

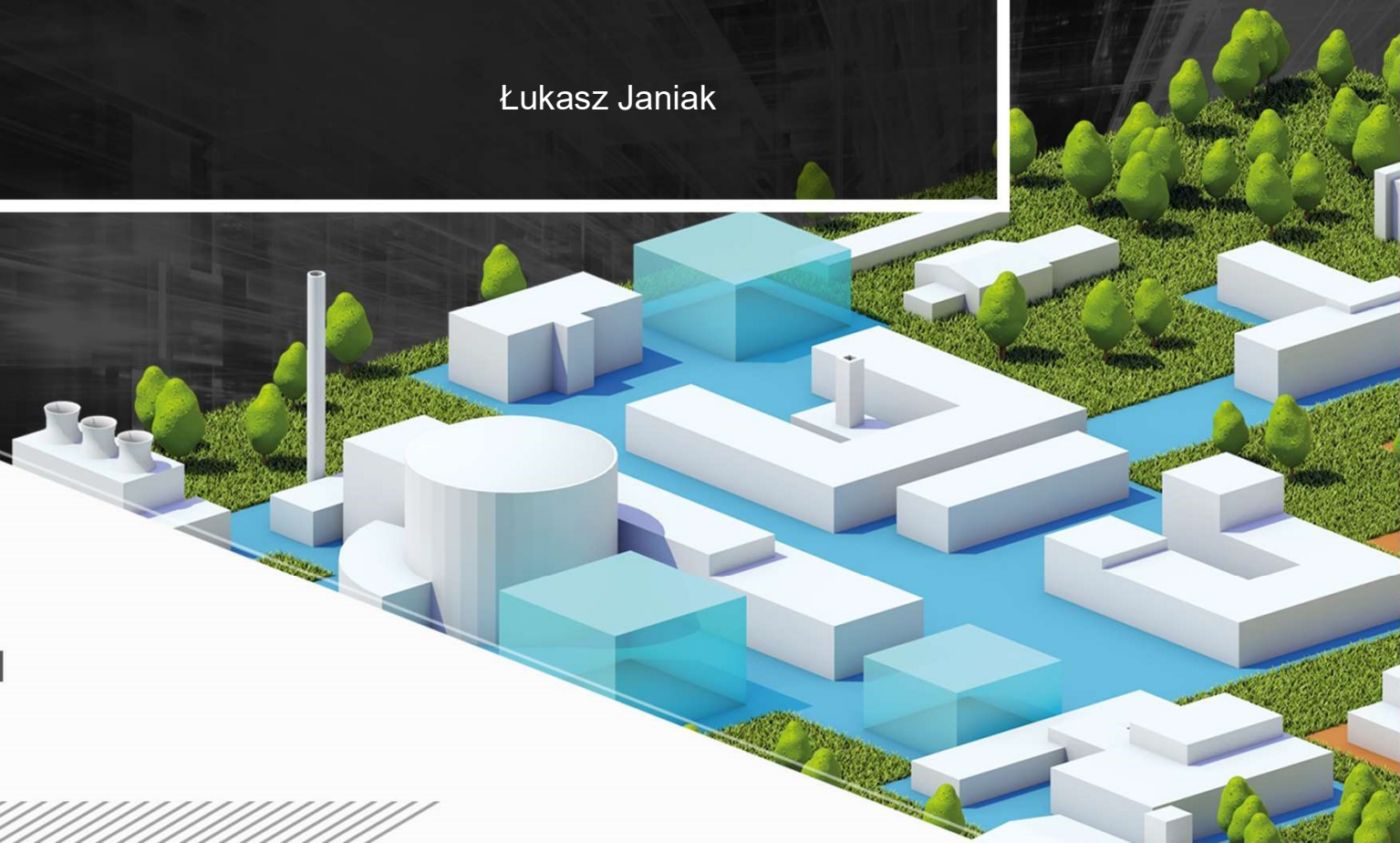
Pomiar czasu połowicznego zaniku stanu izomerycznego

^{184}Re

Łukasz Janiak



NARODOWE
CENTRUM
BADAŃ
JĄDROWYCH
ŚWIERK



Plan seminarium

1) Motywacja do badań

2) Eksperyment i wyniki

3) Plany kolejnych pomiarów

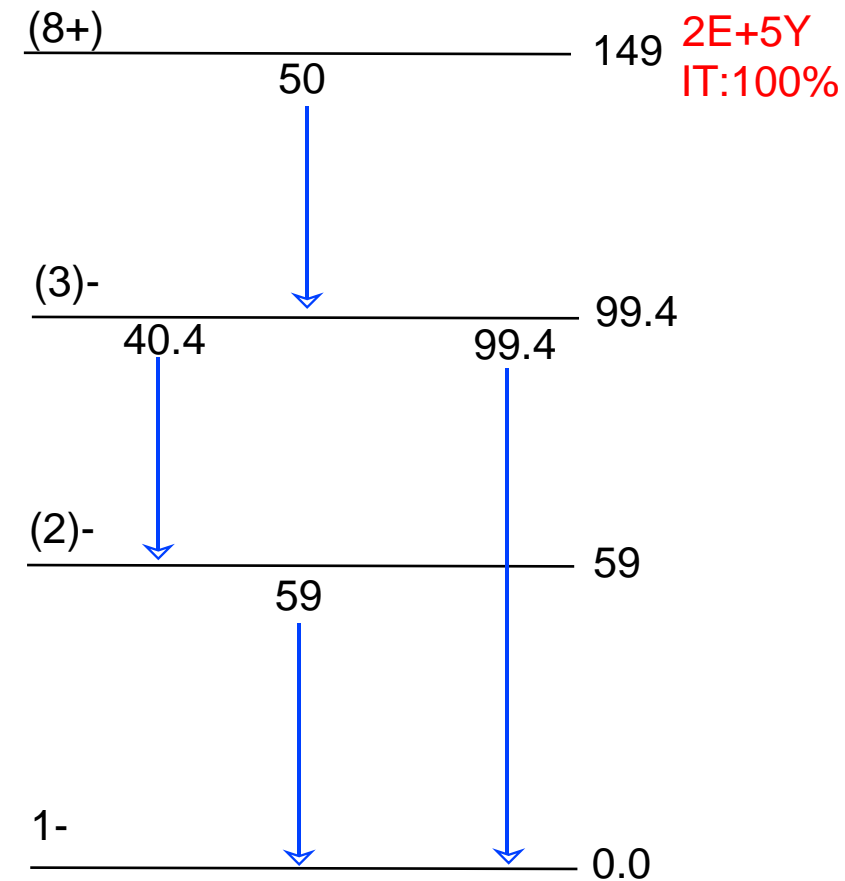
Projekt ARL

U.S. Army Combat Capabilities Development Command (DEVCOM)

Możliwości produkcji izomeru ^{186}Re

Badanie depopulacji ^{186}Re

185Ir	186Ir	187Ir	188Ir	189Ir	190Ir
184Os	185Os	186Os	187Os	188Os	189Os
183Re	184Re	185Re 37%	186Re	187Re 63%	188Re
182W	183W	184W	185W	186W	187W
181Ta	182Ta	183Ta	184Ta	185Ta	186Ta



