## Muons in thorium (Th)

| Z | $A$ [g/mol] | $\rho$ [g/cm$^3$] | $I$ [eV] | $a$ | $k = m_s$ | $x_0$ | $x_1$ | $\overline{C}$ | $\delta_0$ |
|---|---|---|---|---|---|---|---|---|---|
| 90 (Th) | [232.0377(4)] | 11.720 | 847.0 | 0.08655 | 3.2610 | 0.4202 | 3.7681 | 6.2473 | 0.14 |

| $T$ | $p$ [MeV/$c$] | Ionization | Brems | Pair prod | Photonucl | Total | CSDA range [g/cm$^2$] |
|---|---|---|---|---|---|---|---|
| | | [MeV cm$^2$/g] | | | | | |
| 10.0 MeV | $4.704 \times 10^1$ | 3.727 | | | | 3.727 | $1.563 \times 10^0$ |
| 14.0 MeV | $5.616 \times 10^1$ | 2.979 | | | | 2.979 | $2.774 \times 10^0$ |
| 20.0 MeV | $6.802 \times 10^1$ | 2.376 | | | | 2.376 | $5.052 \times 10^0$ |
| 30.0 MeV | $8.509 \times 10^1$ | 1.881 | | | | 1.881 | $9.842 \times 10^0$ |
| 40.0 MeV | $1.003 \times 10^2$ | 1.626 | | | | 1.626 | $1.559 \times 10^1$ |
| 80.0 MeV | $1.527 \times 10^2$ | 1.253 | | | | 1.253 | $4.444 \times 10^1$ |
| 100. MeV | $1.764 \times 10^2$ | 1.187 | | | | 1.188 | $6.087 \times 10^1$ |
| 140. MeV | $2.218 \times 10^2$ | 1.126 | | | | 1.126 | $9.561 \times 10^1$ |
| 200. MeV | $2.868 \times 10^2$ | 1.099 | | | | 1.099 | $1.497 \times 10^2$ |
| 223. MeV | $3.114 \times 10^2$ | 1.098 | 0.000 | | | 1.098 | *Minimum ionization* |
| 300. MeV | $3.917 \times 10^2$ | 1.107 | 0.000 | | 0.000 | 1.107 | $2.405 \times 10^2$ |
| 400. MeV | $4.945 \times 10^2$ | 1.129 | 0.000 | | 0.000 | 1.129 | $3.300 \times 10^2$ |
| 800. MeV | $8.995 \times 10^2$ | 1.214 | 0.001 | | 0.000 | 1.216 | $6.707 \times 10^2$ |
| 1.00 GeV | $1.101 \times 10^3$ | 1.247 | 0.002 | | 0.000 | 1.249 | $8.330 \times 10^2$ |
| 1.40 GeV | $1.502 \times 10^3$ | 1.299 | 0.003 | | 0.001 | 1.302 | $1.146 \times 10^3$ |
| 2.00 GeV | $2.103 \times 10^3$ | 1.354 | 0.004 | 0.001 | 0.001 | 1.360 | $1.597 \times 10^3$ |
| 3.00 GeV | $3.104 \times 10^3$ | 1.417 | 0.007 | 0.003 | 0.001 | 1.429 | $2.313 \times 10^3$ |
| 4.00 GeV | $4.104 \times 10^3$ | 1.459 | 0.011 | 0.006 | 0.002 | 1.478 | $3.000 \times 10^3$ |
| 8.00 GeV | $8.105 \times 10^3$ | 1.556 | 0.027 | 0.023 | 0.003 | 1.609 | $5.583 \times 10^3$ |
| 10.0 GeV | $1.011 \times 10^4$ | 1.585 | 0.035 | 0.032 | 0.004 | 1.657 | $6.808 \times 10^3$ |
| 14.0 GeV | $1.411 \times 10^4$ | 1.626 | 0.054 | 0.053 | 0.005 | 1.739 | $9.163 \times 10^3$ |
| 20.0 GeV | $2.011 \times 10^4$ | 1.667 | 0.084 | 0.087 | 0.007 | 1.847 | $1.251 \times 10^4$ |
