



Scientific Notation

Provides a compact way of expressing very large and very small numbers


Large numbers

$$2.0 \times 10^{\textcircled{6}} = 2,000,000$$



Move the decimal point 6 places to the right

$$2.0 \times 10^6 = \underbrace{2000000.}$$


Small numbers

$$7.0 \times 10^{\textcircled{-5}} = 0.000007$$


Move the decimal point 5 places to the left

$$7.0 \times 10^{-5} = \underbrace{0.000007}$$


Length scales in Nature

1 mm



Grain of sugar, small insects, etc

1 km



Brooklyn bridge

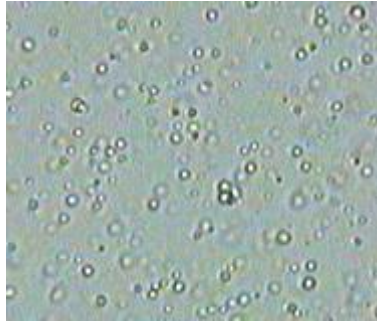
10^{-3} m

1 m

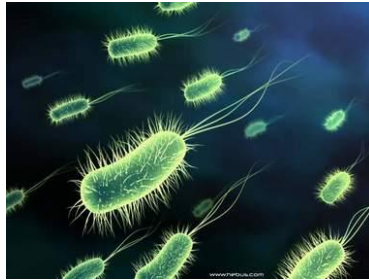
10^3 m

1 micron (1 μ m)

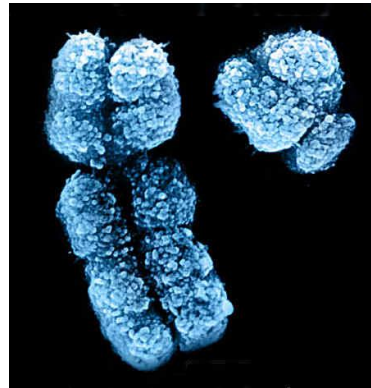
Particles in smoke, milk, etc
(1-20 μ m)



Bacteria
(1-10 μ m)



Human Chromosome
(2 - 10 μ m)



1000 km



10⁻⁶

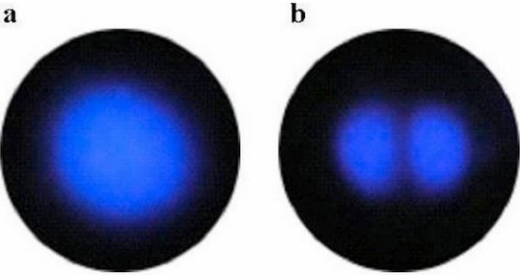
10⁻³

1 m

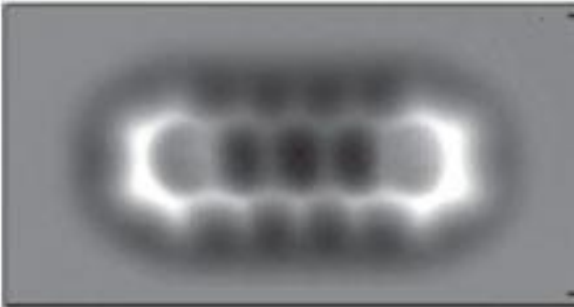
10³

10⁶

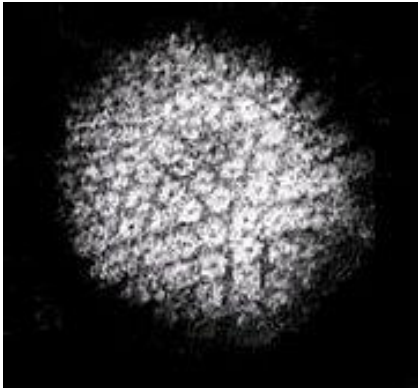
1 nanometer = 10 Angstrom
(1 nm = 10 Å)



Atom (1 Å)

