

**Table 093: Muons in Neptunium**

| Z        | A [g/mol]           | $\rho$ [g/cm <sup>3</sup> ] | I [eV]  | a                                     | $k = m_s$ | $x_0$    | $x_1$                              | $\bar{C}$ | $\delta_0$ |
|----------|---------------------|-----------------------------|---------|---------------------------------------|-----------|----------|------------------------------------|-----------|------------|
| 93 (Np)  | [237.04817 (2)]     | 20.250                      | 902.0   | 0.19741                               | 2.8082    | 0.1869   | 3.3690                             | 5.8149    | 0.14       |
| T        | p<br>[MeV/c]        | Ionization                  | Brems   | Pair prod<br>[MeV cm <sup>2</sup> /g] | Photonucl | Total    | CSDA range<br>[g/cm <sup>2</sup> ] |           |            |
| 10.0 MeV | $4.704 \times 10^1$ | 3.707                       |         |                                       |           | 3.707    | $1.578 \times 10^0$                |           |            |
| 14.0 MeV | $5.616 \times 10^1$ | 2.967                       |         |                                       |           | 2.968    | $2.795 \times 10^0$                |           |            |
| 20.0 MeV | $6.802 \times 10^1$ | 2.370                       |         |                                       |           | 2.370    | $5.080 \times 10^0$                |           |            |
| 30.0 MeV | $8.509 \times 10^1$ | 1.878                       |         |                                       |           | 1.878    | $9.879 \times 10^0$                |           |            |
| 40.0 MeV | $1.003 \times 10^2$ | 1.623                       |         |                                       |           | 1.623    | $1.564 \times 10^1$                |           |            |
| 80.0 MeV | $1.527 \times 10^2$ | 1.249                       |         |                                       |           | 1.249    | $4.456 \times 10^1$                |           |            |
| 100. MeV | $1.764 \times 10^2$ | 1.183                       |         |                                       |           | 1.183    | $6.106 \times 10^1$                |           |            |
| 140. MeV | $2.218 \times 10^2$ | 1.123                       |         |                                       |           | 1.123    | $9.590 \times 10^1$                |           |            |
| 200. MeV | $2.868 \times 10^2$ | 1.096                       |         |                                       |           | 1.097    | $1.502 \times 10^2$                |           |            |
| 227. MeV | $3.154 \times 10^2$ | 1.095                       | 0.000   |                                       |           | 1.095    | <i>Minimum ionization</i>          |           |            |
| 300. MeV | $3.917 \times 10^2$ | 1.102                       | 0.000   |                                       | 0.000     | 1.102    | $2.413 \times 10^2$                |           |            |
| 400. MeV | $4.945 \times 10^2$ | 1.122                       | 0.000   |                                       | 0.000     | 1.123    | $3.312 \times 10^2$                |           |            |
| 800. MeV | $8.995 \times 10^2$ | 1.205                       | 0.001   |                                       | 0.000     | 1.207    | $6.743 \times 10^2$                |           |            |
| 1.00 GeV | $1.101 \times 10^3$ | 1.237                       | 0.002   |                                       | 0.000     | 1.240    | $8.377 \times 10^2$                |           |            |
| 1.40 GeV | $1.502 \times 10^3$ | 1.289                       | 0.003   |                                       | 0.001     | 1.292    | $1.153 \times 10^3$                |           |            |
| 2.00 GeV | $2.103 \times 10^3$ | 1.344                       | 0.004   | 0.001                                 | 0.001     | 1.350    | $1.607 \times 10^3$                |           |            |
| 3.00 GeV | $3.104 \times 10^3$ | 1.406                       | 0.008   | 0.003                                 | 0.001     | 1.418    | $2.329 \times 10^3$                |           |            |
| 4.00 GeV | $4.104 \times 10^3$ | 1.449                       | 0.011   | 0.006                                 | 0.002     | 1.468    | $3.021 \times 10^3$                |           |            |
| 8.00 GeV | $8.105 \times 10^3$ | 1.545                       | 0.028   | 0.023                                 | 0.003     | 1.600    | $5.621 \times 10^3$                |           |            |
| 10.0 GeV | $1.011 \times 10^4$ | 1.574                       | 0.037   | 0.033                                 | 0.004     | 1.649    | $6.852 \times 10^3$                |           |            |
