Alpha-decay fine structure in ^{179}Hg and ^{177}Au

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HIL
Heavy Ion Laboratory

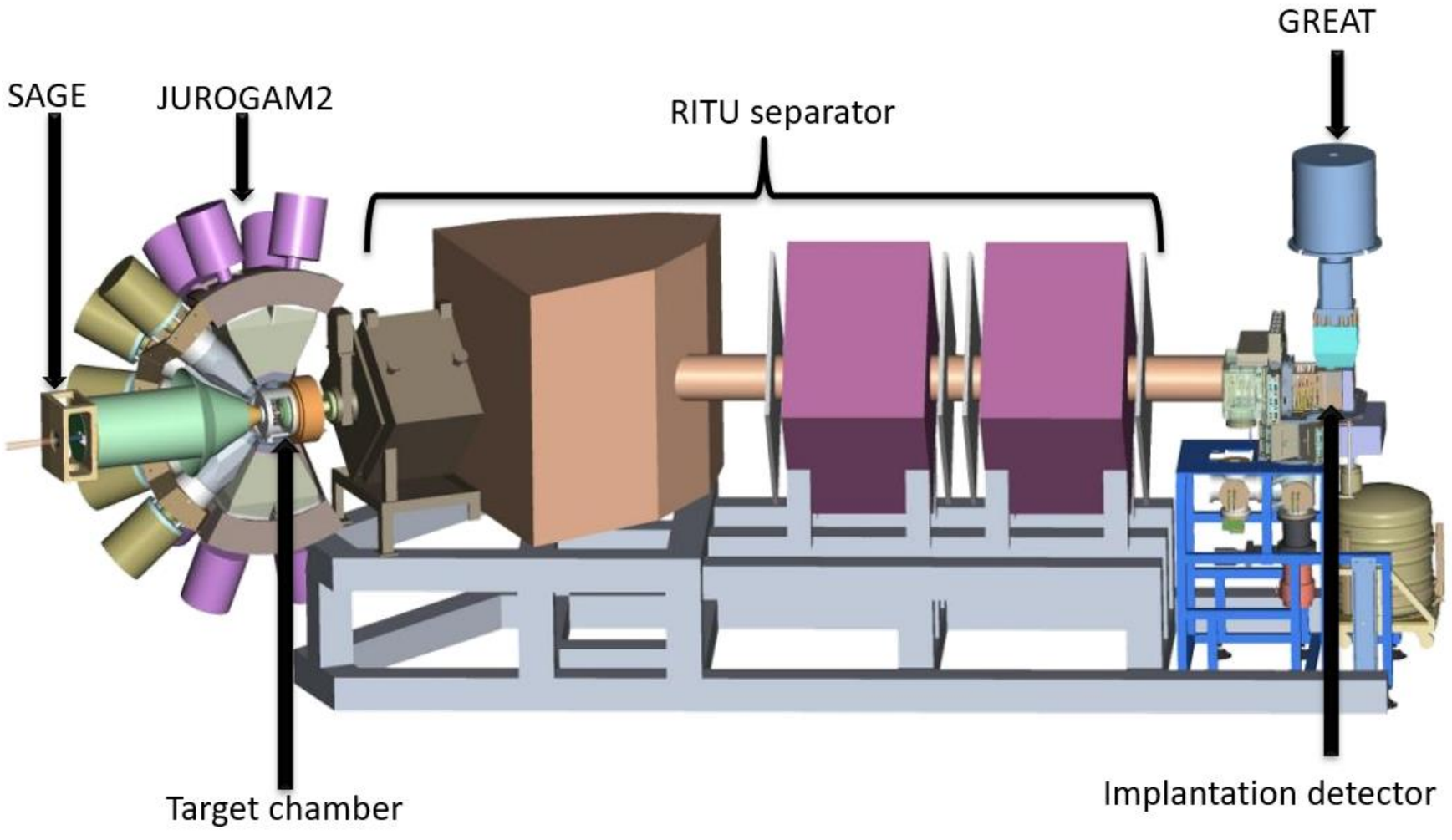
Experimental setup

Reaction used in the experiment S17: ^{82}Kr + ^{100}Ru

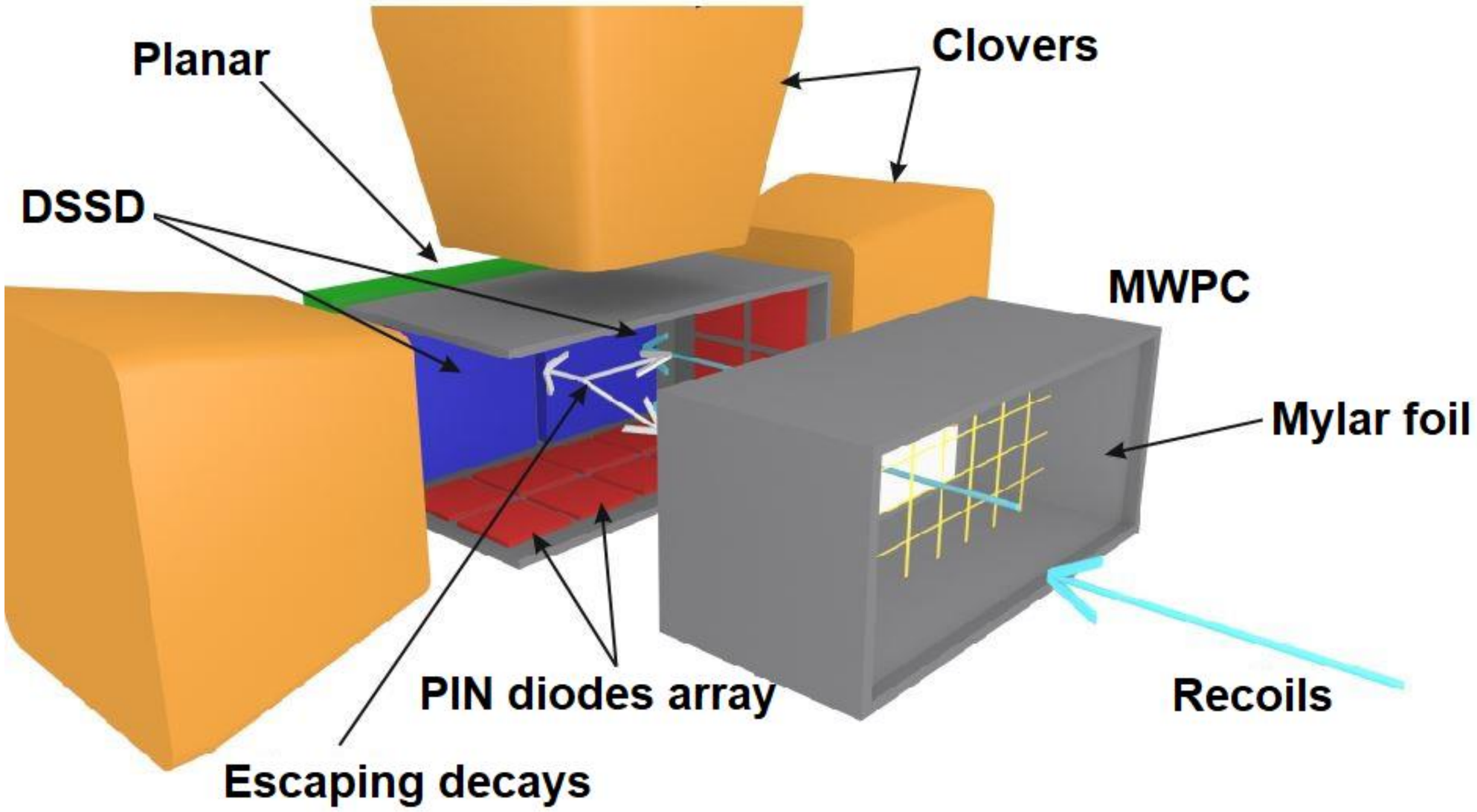
E = 352 MeV

Reaction used in the experiment JR115: ^{88}Sr + ^{92}Mo

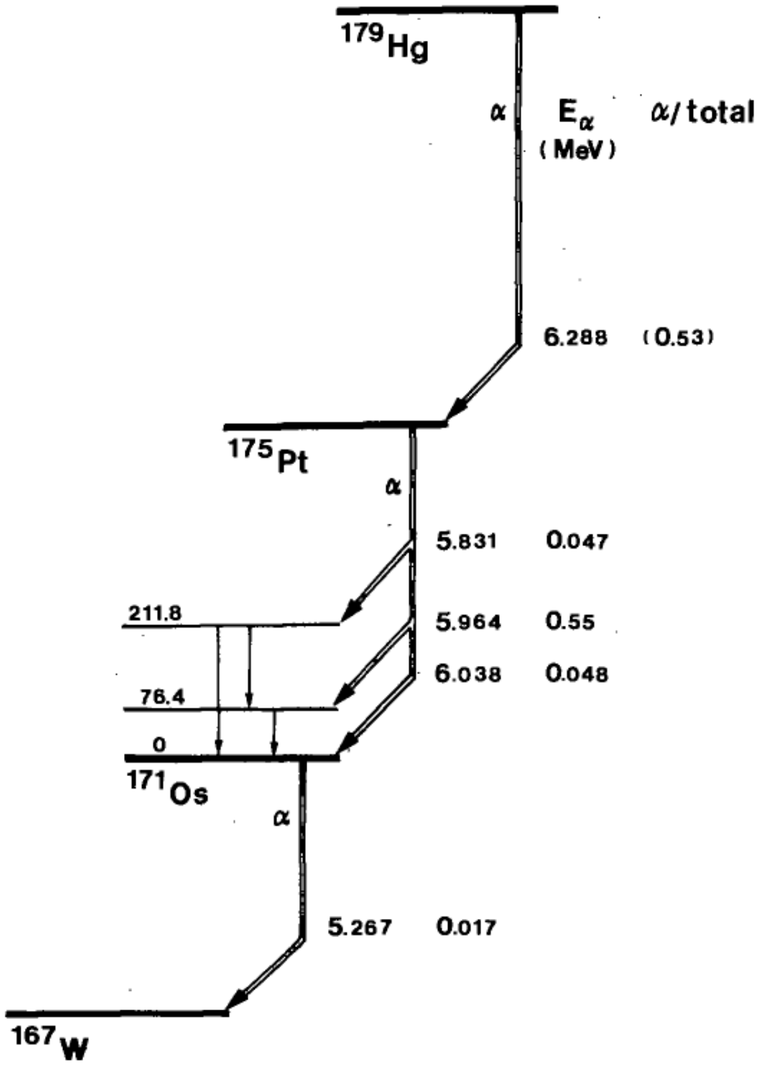
E = 399 MeV



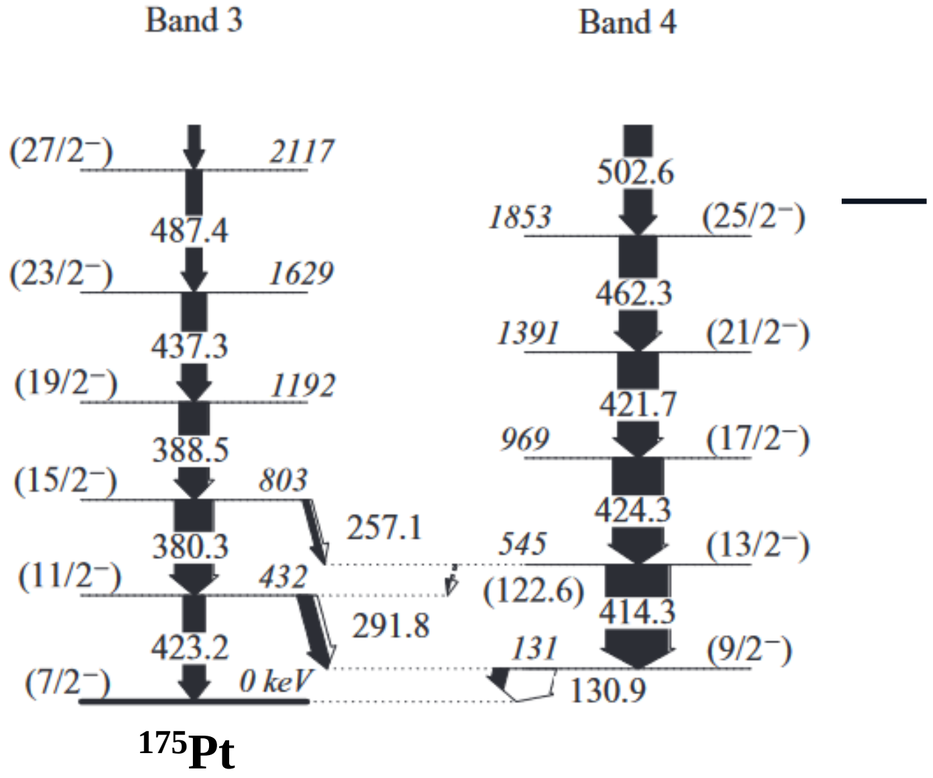
The GREAT focal plane spectrometer



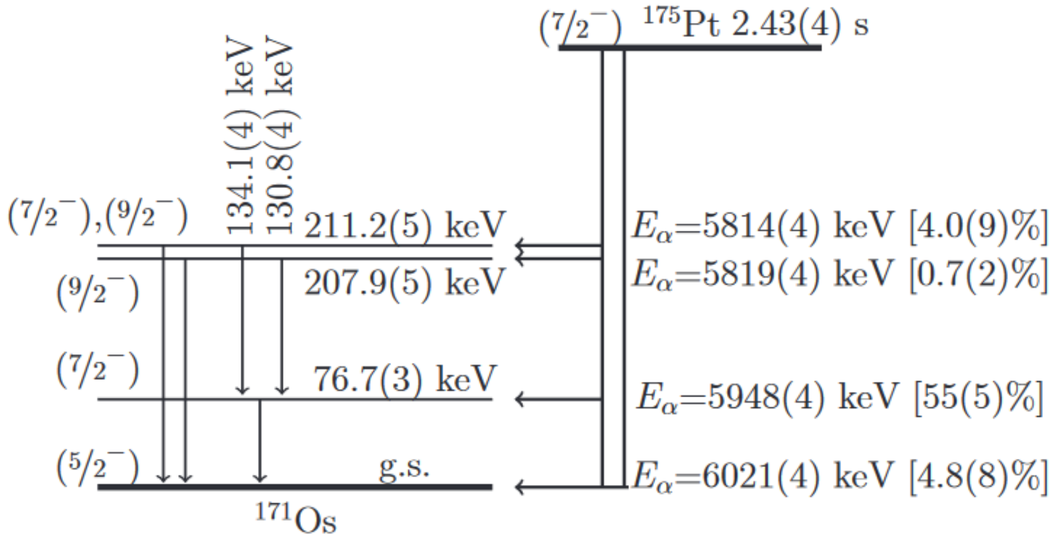
Previous study of ^{175}Pt