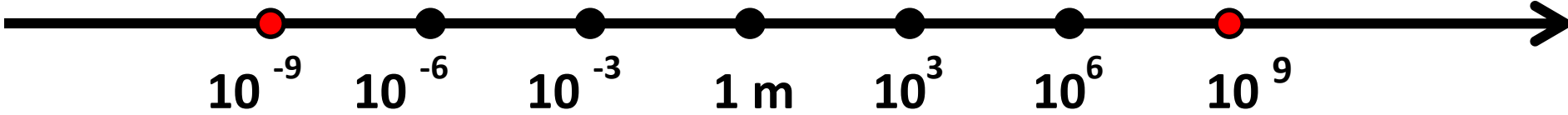


Molecule
(1nm)

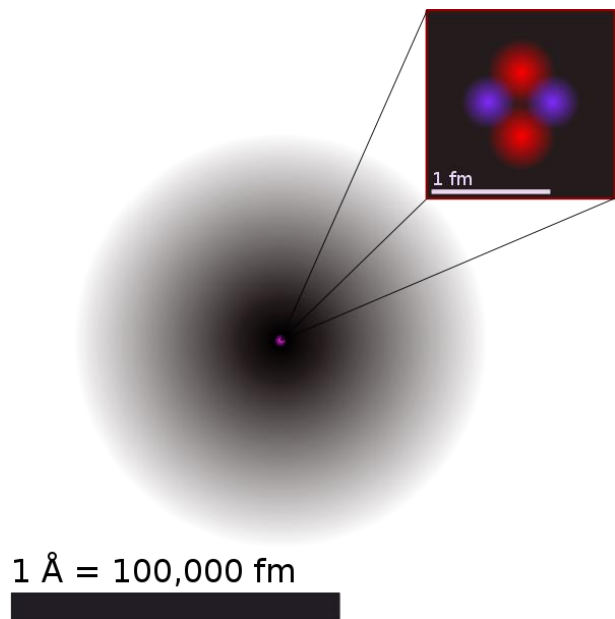


Virus (>10 nm)

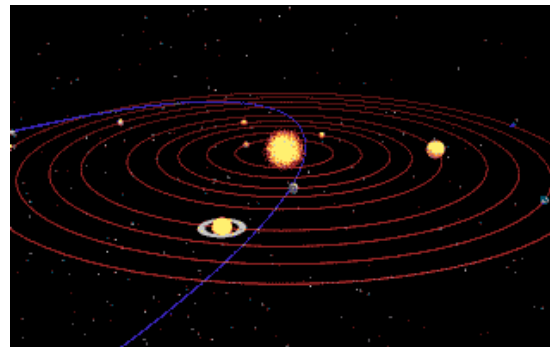
1,000,000 km
(3 light seconds)



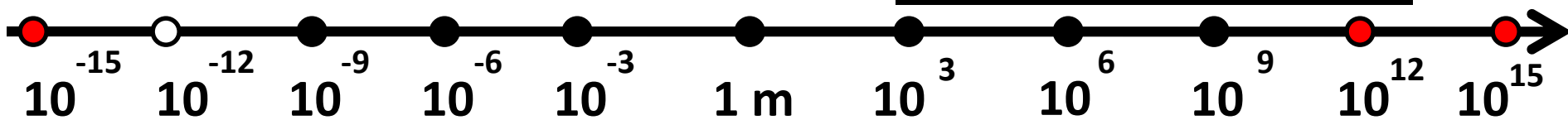
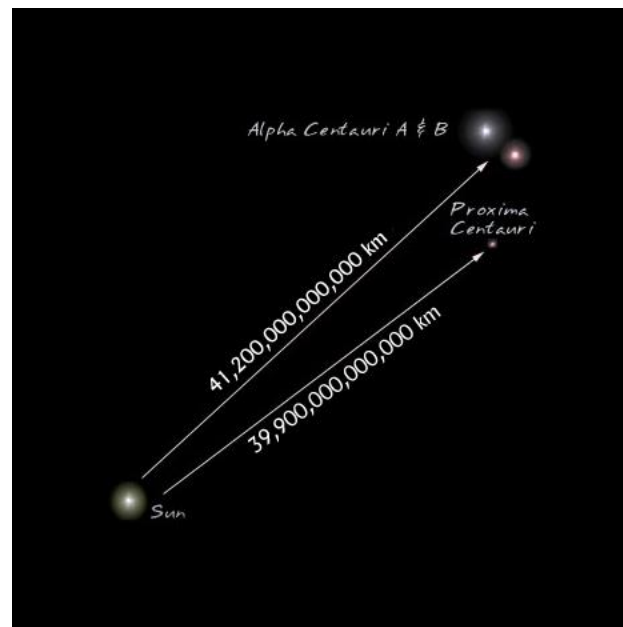
Proton, neutron, atomic nucleus