Motywacja do badań

$$\underline{T_{1/2} = 169 \pm 8 \text{ d}} \quad {}^{184m}\text{Re}$$

N.R. Johnson 1963

$$\underline{T_{1/2} = 35.4 \pm 0.7 \text{ d}} \quad {}^{184}\text{Re}$$

Motywacja do badań

$$T_{1/2} = 169 \pm 8 \text{ d}$$

^{184m}Re

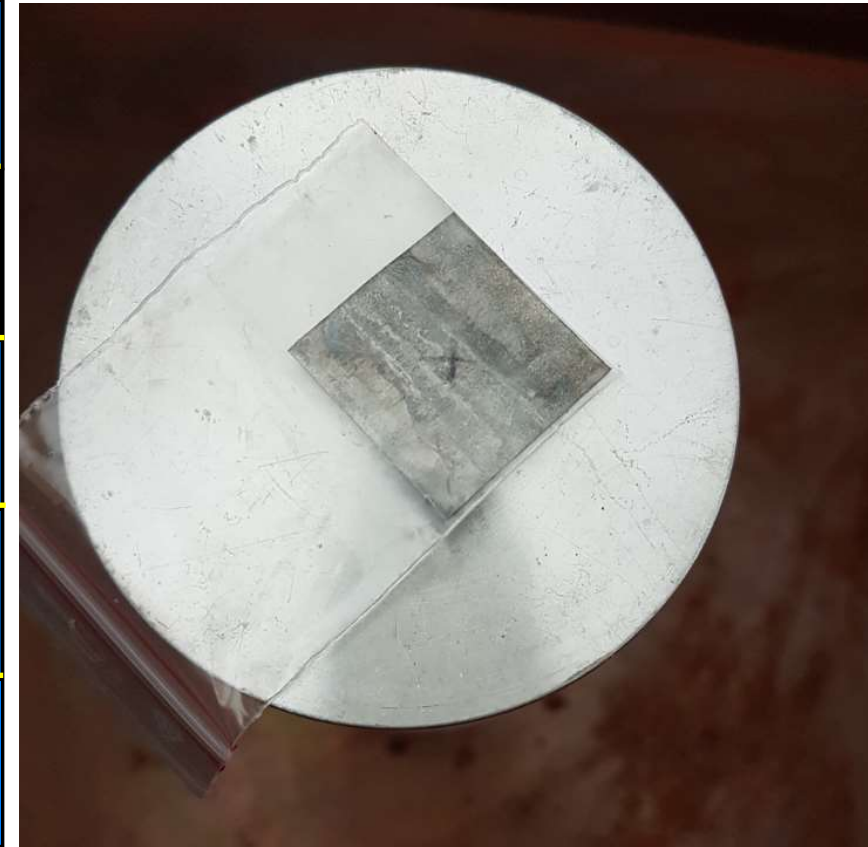
N.R. Johnson 1963

$$T_{1/2} = 35.4 \pm 0.7 \text{ d}$$

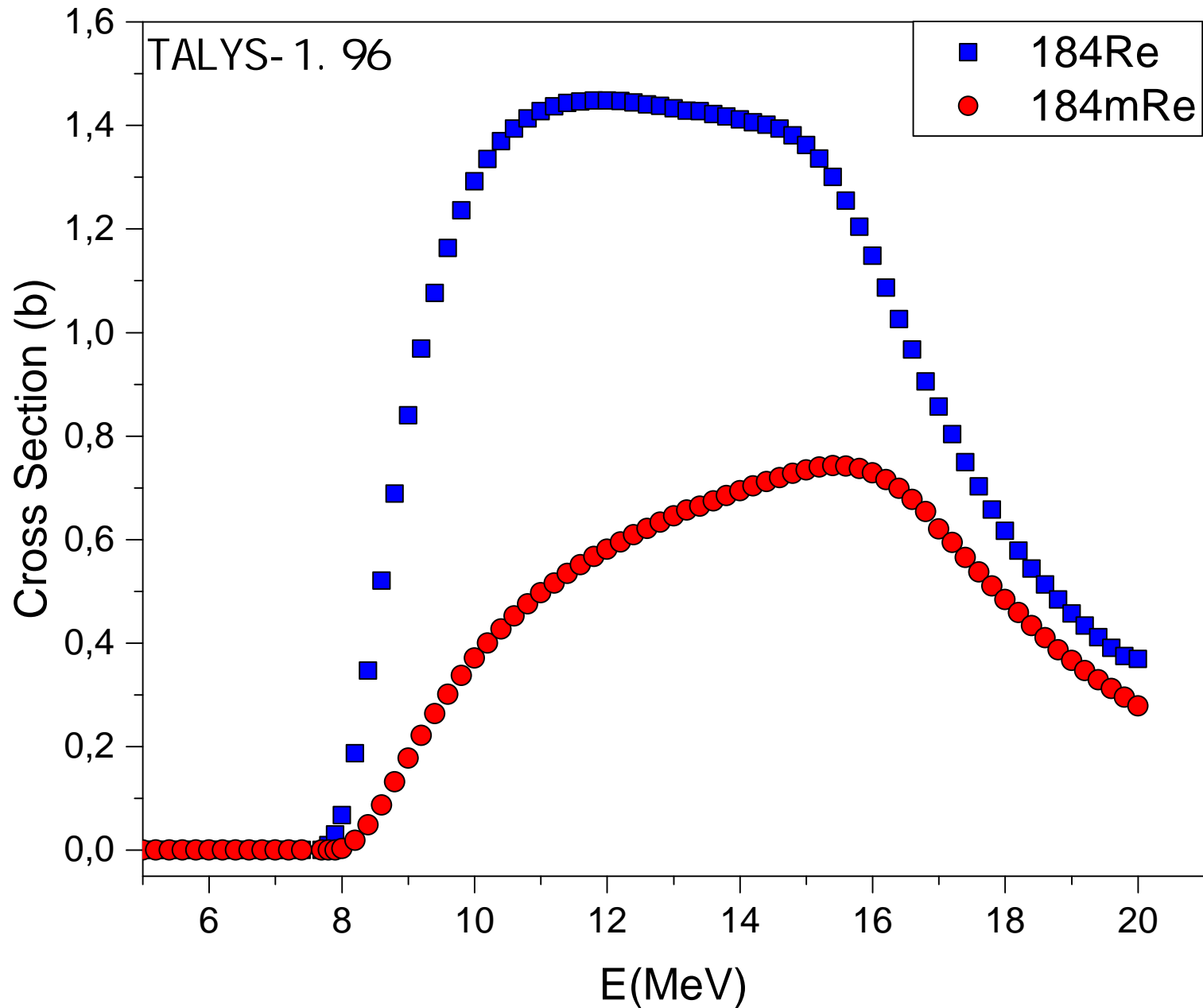
^{184}Re

Produkcja ^{184}Re

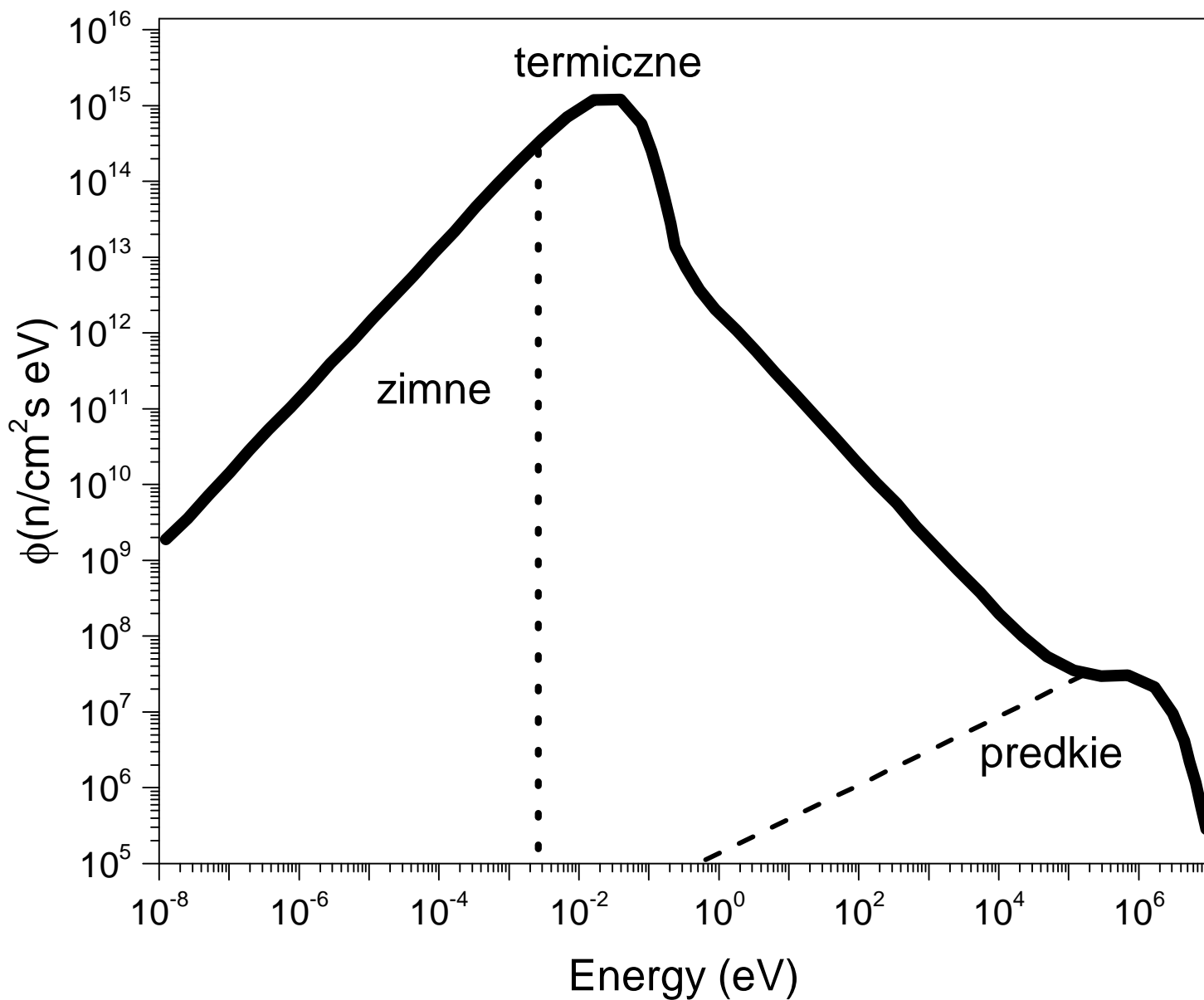
185Ir	186Ir	187Ir	188Ir	189Ir	190Ir
184Os	185Os	186Os	187Os	188Os	189Os
183Re	184Re	185Re 37%	186Re	187Re 63%	188Re
182W	183W	184W	185W	186W	187W
181Ta	182Ta	183Ta	184Ta	185Ta	186Ta