E. Hagberg *et al.* Nucl. Phys. A **318,** (1979)

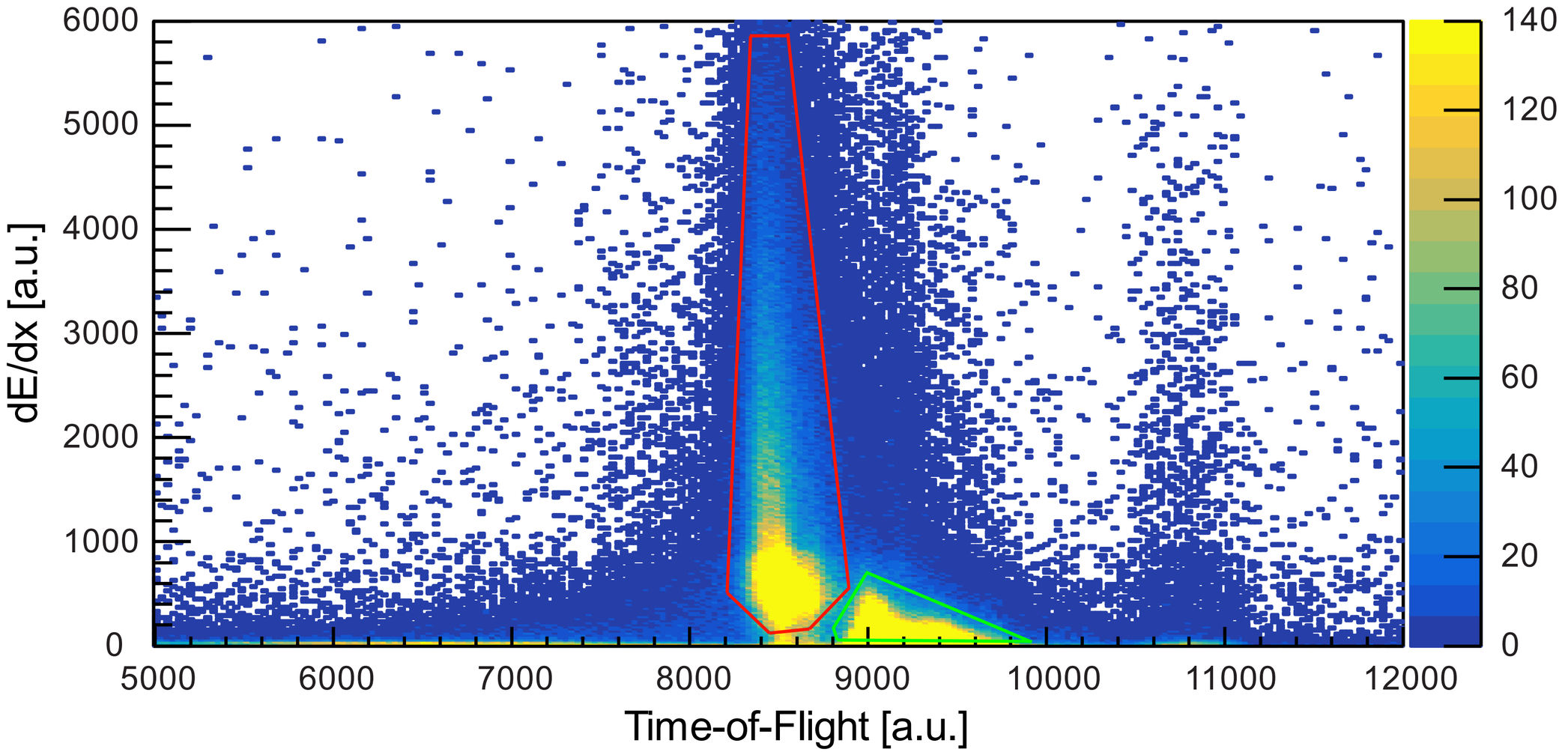


^{175}Pt



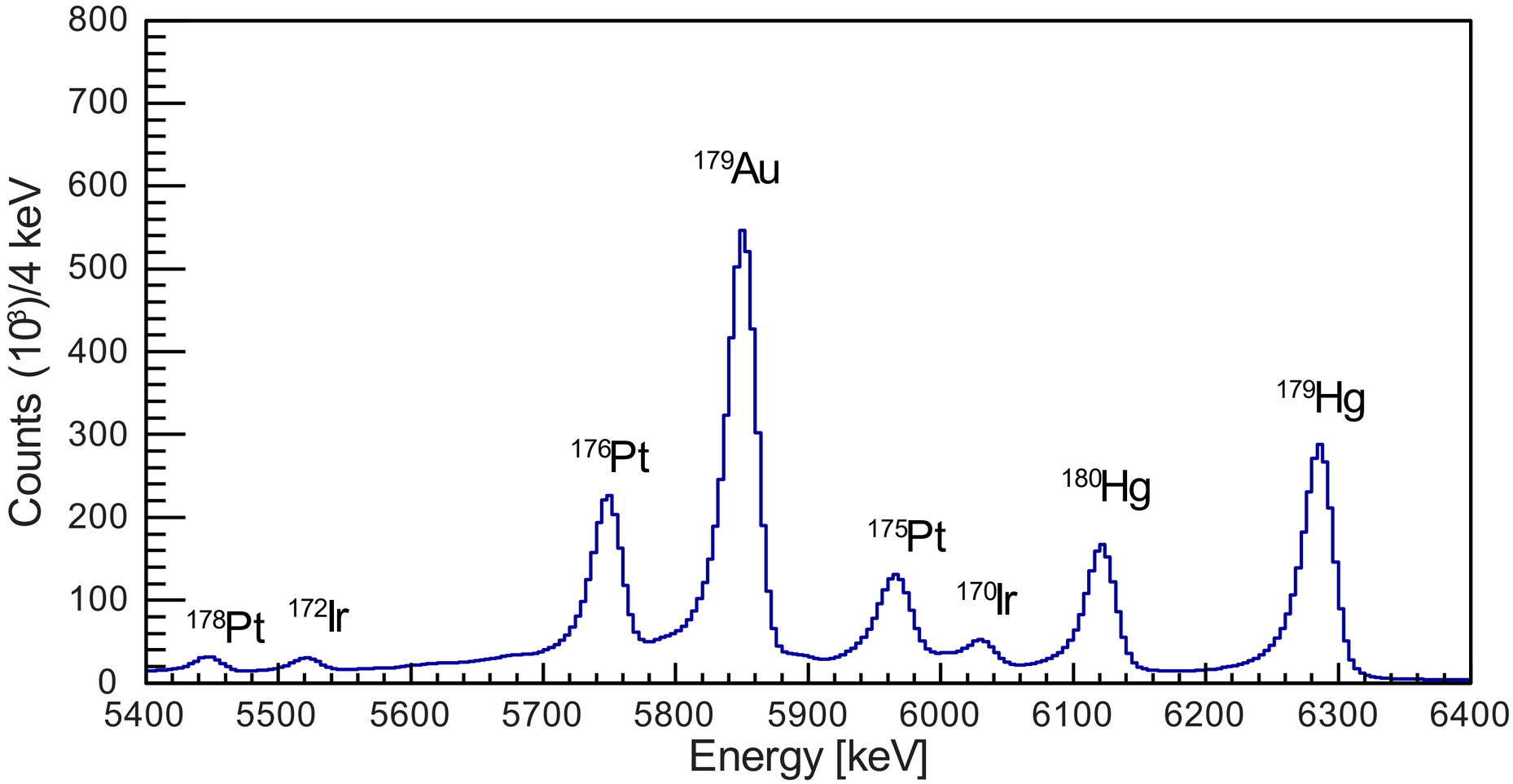
P. Peura *et al.*, Phys. Rev. C **89,** 024316 (2014)

Recoil gating

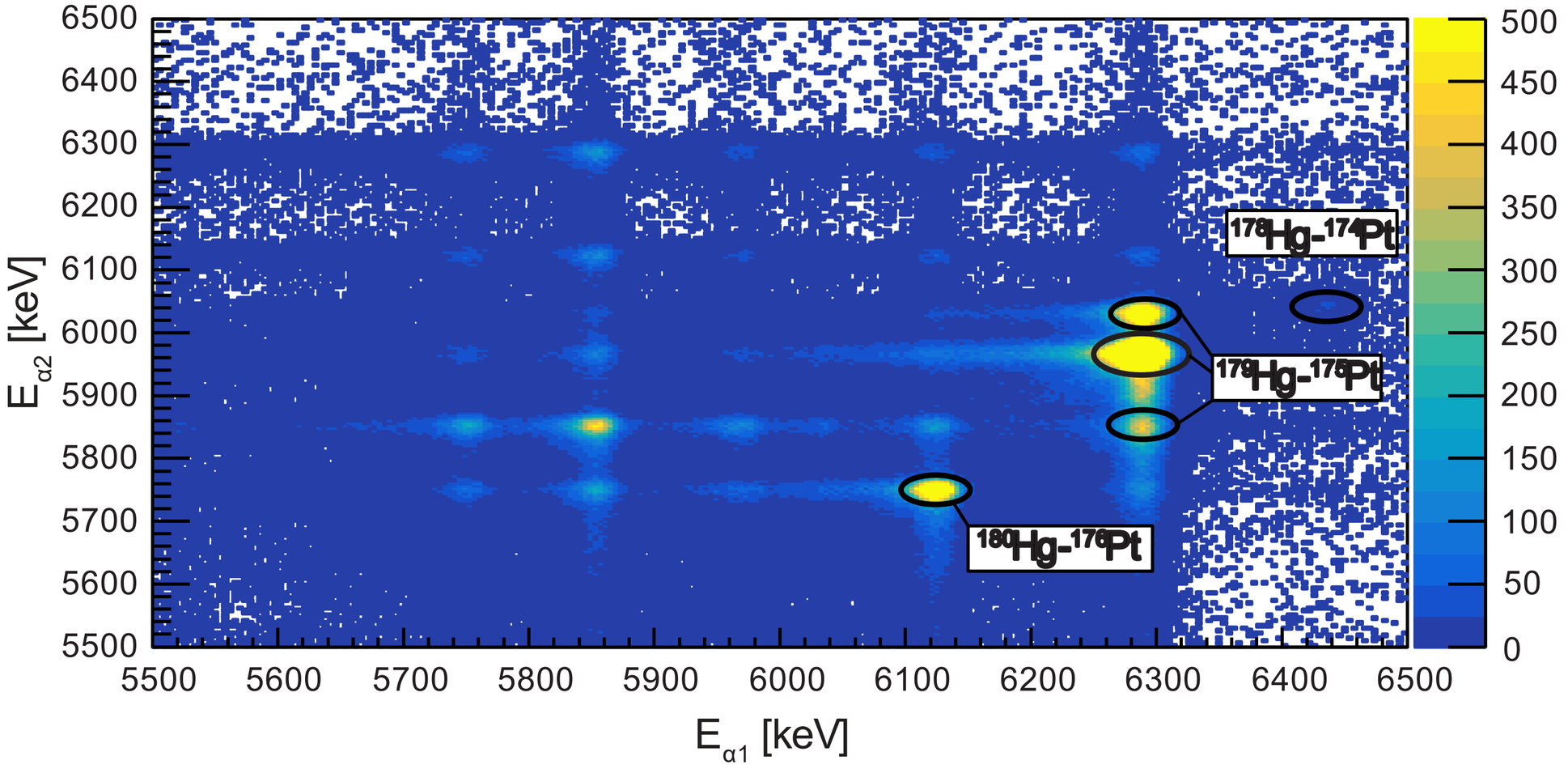


The Time-of-Flight between the MWPC and the DSSD vs. energy loss dE/dx measured in MWPC during experiment S17. This matrix was used to select the nuclei of interest - recoils, from the unwanted particles that passed through the MWPC. The red line marks the 2-dimensional gate used for the selection of recoils and the green line marks the beam particles.

