

# Shape coexistence in odd-Au isotopes investigated with BEGe detectors

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# Why to study odd-mass nuclei?

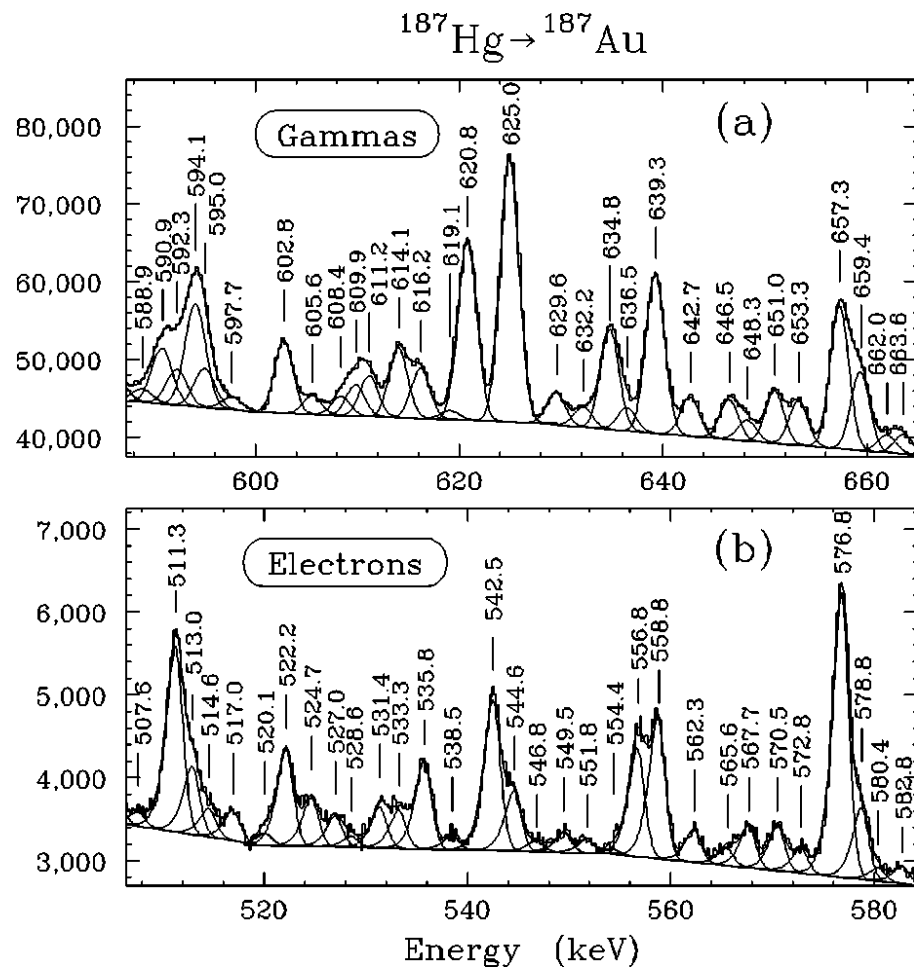
- An odd particle acts as a probe of the core
  - Information on independent particle states
  - Information on deformation: axial and triaxial shapes
  - Information on pairing from blocking
  - Identification of intruder states free of mixing
  - Information on rotational collectivity

# Problems encountered in odd-mass studies

- Complexity
  - Multiple independent particle states coupling with core states: very high level density
  - Decay scheme spectroscopy involves multiple paths to the ground state (cf. even-even nuclei where most decay is through first  $2^+$  state)
  - Multipolarities not dominated by  $E2$  ( $M1$ ,  $M1 + E2$ )
  - Critical to identify  $E1$  multipolarity (cf. even-even nuclei, where  $E1$  decay is high energy)

# Complexity !

- $^{187}\text{Hg}^{m,g}$  decay studied at UNISOR
- Singles  $\gamma$  ray and conversion electrons spectra
- Note: line identification from coincidences: more than 50 % lines found
- High resolution is needed
- Conversion electrons measurements are needed