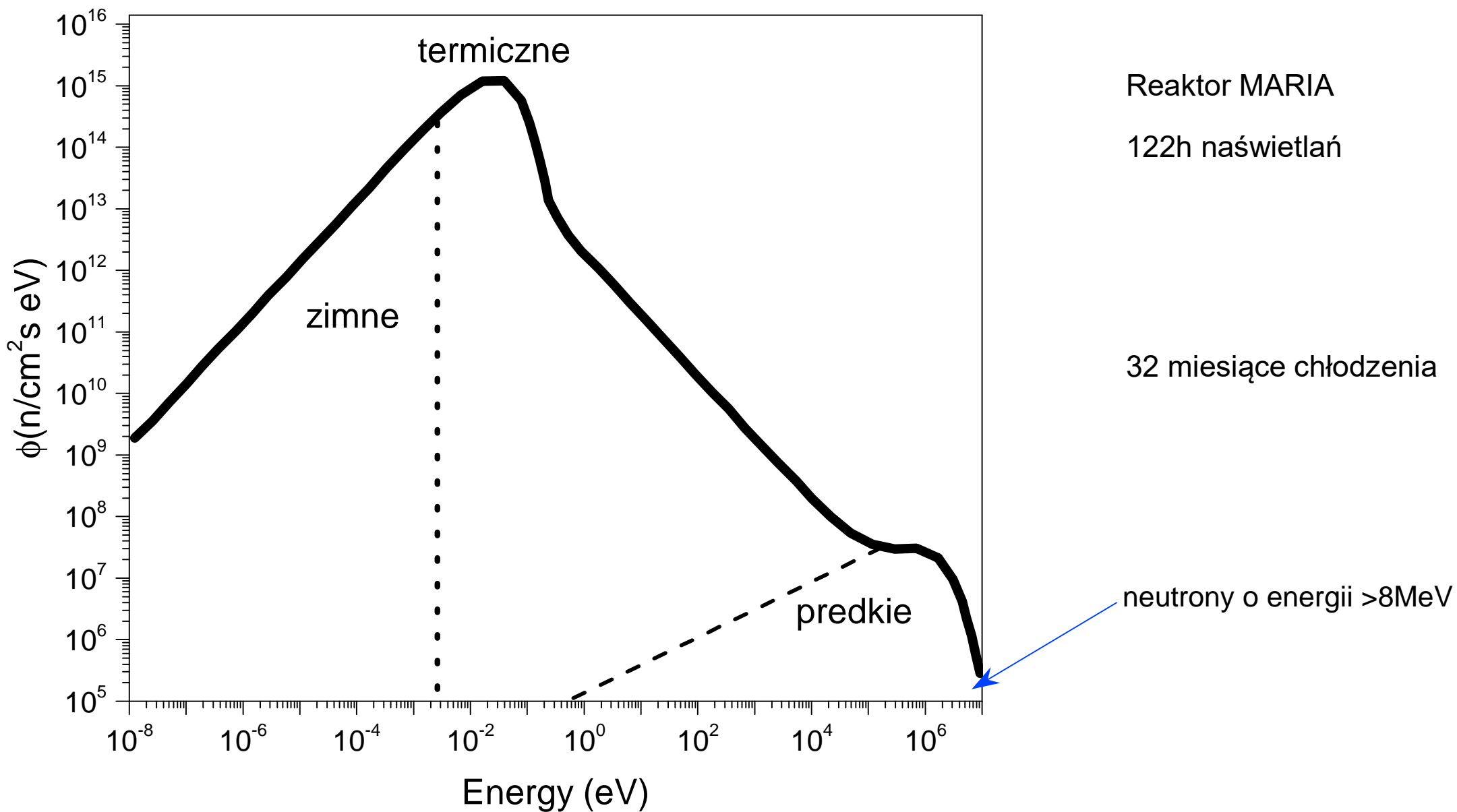
Produkcja: $^{185}\text{Re}(n,2n)$



Widmo neutronów



Widmo neutronów



Reaktor MARIA

122h naświetlań

32 miesiące chłodzenia

neutrony o energii >8MeV