Energy spectrum of alpha particles



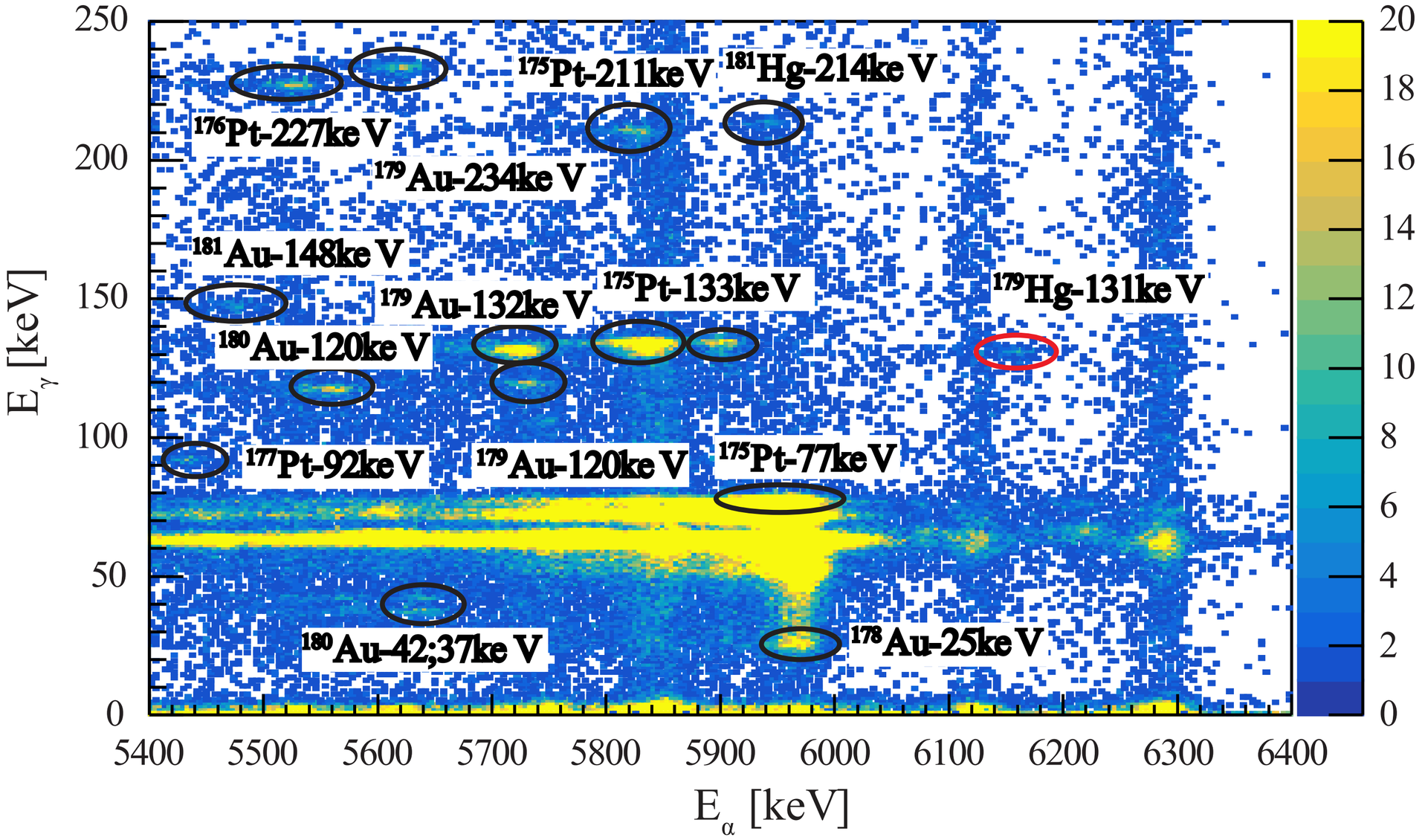
Correlated alpha decays



$\Delta t_1(\alpha_1 - \mathrm{ER}) \leq 3\mathrm{s}$

$\Delta(\alpha_2 - \alpha_1) \leq 7\mathrm{s}$

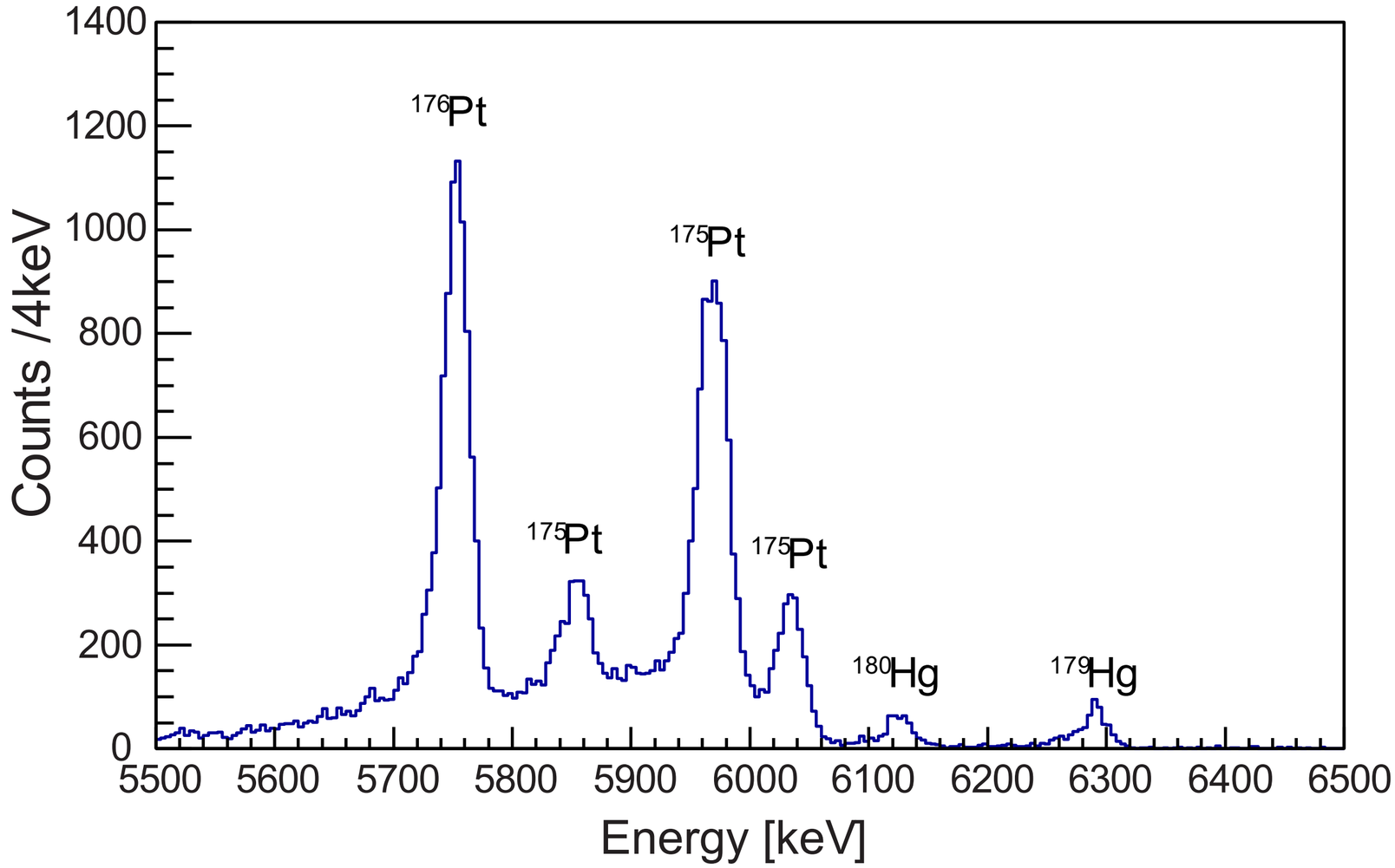
The α–γ coincidence matrix from the experiment S17



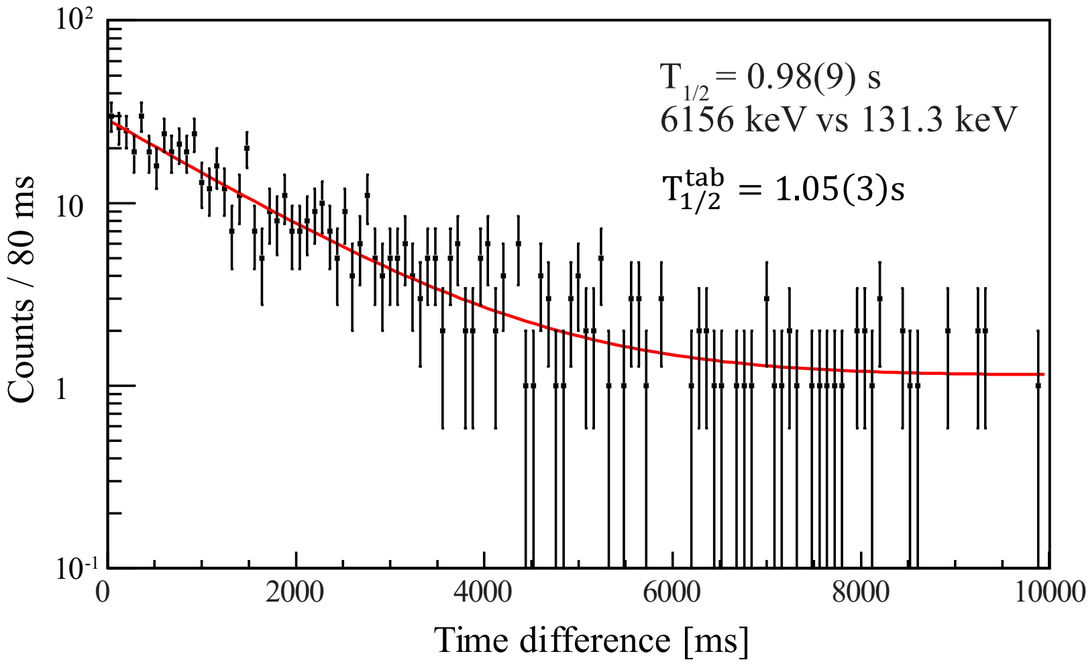
$\Delta t(\gamma - \alpha) = 200$ ns,
$\Delta t(\alpha - ER) \leq 3$ s

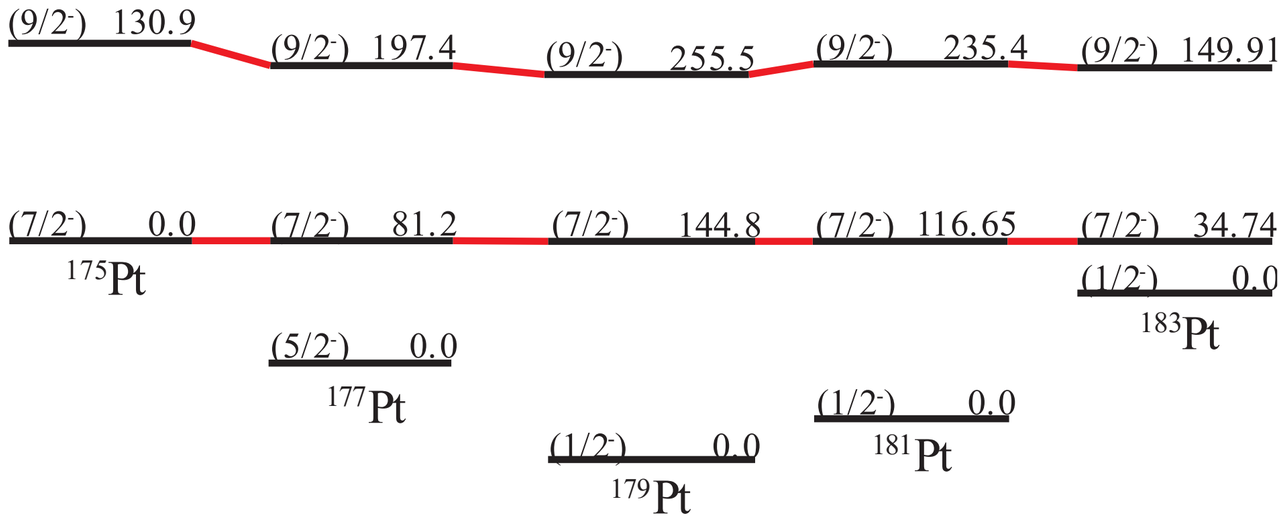
$E_\alpha = 6156(7)$ keV vs
$E_\gamma = 131.3(5)$ keV

