

# Muons in ruthenium (Ru)

| Z        | A [g/mol]           | $\rho$ [g/cm <sup>3</sup> ] | I [eV]  | a                                     | $k = m_s$ | $x_0$    | $x_1$                              | $\overline{C}$ | $\delta_0$ |
|----------|---------------------|-----------------------------|---------|---------------------------------------|-----------|----------|------------------------------------|----------------|------------|
| 44 (Ru)  | 101.07(2)           | 12.410                      | 441.0   | 0.19342                               | 2.8707    | 0.0599   | 3.0834                             | 4.7694         | 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 | $4.704 \times 10^1$ | 4.772                       |         |                                       |           | 4.772    | $1.191 \times 10^0$                |                |            |
| 14.0 MeV | $5.616 \times 10^1$ | 3.770                       |         |                                       |           | 3.770    | $2.143 \times 10^0$                |                |            |
| 20.0 MeV | $6.802 \times 10^1$ | 2.977                       |         |                                       |           | 2.977    | $3.954 \times 10^0$                |                |            |
| 30.0 MeV | $8.509 \times 10^1$ | 2.334                       |         |                                       |           | 2.334    | $7.798 \times 10^0$                |                |            |
| 40.0 MeV | $1.003 \times 10^2$ | 2.005                       |         |                                       |           | 2.005    | $1.245 \times 10^1$                |                |            |
| 80.0 MeV | $1.527 \times 10^2$ | 1.524                       |         |                                       |           | 1.524    | $3.604 \times 10^1$                |                |            |
| 100. MeV | $1.764 \times 10^2$ | 1.439                       |         |                                       |           | 1.439    | $4.958 \times 10^1$                |                |            |
| 140. MeV | $2.218 \times 10^2$ | 1.355                       |         |                                       |           | 1.355    | $7.835 \times 10^1$                |                |            |
| 200. MeV | $2.868 \times 10^2$ | 1.314                       |         |                                       |           | 1.314    | $1.235 \times 10^2$                |                |            |
| 253. MeV | $3.431 \times 10^2$ | 1.307                       |         |                                       |           | 1.307    | <i>Minimum ionization</i>          |                |            |
| 300. MeV | $3.917 \times 10^2$ | 1.310                       | 0.000   |                                       | 0.000     | 1.310    | $1.999 \times 10^2$                |                |            |
| 400. MeV | $4.945 \times 10^2$ | 1.327                       | 0.000   |                                       | 0.000     | 1.327    | $2.757 \times 10^2$                |                |            |
| 800. MeV | $8.995 \times 10^2$ | 1.408                       | 0.001   |                                       | 0.000     | 1.409    | $5.679 \times 10^2$                |                |            |
| 1.00 GeV | $1.101 \times 10^3$ | 1.441                       | 0.001   |                                       | 0.000     | 1.443    | $7.081 \times 10^2$                |                |            |
| 1.40 GeV | $1.502 \times 10^3$ | 1.494                       | 0.002   | 0.000                                 | 0.001     | 1.496    | $9.800 \times 10^2$                |                |            |
| 2.00 GeV | $2.103 \times 10^3$ | 1.551                       | 0.003   | 0.001                                 | 0.001     | 1.555    | $1.373 \times 10^3$                |                |            |
| 3.00 GeV | $3.104 \times 10^3$ | 1.615                       | 0.004   | 0.003                                 | 0.001     | 1.623    | $2.001 \times 10^3$                |                |            |
| 4.00 GeV | $4.104 \times 10^3$ | 1.659                       | 0.006   | 0.005                                 | 0.002     | 1.672    | $2.608 \times 10^3$                |                |            |
| 8.00 GeV | $8.105 \times 10^3$ | 1.759                       | 0.016   | 0.016                                 | 0.003     | 1.794    | $4.909 \times 10^3$                |                |            |
| 10.0 GeV | $1.011 \times 10^4$ | 1.789                       | 0.021   | 0.022                                 | 0.004     | 1.836    | $6.011 \times 10^3$                |                |            |
| 14.0 GeV | $1.411 \times 10^4$ | 1.831                       | 0.032   | 0.035                                 | 0.005     | 1.904    | $8.149 \times 10^3$                |                |            |