| 30.0 GeV | $3.011 \times 10^4$ | 1.711 | 0.138 | 0.154 | 0.011 | 2.015 | $1.769 \times 10^4$ |
| 40.0 GeV | $4.011 \times 10^4$ | 1.740 | 0.195 | 0.228 | 0.014 | 2.178 | $2.246 \times 10^4$ |
| 80.0 GeV | $8.011 \times 10^4$ | 1.804 | 0.441 | 0.553 | 0.027 | 2.827 | $3.854 \times 10^4$ |
| 100. GeV | $1.001 \times 10^5$ | 1.823 | 0.572 | 0.729 | 0.034 | 3.159 | $4.523 \times 10^4$ |
| 132. GeV | $1.321 \times 10^5$ | 1.847 | 0.785 | 1.017 | 0.045 | 3.695 | *Muon critical energy* |
| 140. GeV | $1.401 \times 10^5$ | 1.851 | 0.839 | 1.091 | 0.047 | 3.830 | $5.672 \times 10^4$ |
| 200. GeV | $2.001 \times 10^5$ | 1.881 | 1.257 | 1.664 | 0.067 | 4.871 | $7.058 \times 10^4$ |
| 300. GeV | $3.001 \times 10^5$ | 1.913 | 1.971 | 2.621 | 0.101 | 6.608 | $8.815 \times 10^4$ |
| 400. GeV | $4.001 \times 10^5$ | 1.936 | 2.708 | 3.613 | 0.135 | 8.394 | $1.016 \times 10^5$ |
| 800. GeV | $8.001 \times 10^5$ | 1.992 | 5.748 | 7.680 | 0.273 | 15.695 | $1.359 \times 10^5$ |
| 1.00 TeV | $1.000 \times 10^6$ | 2.010 | 7.309 | 9.760 | 0.343 | 19.423 | $1.473 \times 10^5$ |
| 1.40 TeV | $1.400 \times 10^6$ | 2.037 | 10.434 | 13.907 | 0.485 | 26.866 | $1.648 \times 10^5$ |
| 2.00 TeV | $2.000 \times 10^6$ | 2.067 | 15.212 | 20.235 | 0.702 | 38.218 | $1.834 \times 10^5$ |
| 3.00 TeV | $3.000 \times 10^6$ | 2.101 | 23.182 | 30.750 | 1.073 | 57.107 | $2.047 \times 10^5$ |
| 4.00 TeV | $4.000 \times 10^6$ | 2.125 | 31.254 | 41.375 | 1.449 | 76.205 | $2.198 \times 10^5$ |
| 8.00 TeV | $8.000 \times 10^6$ | 2.185 | 63.776 | 84.077 | 3.009 | 153.049 | $2.561 \times 10^5$ |
| 10.0 TeV | $1.000 \times 10^7$ | 2.205 | 80.155 | 105.539 | 3.809 | 191.710 | $2.677 \times 10^5$ |
| 14.0 TeV | $1.400 \times 10^7$ | 2.235 | 112.825 | 148.365 | 5.450 | 268.877 | $2.853 \times 10^5$ |
| 20.0 TeV | $2.000 \times 10^7$ | 2.268 | 162.098 | 212.874 | 7.964 | 385.206 | $3.038 \times 10^5$ |
| 30.0 TeV | $3.000 \times 10^7$ | 2.305 | 244.125 | 320.192 | 12.304 | 578.930 | $3.248 \times 10^5$ |
| 40.0 TeV | $4.000 \times 10^7$ | 2.333 | 326.426 | 427.757 | 16.745 | 773.263 | $3.397 \times 10^5$ |
| 80.0 TeV | $8.000 \times 10^7$ | 2.399 | 656.056 | 858.311 | 35.269 | 1552.038 | $3.755 \times 10^5$ |
| 100. TeV | $1.000 \times 10^8$ | 2.421 | 821.120 | 1073.780 | 44.830 | 1942.153 | $3.870 \times 10^5$ |