Alpha decays correlated with 6156 keV alpha decay

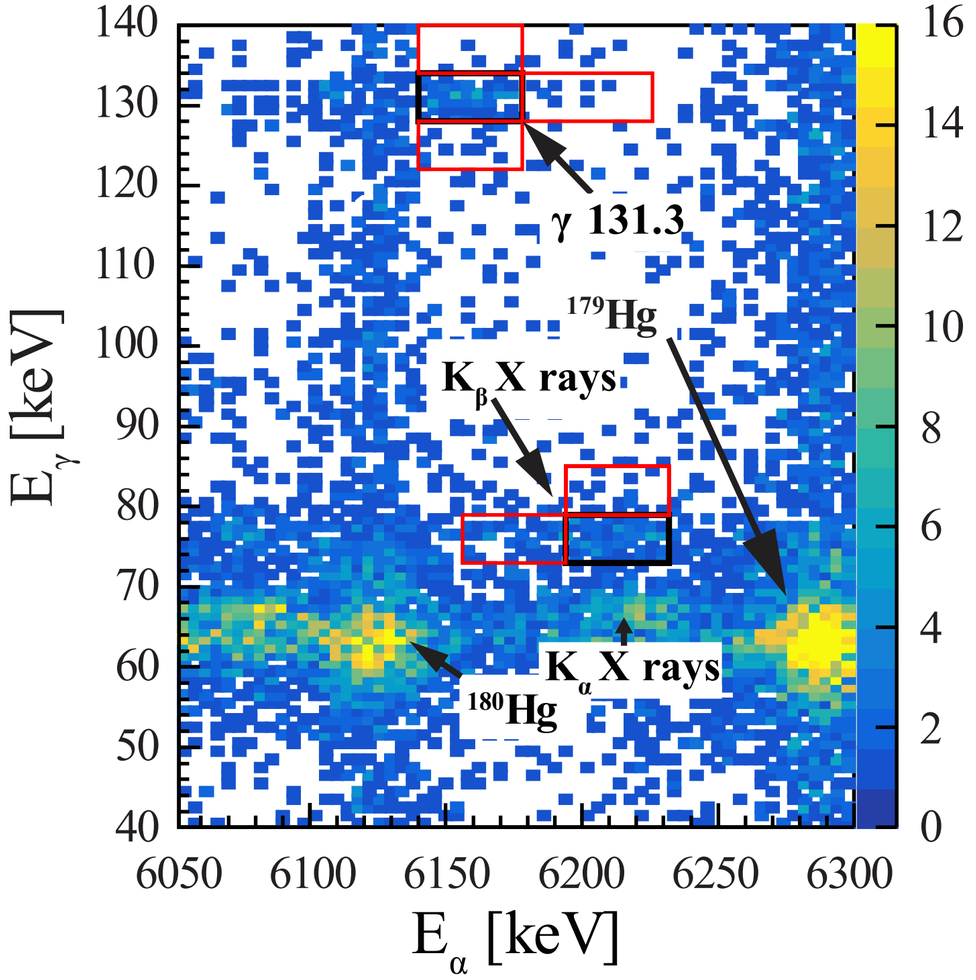


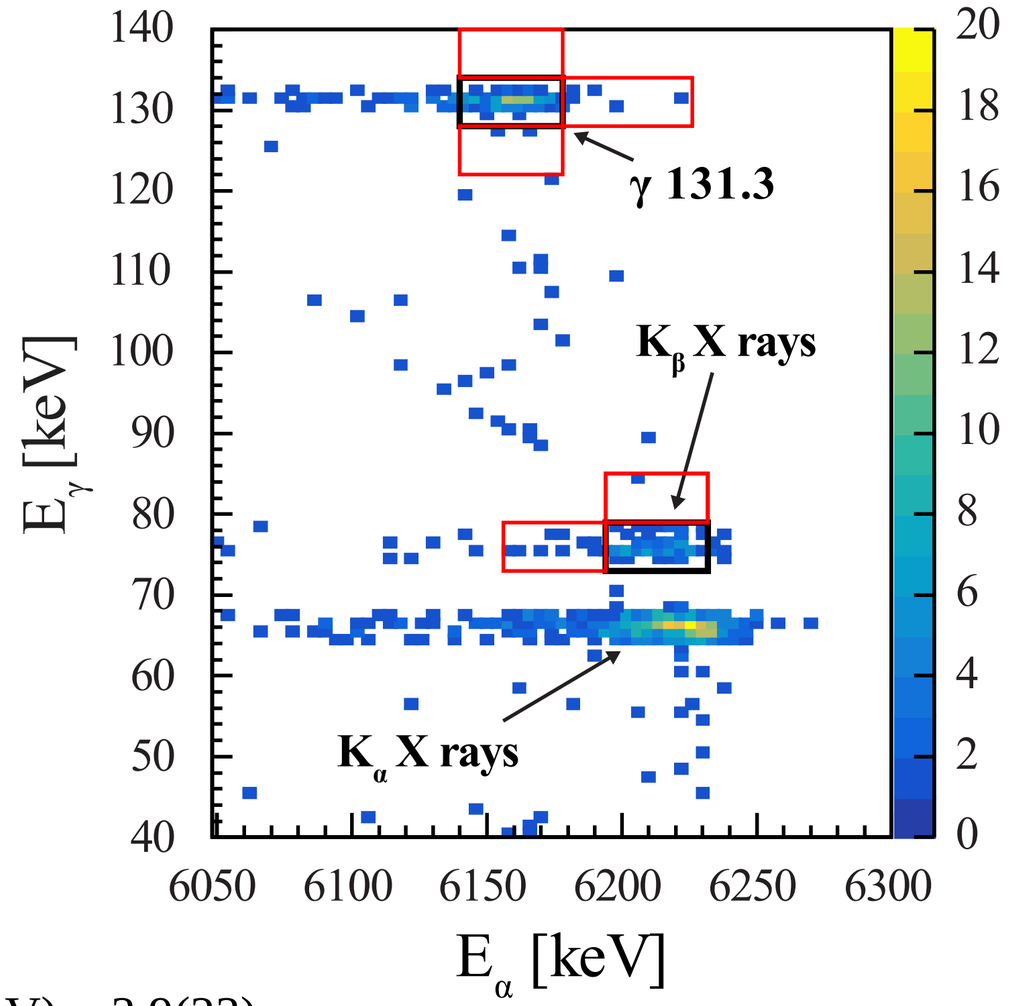
Time distribution of ^{179}Hg α decay populating the 131.3 keV excited state in ^{175}Pt