| 20.0 GeV | $2.011 \times 10^4$ | 1.874                       | 0.049   | 0.057                                 | 0.008     | 1.989    | $1.123 \times 10^4$                |                |            |
| 30.0 GeV | $3.011 \times 10^4$ | 1.919                       | 0.081   | 0.099                                 | 0.011     | 2.112    | $1.611 \times 10^4$                |                |            |
| 40.0 GeV | $4.011 \times 10^4$ | 1.949                       | 0.114   | 0.146                                 | 0.015     | 2.225    | $2.072 \times 10^4$                |                |            |
| 80.0 GeV | $8.011 \times 10^4$ | 2.017                       | 0.258   | 0.349                                 | 0.030     | 2.654    | $3.715 \times 10^4$                |                |            |
| 100. GeV | $1.001 \times 10^5$ | 2.037                       | 0.334   | 0.458                                 | 0.037     | 2.867    | $4.440 \times 10^4$                |                |            |
| 140. GeV | $1.401 \times 10^5$ | 2.068                       | 0.490   | 0.684                                 | 0.051     | 3.294    | $5.741 \times 10^4$                |                |            |
| 200. GeV | $2.001 \times 10^5$ | 2.100                       | 0.735   | 1.041                                 | 0.073     | 3.949    | $7.402 \times 10^4$                |                |            |
| 225. GeV | $2.254 \times 10^5$ | 2.110                       | 0.839   | 1.190                                 | 0.082     | 4.222    | <i>Muon critical energy</i>        |                |            |
| 300. GeV | $3.001 \times 10^5$ | 2.136                       | 1.153   | 1.639                                 | 0.109     | 5.038    | $9.640 \times 10^4$                |                |            |
| 400. GeV | $4.001 \times 10^5$ | 2.162                       | 1.585   | 2.258                                 | 0.145     | 6.151    | $1.143 \times 10^5$                |                |            |
| 800. GeV | $8.001 \times 10^5$ | 2.224                       | 3.370   | 4.799                                 | 0.293     | 10.687   | $1.631 \times 10^5$                |                |            |
| 1.00 TeV | $1.000 \times 10^6$ | 2.244                       | 4.287   | 6.099                                 | 0.369     | 13.000   | $1.800 \times 10^5$                |                |            |
| 1.40 TeV | $1.400 \times 10^6$ | 2.275                       | 6.127   | 8.692                                 | 0.522     | 17.618   | $2.064 \times 10^5$                |                |            |
| 2.00 TeV | $2.000 \times 10^6$ | 2.308                       | 8.941   | 12.651                                | 0.755     | 24.657   | $2.350 \times 10^5$                |                |            |
| 3.00 TeV | $3.000 \times 10^6$ | 2.346                       | 13.642  | 19.231                                | 1.155     | 36.375   | $2.682 \times 10^5$                |                |            |
| 4.00 TeV | $4.000 \times 10^6$ | 2.374                       | 18.406  | 25.880                                | 1.561     | 48.222   | $2.920 \times 10^5$                |                |            |
| 8.00 TeV | $8.000 \times 10^6$ | 2.441                       | 37.618  | 52.615                                | 3.245     | 95.921   | $3.497 \times 10^5$                |                |            |
| 10.0 TeV | $1.000 \times 10^7$ | 2.463                       | 47.302  | 66.055                                | 4.110     | 119.932  | $3.683 \times 10^5$                |                |            |
| 14.0 TeV | $1.400 \times 10^7$ | 2.497                       | 66.618  | 92.871                                | 5.885     | 167.873  | $3.964 \times 10^5$                |                |            |
| 20.0 TeV | $2.000 \times 10^7$ | 2.534                       | 95.768  | 133.268                               | 8.606     | 240.177  | $4.261 \times 10^5$                |                |            |
| 30.0 TeV | $3.000 \times 10^7$ | 2.576                       | 144.295 | 200.482                               | 13.309    | 360.663  | $4.599 \times 10^5$                |                |            |
| 40.0 TeV | $4.000 \times 10^7$ | 2.606                       | 193.001 | 267.858                               | 18.123    | 481.589  | $4.838 \times 10^5$                |                |            |
| 80.0 TeV | $8.000 \times 10^7$ | 2.682                       | 388.132 | 537.566                               | 38.226    | 966.607  | $5.412 \times 10^5$                |                |            |
| 100. TeV | $1.000 \times 10^8$ | 2.706                       | 485.870 | 672.550                               | 48.610    | 1209.737 | $5.597 \times 10^5$                |                |            |