

### Muons in carbon (gem diamond)

| Z        | A [g/mol]           | $\rho$ [g/cm <sup>3</sup> ] | I [eV]  | $a$                                   | $k = m_s$ | $x_0$   | $x_1$                              | $\bar{C}$ | $\delta_0$ |
|----------|---------------------|-----------------------------|---------|---------------------------------------|-----------|---------|------------------------------------|-----------|------------|
| 6 (C)    | 12.0107 (8)         | 3.520                       | 78.0    | 0.26142                               | 2.8697    | -0.1135 | 2.2458                             | 2.4271    | 0.12       |
| $T$      | $p$<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 | $4.704 \times 10^1$ | 7.109                       |         |                                       |           | 7.109   | $7.776 \times 10^{-1}$             |           |            |
| 14.0 MeV | $5.616 \times 10^1$ | 5.542                       |         |                                       |           | 5.542   | $1.422 \times 10^0$                |           |            |
| 20.0 MeV | $6.802 \times 10^1$ | 4.323                       |         |                                       |           | 4.323   | $2.662 \times 10^0$                |           |            |
| 30.0 MeV | $8.509 \times 10^1$ | 3.345                       |         |                                       |           | 3.345   | $5.328 \times 10^0$                |           |            |
| 40.0 MeV | $1.003 \times 10^2$ | 2.846                       |         |                                       |           | 2.846   | $8.590 \times 10^0$                |           |            |
| 80.0 MeV | $1.527 \times 10^2$ | 2.110                       |         |                                       |           | 2.110   | $2.545 \times 10^1$                |           |            |
| 100. MeV | $1.764 \times 10^2$ | 1.975                       |         |                                       |           | 1.975   | $3.527 \times 10^1$                |           |            |
| 140. MeV | $2.218 \times 10^2$ | 1.836                       |         |                                       |           | 1.837   | $5.638 \times 10^1$                |           |            |
| 200. MeV | $2.868 \times 10^2$ | 1.757                       |         |                                       |           | 1.757   | $8.991 \times 10^1$                |           |            |
| 300. MeV | $3.917 \times 10^2$ | 1.725                       |         |                                       |           | 1.726   | $1.475 \times 10^2$                |           |            |
| 318. MeV | $4.105 \times 10^2$ | 1.725                       |         |                                       |           | 1.725   | <i>Minimum ionization</i>          |           |            |
| 400. MeV | $4.945 \times 10^2$ | 1.730                       |         |                                       |           | 1.730   | $2.054 \times 10^2$                |           |            |
| 800. MeV | $8.995 \times 10^2$ | 1.795                       | 0.000   |                                       |           | 1.795   | $4.325 \times 10^2$                |           |            |
| 1.00 GeV | $1.101 \times 10^3$ | 1.825                       | 0.000   |                                       |           | 1.825   | $5.430 \times 10^2$                |           |            |
| 1.40 GeV | $1.502 \times 10^3$ | 1.873                       | 0.000   |                                       |           | 1.874   | $7.591 \times 10^2$                |           |            |
| 2.00 GeV | $2.103 \times 10^3$ | 1.927                       | 0.000   | 0.000                                 |           | 1.929   | $1.074 \times 10^3$                |           |            |
| 3.00 GeV | $3.104 \times 10^3$ | 1.988                       | 0.001   | 0.001                                 |           | 1.991   | $1.584 \times 10^3$                |           |            |
| 4.00 GeV | $4.104 \times 10^3$ | 2.031                       | 0.001   | 0.001                                 |           | 2.035   | $2.081 \times 10^3$                |           |            |
| 8.00 GeV | $8.105 \times 10^3$ | 2.128                       | 0.003   | 0.003                                 |           | 2.138   | $3.993 \times 10^3$                |           |            |
| 10.0 GeV | $1.011 \times 10^4$ | 2.158                       | 0.004   | 0.004                                 |           | 2.171   | $4.921 \times 10^3$                |           |            |
| 14.0 GeV | $1.411 \times 10^4$ | 2.201                       | 0.006   | 0.007                                 |           | 2.220   | $6.742 \times 10^3$                |           |            |