Experimental vs simulated data

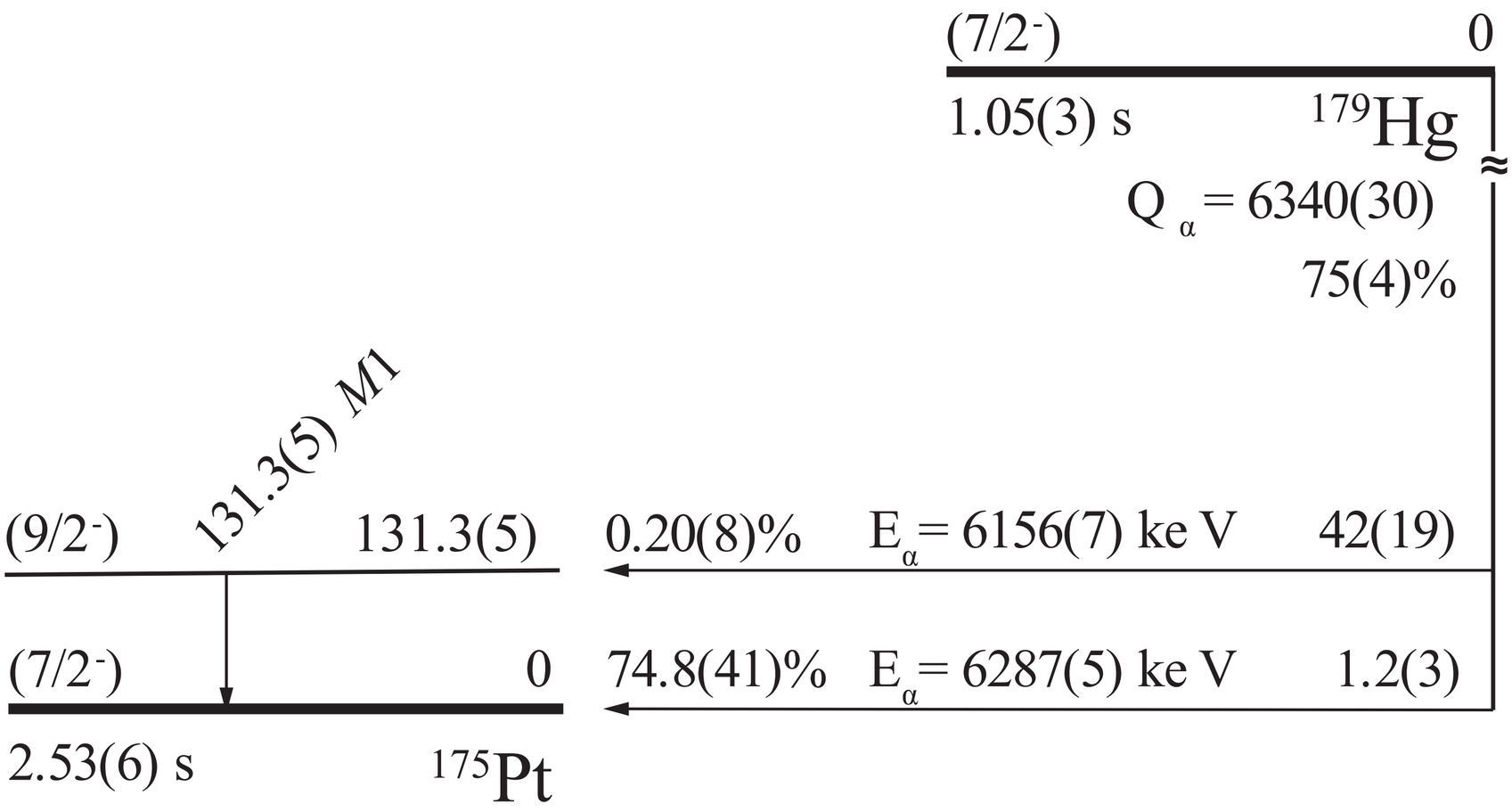




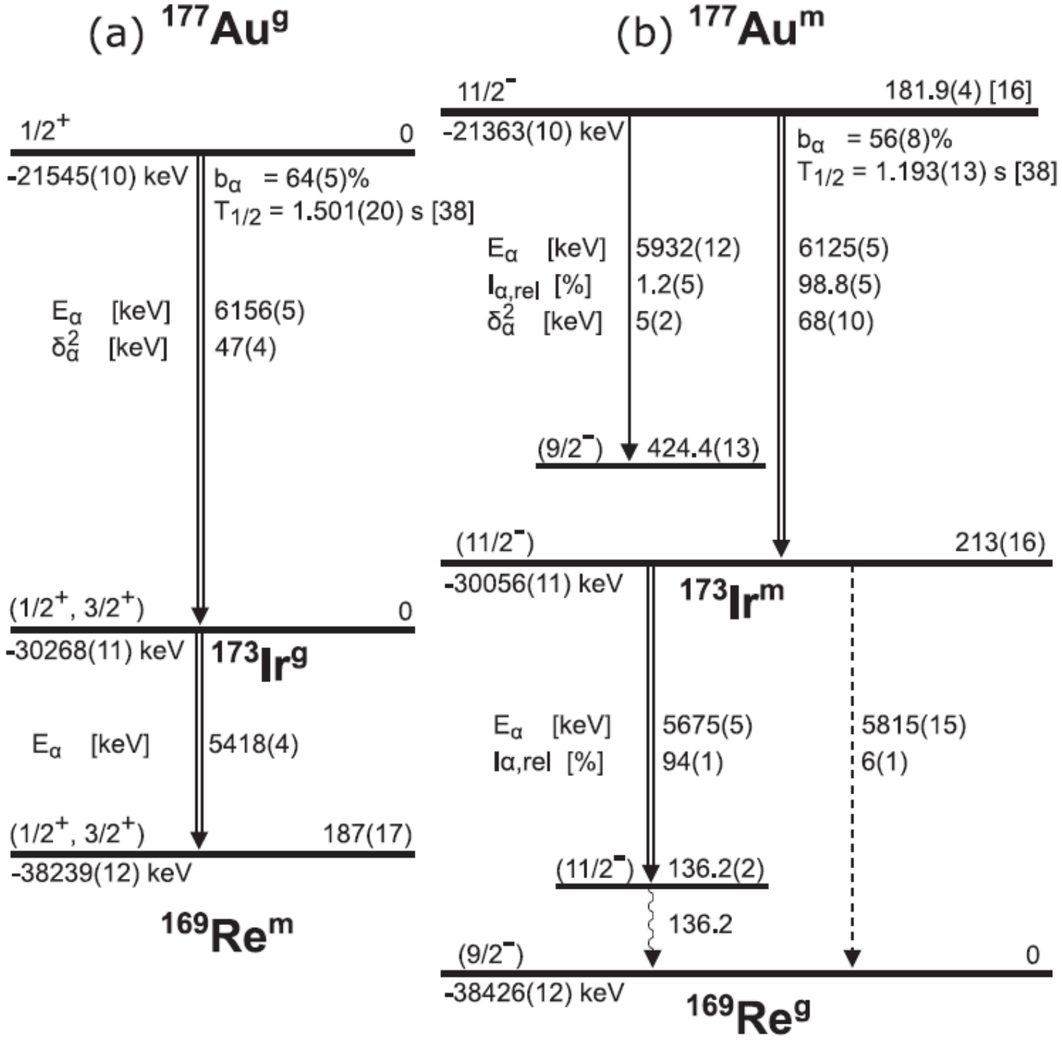
$\alpha_{K,\,exp}(131\ keV) = 3.9(23)$

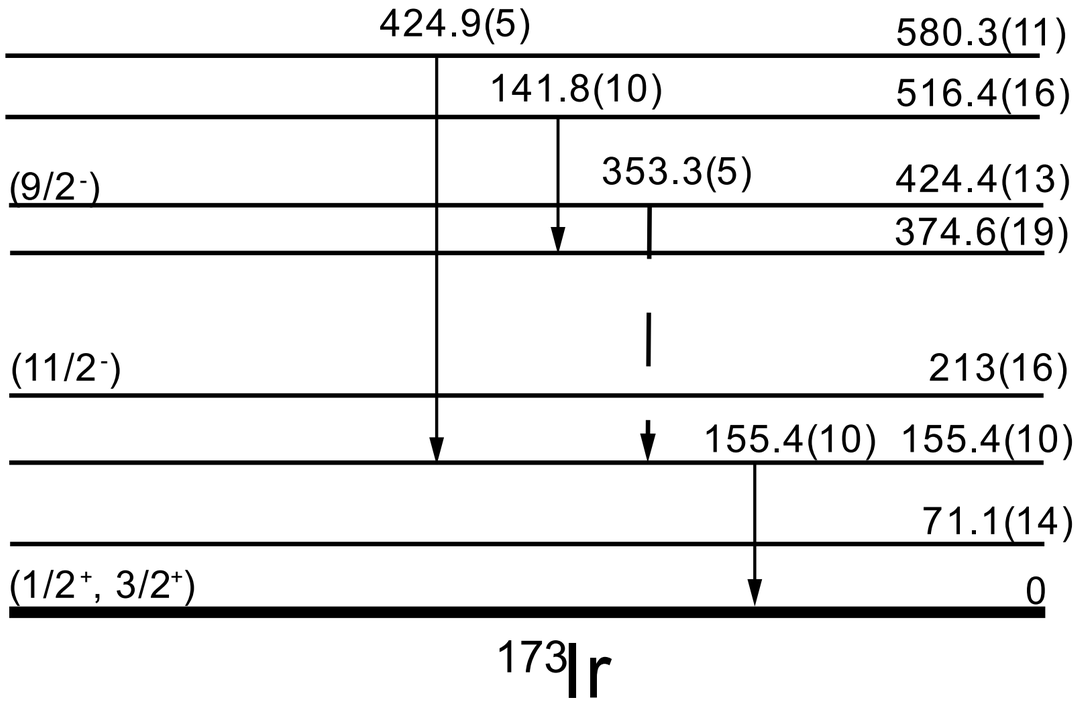
$\alpha_{K,theo}(131\ keV) = 2.52(5)$

Updated decay scheme of ^{179}Hg



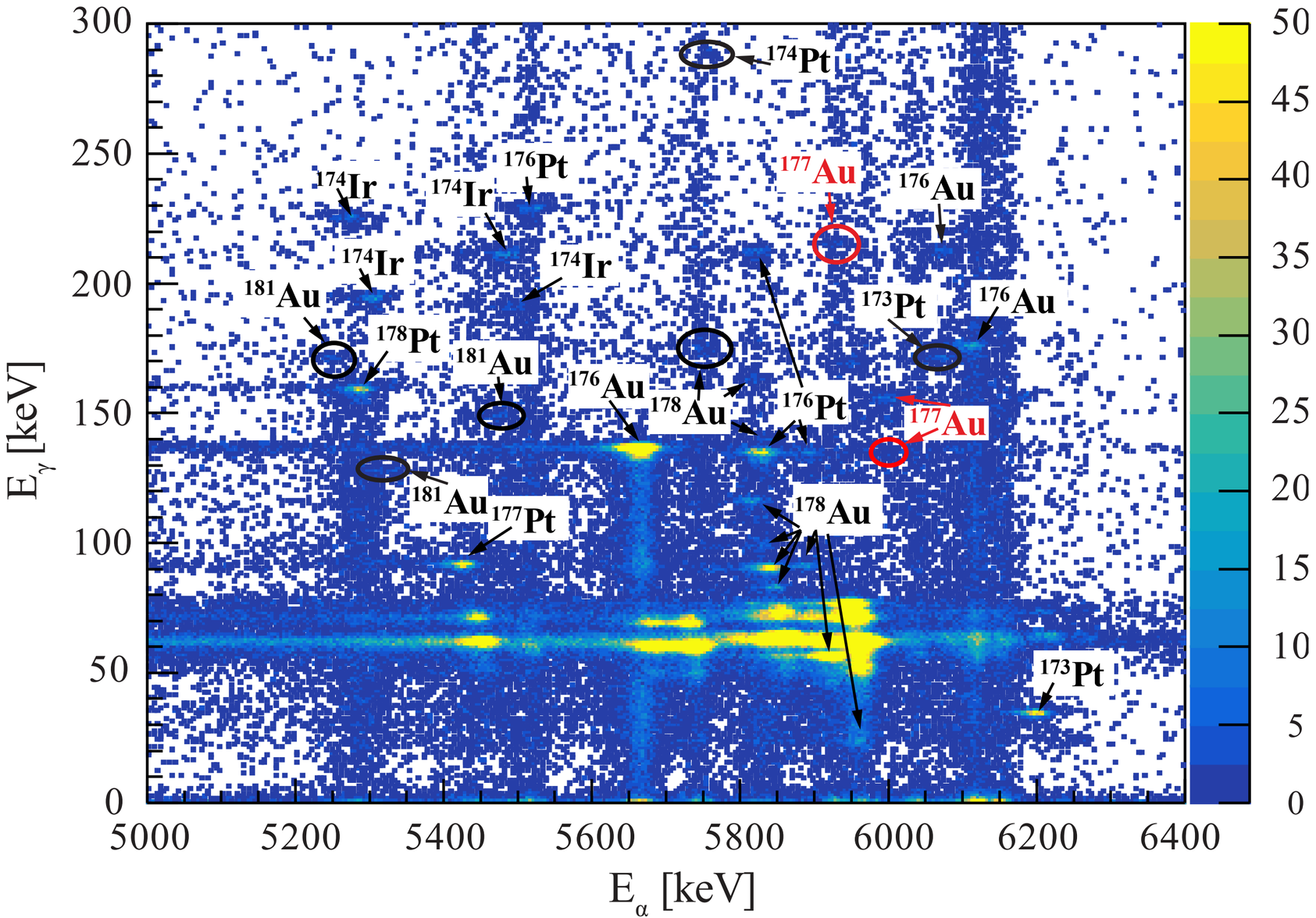
Previous decay scheme of ^{177}Au





R. D. Harding *et al.*, Phys. Rev. C **104**, 024326 (2021)

The α–γ coincidence matrix from the experiment JR115



$\Delta t(\alpha - \gamma)$ = 200 ns,