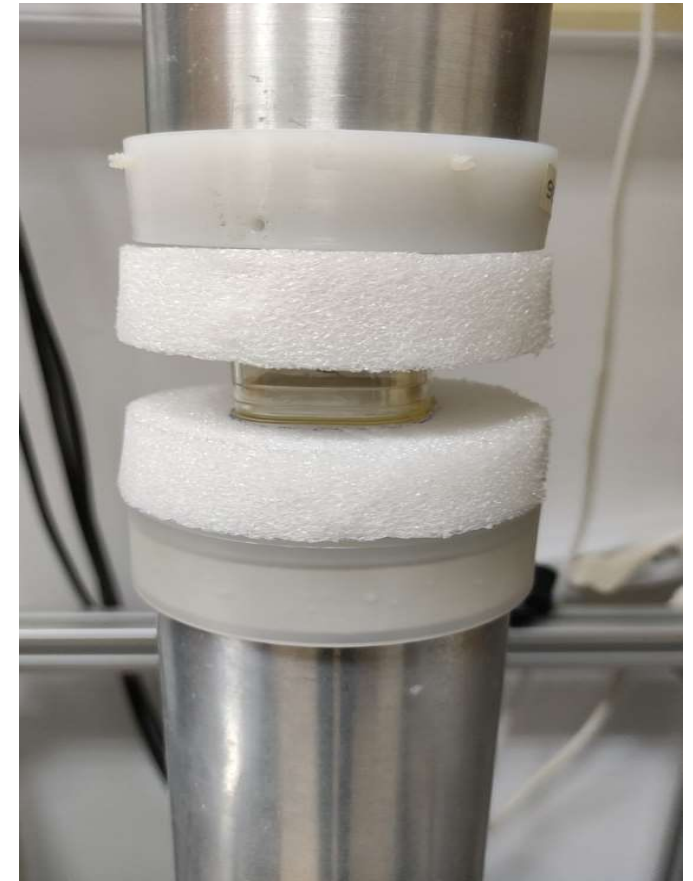
Stanowisko pomiarowe

D1 Ortec

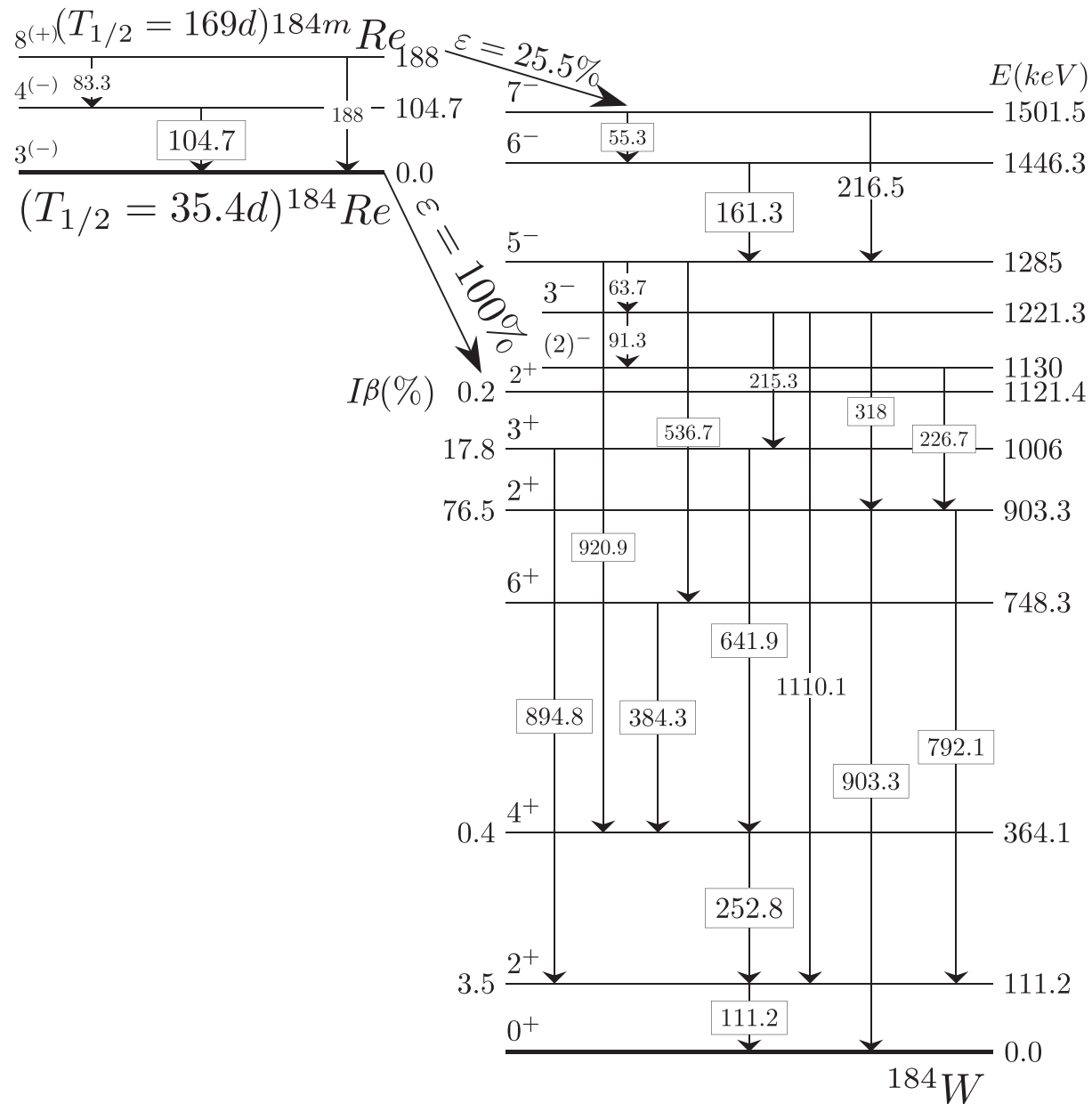
GLP-25300

D2 Canberra

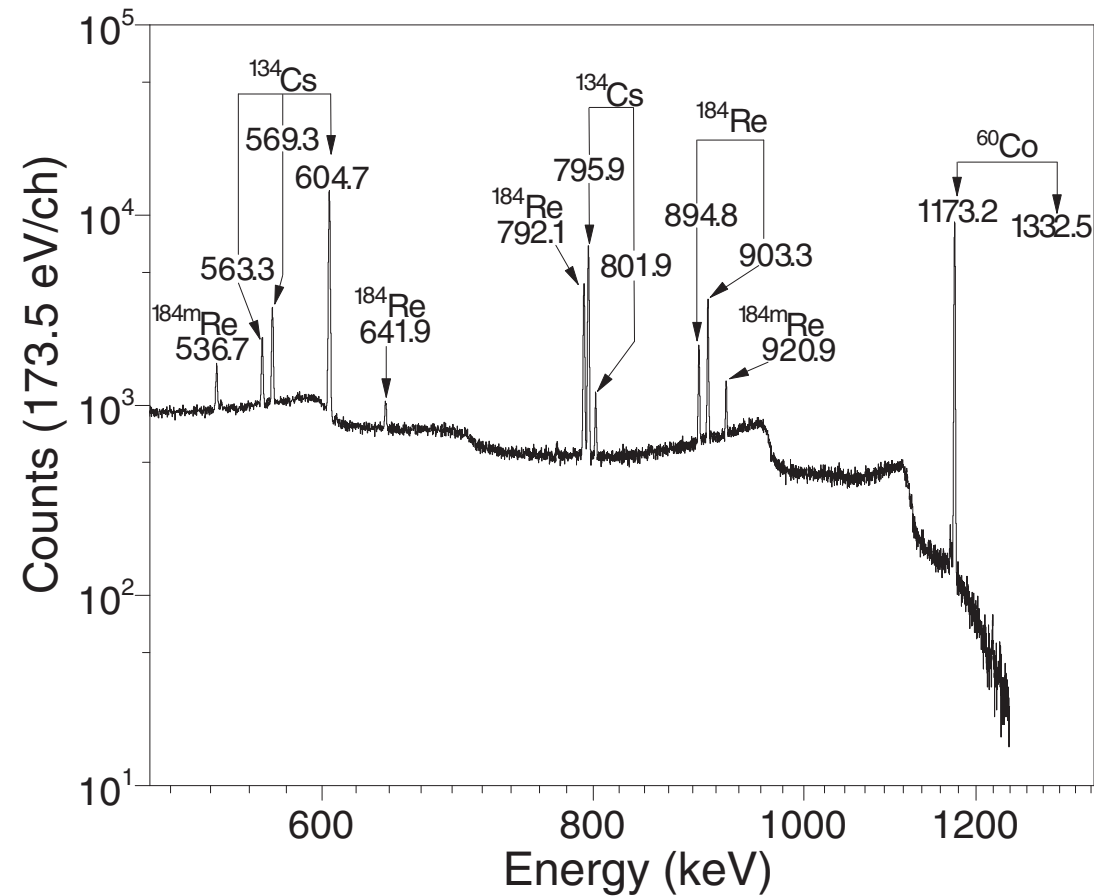
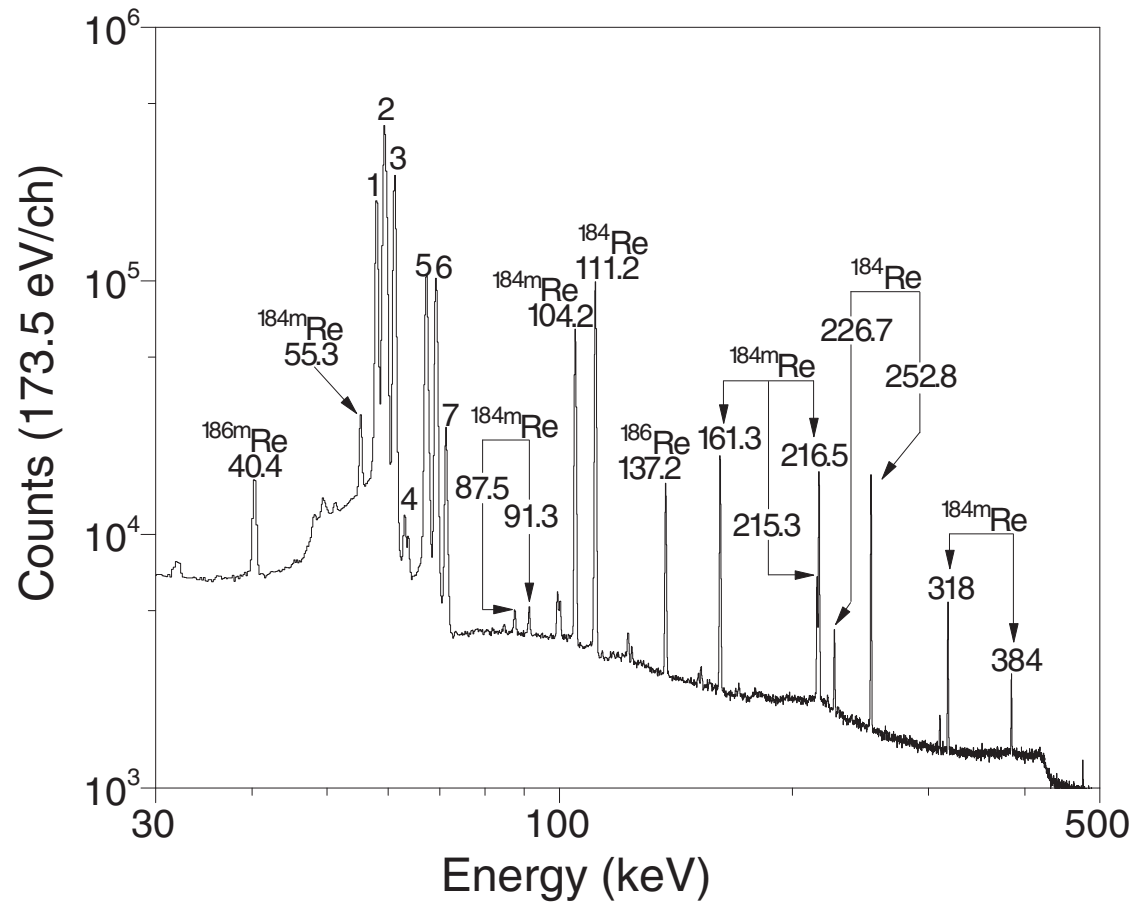
GX3520



