

Length scales in Nature

1 mm



Grain of sugar, small insects, etc

1 km



Brooklyn bridge

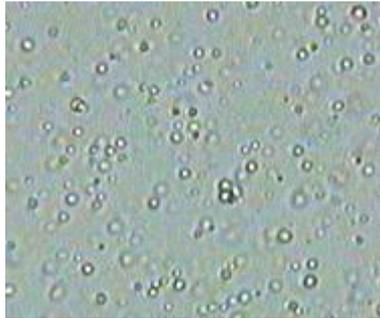
10^{-3} m

1 m

10^3 m

1 micron (1 μ m)

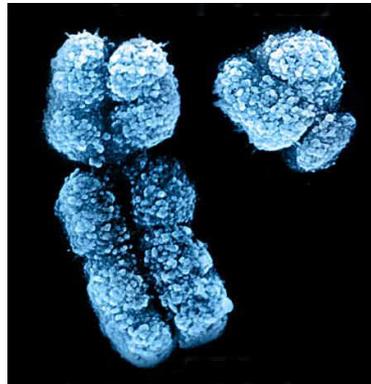
Particles in smoke, milk, etc
(1-20 μ m)



Bacteria
(1-10 μ m)



Human Chromosome
(2 - 10 μ m)



1000 km



10⁻⁶

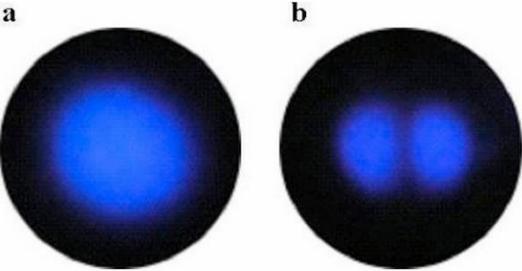
10⁻³

1 m

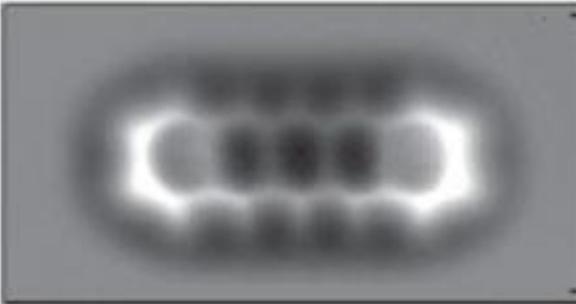
10³

10⁶

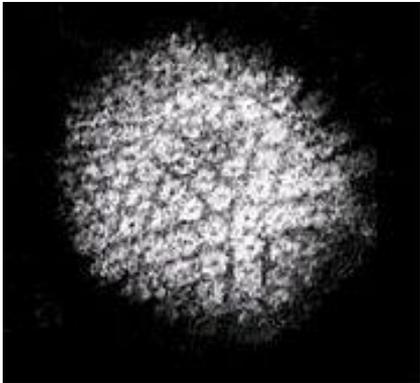
1 nanometer = 10 Angstrom
(1 nm = 10 Å)



Atom (1 Å)

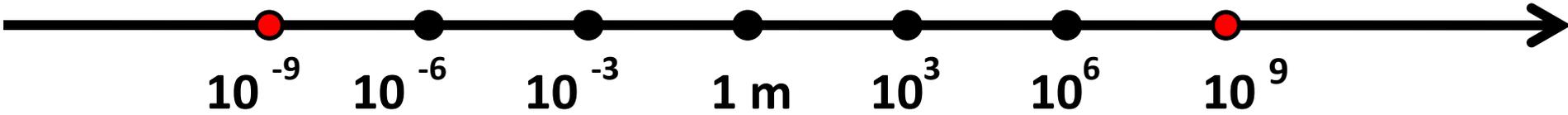


Molecule
(1nm)

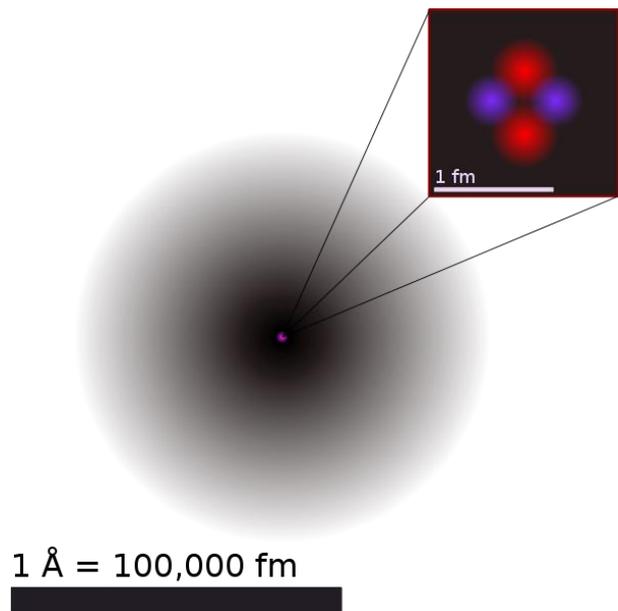


Virus (>10 nm)

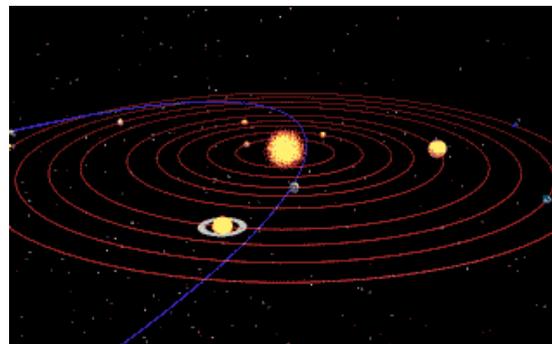
1,000,000 km
(3 light seconds)