$\Delta t(\alpha$ –ER) $\leq$ 4 s

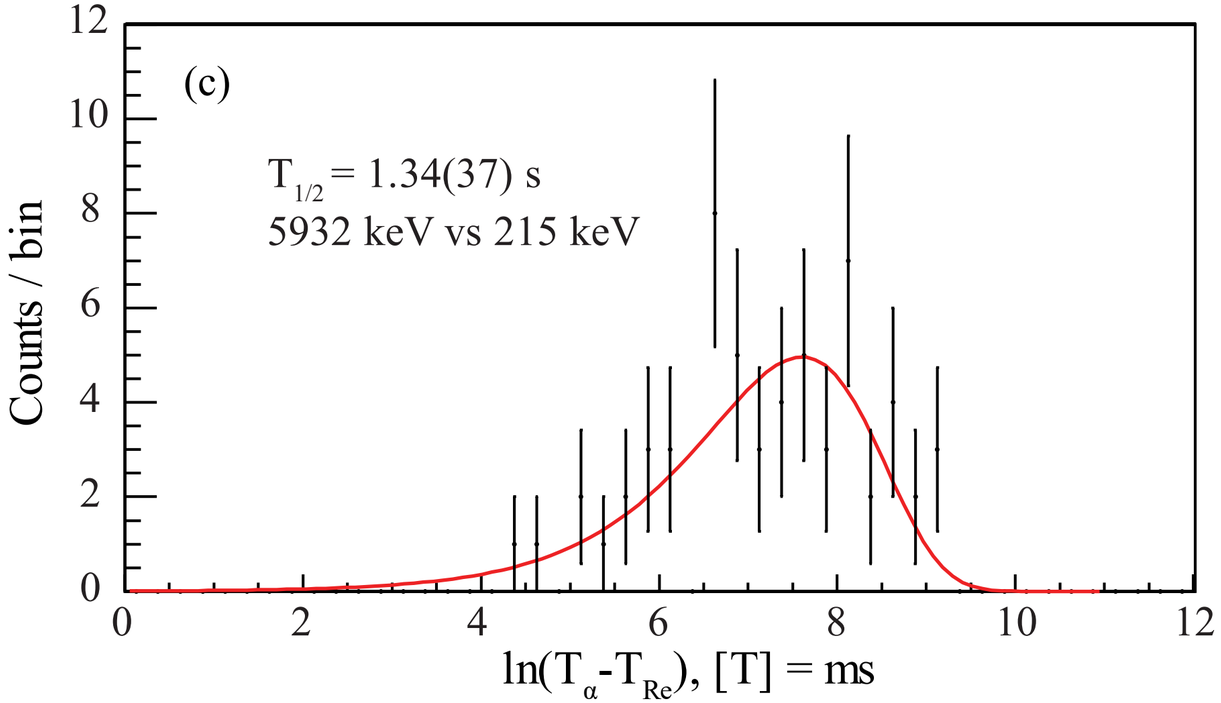
E_α = 5932(6) keV vs E_γ = 215.7(7)keV

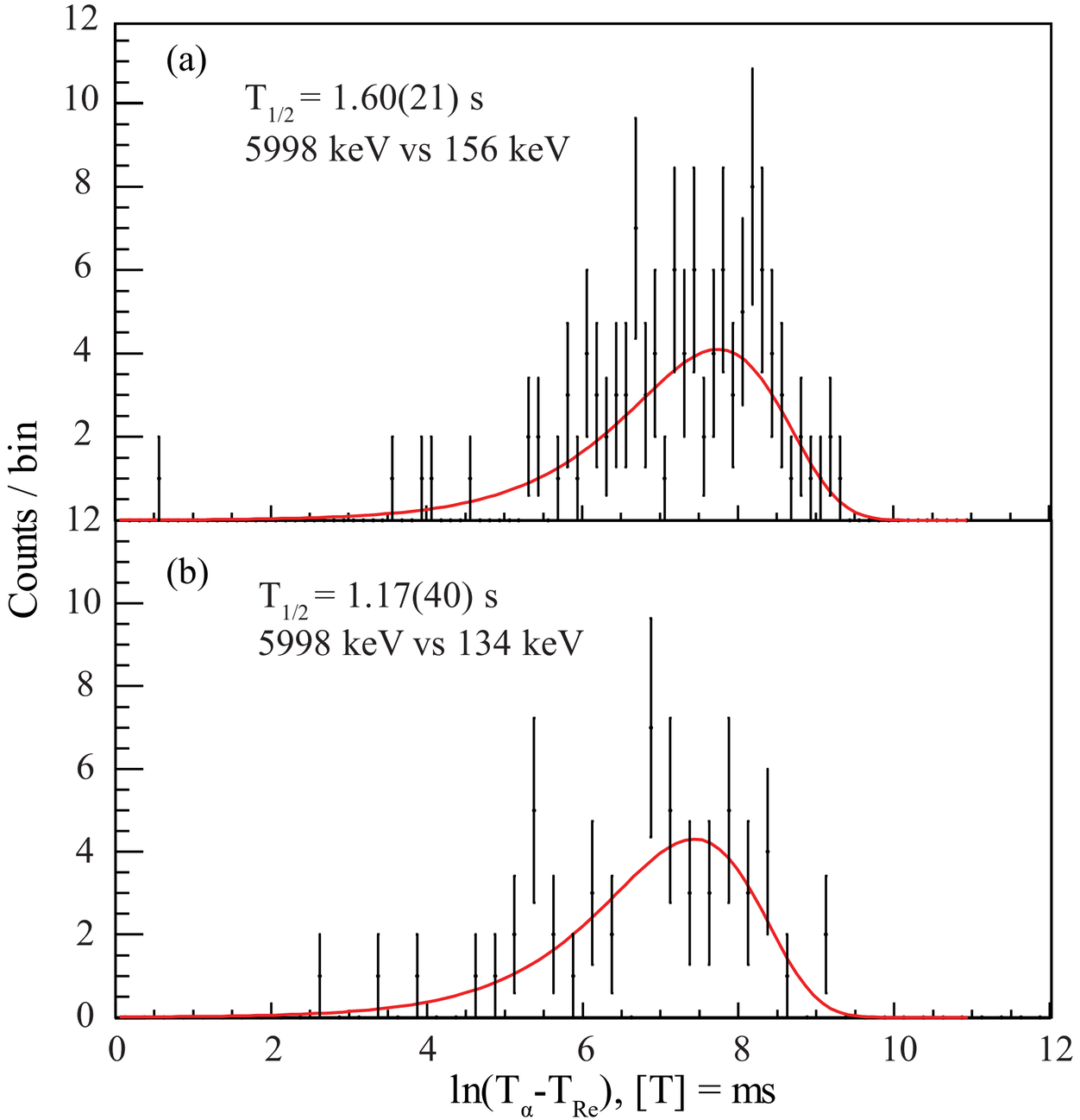
E_α = 5998(5) keV vs E_γ = 156.1(6) keV

E_α = 5998(5) keV vs E_γ = 134.5(5) keV

Time distribution of ^{177}Au α decays observed in coincidence with 156 keV, 134.5 keV and 215 keV transitions

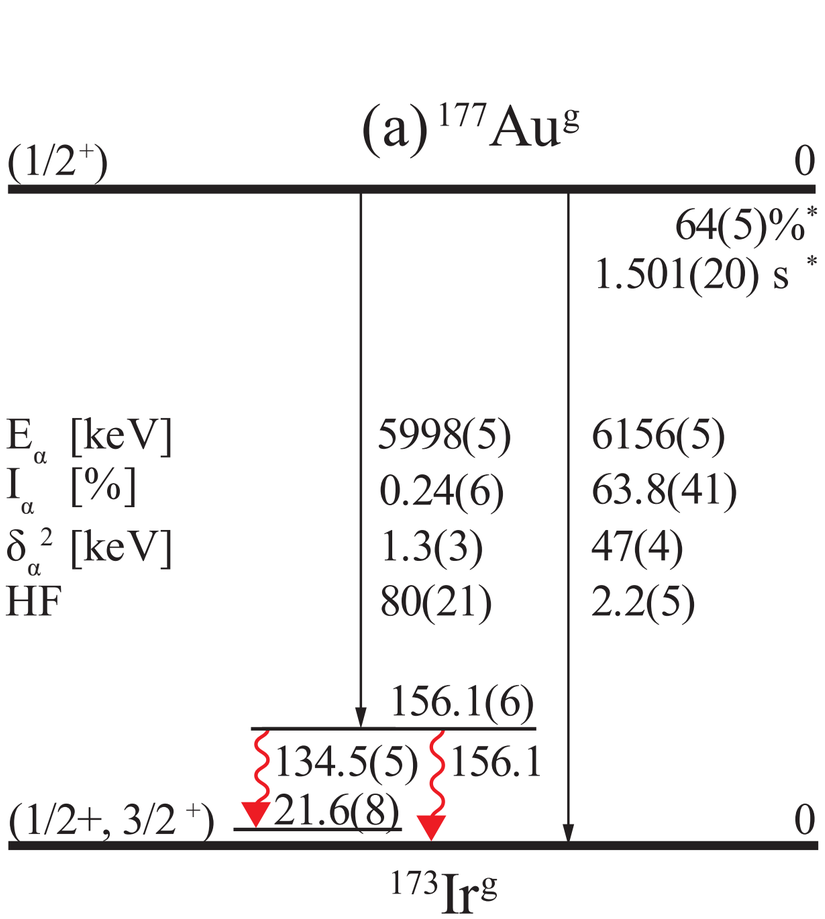
$T_{1/2}^{tab}(^{177}Au^{g}) = 1.501(20)s \quad T_{1/2}^{tab}(^{177}Au^{m}) = 1.193(13)s$