Schemat rozpadu ^{184}Re



Widmo gamma



Wyznaczenie czasu życia

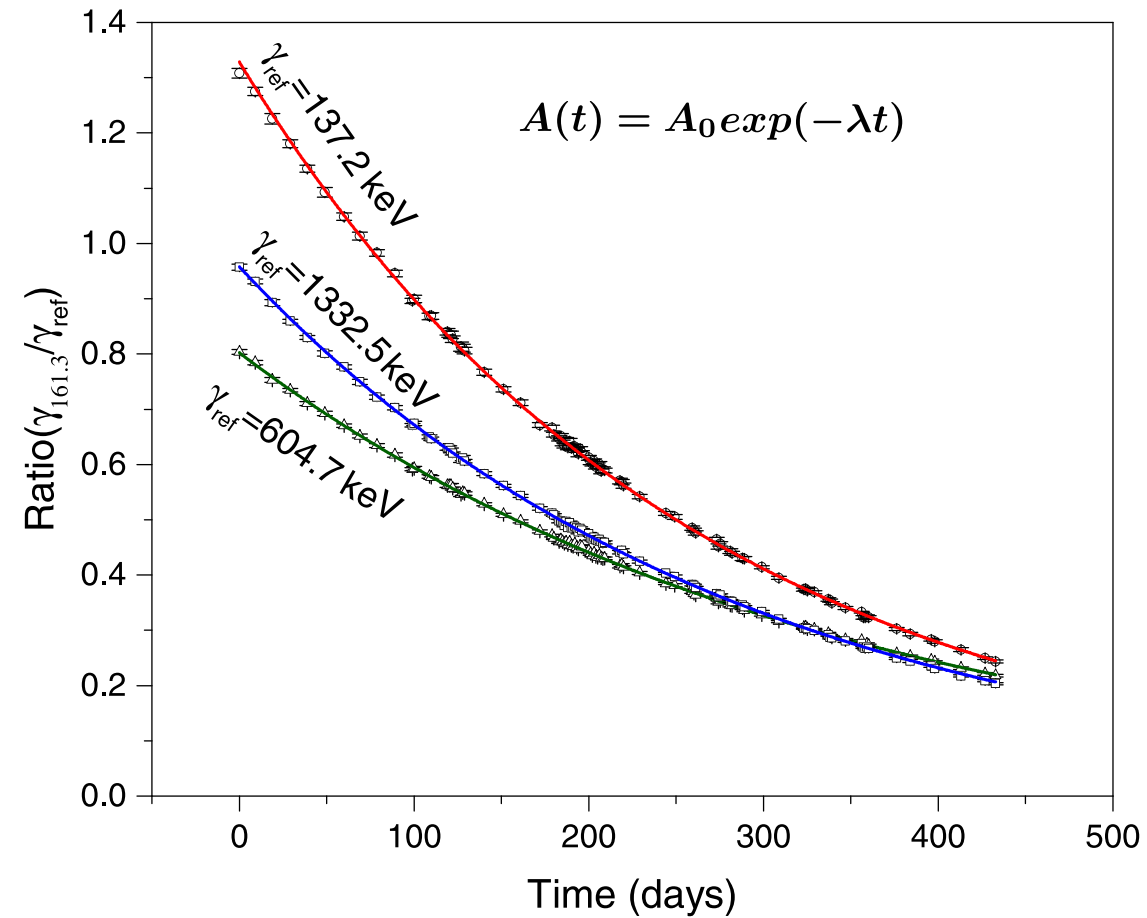
$$A(t) = A_0 \exp(-\lambda t) = \frac{A_{\text{Re}}(t)}{A_{\text{ref}}(t)}$$

$$T_{1/2} = \frac{\ln(2)}{\lambda_{\text{ref}} + \lambda}$$

$${}^{60}\text{Co} \quad T_{1/2} = 1925.28 \pm 0.14 \text{ d}$$

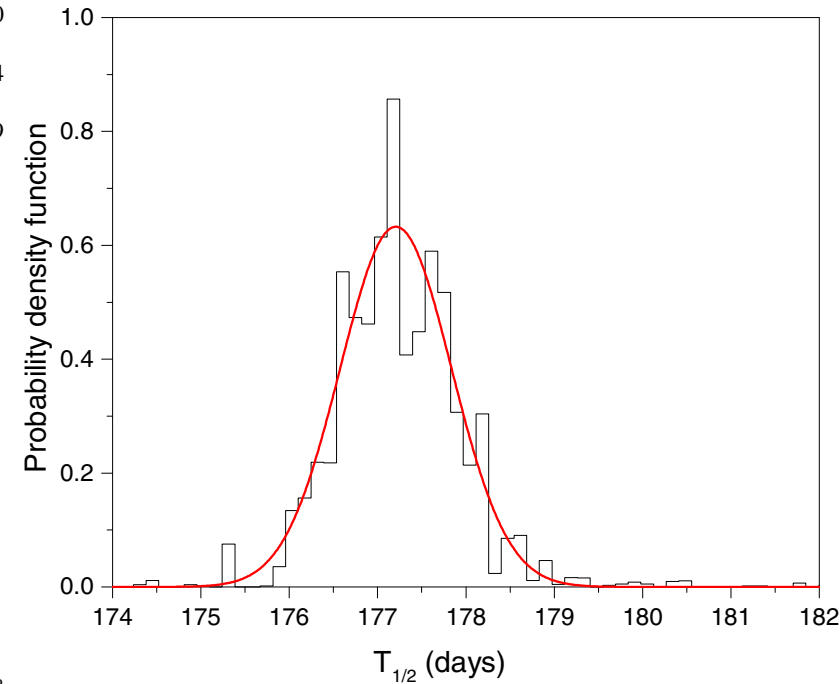
$${}^{134}\text{Cs} \quad T_{1/2} = 2.0652 \pm 0.0004 \text{ yr}$$

