



New cross section measurement for the ¹⁰⁰Mo(p,2n)^{99m}Tc reaction

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Why ¹⁰⁰Mo(p,2n)^{99m}Tc is interesting ?



- More than 80% of all diagnostic nuclear procedures uses ^{99m}Tc world wide.
- ➢ Five nuclear reactors produce ^{99m}Tc.
- The world demand is about 6000 Ci/week
- Problem with the reactors and planned shutdown
- Alternative solution: direct production of ^{99m}Tc



Accelerator production of ^{99m}Tc



Reactions on Mo

¹⁰⁰Mo(p,2n)^{99m}Tc ¹⁰⁰Mo(p,x)⁹⁹Mo → ^{99m}Tc ¹⁰⁰Mo(n,2n)⁹⁹Mo → ^{99m}Tc ¹⁰⁰Mo(γ,n)⁹⁹Mo → ^{99m}Tc ⁹⁸Mo(n,γ)⁹⁹Mo → ^{99m}Tc

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Experimental cross sections of ⁹⁹Mo





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Experimental cross sections of ^{99m}Tc







Selected cross sections of ^{99m}Tc





Normalized cross sections of ^{99m}Tc

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Accelerator production of ^{99m}Tc

| Ru 90 11.7 s | Ru 91 7.6 s 7.85 s β ⁺ γ.394; βp 1097; m 905 | Ru 92 3.65 m β ⁺ γ214; 259; | Ru 93 10.8 s 59.7 s β ⁺ γ1396; 1111; m γ681; 1y 734 1435 | Ru 94 51.8 m ^ε <u>γ</u> 367; 891 | Ru 95 1.65 h ε; β ⁺ 1.2 γ336; 1097; 627 | Ru 96 5.54 | Ru 97 2.9 d | Ru 98 1.87 | Ru 99 12.76 | Ru 100 12.60 | Ru 101 17.06 | Ru 102 31.55 | Ru 103 39.35 d β ⁻ 0.2; 0.7 γ 497; 610 m |
|--|--|--|---|--|--|---|--|---|---|---|--|---|---|
| γ 155; 493 Tc 89 12.9 s 12.8 s β ⁺ 12.8 s γ 119; β ⁺ 6.4 269 γ | hγ ? 9 Tc 90 49.2 s 8.7 s β ⁺ 5.3; 5.7 γ 948; 1054 γ 948 β ⁺ 7.3; 9 948 | $\begin{array}{c} \textbf{TC 91}\\ \textbf{3.3 m}\\ \textbf{3.3 m}\\ \textbf{3.3 m}\\ \textbf{3.14 m}\\ \textbf{3.14 m}\\ \textbf{3.52}\\ \textbf{3.14 m}\\ 3.14 $ | βp 2.48. g Tc 92 4.4 m β ⁺ 4.2 γ 1510; 773; 329; 148 | $\begin{array}{c c} m \\ \hline TC 93 \\ \hline 43.5 m & 2.7 h \\ \hline _{1 \gamma 392} & \\ \epsilon \\ \gamma 2645 & \\ 9 \\ g \end{array} \\ \begin{array}{c} \epsilon \\ \gamma 1363i \\ 1520i \\ 1520i \\ 1477ig \\ q \end{array}$ | g Tc 94 53 m 4.9 h § +0.8 γ 871; γ 871; 703; γ 871; 850 | Tc 95 60 d 20 h •; β ⁺ • • • y204; • • • 835 y766; • • iy(39) 1074 • • | g Tc 96 52 m 4.3 d e ⁻ no β ⁺ γ 778; 850; 1200 813 | Тс 97 92.2 d 4.0 · 10 ⁶ а ¹ у (97) е е ⁻ по у | Tc 98 4.2 · 10 ⁶ a ^{β⁻ 0.4} ^{γ 745; 652} _{σ 0.9 + ?} | Tc 99 6.0 h 2.1 · 105 a 105 a hy141 β = 0.3 g ⁻ γ (90) γ (322,) σ 23 | Tc 100 15.8 s β ⁻ 3.4 ^ε γ 540; 591 | Tc 101 14.2 m β ⁻ 1.3 γ 307; 545 | Tc 102 4.3 m 5.3 s β ^{-1.6;} 3.2 γ 475; 631; 628; hy γ 475 |