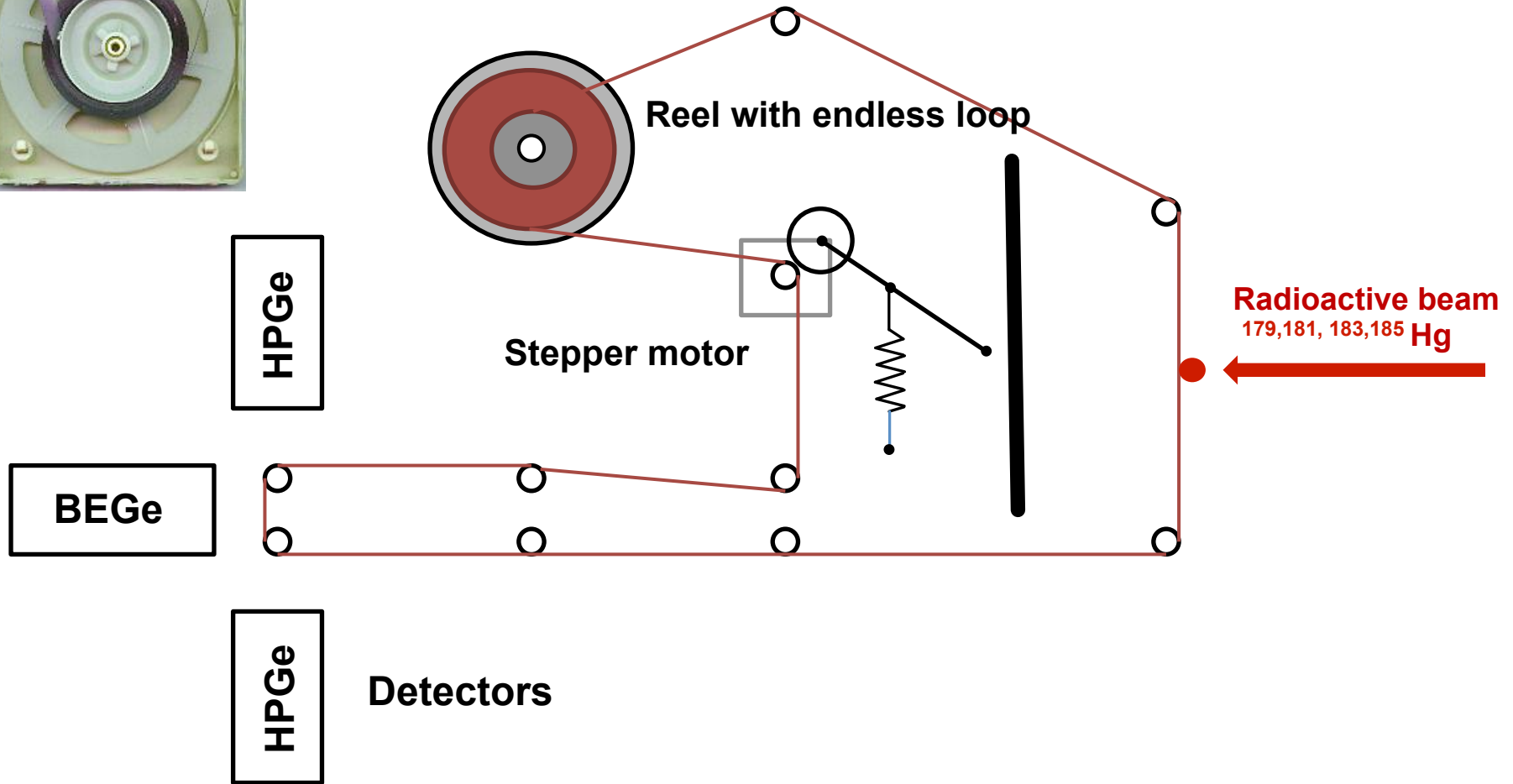


D. Rupnik *et al.*, Phys. Rev. C **58**, 771 (1998).

# TATRA operation principle



8-track tape design, used by Ed Zganjar at the UNISOR facility (ORNL)