$${}^{186}\text{Re} \quad T_{1/2} = 2 \times 10^5 \text{ yr}$$

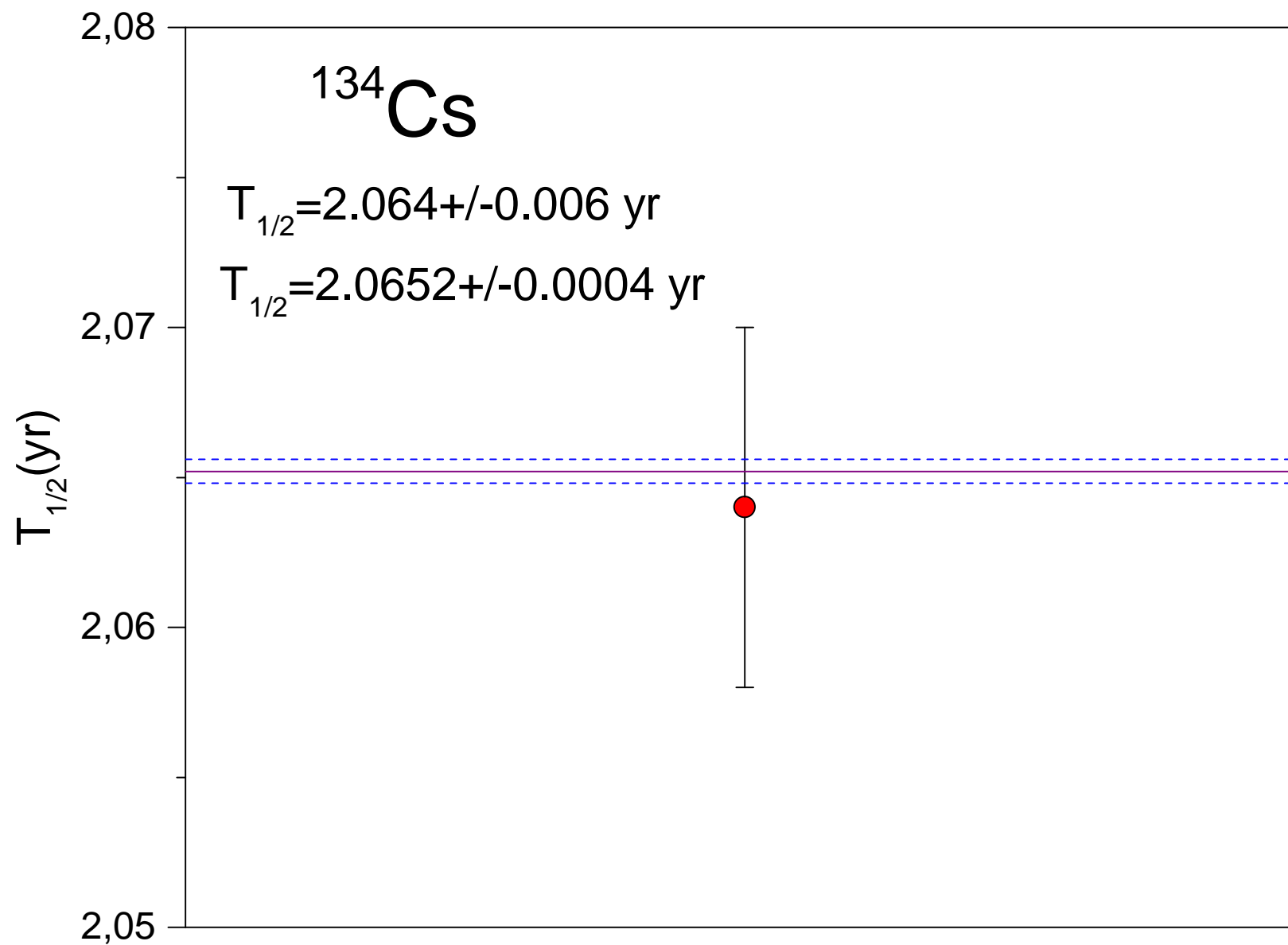


Wyznaczenie czasu życia

¹⁸⁴ Re	Det.	¹⁸⁶ Re 137.2	¹³⁴ Cs 563.3	¹³⁴ Cs 569.3	¹³⁴ Cs 604.7	¹³⁴ Cs 795.9	¹³⁴ Cs 801.9	⁶⁰ Co 1173.2	⁶⁰ Co 1332.5
55.3	d1	177.9 ± 0.6	176.7 ± 1.1	176.6 ± 0.8	177.2 ± 0.6	177.4 ± 0.7	178.9 ± 1.3	177.9 ± 0.7	177.5 ± 0.7
104.7	d1	177.72 ± 0.26	176.4 ± 0.8	176.4 ± 0.5	177.6 ± 0.3	177.4 ± 0.3	179.2 ± 1.0	178.11 ± 0.28	177.96 ± 0.30
	d2	176.91 ± 0.24	176.6 ± 0.4	176.3 ± 0.4	176.6 ± 0.3	177.9 ± 0.4	176.6 ± 1.0	176.7 ± 0.4	176.2 ± 0.5
111.2	d1	177.73 ± 0.21	176.5 ± 0.8	176.6 ± 0.5	177.81 ± 0.21	177.56 ± 0.28	179.3 ± 1.0	178.24 ± 0.23	178.07 ± 0.24
	d2	176.73 ± 0.22	175.3 ± 0.3	176.69 ± 0.27	176.34 ± 0.26	177.2 ± 0.4	176.8 ± 0.9	176.4 ± 0.3	176.0 ± 0.4
161.3	d1	177.3 ± 0.3	176.0 ± 0.8	175.9 ± 0.4	177.17 ± 0.28	177.1 ± 0.3	178.1 ± 1.0	177.67 ± 0.28	177.47 ± 0.29
	d2	177.67 ± 0.17	176.9 ± 0.4	177.18 ± 0.25	177.50 ± 0.24	178.6 ± 0.3	177.5 ± 1.0	177.7 ± 0.3	177.1 ± 0.4
226.7	d1	178.3 ± 1.3	176.6 ± 1.4	176.3 ± 1.3	175.5 ± 1.2	177.2 ± 1.3	178.5 ± 1.6	178.1 ± 1.2	177.8 ± 1.2
	d2	178.9 ± 1.1	177.9 ± 1.1	178.8 ± 1.1	178.9 ± 1.1	180.5 ± 1.2	179.0 ± 1.4	179.3 ± 1.2	178.7 ± 1.2
252.8	d1	177.4 ± 0.4	176.2 ± 0.8	176.0 ± 0.6	177.1 ± 0.4	177.1 ± 0.4	178.6 ± 1.0	177.7 ± 0.4	177.5 ± 0.4
	d2	177.19 ± 0.21	176.18 ± 0.30	176.56 ± 0.24	176.89 ± 0.19	177.89 ± 0.28	177.1 ± 0.9	177.03 ± 0.27	176.5 ± 0.3
318.0	d1	178.6 ± 0.7	176.9 ± 0.9	176.5 ± 0.9	177.6 ± 0.6	177.7 ± 0.7	179.3 ± 1.2	178.50 ± 0.6	178.2 ± 0.6
	d2	177.4 ± 0.4	176.0 ± 0.4	176.9 ± 0.5	177.3 ± 0.5	178.4 ± 0.6	177.0 ± 1.0	177.5 ± 0.5	176.9 ± 0.6
384.3	d1	177.2 ± 1.3	176.0 ± 1.4	175.3 ± 1.4	176.3 ± 1.3	176.4 ± 1.3	178.1 ± 1.8	176.9 ± 1.3	176.6 ± 1.3
	d2	177.3 ± 0.8	177.1 ± 0.8	177.3 ± 0.8	177.5 ± 0.7	179.2 ± 0.8	176.6 ± 1.3	177.9 ± 0.8	177.3 ± 0.8
536.7	d1	177.6 ± 2.0	176.1 ± 2.2	175.7 ± 2.1	176.8 ± 2.0	177.0 ± 2.1	178.6 ± 2.3	177.5 ± 2.0	177.2 ± 2.0
	d2	180.4 ± 1.2	179.9 ± 1.2	180.0 ± 1.1	180.3 ± 1.1	181.7 ± 1.1	179.8 ± 1.3	180.5 ± 1.2	179.9 ± 1.2
641.9	d1	185 ± 4	183 ± 3	183 ± 4	184 ± 3	184 ± 4	185 ± 4	185 ± 4	184 ± 4
	d2	174.5 ± 1.3	173.8 ± 1.3	174.4 ± 1.2	174.5 ± 1.3	176.1 ± 1.3	175.1 ± 1.8	174.9 ± 1.3	174.3 ± 1.3
792.1	d1	178.0 ± 0.6	176.2 ± 1.0	176.1 ± 0.8	177.1 ± 0.6	177.3 ± 0.6	178.9 ± 1.3	177.8 ± 0.6	177.4 ± 0.6
	d2	177.7 ± 0.6	177.6 ± 0.8	177.3 ± 0.5	177.7 ± 0.5	178.9 ± 0.5	176.2 ± 0.8	177.9 ± 0.5	177.3 ± 0.4
894.8	d1	178.0 ± 1.0	177.1 ± 1.3	176.3 ± 1.1	177.3 ± 0.9	177.6 ± 0.9	179.6 ± 1.4	178.0 ± 0.9	177.6 ± 0.9
	d2	177.2 ± 0.4	176.5 ± 0.4	176.9 ± 0.3	177.12 ± 0.28	178.5 ± 0.3	177.7 ± 0.9	177.36 ± 0.29	176.8 ± 0.3
903.3	d1	178.2 ± 0.6	176.6 ± 0.9	176.6 ± 0.8	177.3 ± 0.6	177.4 ± 0.6	179.1 ± 1.2	177.9 ± 0.6	177.6 ± 0.6
	d2	177.3 ± 0.3	176.5 ± 0.3	176.82 ± 0.22	177.05 ± 0.14	178.22 ± 0.21	177.5 ± 0.9	177.24 ± 0.15	176.67 ± 0.18
920.9	d1	182.4 ± 2.1	180.5 ± 2.2	179.8 ± 2.1	181.3 ± 2.1	181.4 ± 2.1	182.5 ± 2.5	182.1 ± 2.1	181.8 ± 2.1
	d2	176.2 ± 0.7	176.2 ± 0.6	176.2 ± 0.6	176.3 ± 0.6	177.9 ± 0.6	177.9 ± 1.1	176.7 ± 0.6	176.1 ± 0.6

