Source: KBhPHYS201QuantumWorldBookNotesIndex

0.1 | How to Deal with Large and Small

- Scientific notation is required to deal with large and small quantities
  - This is required in much of particle physics since particles tend to be very small and fast
- People also tend to create more fitting units for a specific application

0.1.1 | Units

Fentometers are used as a unit of measurement in the atomic world. They're $10^{15}m$.

For **speed** we use fractions of the speed of light c ~$3 * 10^8 m/s$

Volts are used for charge.

Particle Masses can also be expressed in eV units. Particle masses are actually pretty large with the eV unit.

Planck Size is about $10^{-35}m$

0.1.2 | Relative Scales Distance

- The nucleus takes up a very small amount of a particle
  - Comparison drawn here is a basketball in an airport for a large nucleus and a golf ball for smaller ones
- Electrons occupy in a probability distribution the rest of the space more or less
- The only viable way to measure distances that small are through scattering experiments involving shooting electrons at say a proton and observing the scatter pattern
  - The diameter of 1 proton is approximately 1 fermi
- Short Wavelengths can also be observed to estimate the size of such small particles
- The Planck size is the smallest meaningful distance before spacetime breaks down into quantum foam

0.1.3 | Relative Scales Speed

- The fastest anything can go so far as we know is the speed of light
- It's hard to get anything close to the speed of light, but for stuff like particle accelerators and cosmic rays it isn't super uncommon to get close
- Mass being the reluctance to accelerate means that the mass-less photon should be the fastest particle requiring no energy to reach the speed of light. For anything to go faster would be difficult.
  - However, physicists have studied the Tachyon which is theoretically capable of doing so but has not been discovered and also creates strange circumstances
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