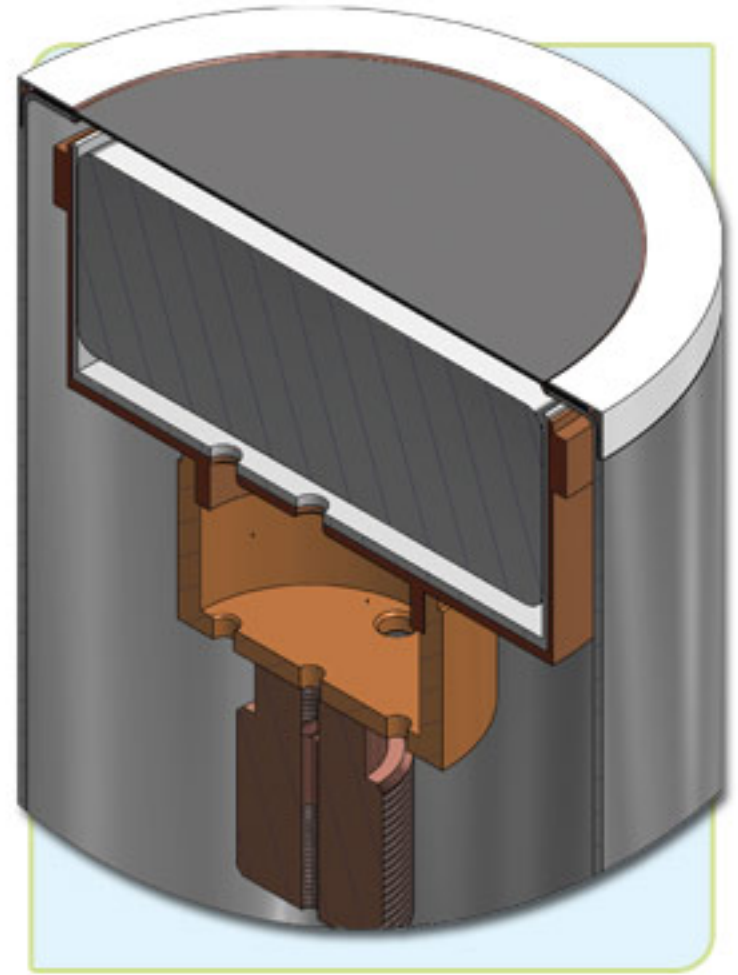


# Amorphous metallic tape (courtesy of Metal physics Dept.)

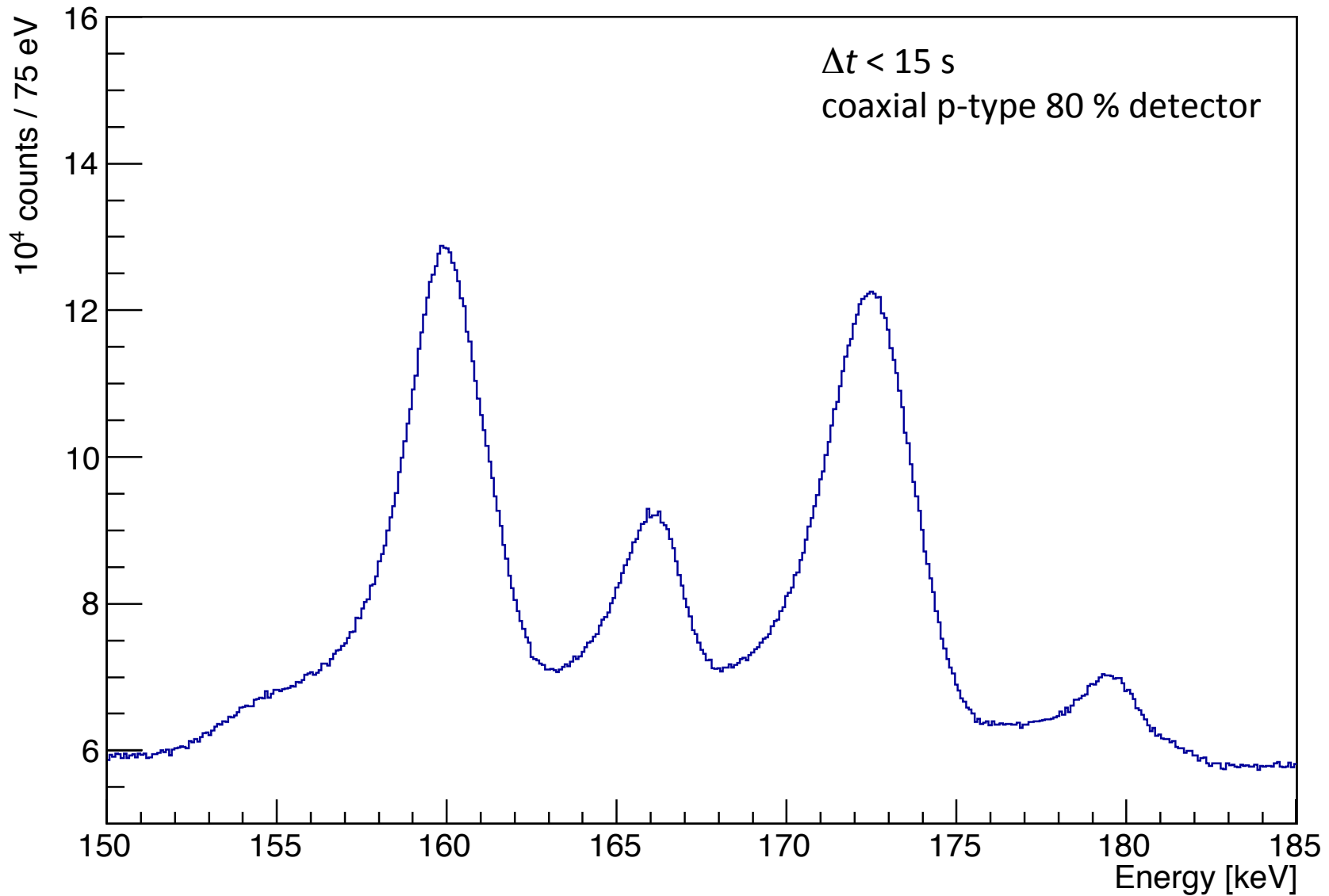
- Amorphous metallic tape produced by rapid quenching of an alloy
- **Rapid =  $1\text{E}+6$  K per second!**
- Material of dream for tape systems:
  - Tape does not stretch
  - Tape cannot be broken by the power of stepper motor
  - It keeps metallic properties: no problem with vacuum: **below  $1\text{E}-7$  mbar in whole system**
- To operate in 8-track mode: alloy of 7 elements is used

# BE2020 Broad Energy germanium detector (BEGe)

- p-type HPGe detector designed by Canberra
- Active diameter 51 mm and thickness 20 mm
- Relative efficiency of approximately 9 %
- Designed for environmental applications
- IS521 – (one of) the first nuclear structure experiments
- **Detector provided by the University of Liverpool**
- Very promising gamma-detector for future