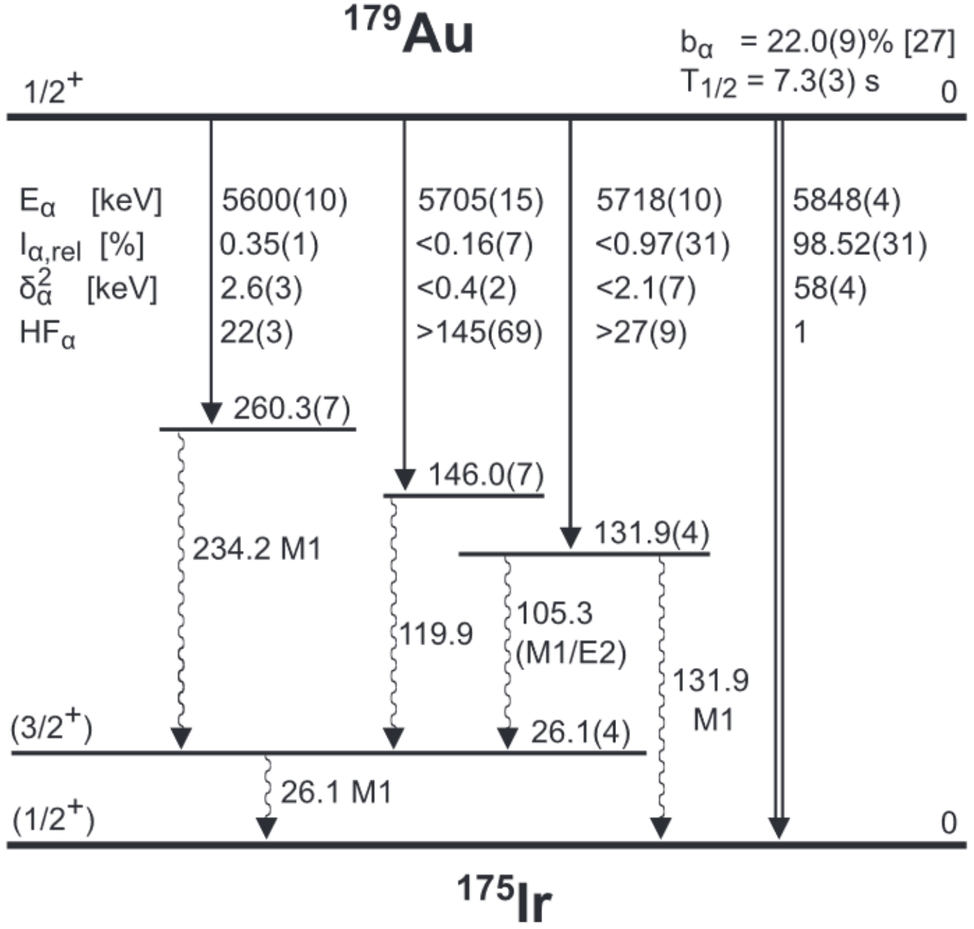




K. H. Schmidt, Eur. Phys. J. A **8,** (2000),

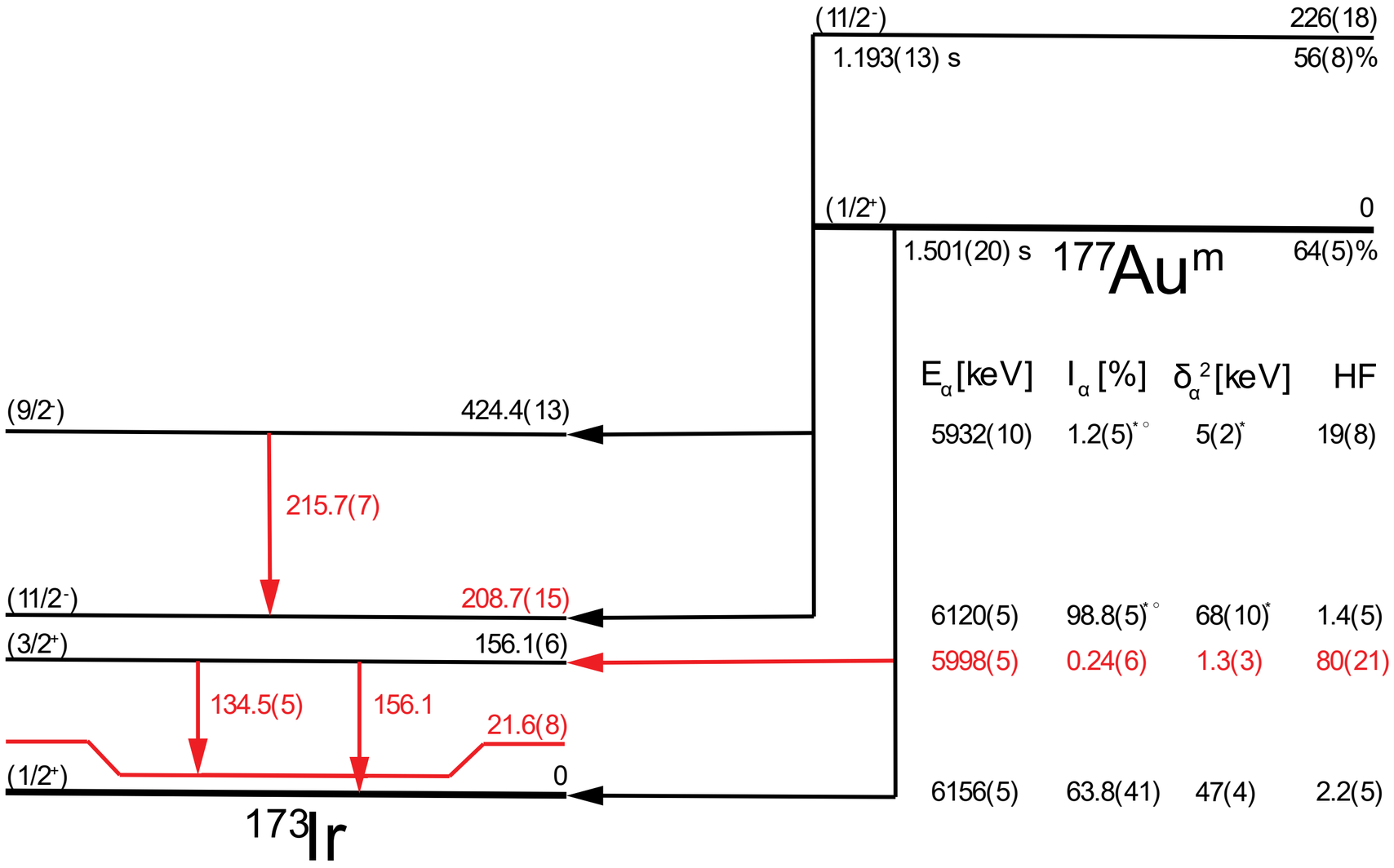
Comparison with neighbouring isotope



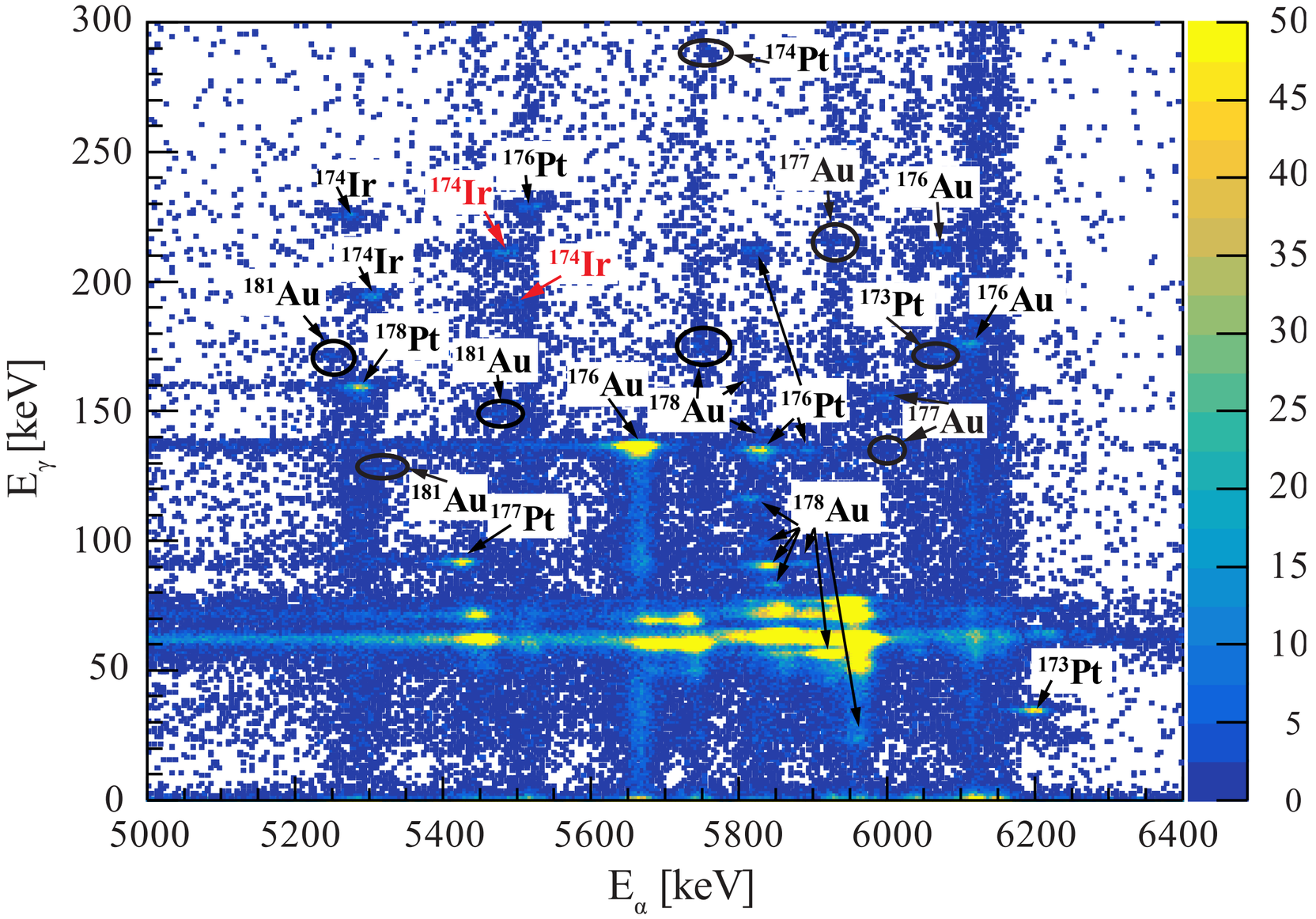


R. D. Harding *et al.,* Phys. Rev. C **104,** 024326 (2021)

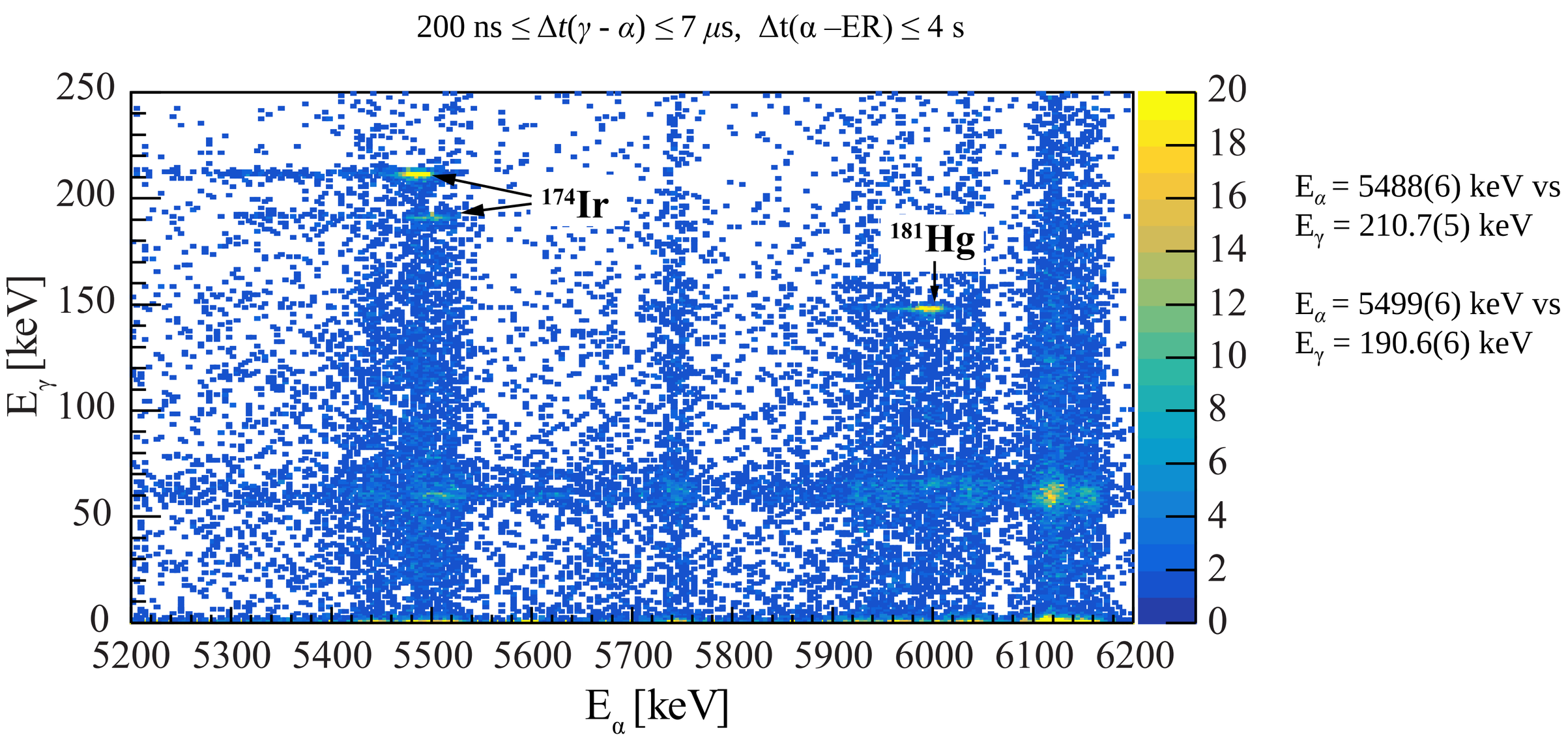
Updated decay scheme of ^{177}Au



The α–γ coincidence matrix from the experiment JR115



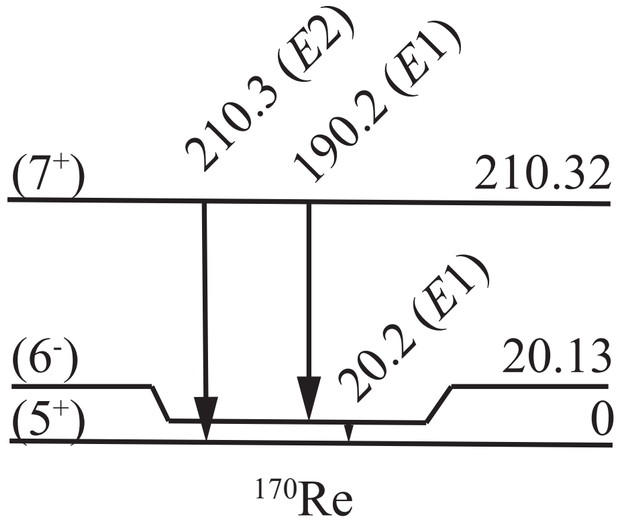
The delayed α-γ coincidence matrix from the experiment JR115



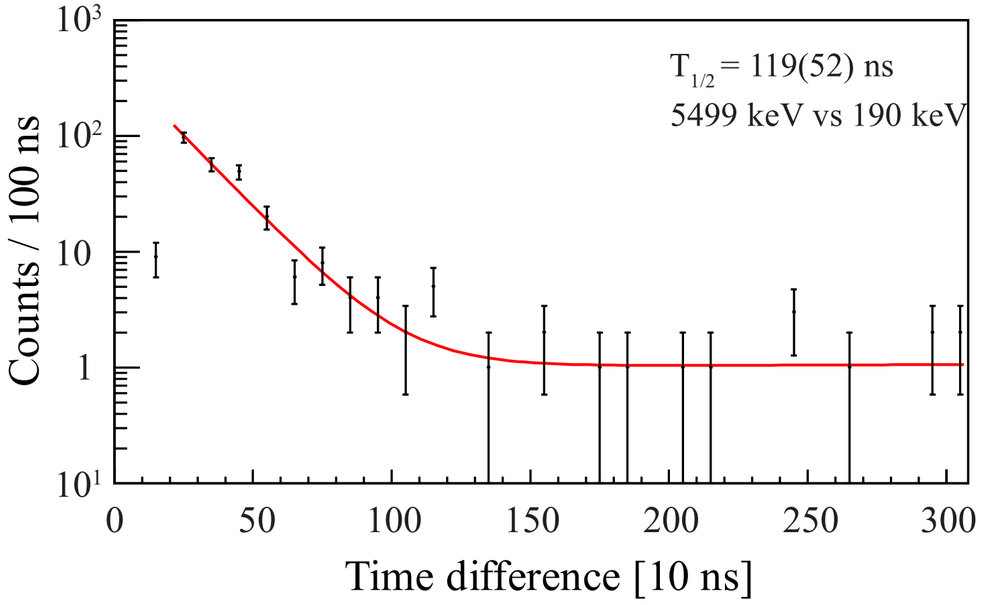
E_α = 5488(6) keV vs
E_γ = 210.7(5) keV

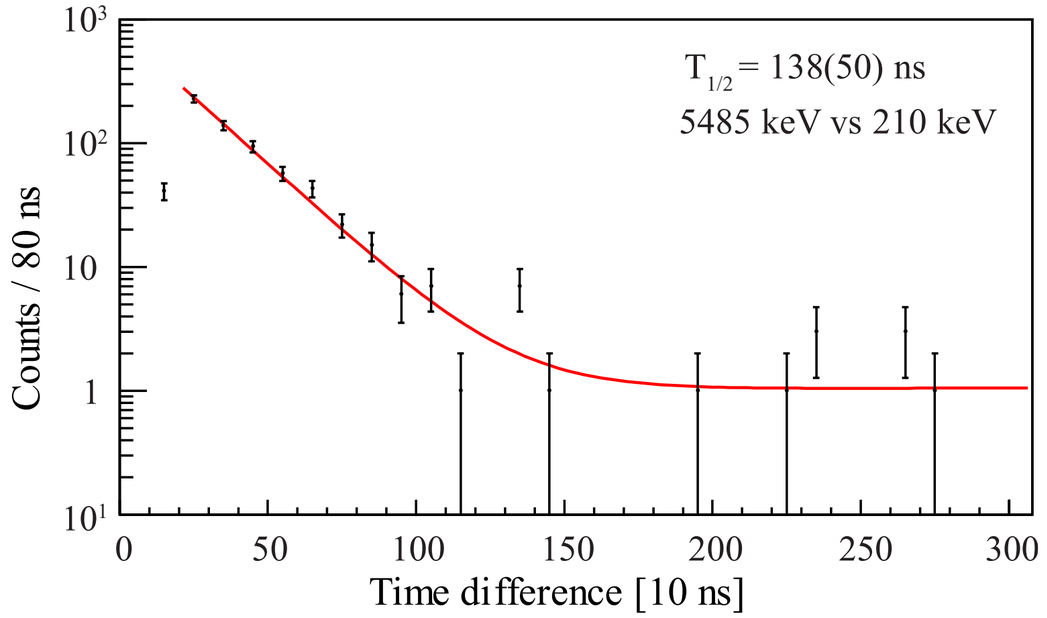
E_α = 5499(6) keV vs
E_γ = 190.6(6) keV

Half-life measurement for the 210 keV excited state in ^{170}Re



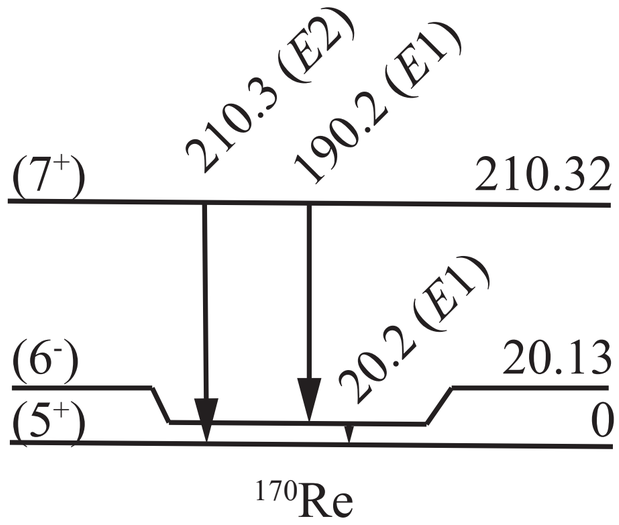
$T_{1/2} = 129(72)$ ns





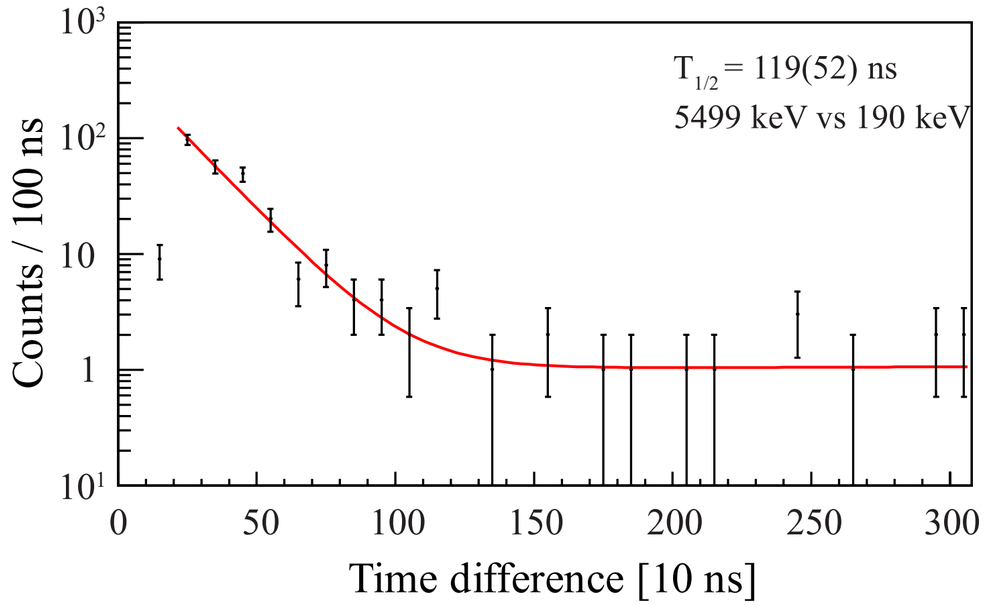
Half-life measurement fr the 210 keV excited state in ^{170}Re