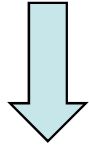


Oszacowanie błędów systematycznych

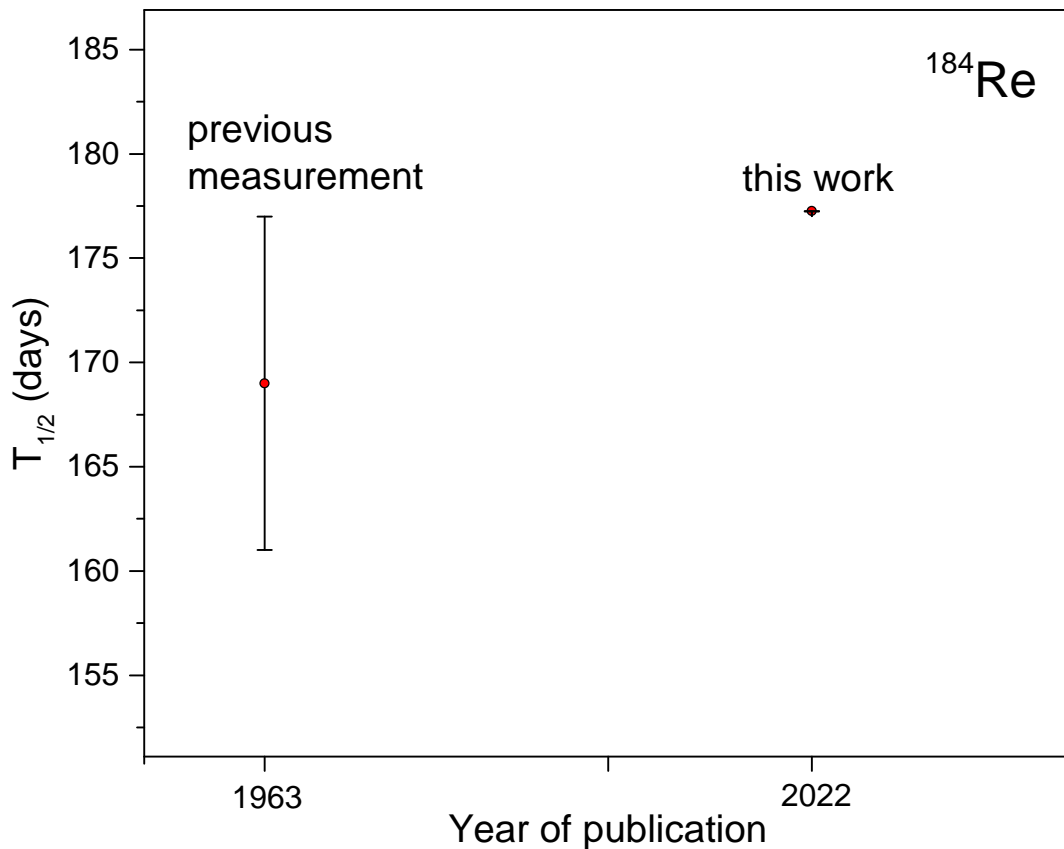


Ostateczny wynik

$$T_{1/2} = 169 \pm 8 \text{ d}$$







$$T_{1/2} = 177.25 \pm 0.07 \text{ d}$$




PHYSICAL REVIEW C **106**, 044303 (2022)

Half-life of the 188-keV isomer of ^{184}Re

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National Centre for Nuclear Research, PL 05-400 Świerk-Otwock, Poland

J. J. Carroll  and C. J. Chiara 
DEVCOM Army Research Laboratory, Adelphi, Maryland 20783, USA

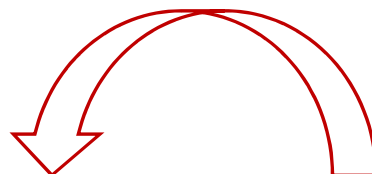
 (Received 29 July 2022; accepted 19 September 2022; published 7 October 2022)

We report a new half-life measurement of the 188-keV isomeric state in ^{184}Re . The ^{184m}Re isomer was produced by means of neutron activation of natural rhenium foil in the MARIA nuclear reactor at the National Centre for Nuclear Research (NCBJ). The observation of the ^{184m}Re decay for over two half-life periods has yielded the new value of $T_{1/2} = 177.25 \pm 0.07$ d. Our result is the most precise determination of the half-life of the ^{184m}Re isomer and improves the precision of the previously known value of $T_{1/2} = 169 \pm 8$ d by two orders of magnitude.