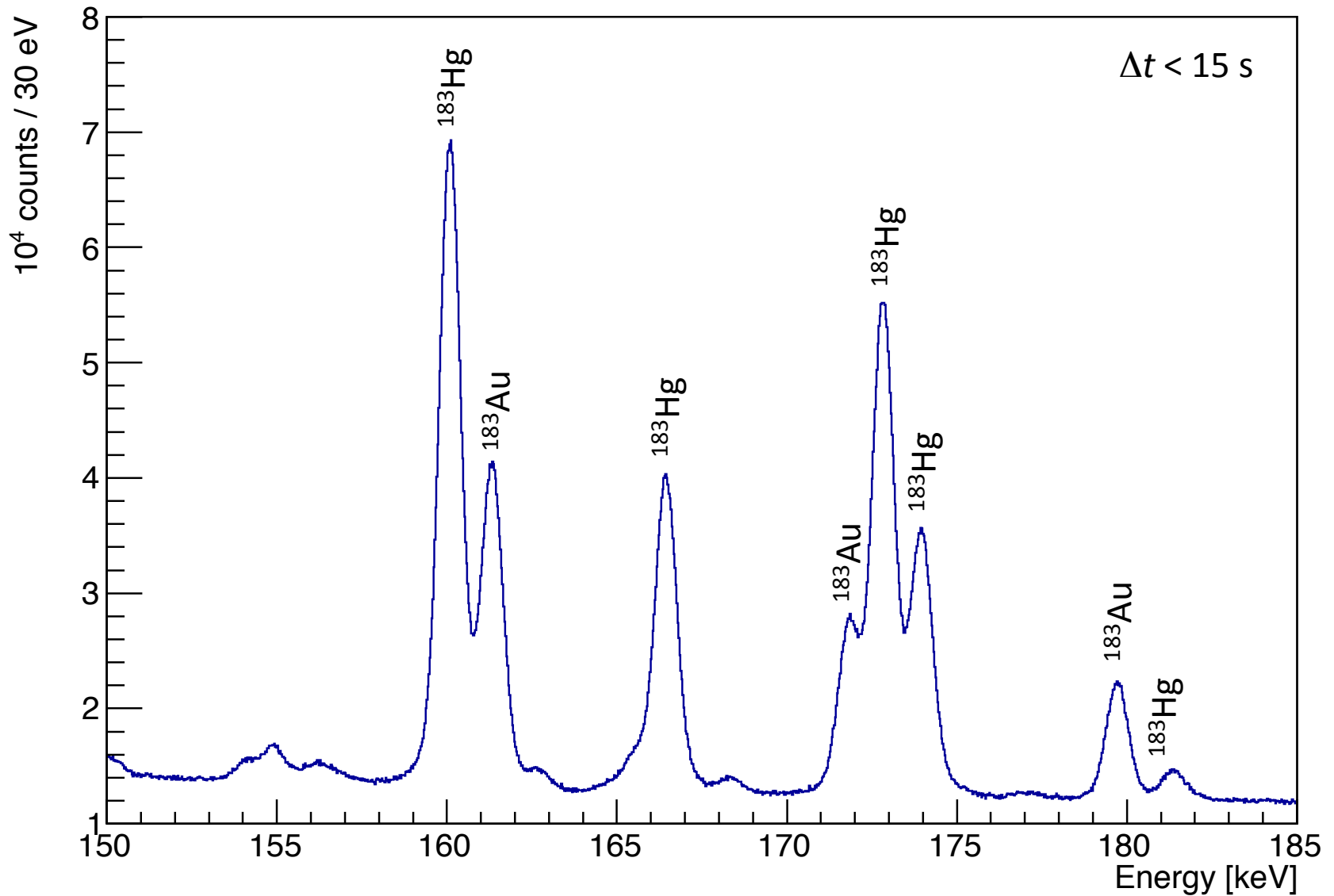


# Study of $^{183}\text{Hg} \rightarrow ^{183}\text{Au}$ decay at ISOLDE: coaxial Ge detector

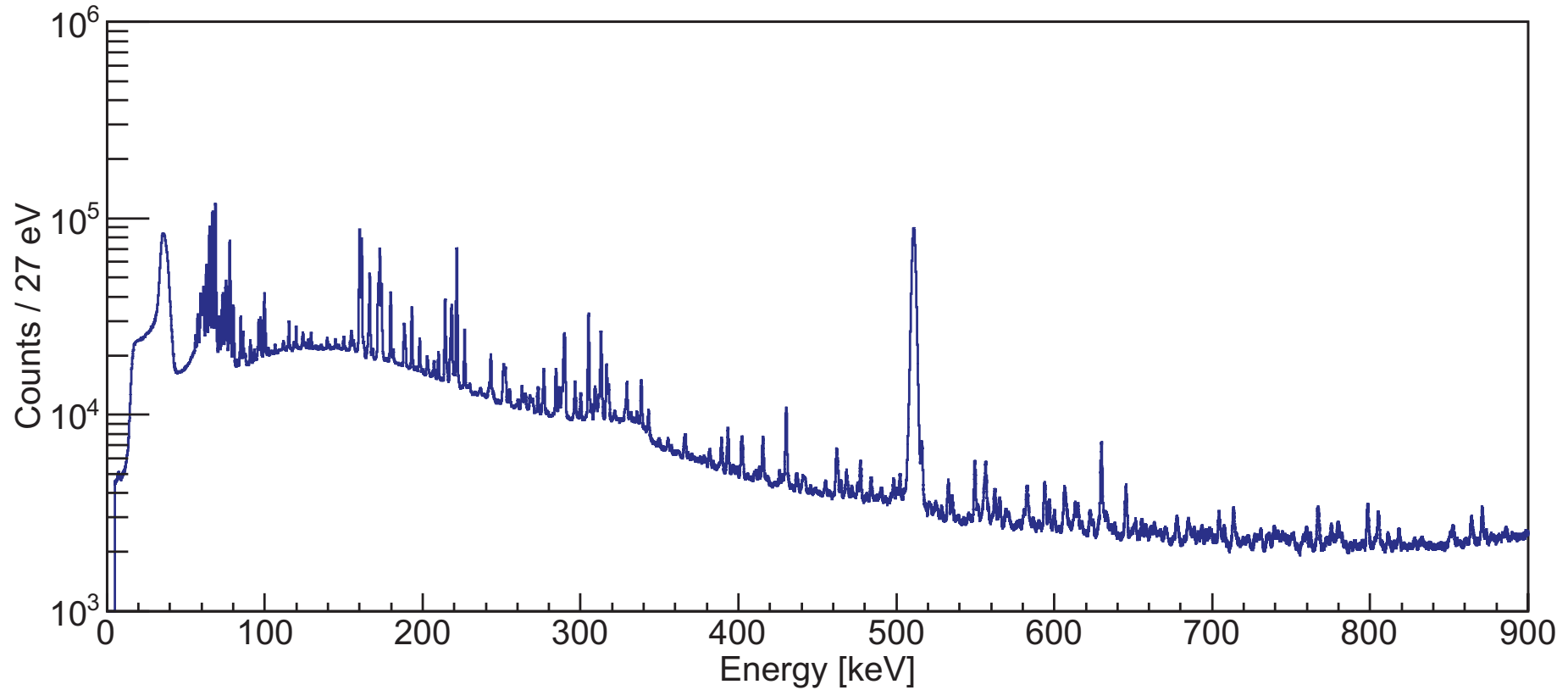




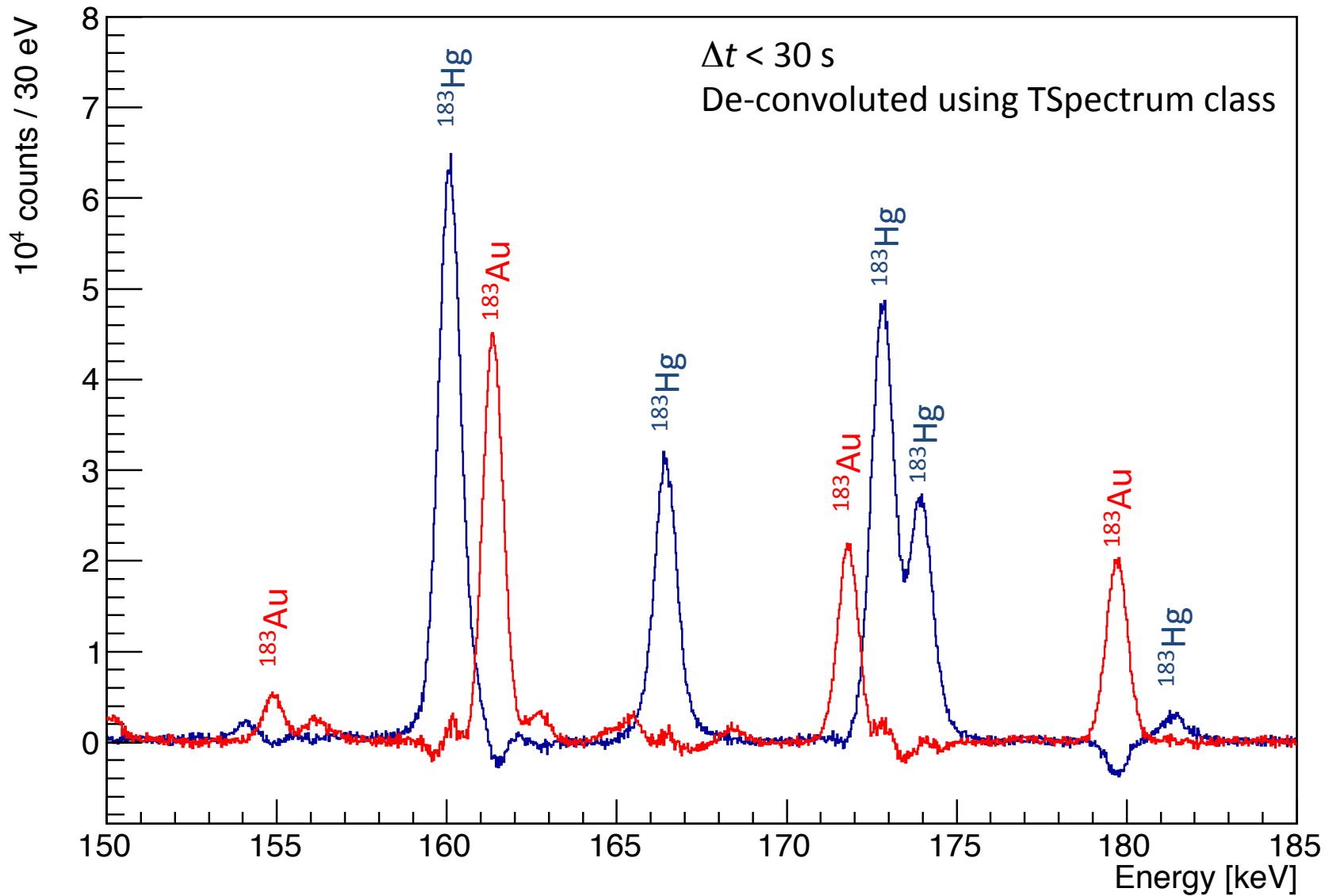
