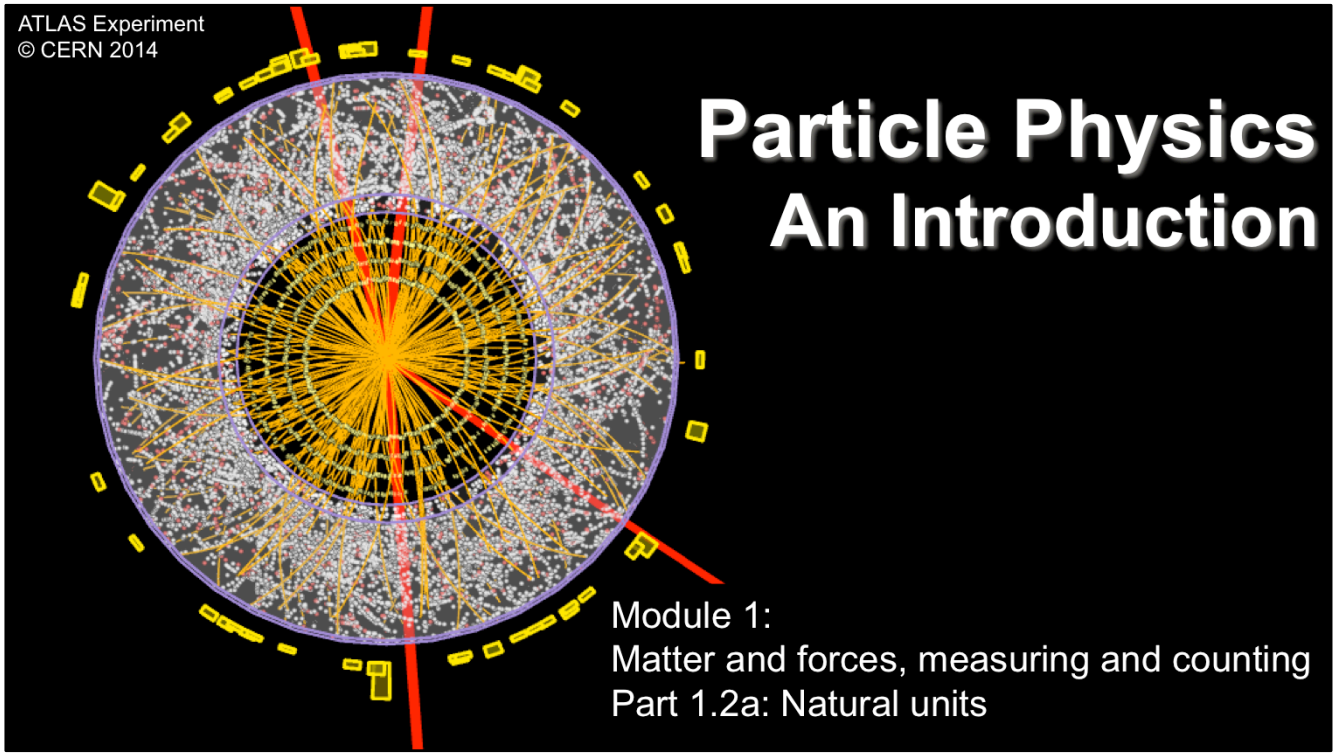


For those who are unfamiliar with the system of natural units, we will briefly introduce it.

Planck's constant $\hbar$ and speed of light c:

$$\hbar \equiv \frac{h}{2\pi} \simeq 1.055 \times 10^{-34}\,\text{J s}$$
$$c \simeq 2.998 \times 10^{8}\,\text{m/s}$$

Units in the international system:

$$[\hbar] = \frac{ML^2}{T} = \frac{\text{kg m}^2}{\text{s}}$$
$$[c] = \frac{L}{T} = \frac{\text{m}}{\text{s}}$$

"Natural" units:

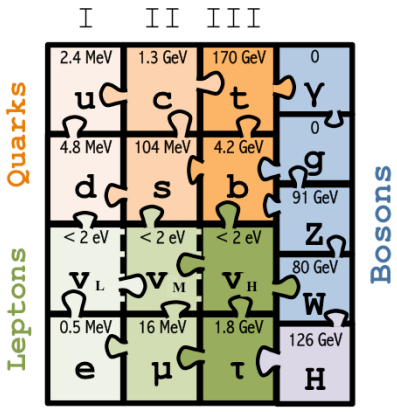
$$\hbar = c \equiv 1 \quad ; \quad [\hbar] = [c] = 1$$
$$[e] = [\sqrt{\hbar c}] = [1] \quad ; \quad \alpha = \frac{\frac{1}{4\pi}\frac{e^2}{\hbar/mc}}{mc^2} = \frac{e^2}{4\pi\hbar c} \simeq \frac{1}{137}$$

- High energy physics deals with relativistic quantum processes. The scale of the action is thus characterized by Planck's constant $\hbar$, the scale of velocities is given by the speed of light c.
- In the system of natural units, we set $\hbar = c = 1$. This means that we define $\hbar$ as the unit of action, and c as the unit of velocity. In such a system, 1s is equal to approximately 3×10^8 m.
- As an added value, the electric charge is now dimensionless. It often shows up as the fine structure constant α, which is the electrostatic potential energy of two electrons at unit distance, divided by the mass of the electron. This constant is equal to 1/137 to a good approximation.

Basic unit: electronvolt (eV) ≡ energy gained by an electron in a potential difference of 1V:

$$[E, M, p] = \frac{ML^2}{T^2} = \text{eV}$$

$$1\ \text{GeV} = 10^9\ \text{eV} \simeq M_p$$



Quantity	Conversion factor	Natural units	IS units
Mass	$1\ \text{kg} = 5.61 \times 10^{26}\ \text{GeV}$	GeV	GeV/c^2
Length	$1\ \text{m} = 5.07 \times 10^{15}\ \text{GeV}^{-1}$	GeV^{-1}	$\hbar c/\text{GeV}$
Time	$1\ \text{s} = 1.52 \times 10^{24}\ \text{GeV}^{-1}$	GeV^{-1}	$\hbar/\text{GeV}$

- The system of natural units is of great practical value, since it eliminates a lot of constants from the equations. It thus makes them less heavy and more easy to understand.
- The basic unit, the electronvolt (eV) is defined as the gain in energy of an electron when it traverses a potential difference of 1V.
- In the system of natural units, the electronvolt is the common unit of energy, momentum and mass.
- A billion of these units corresponds roughly to the mass of the proton, M_p, and thus sets the natural scale of high energy physics.
- Whenever you want to convert a result to units of the International System, this table can be useful.