| Mo 88 8.2 m β ⁺ γ 171; 80; 131 m | Mo 89 2.15 m ^{β+} γ 659; 1272; 1155 9 | Mo 90 5.7 h ^ε β ⁺ 1.1 γ 257 m; g | Mo 91 65 s 15.5 m hy 653 8 ⁺ 2.5; 40 y 1506; 1208; m 9 | Mo 92 14.77 | $\begin{array}{c} Mo \ 93 \\ \hline 6.9 \ h \\ 5.5 \\ .7 \\ .7 \\ .7 \\ .7 \\ .7 \\ .7 \\ .$ | Mo 94 9.23 | Mo 95 15.90 σ 13.4 σ _{n, α} 0.000030 | Мо 96 16.68 16.5 | Mo 97 9.56 σ _{2.5} σ _{n, α} 4E-7 | Мо 98 24.19 ^{о 0.14} | Mo 99 66.0 h β ⁻ 1.2 γ 740; 182; 778 m; g | Mo 100 9.67 1.15 · 10 ¹⁹ a ^{2β⁻} σ ^{0.19} | Mo 101 14.6 m β ⁻ 0.8; 2.6 γ 192; 591; 1013; 506 |
| Nb 87 2.6 m 3.9 m β ⁺ γ 201; 471 9 β ⁺ m | $\begin{array}{c c} \textbf{Nb} \ \textbf{88} \\ \hline \textbf{7.8 m} & \textbf{14.3 m} \\ \beta^{+} & \gamma 1057; \\ \gamma 1057; & 1083; \\ 1083; & 503; \\ 340 & 671 \end{array}$ | Nb 89 66 m 2.0 h β ⁺ 2.4; β ⁺ 3.3 2.9 y 1827; y 588; 1833; 507 3093 m g | Nb 90 18.8 s 14.6 h β* 1.5 γ 1129: γ 1122 2319; e ⁻ 141 | Nb 91 60.9 d 680 a ^μ γ (105) - e ⁻ , β ⁺ , β ⁺ | Nb 92 10.15 d 3.6 · 10 ⁷ a ^ε β ⁺ γ 934 ^ε ^ε γ 561; 934 | Nb 93 16.13 a 100 I ^{ly} (31) e ⁻ r ^{0.86 +} 0.29 | Nb 94 6.26 m 2 · 10 ⁴ a β ⁻ 0.5 γ 871; σ ⁻ 0.5 γ 871; σ ⁻ 0.6 + 14.4 | Nb 95 86.6 h 34.97 d ly236 e ⁻ β ⁻ 0.2; 0.9 β ⁻ 1.0 γ 204 σ < 7 | Nb 96 23.4 h ^{β⁻ 0.7 γ778; 569; 1091} | Nb 97 53 s 74 m μγ 743 β ^{-1.3} γ 658 | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | Nb 99 2.6 m 15 s γ 38; 254; 2842; β ⁻³ 3.1 2854 γ 138; γ 365 ? 98 | $\begin{array}{c c c c c c c c c c c c c c c c c c c $ |
| Zr 86 16.5 h ^ε ηο β ⁺ γ243; 28; 612 | Zr 87 14.0 s 1.6 h β ⁺ 2.3 γ 1227; 1210; 1924 | Zr 88 83.4 d | Zr 89 4.16 m 78.4 h hy 588 6 b ⁺ 0.9; b ⁺ 0.9 24 y (1713). | Zr 90 51.45 | Zr 91 11.22 | Zr 92 17.15 | Zr 93 1.5 · 10 ⁶ a β ⁻ 0.06 | Zr 94 17.38 | Zr 95 64.0 d β ⁻ 0.4; 1.1 γ757; 724 | Zr 96 2.80 3.9 · 10 ¹⁹ a | Zr 97 16.8 h β ⁻ 1.9 γ 508; 1148; 355 m | Zr 98 30.7 s | Zr 99 2.1 s β ⁻ 3.5; 3.6 γ 469; 546; 594 α; m |