# $^{183}\text{Hg} \rightarrow ^{183}\text{Au}$ decay: Example of BE2020 spectrum



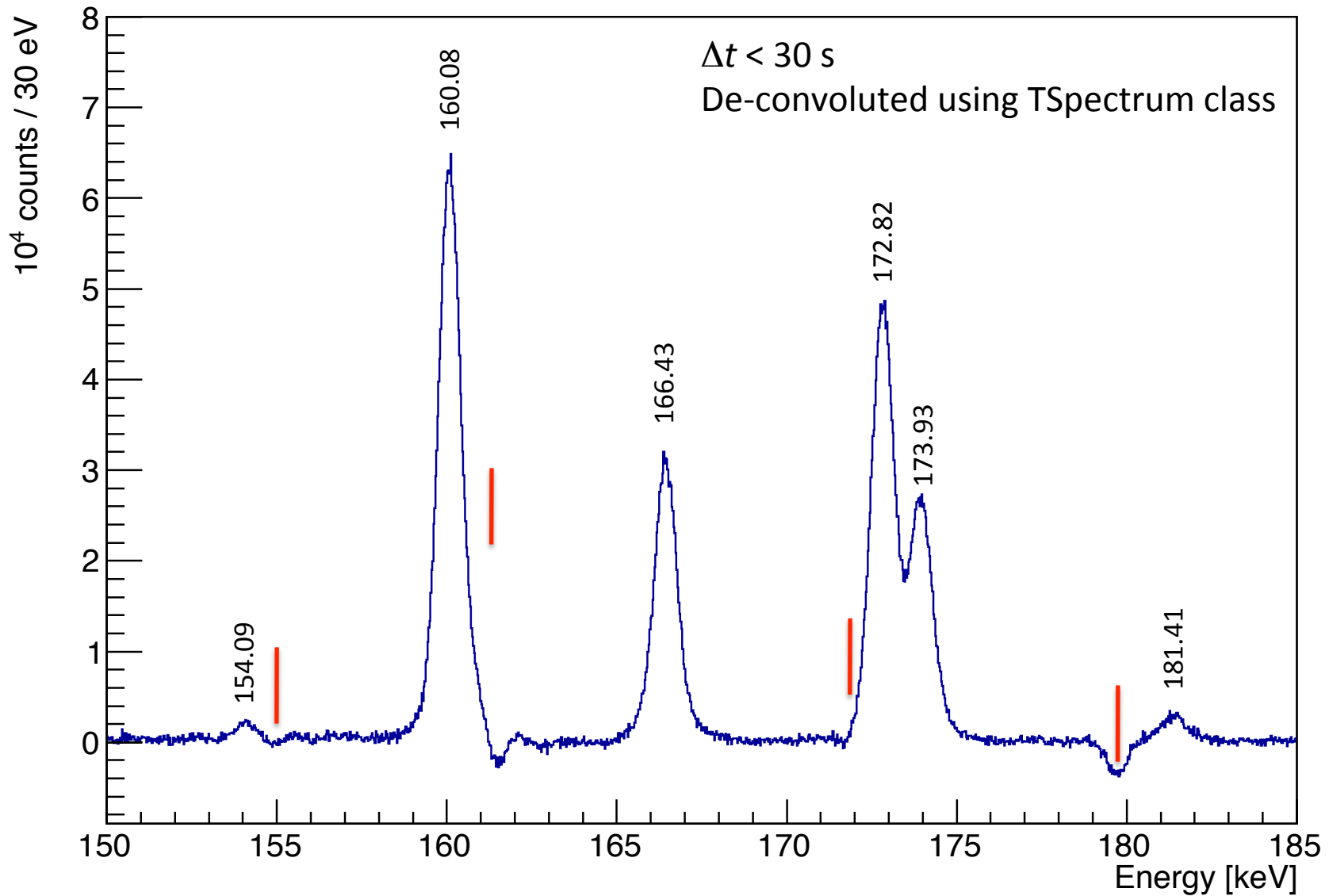
# $^{183}\text{Hg} \rightarrow ^{183}\text{Au}$ decay: Spectrum complexity



