## Muons in liquid nitrogen ($N_2$)

| Z | $A$ [g/mol] | $\rho$ [g/cm$^3$] | $I$ [eV] | $a$ | $k = m_s$ | $x_0$ | $x_1$ | $\overline{C}$ | $\delta_0$ |
|---|---|---|---|---|---|---|---|---|---|
| 7 (N) | 14.007(2) | 0.807 | 82.0 | 0.53289 | 3.0000 | 0.3039 | 2.0000 | 3.9996 | 0.00 |

| $T$ | $p$ [MeV/$c$] | Ionization | Brems | Pair prod | Photonucl | Total | CSDA range [g/cm$^2$] |
|---|---|---|---|---|---|---|---|
| | | [MeV cm$^2$/g] | | | | | |
| 10.0 MeV | $4.704 \times 10^1$ | 7.084 | | | | 7.084 | $7.814 \times 10^{-1}$ |
| 14.0 MeV | $5.616 \times 10^1$ | 5.530 | | | | 5.530 | $1.427 \times 10^0$ |
| 20.0 MeV | $6.802 \times 10^1$ | 4.321 | | | | 4.321 | $2.669 \times 10^0$ |
| 30.0 MeV | $8.509 \times 10^1$ | 3.354 | | | | 3.354 | $5.332 \times 10^0$ |
| 40.0 MeV | $1.003 \times 10^2$ | 2.865 | | | | 2.865 | $8.580 \times 10^0$ |
| 80.0 MeV | $1.527 \times 10^2$ | 2.152 | | | | 2.152 | $2.520 \times 10^1$ |
| 100. MeV | $1.764 \times 10^2$ | 2.025 | | | | 2.025 | $3.481 \times 10^1$ |
| 140. MeV | $2.218 \times 10^2$ | 1.900 | | | | 1.900 | $5.529 \times 10^1$ |
| 200. MeV | $2.868 \times 10^2$ | 1.833 | | | | 1.833 | $8.756 \times 10^1$ |
| 288. MeV | $3.788 \times 10^2$ | 1.813 | | | 0.000 | 1.814 | *Minimum ionization* |
| 300. MeV | $3.917 \times 10^2$ | 1.814 | | | 0.000 | 1.814 | $1.426 \times 10^2$ |
| 400. MeV | $4.945 \times 10^2$ | 1.826 | | | 0.000 | 1.826 | $1.975 \times 10^2$ |
| 800. MeV | $8.995 \times 10^2$ | 1.904 | 0.000 | | 0.000 | 1.905 | $4.120 \times 10^2$ |
| 1.00 GeV | $1.101 \times 10^3$ | 1.937 | 0.000 | | 0.000 | 1.937 | $5.161 \times 10^2$ |
| 1.40 GeV | $1.502 \times 10^3$ | 1.989 | 0.000 | | 0.001 | 1.990 | $7.196 \times 10^2$ |
| 2.00 GeV | $2.103 \times 10^3$ | 2.044 | 0.001 | 0.000 | 0.001 | 2.046 | $1.017 \times 10^3$ |
| 3.00 GeV | $3.104 \times 10^3$ | 2.106 | 0.001 | 0.001 | 0.001 | 2.109 | $1.498 \times 10^3$ |
| 4.00 GeV | $4.104 \times 10^3$ | 2.148 | 0.001 | 0.001 | 0.002 | 2.152 | $1.967 \times 10^3$ |
| 8.00 GeV | $8.105 \times 10^3$ | 2.243 | 0.003 | 0.003 | 0.004 | 2.254 | $3.778 \times 10^3$ |
| 10.0 GeV | $1.011 \times 10^4$ | 2.272 | 0.005 | 0.005 | 0.005 | 2.286 | $4.659 \times 10^3$ |
| 14.0 GeV | $1.411 \times 10^4$ | 2.315 | 0.007 | 0.007 | 0.007 | 2.336 | $6.389 \times 10^3$ |