| 14.0 GeV | $1.411 \times 10^4$ | 1.616                       | 0.056   | 0.054                                 | 0.005     | 1.733    | $9.217 \times 10^3$                |           |            |
| 20.0 GeV | $2.011 \times 10^4$ | 1.657                       | 0.088   | 0.090                                 | 0.007     | 1.843    | $1.257 \times 10^4$                |           |            |
| 30.0 GeV | $3.011 \times 10^4$ | 1.700                       | 0.144   | 0.159                                 | 0.011     | 2.015    | $1.776 \times 10^4$                |           |            |
| 40.0 GeV | $4.011 \times 10^4$ | 1.729                       | 0.203   | 0.236                                 | 0.014     | 2.183    | $2.252 \times 10^4$                |           |            |
| 80.0 GeV | $8.011 \times 10^4$ | 1.793                       | 0.460   | 0.573                                 | 0.027     | 2.855    | $3.850 \times 10^4$                |           |            |
| 100. GeV | $1.001 \times 10^5$ | 1.812                       | 0.596   | 0.755                                 | 0.034     | 3.199    | $4.512 \times 10^4$                |           |            |
| 127. GeV | $1.271 \times 10^5$ | 1.832                       | 0.783   | 1.006                                 | 0.043     | 3.666    | <i>Muon critical energy</i>        |           |            |
| 140. GeV | $1.401 \times 10^5$ | 1.840                       | 0.875   | 1.130                                 | 0.047     | 3.894    | $5.644 \times 10^4$                |           |            |
| 200. GeV | $2.001 \times 10^5$ | 1.869                       | 1.312   | 1.725                                 | 0.067     | 4.974    | $7.005 \times 10^4$                |           |            |
| 300. GeV | $3.001 \times 10^5$ | 1.902                       | 2.056   | 2.717                                 | 0.101     | 6.777    | $8.721 \times 10^4$                |           |            |
| 400. GeV | $4.001 \times 10^5$ | 1.925                       | 2.824   | 3.746                                 | 0.135     | 8.631    | $1.003 \times 10^5$                |           |            |
| 800. GeV | $8.001 \times 10^5$ | 1.981                       | 5.995   | 7.962                                 | 0.272     | 16.212   | $1.336 \times 10^5$                |           |            |
| 1.00 TeV | $1.000 \times 10^6$ | 1.999                       | 7.622   | 10.119                                | 0.342     | 20.084   | $1.446 \times 10^5$                |           |            |
| 1.40 TeV | $1.400 \times 10^6$ | 2.027                       | 10.880  | 14.419                                | 0.485     | 27.813   | $1.615 \times 10^5$                |           |            |
| 2.00 TeV | $2.000 \times 10^6$ | 2.057                       | 15.861  | 20.982                                | 0.701     | 39.602   | $1.795 \times 10^5$                |           |            |
| 3.00 TeV | $3.000 \times 10^6$ | 2.091                       | 24.170  | 31.884                                | 1.071     | 59.218   | $2.000 \times 10^5$                |           |            |
| 4.00 TeV | $4.000 \times 10^6$ | 2.116                       | 32.585  | 42.901                                | 1.446     | 79.051   | $2.146 \times 10^5$                |           |            |
| 8.00 TeV | $8.000 \times 10^6$ | 2.177                       | 66.487  | 87.181                                | 3.002     | 158.849  | $2.495 \times 10^5$                |           |            |
| 10.0 TeV | $1.000 \times 10^7$ | 2.197                       | 83.561  | 109.435                               | 3.801     | 198.996  | $2.608 \times 10^5$                |           |            |
| 14.0 TeV | $1.400 \times 10^7$ | 2.227                       | 117.615 | 153.842                               | 5.438     | 279.125  | $2.777 \times 10^5$                |           |            |
| 20.0 TeV | $2.000 \times 10^7$ | 2.260                       | 168.976 | 220.732                               | 7.946     | 399.916  | $2.955 \times 10^5$                |           |            |
| 30.0 TeV | $3.000 \times 10^7$ | 2.298                       | 254.563 | 332.013                               | 12.277    | 601.154  | $3.158 \times 10^5$                |           |            |
| 40.0 TeV | $4.000 \times 10^7$ | 2.326                       | 340.457 | 443.549                               | 16.709    | 803.043  | $3.301 \times 10^5$                |           |            |
| 80.0 TeV | $8.000 \times 10^7$ | 2.393                       | 684.014 | 890.002                               | 35.192    | 1611.604 | $3.646 \times 10^5$                |           |            |
| 100. TeV | $1.000 \times 10^8$ | 2.416                       | 855.900 | 1113.430                              | 44.730    | 2016.478 | $3.757 \times 10^5$                |           |            |