10^{12} m = 1 billion km \approx 1 light hour



10^{16} m \approx 1 light year

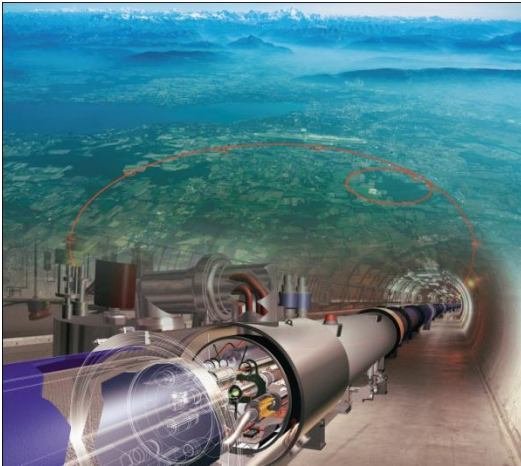


Modern Physics

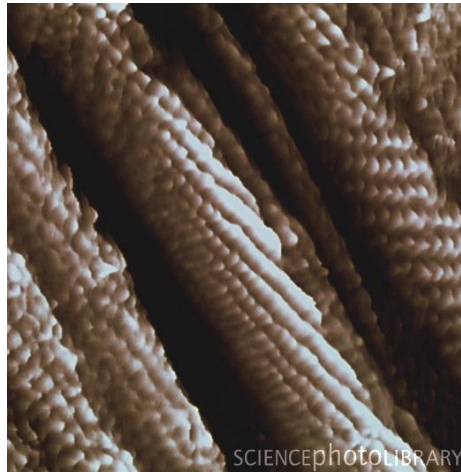
High Energy Physics

Condensed Matter Physics

Astrophysics & Cosmology



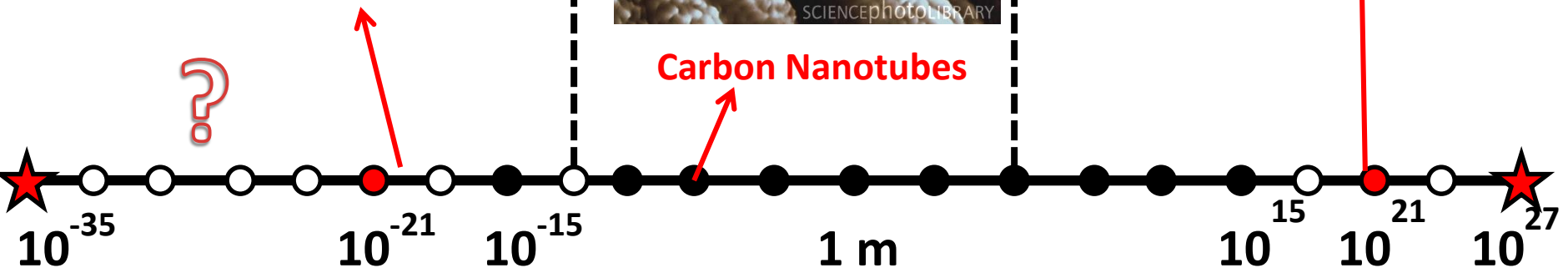
Large Hadron Collider (LHC)



Carbon Nanotubes



Our Galaxy (Milky Way)



Homework 1

Problem 0.

Watch the documentary called “Cosmic Voyage” at

<https://www.youtube.com/watch?v=k-xcc2vGE7s>

paying particular attention to the length scales displayed.

Now, it is time for you to explore the different scales of the universe by going to

<http://htwins.net/scale2/>

Problem 1.

Estimate the number of atom in a grain of salt. Assume the grain to be a cube $1 \times 1 \times 1$ mm, and each atom to be a cubic brick.

Problem 2.

Estimate the number of cells in your body, if a typical human cell is about 10 micron in size.