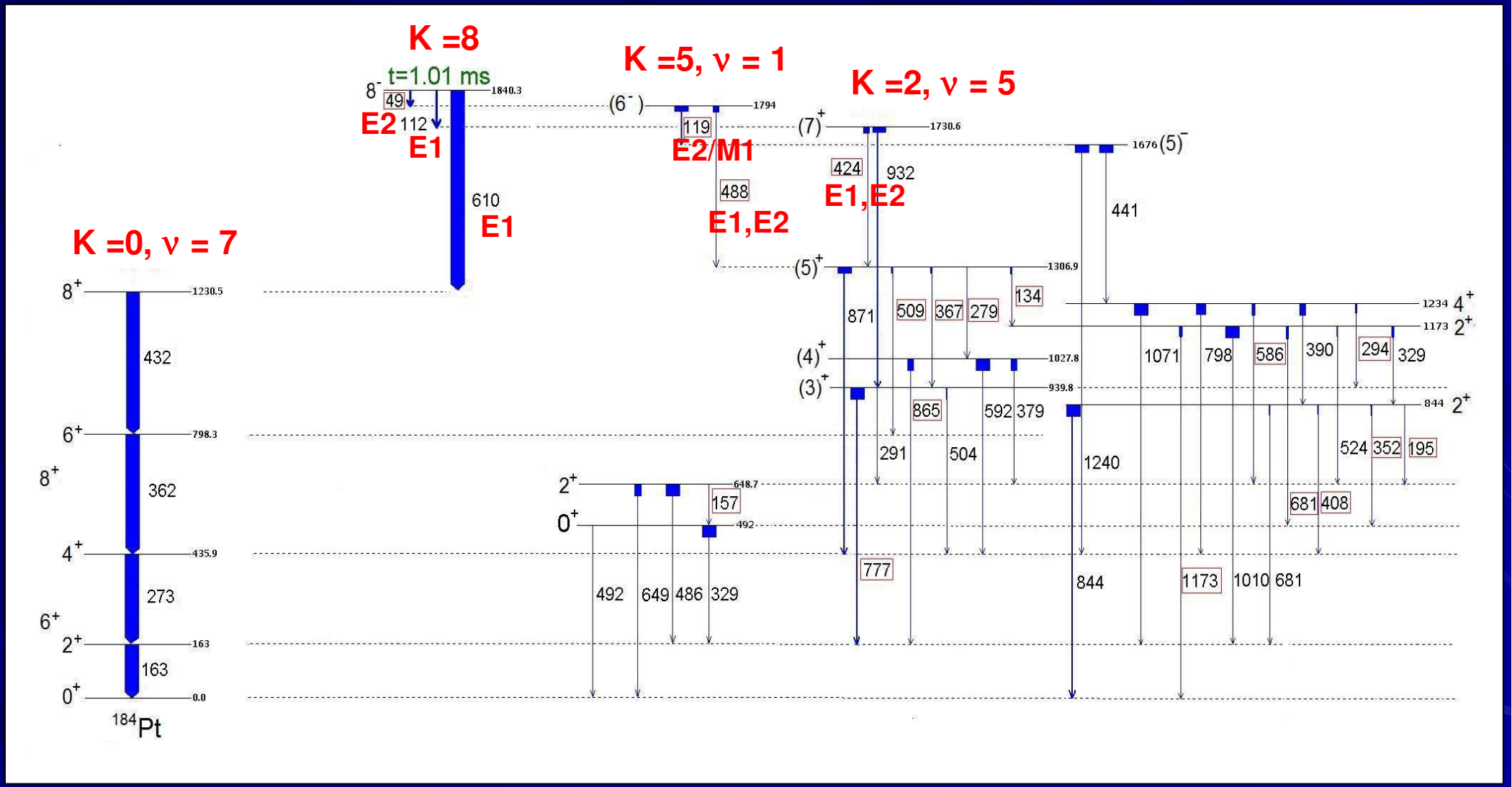


α_L(119 keV) =1.37 ± 0.42 (31%)

α_L = 56% E2 + 44 % M1

$$\delta^2 = \frac{p(E\lambda)}{1-p(E\lambda)} = 1.3(1.9)$$

Measurements for ^{184}Pt



Summary

1. The design of the spectrometer allows to reduced significantly the number of delta electrons, positrons and photons from stream of the particles reaching the silicon detector,
2. The efficiency of the ULESE spectrometer equals 9 % at energy of 300 keV,
3. The electron spectrometer together with the EAGLE array allows to measure in electron-gamma and gamma-gamma coincidence modes and during „in-beam" and „off-beam" time intervals of a cyclotron beam,
4. We have studied mainly property of decay of the $K^{\pi} = 8^{-}$ isomeric states in nuclei for N=74 (^{130}Ba, ^{132}Ce, ^{134}Nd) and N = 106 (^{184}Pt),
5. The comparison between reduced matrix elements and predictions of the Dawydow-Filipov model allows to determined the gamma deformation of excited states,
6. We are going to study the same isomeric state in ^{186}Hg in the nearest future.