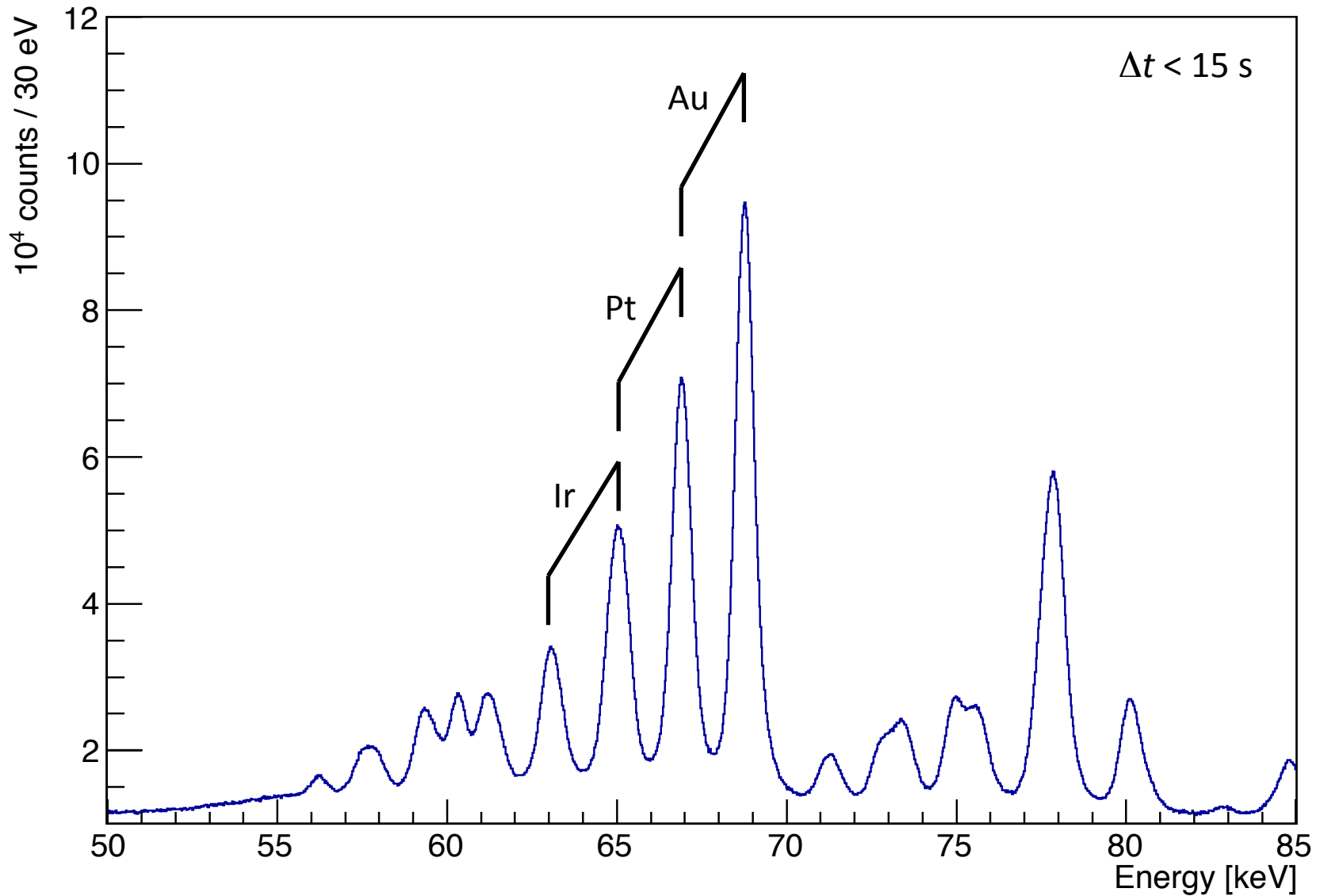
# $^{183}\text{Hg} \rightarrow ^{183}\text{Au}$ decay: Identification of peaks using timing