| | | Q-value | Thrshold |
|------------------|---|---------|----------|
| | | MeV | MeV |
| ⁹⁹ Mo | ¹⁰⁰ Mo(p,pn) | -8.29 | 8.38 |
| | ¹⁰⁰ Mo(p,d) | -6.07 | 6.13 |
| ⁹⁹ Nb | ¹⁰⁰ Mo(p,2p) | -11.15 | 11.26 |
| ⁹⁹ Tc | ¹⁰⁰ Mo(p,2n) | -7.72 | 7.79 |
| 90NIK | ⁹⁴ M ₂ (p, s, p) | 0.00 | 0.05 |
| DI | $NO(p,\alpha n)$ | -8.96 | 9.05 |
| | ^{oz} Mo(p, He) | -11.79 | 11.92 |
| ⁹⁰ Mo | ⁹² Mo(p,t) | -14.30 | 14.45 |

Systematic error sources

- beam current measurement or charge integration (Faraday-cup, black current, secondary electrons, electron suppression)
- detector efficiency calibration
 (140 keV is the most problematic part of the efficiency curve)
- target thickness measurement
- use of out dated decay data
- problematic peak area determination and data evaluation

Decay of ⁹⁹Mo

Intensity of the 140.5 keV gamma-line

| 40.58323 17 | 1.06 % 4 | 4.32E-4 15 |
|------------------|-------------------|-------------------|
| 158.782 15 | 0.0191 % 8 | 3.04E-5 <i>13</i> |
| 162.370 15 | 0.0120 % 6 | 1.95E-5 10 |
| 181.068 <i>8</i> | 6.14 % 12 | 0.01112 23 |
| 242.29 8 | 0.0026 % <i>5</i> | 6.2E-6 <i>12</i> |
| 249.03 <i>3</i> | 0.0039 % 5 | 9.8E-6 <i>12</i> |
| 366.421 15 | 1.204 % 22 | 0.00441 8 |
| 380.13 8 | 0.0105 % 9 | 4.0E-5 3 |
| 391.7 4 ? | 0.0032 % 6 | 1.25E-5 <i>24</i> |
| 410.27 10 | 0.0020 % 4 | 8.0E-6 15 |
| 411.491 15 | 0.0147 % 6 | 6.1E-5 <i>3</i> |
| 457.60 3 | 0.0082 % 6 | 3.8E-5 <i>3</i> |
| 469.63 7 | 0.0027 % 5 | 1.27E-5 <i>23</i> |
| 528.788 15 | 0.058 % <i>3</i> | 3.05E-4 14 |
| 537.79 15 | 0.0033 % 6 | 1.8E-5 <i>3</i> |
| 580.51 7 | 0.0032 % <i>5</i> | 1.9E-5 <i>3</i> |
| 620.03 4 | 0.0023 % 9 | 1.4E-5 5 |
| 621.771 24 | 0.018 % 4 | 1.14E-4 23 |
| 689.6 9 | 4.3E-4 % 18 | 3.0E-6 1 <i>3</i> |
| 739.500 17 | 12.26 % <i>22</i> | 0.0907 16 |
| 761.77 8 | 4.0E-4 % 4 | 3.1E-6 <i>3</i> |
| 777.921 20 | 4.30 % 8 | 0.0335 6 |
| | | |

