

## Muons in bromine liquid (Br<sub>2</sub>)

| Z        | A [g/mol]           | $\rho$ [g/cm <sup>3</sup> ] | I [eV]  | $a$                                   | $k = m_s$ | $x_0$    | $x_1$                              | $\bar{C}$ | $\delta_0$ |
|----------|---------------------|-----------------------------|---------|---------------------------------------|-----------|----------|------------------------------------|-----------|------------|
| 35 (Br)  | 79.904(1)           | 3.103                       | 357.0   | 0.22114                               | 3.0000    | 0.3669   | 3.0000                             | 5.7268    | 0.00       |
| $T$      | $p$<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 | $4.704 \times 10^1$ | 4.992                       |         |                                       |           | 4.992    | $1.134 \times 10^0$                |           |            |
| 14.0 MeV | $5.616 \times 10^1$ | 3.937                       |         |                                       |           | 3.937    | $2.045 \times 10^0$                |           |            |
| 20.0 MeV | $6.802 \times 10^1$ | 3.106                       |         |                                       |           | 3.106    | $3.779 \times 10^0$                |           |            |
| 30.0 MeV | $8.509 \times 10^1$ | 2.434                       |         |                                       |           | 2.434    | $7.466 \times 10^0$                |           |            |
| 40.0 MeV | $1.003 \times 10^2$ | 2.091                       |         |                                       |           | 2.092    | $1.193 \times 10^1$                |           |            |
| 80.0 MeV | $1.527 \times 10^2$ | 1.593                       |         |                                       |           | 1.593    | $3.451 \times 10^1$                |           |            |
| 100. MeV | $1.764 \times 10^2$ | 1.506                       |         |                                       |           | 1.506    | $4.745 \times 10^1$                |           |            |
| 140. MeV | $2.218 \times 10^2$ | 1.422                       |         |                                       |           | 1.422    | $7.491 \times 10^1$                |           |            |
| 200. MeV | $2.868 \times 10^2$ | 1.384                       |         |                                       |           | 1.384    | $1.178 \times 10^2$                |           |            |
| 243. MeV | $3.325 \times 10^2$ | 1.380                       |         |                                       |           | 1.380    | <i>Minimum ionization</i>          |           |            |
| 300. MeV | $3.917 \times 10^2$ | 1.385                       | 0.000   |                                       | 0.000     | 1.386    | $1.902 \times 10^2$                |           |            |
| 400. MeV | $4.945 \times 10^2$ | 1.406                       | 0.000   |                                       | 0.000     | 1.407    | $2.618 \times 10^2$                |           |            |
| 800. MeV | $8.995 \times 10^2$ | 1.497                       | 0.001   |                                       | 0.000     | 1.498    | $5.371 \times 10^2$                |           |            |
| 1.00 GeV | $1.101 \times 10^3$ | 1.532                       | 0.001   |                                       | 0.000     | 1.534    | $6.690 \times 10^2$                |           |            |
| 1.40 GeV | $1.502 \times 10^3$ | 1.588                       | 0.001   | 0.000                                 | 0.001     | 1.591    | $9.248 \times 10^2$                |           |            |
| 2.00 GeV | $2.103 \times 10^3$ | 1.649                       | 0.002   | 0.001                                 | 0.001     | 1.653    | $1.294 \times 10^3$                |           |            |
| 3.00 GeV | $3.104 \times 10^3$ | 1.716                       | 0.004   | 0.002                                 | 0.001     | 1.723    | $1.886 \times 10^3$                |           |            |
| 4.00 GeV | $4.104 \times 10^3$ | 1.761                       | 0.005   | 0.004                                 | 0.002     | 1.773    | $2.458 \times 10^3$                |           |            |
| 8.00 GeV | $8.105 \times 10^3$ | 1.864                       | 0.013   | 0.013                                 | 0.003     | 1.893    | $4.633 \times 10^3$                |           |            |
| 10.0 GeV | $1.011 \times 10^4$ | 1.894                       | 0.017   | 0.018                                 | 0.004     | 1.933    | $5.678 \times 10^3$                |           |            |
| 14.0 GeV | $1.411 \times 10^4$ | 1.937                       | 0.026   | 0.029                                 | 0.006     | 1.998    | $7.712 \times 10^3$                |           |            |