| 20.0 GeV | $2.011 \times 10^4$ | 2.245                       | 0.010   | 0.011                                 |           | 2.274   | $9.410 \times 10^3$                |           |            |
| 30.0 GeV | $3.011 \times 10^4$ | 2.292                       | 0.016   | 0.019                                 |           | 2.341   | $1.374 \times 10^4$                |           |            |
| 40.0 GeV | $4.011 \times 10^4$ | 2.325                       | 0.022   | 0.028                                 |           | 2.393   | $1.797 \times 10^4$                |           |            |
| 80.0 GeV | $8.011 \times 10^4$ | 2.400                       | 0.050   | 0.068                                 |           | 2.553   | $3.412 \times 10^4$                |           |            |
| 100. GeV | $1.001 \times 10^5$ | 2.424                       | 0.065   | 0.089                                 |           | 2.621   | $4.185 \times 10^4$                |           |            |
| 140. GeV | $1.401 \times 10^5$ | 2.459                       | 0.097   | 0.134                                 |           | 2.749   | $5.675 \times 10^4$                |           |            |
| 200. GeV | $2.001 \times 10^5$ | 2.496                       | 0.145   | 0.206                                 |           | 2.930   | $7.788 \times 10^4$                |           |            |
| 300. GeV | $3.001 \times 10^5$ | 2.537                       | 0.230   | 0.327                                 |           | 3.219   | $1.104 \times 10^5$                |           |            |
| 400. GeV | $4.001 \times 10^5$ | 2.566                       | 0.317   | 0.453                                 |           | 3.504   | $1.402 \times 10^5$                |           |            |
| 800. GeV | $8.001 \times 10^5$ | 2.638                       | 0.681   | 0.981                                 |           | 4.637   | $2.391 \times 10^5$                |           |            |
| 1.00 TeV | $1.000 \times 10^6$ | 2.661                       | 0.869   | 1.254                                 |           | 5.209   | $2.798 \times 10^5$                |           |            |
| 1.04 TeV | $1.044 \times 10^6$ | 2.666                       | 0.910   | 1.313                                 |           | 5.332   | <i>Muon critical energy</i>        |           |            |
| 1.40 TeV | $1.400 \times 10^6$ | 2.697                       | 1.248   | 1.797                                 |           | 6.343   | $3.492 \times 10^5$                |           |            |
| 2.00 TeV | $2.000 \times 10^6$ | 2.735                       | 1.830   | 2.630                                 |           | 8.066   | $4.330 \times 10^5$                |           |            |
| 3.00 TeV | $3.000 \times 10^6$ | 2.778                       | 2.806   | 4.016                                 |           | 10.936  | $5.390 \times 10^5$                |           |            |
| 4.00 TeV | $4.000 \times 10^6$ | 2.810                       | 3.799   | 5.422                                 |           | 13.839  | $6.202 \times 10^5$                |           |            |
| 8.00 TeV | $8.000 \times 10^6$ | 2.887                       | 7.821   | 11.088                                |           | 25.569  | $8.296 \times 10^5$                |           |            |
| 10.0 TeV | $1.000 \times 10^7$ | 2.913                       | 9.855   | 13.942                                |           | 31.495  | $9.000 \times 10^5$                |           |            |
| 14.0 TeV | $1.400 \times 10^7$ | 2.952                       | 13.913  | 19.628                                |           | 43.364  | $1.008 \times 10^6$                |           |            |
| 20.0 TeV | $2.000 \times 10^7$ | 2.994                       | 20.052  | 28.206                                |           | 61.328  | $1.124 \times 10^6$                |           |            |
| 30.0 TeV | $3.000 \times 10^7$ | 3.042                       | 30.273  | 42.478                                |           | 91.433  | $1.256 \times 10^6$                |           |            |
| 40.0 TeV | $4.000 \times 10^7$ | 3.077                       | 40.549  | 56.796                                |           | 121.773 | $1.351 \times 10^6$                |           |            |
| 80.0 TeV | $8.000 \times 10^7$ | 3.163                       | 81.720  | 114.122                               |           | 244.322 | $1.578 \times 10^6$                |           |            |
| 100. TeV | $1.000 \times 10^8$ | 3.191                       | 102.350 | 142.820                               |           | 306.102 | $1.651 \times 10^6$                |           |            |