Momentum in SI Units and Atomic Units (Hartree and Rydberg)

Momentum https://en.wikipedia.org/wiki/Momentum

$$p = mv$$

SI Units

Let:

$m = m_e = 9.11 \times 10^{-31} kg$ (electron rest mass) https://en.wikipedia.org/wiki/Electron_rest_mass

$$v = 2 \times 10^6 \frac{m}{s}$$

such that

$$p = (9.11 \times 10^{-31} kg)\left(2 \times 10^6 \frac{m}{s}\right) = 1.82 \times 10^{-24} \frac{kg \cdot m}{s}$$

Hartree Atomic Units

$1 a.u. of\ mass = 9.11 \times 10^{-31} kg$ http://www.yorku.ca/renef/constants.pdf

$$m_e = \left(9.11 \times 10^{-31} kg\right)\left(\frac{1 a.u. of\ mass}{9.11 \times 10^{-31} kg}\right) = 1 a.u. of\ mass$$

$1 \alpha c\ a.u. of\ velocity = 2.19 \times 10^6 m/s$ https://en.wikipedia.org/wiki/Atomic_units

$$v = \left(2 \times 10^6 m/s\right)\left(\frac{\alpha c\ a.u. of\ velocity}{2.19 \times 10^6 m/s}\right) = 0.913 \alpha c\ a.u. of\ velocity$$

$$p = (1 a.u. of\ mass)(0.913 \alpha c\ a.u. of\ velocity) = 0.913 \alpha c\ [a.u. of\ mass \cdot a.u. of\ velocity]$$

$$a.u. of\ momentum = a.u. of\ mass \cdot a.u. of\ velocity$$

$c = \frac{1}{\alpha}$ https://en.wikipedia.org/wiki/Natural_units

$$p = 0.913 \alpha \frac{1}{\alpha} a.u. of\ momentum = 0.913\ a.u. of\ momentum$$

Rydberg Atomic Units

$0.5 a.u. of\ mass = 9.11 \times 10^{-31} kg$ https://en.wikipedia.org/wiki/Natural_units

$$m_e = \left(9.11\times10^{-31}\,kg\right)\left(\frac{0.5\,a.u.of\ mass}{9.11\times10^{-31}\,kg}\right) = \frac{1}{2}\,a.u.of\ mass$$

$$v = \left(2\times10^{6}\,m/s\right)\left(\frac{\alpha c\,a.u.of\ velocity}{2.19\times10^{6}\,m/s}\right) = 0.913\alpha c\,a.u.of\ velocity$$

$$p = \left(\frac{1}{2}\,a.u.of\ mass\right)\left(0.913\alpha c\,a.u.of\ velocity\right) = 0.457\alpha c\,[a.u.of\ mass\cdot a.u.of\ velocity]$$

$c = \frac{2}{\alpha}$ https://en.wikipedia.org/wiki/Natural_units

$$p = 0.457\alpha\,\frac{2}{\alpha}\,a.u.of\ momentum = 0.913\,a.u.of\ momentum$$

$1\,a.u.of\ momentum = 1.99\times10^{-24}\,\frac{kg\cdot m}{s}$ http://faculty.kfupm.edu.sa/PHYS/aanaqvi/rydberg.pdf

$$p = 0.913\left(\frac{1.99\times10^{-24}\,\frac{kg\cdot m}{s}}{1\,a.u.of\ momentum}\right) = 1.82\times10^{-24}\,\frac{kg\cdot m}{s}$$