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| | Energy keV | Photons per 100 disint. |
|--------------------------|---------------|----------------------------|
| $\gamma_{2,1}({\rm Tc})$ | 2,1726 (4) | 7.10^{-9} |
| $\gamma_{3,1}(Tc)$ | 40,58323 (17 |) $1,022(27)$ |
| $\gamma_{1,0}(Tc)$ | 140,511(1) | 89,6 (17) |
| $\gamma_{2,0}(Tc)$ | 142,675 (25 |) 0,0211 (17) |
| $\gamma_{9,7}({ m Tc})$ | 158,782 (15) |) 0,0145 (9) |
| $\gamma_{6,4}(Tc)$ | 162,370 (15) |) 0,0114 (6) |
| $\gamma_{3,0}({ m Tc})$ | 181,068 (8) | 6,01 (11) |
| $\gamma_{10,7}(Tc)$ | 242,29 (8) | 0,0014(3) |
| $\gamma_{9,6}(Tc)$ | 249,03(3) | 0,0035(4) |
| $\gamma_{4,2}(Tc)$ | 366,421 (15 |) 1,194 (23) |
| $\gamma_{13,7}(Tc)$ | 380,13 (8) | 0,0091(5) |
| $\gamma_{5,2}(Tc)$ | 391,7(4) | 0,0025 (6) |
| $\gamma_{14,7}(Tc)$ | 410,27 (10 |) 0,0016 (4) |
| $\gamma_{9,4}(Tc)$ | 411,491 (15 |) 0,0161 (12) |
| $\gamma_{12,6}(Tc)$ | 457,60 (3) | 0,0074(6) |
| $\gamma_{13,6}(Tc)$ | 469,63 (7) | 0,0027(5) |
| $\gamma_{6,2}(Tc)$ | 528,788 (15 |) 0,0541 (19) |
| $\gamma_{11.5}(Tc)$ | 537,79 (15 |) 0,0015 (5) |
| $\gamma_{7,3}(Tc)$ | 580,51 (5) | 0,0036(4) |
| $\gamma_{8,3}(Tc)$ | 581,30 (12 |) 0,00010 (5) |
| $\gamma_{12.4}(Tc)$ | 620,03(5) | 0,0024 (6) |
| $\gamma_{8,1}(Tc)$ | 621,773 (24 |) 0,0262 (10) |
| $\gamma_{15,4}(Tc)$ | 689,6 (9) | 0,00042 (18) |
| $\gamma_{9,3}({ m Tc})$ | 739,500 (17 |) 12,12 (15) |

Monographie BIPM-5

Contribution to 140.5 keV gamma-line

| 0.896 | in equilibrium |
|--------|----------------|
| 0.885 | just 99mTc |
| 0.0472 | prompt |

Gammas

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Contribution to 140.5 keV gamma-line

 t_b bombarding time, t_c cooling time, t_m measuring time (number of decay during measuring time) t_m measuring time

$$\Delta N(direct)_{D} = N_{t}N_{b}\sigma_{2}\left(1 - e^{-\lambda_{2}t_{b}}\right)\frac{1}{\lambda_{2}}e^{-\lambda_{2}t_{c}}\left(1 - e^{-\lambda_{2}t_{m}}\right)$$

$$\Delta N(decay)_{1} = \frac{fN_{t}N_{b}\sigma_{1}}{(\lambda_{1}-\lambda_{2})} \Big[\lambda_{1}\Big(1-e^{-\lambda_{2}t_{b}}\Big) - \lambda_{2}\Big(1-e^{-\lambda_{1}t_{b}}\Big)\Big]\frac{1}{\lambda_{2}}e^{-\lambda_{2}t_{c}}\Big(1-e^{-\lambda_{2}t_{m}}\Big)$$

$$\Delta N(decay)_{2} = \frac{fN_{t}N_{b}\sigma_{1}}{(\lambda_{1}-\lambda_{2})} \left(1-e^{-\lambda_{1}t_{b}}\right) \left[e^{-\lambda_{2}t_{c}}\left(1-e^{-\lambda_{2}t_{m}}\right)-\frac{\lambda_{2}}{\lambda_{1}}e^{-\lambda_{1}t_{c}}\left(1-e^{-\lambda_{1}t_{m}}\right)\right]$$