| 20.0 GeV | $2.011 \times 10^4$ | 2.359 | 0.011 | 0.012 | 0.009 | 2.391 | $8.926 \times 10^3$ |
| 30.0 GeV | $3.011 \times 10^4$ | 2.406 | 0.018 | 0.022 | 0.013 | 2.459 | $1.305 \times 10^4$ |
| 40.0 GeV | $4.011 \times 10^4$ | 2.439 | 0.025 | 0.032 | 0.018 | 2.514 | $1.707 \times 10^4$ |
| 80.0 GeV | $8.011 \times 10^4$ | 2.514 | 0.057 | 0.077 | 0.034 | 2.683 | $3.244 \times 10^4$ |
| 100. GeV | $1.001 \times 10^5$ | 2.538 | 0.074 | 0.102 | 0.042 | 2.757 | $3.980 \times 10^4$ |
| 140. GeV | $1.401 \times 10^5$ | 2.573 | 0.110 | 0.153 | 0.059 | 2.894 | $5.395 \times 10^4$ |
| 200. GeV | $2.001 \times 10^5$ | 2.610 | 0.165 | 0.234 | 0.083 | 3.092 | $7.400 \times 10^4$ |
| 300. GeV | $3.001 \times 10^5$ | 2.651 | 0.261 | 0.372 | 0.124 | 3.408 | $1.048 \times 10^5$ |
| 400. GeV | $4.001 \times 10^5$ | 2.681 | 0.360 | 0.515 | 0.166 | 3.722 | $1.329 \times 10^5$ |
| 800. GeV | $8.001 \times 10^5$ | 2.752 | 0.772 | 1.113 | 0.335 | 4.972 | $2.255 \times 10^5$ |
| 982. GeV | $9.824 \times 10^5$ | 2.773 | 0.966 | 1.394 | 0.413 | 5.547 | *Muon critical energy* |
| 1.00 TeV | $1.000 \times 10^6$ | 2.775 | 0.985 | 1.422 | 0.421 | 5.603 | $2.634 \times 10^5$ |
| 1.40 TeV | $1.400 \times 10^6$ | 2.811 | 1.414 | 2.036 | 0.597 | 6.858 | $3.278 \times 10^5$ |
| 2.00 TeV | $2.000 \times 10^6$ | 2.849 | 2.073 | 2.977 | 0.864 | 8.763 | $4.050 \times 10^5$ |
| 3.00 TeV | $3.000 \times 10^6$ | 2.893 | 3.176 | 4.543 | 1.324 | 11.937 | $5.025 \times 10^5$ |
| 4.00 TeV | $4.000 \times 10^6$ | 2.924 | 4.299 | 6.132 | 1.792 | 15.147 | $5.767 \times 10^5$ |
| 8.00 TeV | $8.000 \times 10^6$ | 3.002 | 8.841 | 12.530 | 3.740 | 28.113 | $7.675 \times 10^5$ |
| 10.0 TeV | $1.000 \times 10^7$ | 3.027 | 11.138 | 15.752 | 4.743 | 34.660 | $8.315 \times 10^5$ |
| 14.0 TeV | $1.400 \times 10^7$ | 3.066 | 15.720 | 22.172 | 6.809 | 47.768 | $9.294 \times 10^5$ |
| 20.0 TeV | $2.000 \times 10^7$ | 3.108 | 22.650 | 31.856 | 9.982 | 67.596 | $1.035 \times 10^6$ |
| 30.0 TeV | $3.000 \times 10^7$ | 3.156 | 34.187 | 47.969 | 15.491 | 100.803 | $1.155 \times 10^6$ |
| 40.0 TeV | $4.000 \times 10^7$ | 3.191 | 45.784 | 64.133 | 21.144 | 134.252 | $1.241 \times 10^6$ |
| 80.0 TeV | $8.000 \times 10^7$ | 3.277 | 92.292 | 128.845 | 44.860 | 269.275 | $1.447 \times 10^6$ |
| 100. TeV | $1.000 \times 10^8$ | 3.306 | 115.610 | 161.240 | 57.150 | 337.306 | $1.513 \times 10^6$ |