| 20.0 GeV | $2.011 \times 10^4$ | 1.980                       | 0.040   | 0.047                                 | 0.008     | 2.076    | $1.066 \times 10^4$                |           |            |
| 30.0 GeV | $3.011 \times 10^4$ | 2.025                       | 0.066   | 0.082                                 | 0.012     | 2.185    | $1.535 \times 10^4$                |           |            |
| 40.0 GeV | $4.011 \times 10^4$ | 2.055                       | 0.093   | 0.120                                 | 0.015     | 2.284    | $1.982 \times 10^4$                |           |            |
| 80.0 GeV | $8.011 \times 10^4$ | 2.122                       | 0.211   | 0.287                                 | 0.030     | 2.651    | $3.605 \times 10^4$                |           |            |
| 100. GeV | $1.001 \times 10^5$ | 2.143                       | 0.273   | 0.377                                 | 0.037     | 2.831    | $4.335 \times 10^4$                |           |            |
| 140. GeV | $1.401 \times 10^5$ | 2.173                       | 0.401   | 0.563                                 | 0.052     | 3.190    | $5.666 \times 10^4$                |           |            |
| 200. GeV | $2.001 \times 10^5$ | 2.206                       | 0.601   | 0.858                                 | 0.074     | 3.739    | $7.402 \times 10^4$                |           |            |
| 281. GeV | $2.811 \times 10^5$ | 2.236                       | 0.877   | 1.256                                 | 0.104     | 4.473    | <i>Muon critical energy</i>        |           |            |
| 300. GeV | $3.001 \times 10^5$ | 2.242                       | 0.943   | 1.351                                 | 0.111     | 4.647    | $9.797 \times 10^4$                |           |            |
| 400. GeV | $4.001 \times 10^5$ | 2.268                       | 1.296   | 1.862                                 | 0.148     | 5.574    | $1.176 \times 10^5$                |           |            |
| 800. GeV | $8.001 \times 10^5$ | 2.330                       | 2.758   | 3.959                                 | 0.299     | 9.348    | $1.724 \times 10^5$                |           |            |
| 1.00 TeV | $1.000 \times 10^6$ | 2.351                       | 3.510   | 5.033                                 | 0.376     | 11.270   | $1.919 \times 10^5$                |           |            |
| 1.40 TeV | $1.400 \times 10^6$ | 2.382                       | 5.018   | 7.176                                 | 0.532     | 15.109   | $2.224 \times 10^5$                |           |            |
| 2.00 TeV | $2.000 \times 10^6$ | 2.415                       | 7.325   | 10.448                                | 0.770     | 20.960   | $2.560 \times 10^5$                |           |            |
| 3.00 TeV | $3.000 \times 10^6$ | 2.454                       | 11.181  | 15.886                                | 1.178     | 30.699   | $2.952 \times 10^5$                |           |            |
| 4.00 TeV | $4.000 \times 10^6$ | 2.481                       | 15.090  | 21.384                                | 1.592     | 40.548   | $3.235 \times 10^5$                |           |            |
| 8.00 TeV | $8.000 \times 10^6$ | 2.549                       | 30.860  | 43.490                                | 3.310     | 80.210   | $3.923 \times 10^5$                |           |            |
| 10.0 TeV | $1.000 \times 10^7$ | 2.571                       | 38.811  | 54.604                                | 4.193     | 100.181  | $4.146 \times 10^5$                |           |            |
| 14.0 TeV | $1.400 \times 10^7$ | 2.606                       | 54.670  | 76.779                                | 6.006     | 140.062  | $4.482 \times 10^5$                |           |            |
| 20.0 TeV | $2.000 \times 10^7$ | 2.642                       | 78.608  | 110.188                               | 8.786     | 200.225  | $4.838 \times 10^5$                |           |            |
| 30.0 TeV | $3.000 \times 10^7$ | 2.685                       | 118.459 | 165.776                               | 13.592    | 300.512  | $5.243 \times 10^5$                |           |            |
| 40.0 TeV | $4.000 \times 10^7$ | 2.715                       | 158.463 | 221.502                               | 18.513    | 401.194  | $5.530 \times 10^5$                |           |            |
| 80.0 TeV | $8.000 \times 10^7$ | 2.791                       | 318.748 | 444.574                               | 39.070    | 805.184  | $6.220 \times 10^5$                |           |            |
| 100. TeV | $1.000 \times 10^8$ | 2.816                       | 399.040 | 556.220                               | 49.690    | 1007.767 | $6.442 \times 10^5$                |           |            |