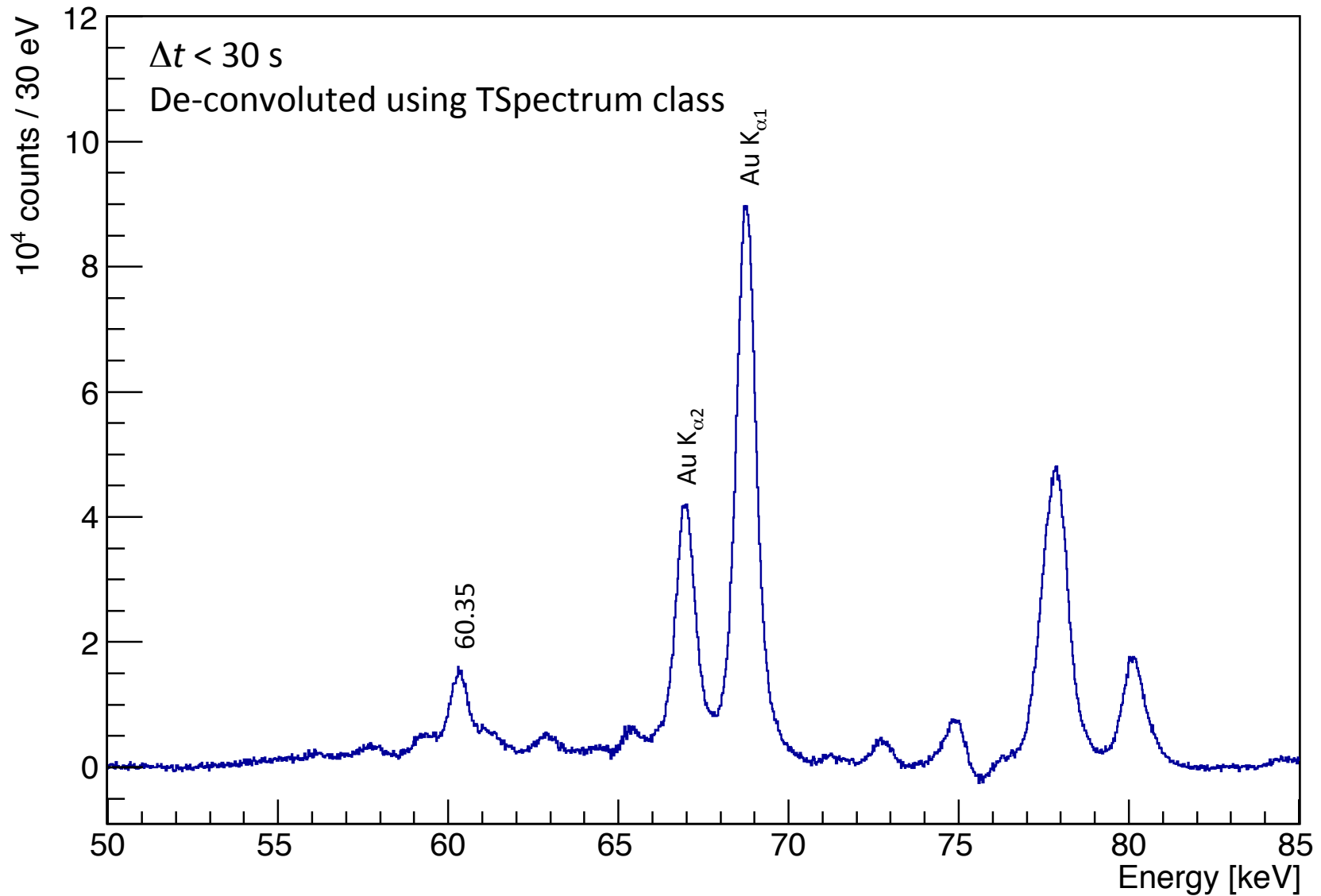
# $^{183}\text{Hg} \rightarrow ^{183}\text{Au}$ decay: Identification of peaks using timing



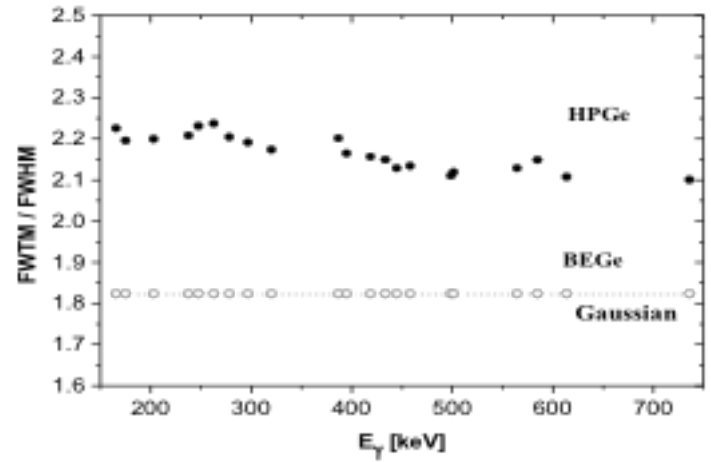
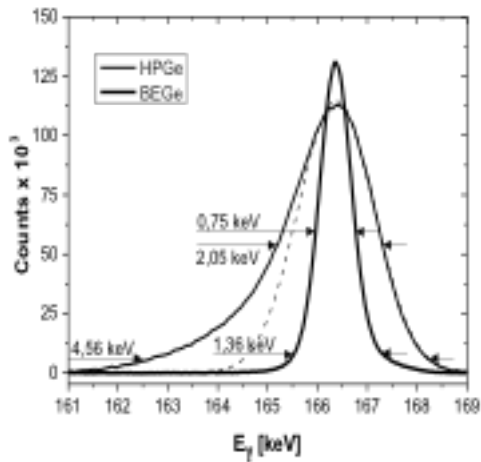
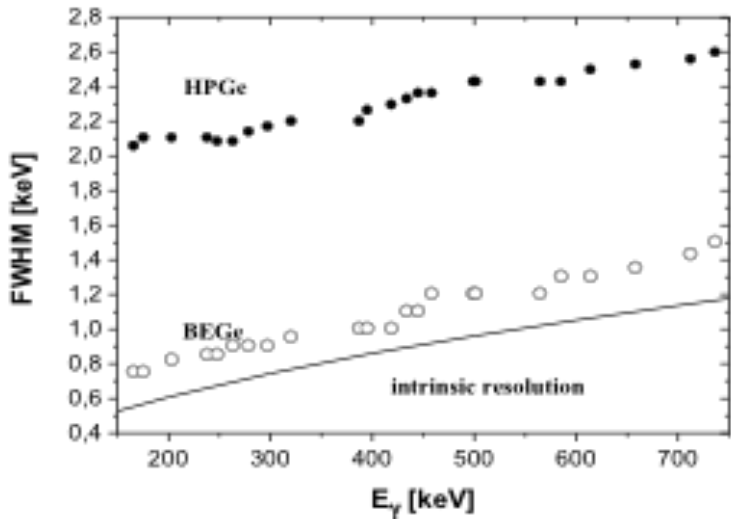
# $^{183}\text{Hg} \rightarrow ^{183}\text{Au}$ decay: K X rays region resolution of BE2020