DOI: [10.1103/PhysRevC.106.044303](https://doi.org/10.1103/PhysRevC.106.044303)

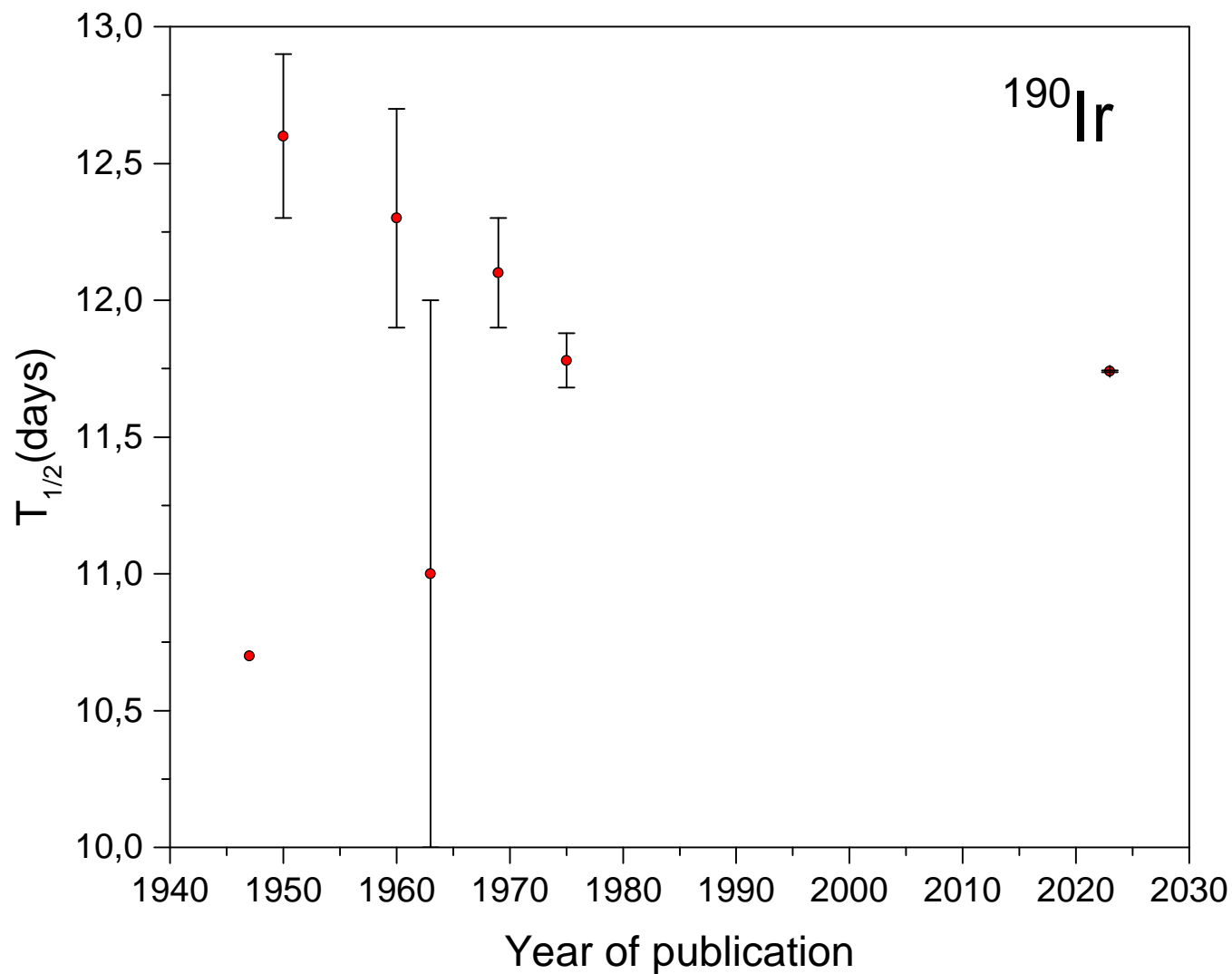
Plany kolejnych pomiarów

$E=13\text{MeV}$
 $S_n=8026.5\text{keV}$

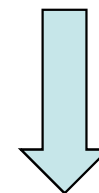


188Ir	189Ir	190Ir	191Ir 37%	192Ir	193Ir 63%
187Os	188Os	189Os	190Os	191Os	192Os
186Re	187Re	188Re	189Re	190Re	191Re
185W	186W	187W	188W	189W	190W
184Ta	185Ta	186Ta	187Ta	188Ta	189Ta

Plany kolejnych pomiarów



$$T_{1/2} = 11.78(10)$$

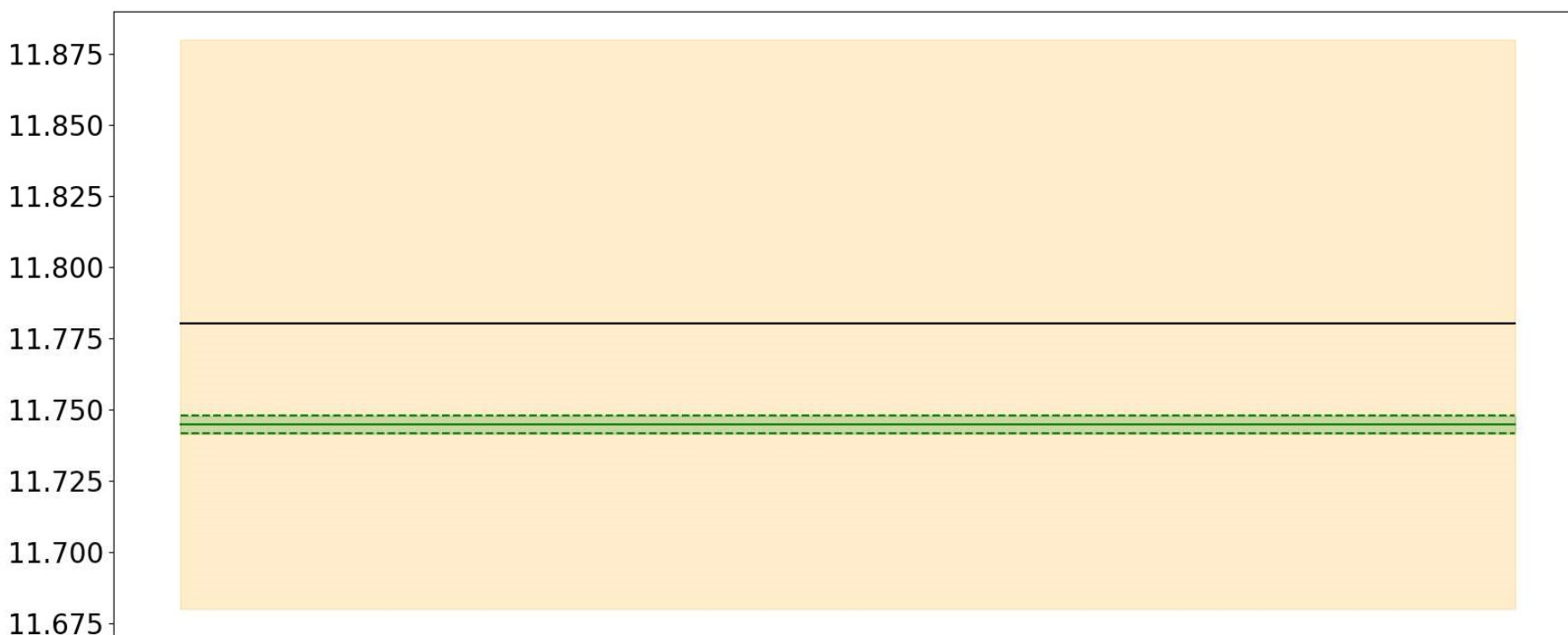


$$T_{1/2} = 11.743(4)$$

Plany kolejnych pomiarów

^{190}Ir

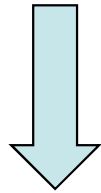
$$T_{1/2} = 11.78(10)$$



11.743(4)

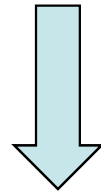
Plany kolejnych pomiarów

^{191}Os



15.4(1)

^{168}Tm



93.1(2)

^{145}Sm



340(3)

Dziękuję za uwagę



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