$$\Delta N (direct)_{M} = g N_{t} N_{b} \sigma_{1} \left(1 - e^{-\lambda_{1} t_{b}} \right) \frac{1}{\lambda_{1}} e^{-\lambda_{1} t_{c}} \left(1 - e^{-\lambda_{1} t_{m}} \right)$$

$$\frac{T_{\gamma}}{\varepsilon_{d}\varepsilon_{\gamma}} = \Delta N (direct)_{D} + \Delta N (decay)_{1} + \Delta N (decay)_{2} + p\Delta N (direct)_{M}$$

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Composition of the stack

| | | E(in) | E(out) | E(moan) | dv[um] Y | ma/cm21 | dE | |
|------------|----------|-------|--------|---------|----------|---------|--------|------|
| mo | 1 | 16.00 | 15 70 | 15 00 | | 12.06 | 1 1 | 0.25 |
| mo | 1 | 15.00 | 15.79 | 15.90 | 11.00 | 12.00 | 1 | 0.25 |
| ti | 1 | 15.79 | 15.00 | 15.09 | 12.05 | 5.47 | 2 | 0.20 |
| mo | 3 | 15.00 | 15.40 | 15.32 | 11.00 | 12.06 | 3 | 0.20 |
| mo | 3 | 15.40 | 15.20 | 15.30 | 11.00 | 12.00 | 4 | 0.20 |
| 1110 +i | 4 | 15.25 | 14.01 | 14.07 | 12.05 | 5.47 | 5 | 0.27 |
| u mo | 2 | 14.01 | 14.91 | 14.97 | 12.05 | 12.06 | 7 | 0.27 |
| mo | 5 6 | 14.91 | 14.09 | 14.00 | 11.00 | 12.00 | 7 | 0.27 |
| ti | 3 | 14.05 | 14.47 | 14.30 | 12.05 | 5.47 | 0 | 0.20 |
| mo | 7 | 14.47 | 14.04 | 14.40 | 11.00 | 12.06 | 10 | 0.20 |
| mo | 7 8 | 14.04 | 13.80 | 14.25 | 11.00 | 12.00 | 10 | 0.29 |
| ti | 4 | 13.80 | 13.09 | 12.92 | 12.05 | 5.47 | 12 | 0.29 |
| mo | 4 | 13.09 | 13.70 | 13.64 | 11.00 | 12.06 | 12 | 0.29 |
| mo | 10 | 13.70 | 13.02 | 12.04 | 11.00 | 12.00 | 14 | 0.30 |
| ti | 5 | 13.02 | 13.25 | 13.41 | 12.05 | 5.47 | 14 | 0.30 |
| mo | 11 | 13.29 | 12.13 | 13.22 | 11.00 | 12.06 | 16 | 0.31 |
| mo | 10 | 10.10 | 12.91 | 13.03 | 11.00 | 12.00 | 17 | 0.31 |
| 1110 ti | 12 | 12.91 | 12.07 | 12.79 | 12.05 | 5.47 | 10 | 0.32 |
| u mo | 12 | 12.07 | 12.00 | 12.00 | 12.05 | 12.06 | 10 | 0.32 |
| mo | 13 | 12.00 | 12.20 | 12.40 | 11.00 | 12.00 | 19 | 0.00 |
| 1110 +i | 7 | 12.20 | 11 00 | 11.15 | 12.05 | 5.47 | 20 | 0.33 |