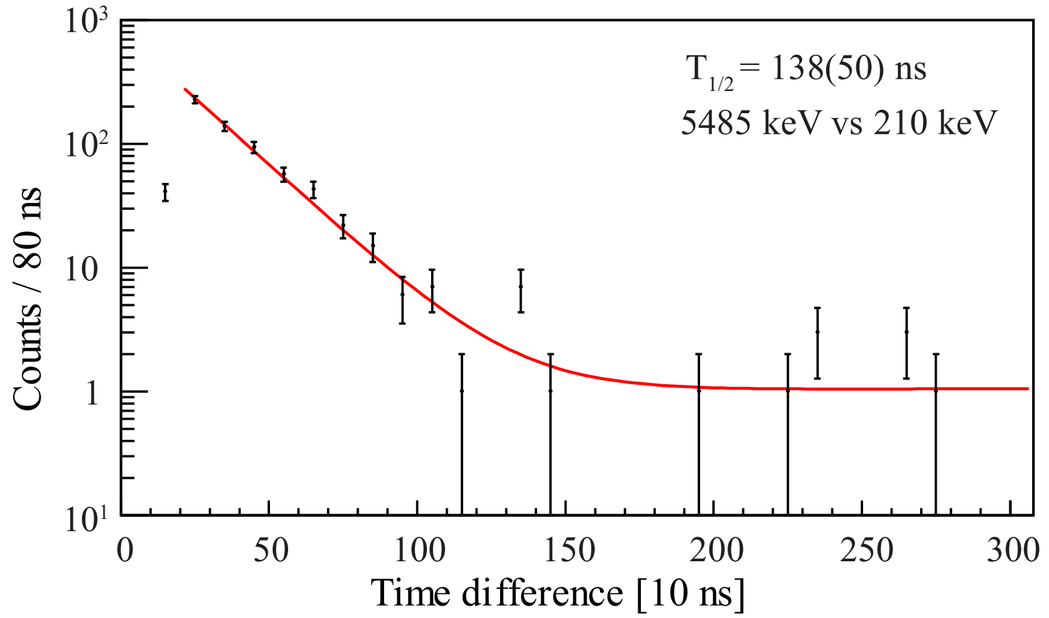
M. Al-Monthery. “Decay Studies of ^{178}Au and Its Daughter ^{174}Ir”. PhD thesis. York, England: University of York, 2019.



^{170}Re

$T_{1/2} = 129(72)$ ns



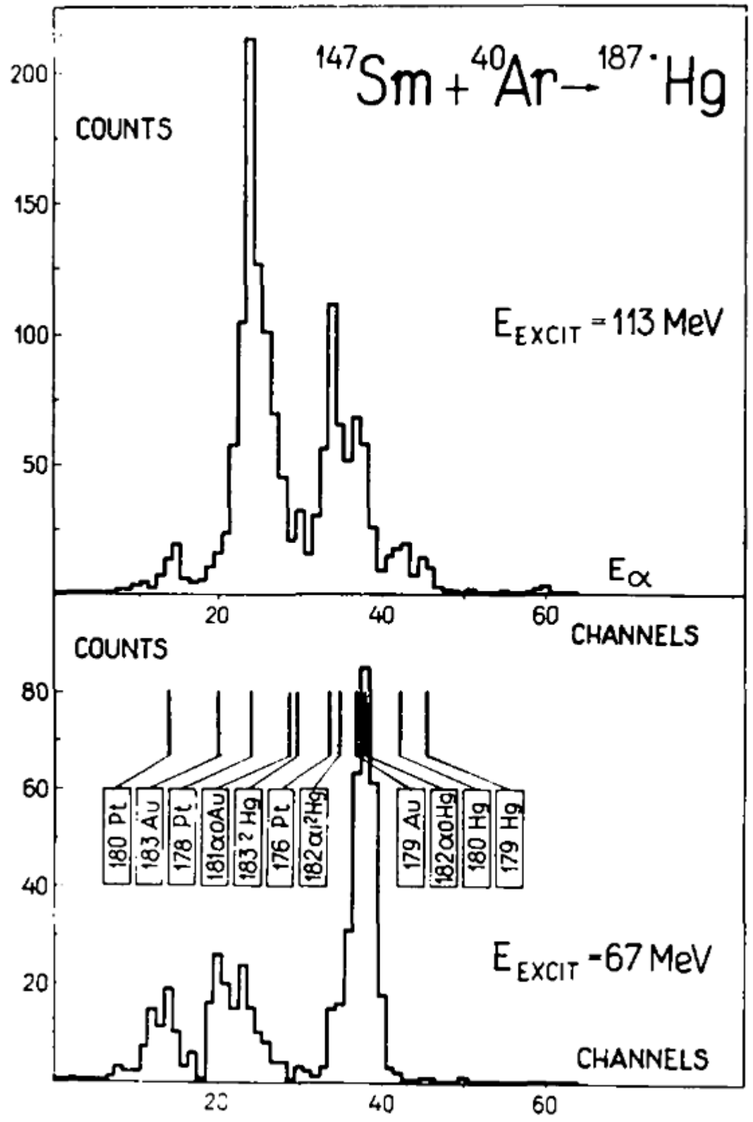


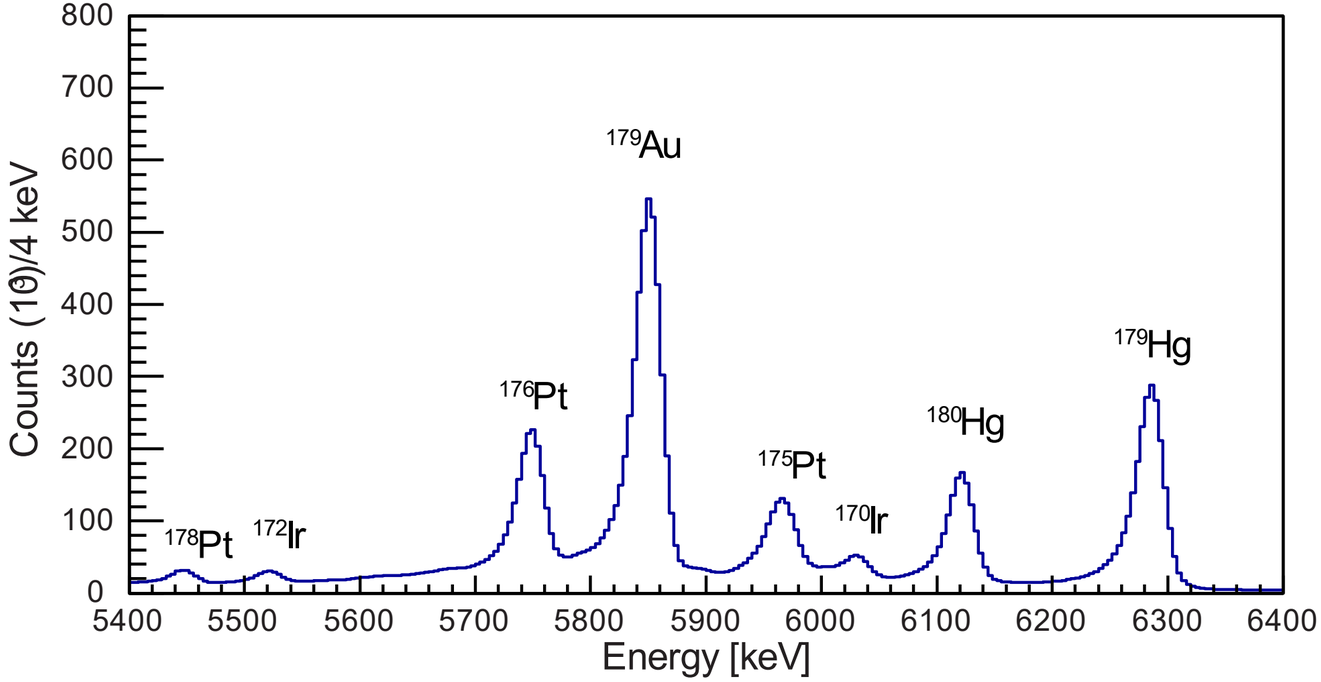
Summary

- **New α decay branch in ^{179}Hg**
- **Multipolarity assignment for 131.3 keV transition in ^{175}Pt**
- **Updated decay scheme for ^{177}Au**

Thank you for your attention

Half-life measurement for the 210 keV excited state in ^{170}Re





Half-life measurement for the 210 keV excited state in ^{170}Re

Parent nucleus	E_α^{exp} [keV]	E_α^{tab} [keV]	E_α^{tab} Reference	Child	E_γ [keV]	$Q_{\alpha,tot}$	$I_i \rightarrow I_f$
^{176}Pt	5529(4)	5537(10)	[69]	^{172}Os	229.0(10)	5885(5)	$2^+ \rightarrow 0^+$
^{177}Pt	5433(5)	5435(10)	[69]	^{173}Os	92.5(7)	5651(5)	$7/2^- \rightarrow 5/2^-$
^{181}Hg	5945(8)	5934(9)	[69]	^{177}Pt	214.2(6)	6293(8)	$(3/2^-)^- \rightarrow 5/2^-$
^{181}Hg	6008(6)	6005(4)	[69]	^{177}Pt	147.8(6)	6292(4)	$1/2^- \rightarrow 5/2^-$
^{178}Au	5967(9)	5961(10)	[88]	^{174}Ir	26.0(10)	6130(9)	$(-) \rightarrow (7,8)$
^{179}Au	5744(8)	5718(10)	[86]	^{175}Ir	105.9(7)	5981(8)	$(-) \rightarrow (3/2^+)$
^{179}Au	5732(7)	5705(15)	[86]	^{175}Ir	119.8(6)	5983(7)	$(-) \rightarrow (3/2^+)$
^{179}Au	5725(7)	5718(10)	[86]	^{175}Ir	132.0(6)	5988(7)	$(-) \rightarrow (1/2^+)$
^{179}Au	5621(8)	5600(10)	[86]	^{175}Ir	234.0(5)	5983(8)	$(-) \rightarrow (3/2^+)$
^{180}Au	5637(10)	5639(7)	[87]	^{176}Ir	37.7(7)	5803(10)	$(-) \rightarrow (-)$
^{180}Au	5574(11)	5598(8)	[87]	^{176}Ir	43.0(6)	5744(11)	$(-) \rightarrow (-)$
^{180}Au	5562(9)	5485(10)	[87]	^{176}Ir	117.7(6)	5806(9)	$(-) \rightarrow (-)$
^{181}Au	5476(7)	5479(5)	[89]	^{177}Ir	150.0(6)	5750(7)	$(3/2^-) \rightarrow 5/2^-$

Table 3.3: Table of identified α-γ coincidences. The 2^{nd} and 6^{th} column denotes measured energies of α and γ-ray transitions, while the 3^{rd} represents tabulated values. The 4^{th} column contains references for the E_α^{tab}. The 7^{th} column represents the $Q_{\alpha,tot}$. The last column represent initial I_i and final I_f spins and parities for γ-ray transitions in child nuclei. In the case of ^{178}Au, the spin and parity of the initial level are unknown.