# Units

March 31, 2024

## 1 Unit systems

Note: the energy unit for the first section below is called the Jerk, whereas in cgs units it is called the erg.

## 2 1st set of units

| variable | definition | in SI |
|---|---|---|
| Length | cm | |
| Mass | g | |
| Time | sh | |
| Temperature | KeV | |
| Velocity | cm/sh | |
| Energy | $\mathrm{g \cdot cm^2 \ / \ sh^2}$ | $10^9$ J ($10^3$ MJ) |
| Pressure | $\mathrm{g \ / \ cm \cdot sh^2}$ | $10^{15}$ Pa ($10^4$ Mbar) |
| Density | $\mathrm{g \ / \ cm^3}$ | |
| Intensity | $\mathrm{g \ / \ sh^3}$ | $10^{21}$ W/m$^2$ ($10^{17}$ W/cm$^2$) |

The Stefan-Boltzman law is

$$I = \frac{1}{\pi}\sigma T^4, \tag{1}$$

where

$$\sigma = \frac{2\pi^5 k_B^4}{15c^2h^3}. \tag{2}$$

If we introduce

$$\eta = \frac{2\pi^5}{15c^2h^3}, \tag{3}$$

then we can re-write the Stefan-Boltzman law as

$$I = \frac{1}{\pi}\eta(k_B T)^4. \tag{4}$$

The value of $\eta$ in adive units can be be derived as follows

$$\begin{aligned}
\eta &= 1.5605532983363822 \times 10^{84} \frac{1}{\mathrm{s} \cdot \mathrm{m}^2 \cdot \mathrm{J}^3} \\
&= 1.5605532983363822 \times 10^{84} \frac{\mathrm{J}}{\mathrm{s} \cdot \mathrm{m}^2 \cdot \mathrm{J}^4} \left| \frac{1.602176634 \times 10^{-16} \mathrm{J}}{1 \mathrm{keV}} \right|^4 \left| \frac{1 \mathrm{m}}{10^2 \mathrm{cm}} \right|^2 \\
&= 1.028300817017691 \times 10^{17} \frac{\mathrm{J}}{\mathrm{s} \cdot \mathrm{cm}^2 \cdot \mathrm{keV}^4} \\
&= 1.028300817017691 \times 10^{17} \frac{\mathrm{W}}{\mathrm{cm}^2 \cdot \mathrm{keV}^4} \\
&= 1.028300817017691 \frac{\mathrm{g}}{\mathrm{sh}^3 \cdot \mathrm{keV}^4}. \qquad (5)
\end{aligned}$$

# 3 2nd set of units

| variable | definition | in SI |
|---|---|---|
| Length | cm | |
| Mass | g | |
| Time | us | |
| Temperature | KeV | |
| Velocity | cm/us | |
| Energy | $\mathrm{g} \cdot \mathrm{cm}^2$ / $\mathrm{us}^2$ | $10^5$ J ($10^{-1}$ MJ) |
| Pressure | g / $\mathrm{cm} \cdot \mathrm{us}^2$ | |
| Density | g / $\mathrm{cm}^3$ | |
| Intensity | g / $\mathrm{us}^3$ | $10^{15}$ W/$\mathrm{m}^2$ ($10^{11}$ W/$\mathrm{cm}^2$) |