| u mo | 15 | 12.03 | 11.00 | 11.95 | 12.05 | 12.06 | 21 | 0.34 |
| mo | 10 | 11.00 | 11.02 | 11.75 | 11.00 | 12.00 | 22 | 0.34 |
| +i | 10 | 11.02 | 11.00 | 11.49 | 12.05 | 5.47 | 23 | 0.35 |
| mo | 17 | 11.00 | 10.04 | 11.20 | 11.00 | 12.06 | 24 | 0.33 |
| mo | 10 | 10.04 | 10.94 | 10.80 | 11.00 | 12.00 | 25 | 0.30 |
| ti | 10 | 10.54 | 10.00 | 10.50 | 12.05 | 5.47 | 20 | 0.30 |
| mo | 10 | 10.00 | 10.00 | 10.30 | 11.00 | 12.06 | 28 | 0.37 |
| mo | 20 | 10.30 | 0.22 | 10.00 | 11.00 | 12.00 | 20 | 0.37 |
| ti | 10 | 0.03 | 9.93 | 9.85 | 12.05 | 5.47 | 30 | 0.30 |
| mo | 21 | 9.95 | 9.70 | 9.61 | 11.00 | 12.06 | 31 | 0.30 |
| mo | 21 | 9.70 | 0.16 | 0.31 | 11.00 | 12.00 | 32 | 0.00 |
| ti | 11 | 0.16 | 8.08 | 9.07 | 12.05 | 5.47 | 33 | 0.40 |
| mo | 23 | 8.08 | 8 66 | 8.82 | 11.00 | 12.06 | 34 | 0.40 |
| mo | 20 | 8 66 | 8 3/ | 8 50 | 11.00 | 12.00 | 35 | 0.41 |
| ti | 12 | 8.34 | 8 15 | 8.24 | 12.05 | 5.47 | 36 | 0.42 |
| mo | 25 | 8 15 | 7.80 | 7 98 | 11.00 | 12.06 | 37 | 0.42 |
| mo | 25 | 7.80 | 7.00 | 7.63 | 11.00 | 12.00 | 38 | 0.43 |
| ti | 13 | 7.00 | 7.45 | 7 35 | 12.05 | 5.47 | 39 | 0.43 |
| mo | 27 | 7.40 | 6.88 | 7.06 | 11.00 | 12.06 | 40 | 0.45 |
| mo | 28 | 6.88 | 6.40 | 88.8 | 11.00 | 12.00 | 40 | 0.45 |
| ti | 14 | 6.49 | 6.26 | 6.37 | 12.05 | 5.47 | 42 | 0.40 |
| ti | 14 | 6.26 | 6.02 | 6 1 4 | 12.05 | 5.47 | 42 | 0.40 |
| ti | 16 | 6.02 | 5 78 | 5 90 | 12.05 | 5.47 | 40 | 0.47 |
| ti | 10 | 5.78 | 5 53 | 5.66 | 12.05 | 5.47 | 44 | 0.48 |
| ti | 18 | 5 53 | 5.00 | 5 40 | 12.05 | 5 47 | 46 | 0.40 |
| ti | 10 | 5.00 | 5.01 | 5.14 | 12.05 | 5 47 | 47 | 0.40 |
| ti | 20 | 5.01 | 4 73 | 4.87 | 12.05 | 5.47 | 48 | 0.50 |
| ti | 21 | 4 73 | 4.10 | 4.58 | 12.05 | 5 47 | 40 | 0.51 |
| | <u> </u> | 1.1 0 | 1. 17 | | 12.00 | 0.11 | 10 | 0.01 |

Bombarding energy: ~16MeV Irradiation time: 1.8 hours Beam current: 116 nA Mo foil thickness: 11.8 micron Ti foil thickness: 12.05 micron