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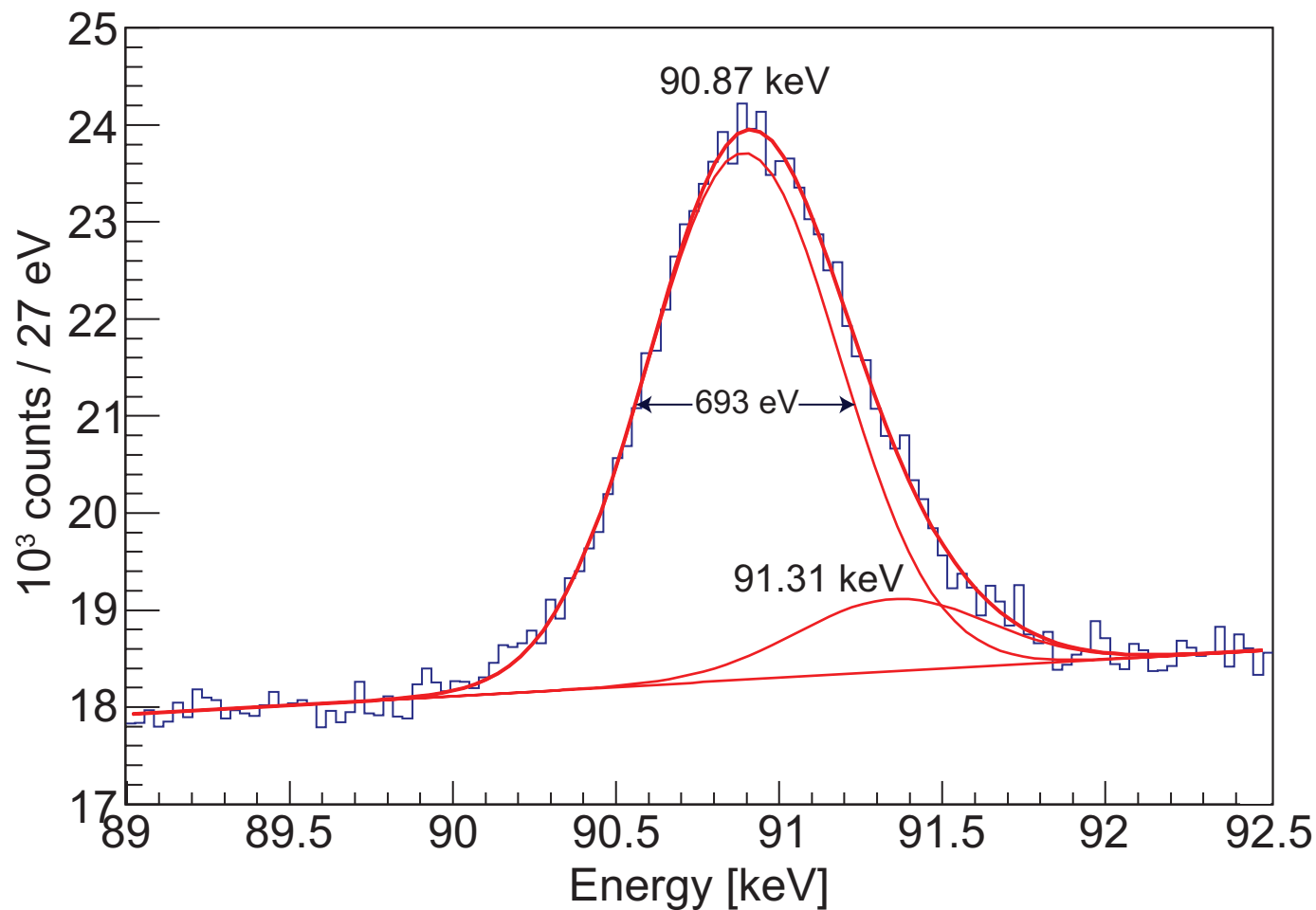
# Resolution of the detector (Gaussian shape)



Courtesy: Š. Motyčák and J. Kliman



# Analysis of the gamma-ray singles spectra



Rydberg-Ritz combination principle using singles spectrum is now powerful tool for the analysis



# Conclusion

- **Comprehensive level scheme for  $^{183}\text{Hg}$  constructed so-far:**
  - Approximately 100 gamma rays placed (both coincidences and R-R combination principle)
  - Another approximately 100 identified (unassigned)
  - Multiplets even in BEGe spectrum identified
  - 17 excited states below 500 keV identified
  - Key information is missing (low-energy transitions, conversion electrons)
- **New version of TATRA ready:**
  - Windowless Super Si(Li) detector 5 mm thick and 80 mm<sup>2</sup> in retractable cryostat
  - High resolution conversion electrons spectroscopy
  - Low-energy X rays and gamma rays (down to 2 keV)
  - Low-energy conversion electrons? Auger spectroscopy?
  - Resolution for conversion electrons?

# Collaboration

- **Institute of Physics, Slovak Academy of Sciences**  
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- **iThemba Labs**  
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- **Australian National University**  
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