Irradiation arrangement

Target preparation

Gamma spectrum of a Mo foil

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Detector calibration

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Beam monitoring

Recoil correction

Recoil correction

Recoil corrected

Intensity corrected -2.5 %

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Energy corrected -100 keV

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Recommended cross section

Origin of the 140.5 keV gammas for ¹⁰⁰Mo(p,x)⁹⁹Mo reaction

| Spectrum | cooling | Direct | Decay | Decay | Prompt |
|----------|---------|--------|--------|--------|--------|
| name | time | prod D | prod.1 | prod.2 | М |
| | (h) | % | % | % | % |
| Mo02p063 | 171 | 0 | 0 | 94.8 | 5.2 |
| Mo04p063 | 187 | 0 | 0 | 94.8 | 5.2 |
| Mo06p063 | 213 | 0 | 0 | 94.8 | 5.2 |
| Mo08p063 | 236 | 0 | 0 | 94.8 | 5.2 |
| Mo10p063 | 245 | 0 | 0 | 94.8 | 5.2 |
| Mo12p063 | 262 | 0 | 0 | 94.8 | 5.2 |
| Mo14p063 | 269 | 0 | 0 | 94.8 | 5.2 |

| Spectrum | cooling | Energy | 140.5 | 181 | 739 |
|----------|---------|--------|-------------|-----|-----|
| name | time | MeV | keV | keV | keV |
| | (h) | е | quiblibriun | า | |
| Mo02p063 | 171 | 15.6 | 3.5 | 3.1 | 3.5 |
| Mo04p063 | 187 | 15.0 | 2.9 | 2.9 | 2.3 |
| Mo06p063 | 213 | 14.5 | 2.2 | 2.3 | 2.2 |
| Mo08p063 | 236 | 13.9 | 1.6 | 1.9 | 1.6 |
| Mo10p063 | 245 | 13.3 | 1.1 | 1.9 | 1.3 |
| Mo12p063 | 262 | 12.7 | 0.8 | 0.5 | 0.3 |
| Mo14p063 | 269 | 12.0 | 0.6 | 0.0 | 0.0 |

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Origin of the 140.5 keV gammas

| Spectrum | cooling | Direct | Decay | Decay | Prompt |
|----------|---------|--------|--------|--------|--------|
| name | time | prod D | prod.1 | prod.2 | М |
| | (h) | % | % | % | % |
| Mo01p121 | 6.6 | 98.1 | 0.1 | 1.6 | 0.2 |
| Mo02p121 | 4.7 | 98.8 | 0.1 | 0.9 | 0.1 |
| Mo03p121 | 7.1 | 98.3 | 0.1 | 1.5 | 0.2 |
| Mo04p121 | 4.3 | 99.0 | 0.1 | 0.8 | 0.1 |
| Mo05p121 | 7.4 | 98.6 | 0.1 | 1.2 | 0.1 |
| Mo06p121 | 4.0 | 99.3 | 0.1 | 0.6 | 0.1 |
| Mo07p121 | 7.7 | 98.9 | 0.1 | 0.9 | 0.1 |
| Mo08p121 | 3.7 | 99.5 | 0.1 | 0.4 | 0.1 |
| Mo09p121 | 8.1 | 99.1 | 0.0 | 0.7 | 0.1 |
| Mo10p121 | 3.5 | 99.8 | 0.0 | 0.2 | 0.0 |
| Mo11p121 | 8.6 | 99.2 | 0.0 | 0.7 | 0.1 |
| Mo12p121 | 3.2 | 99.7 | 0.0 | 0.2 | 0.0 |
| Mo14p121 | 2.9 | 99.9 | 0.0 | 0.0 | 0.0 |
| Mo16p121 | 2.6 | 100.0 | 0.0 | 0.0 | 0.0 |
| Mo18p121 | 2.3 | 100.0 | 0.0 | 0.0 | 0.0 |
| Mo20p121 | 2.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| Mo22p121 | 1.7 | 100.0 | 0.0 | 0.0 | 0.0 |
| Mo24p121 | 1.4 | 100.0 | 0.0 | 0.0 | 0.0 |
| Mo26p121 | 1.2 | 100.0 | 0.0 | 0.0 | 0.0 |
| Mo28p121 | 0.9 | 100.0 | 0.0 | 0.0 | 0.0 |

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Results Cross Check

Conclusion and Summary

Conclusion and Summary

Thank you for Your attention