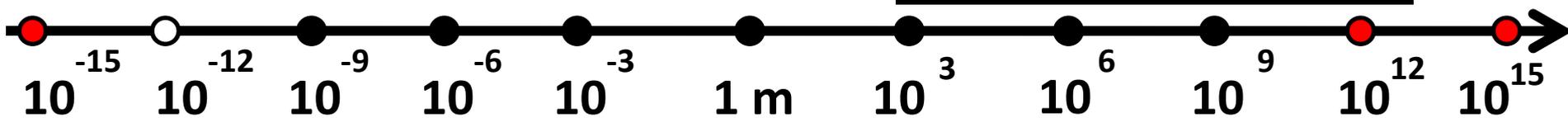
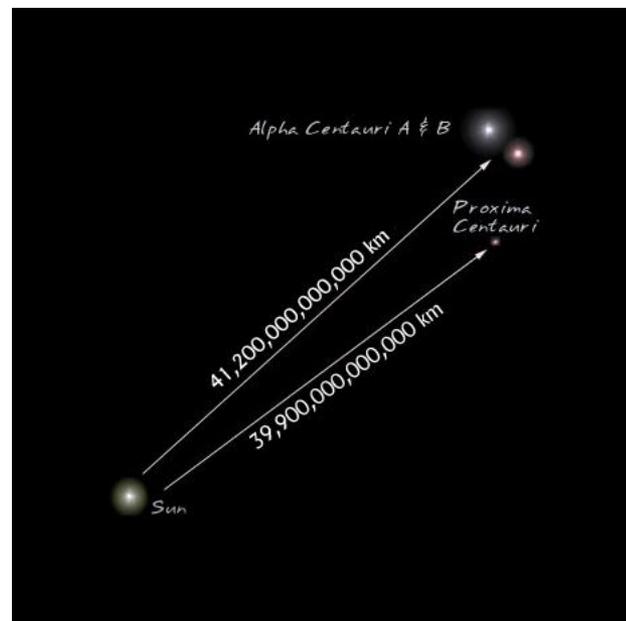
Proton, neutron, atomic nucleus



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



10^{16} m \approx 1 light year

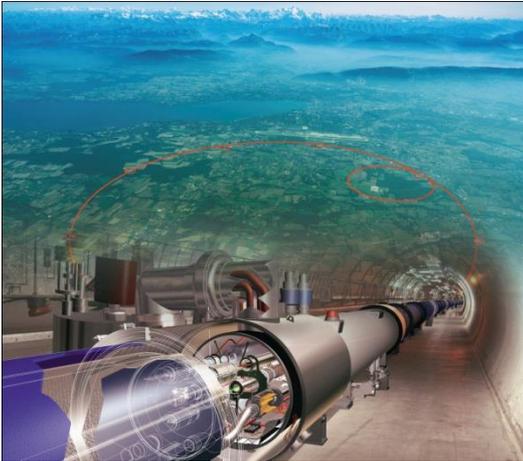


Modern Physics

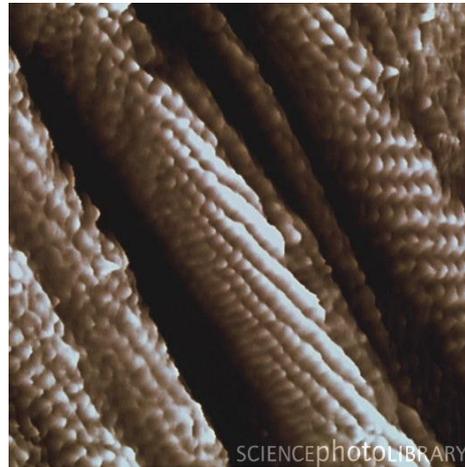
High Energy Physics

Condensed Matter Physics

Astrophysics & Cosmology



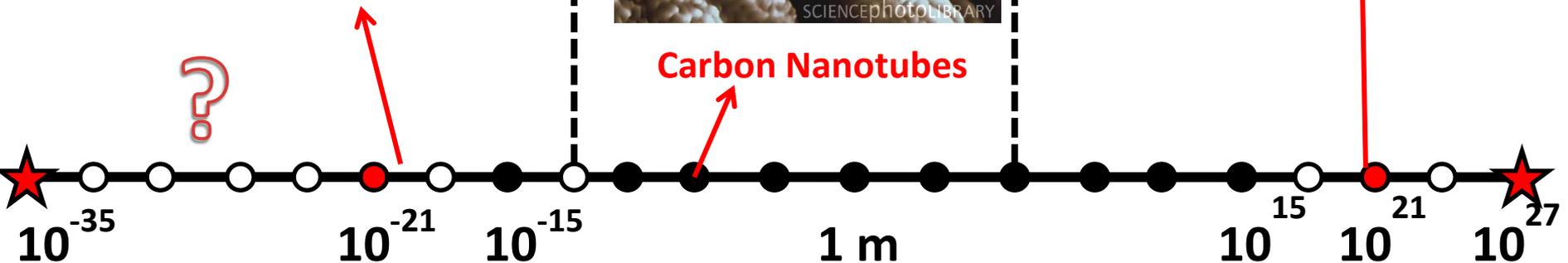
Large Hadron Collider (LHC)



Carbon Nanotubes



Our Galaxy (Milky Way)



Homework 1

Problem 1.

Watch short movie “powers of ten”: <https://youtu.be/44cv416bKP4>

Alternatively, you may check out its older, classical version: <https://youtu.be/OfKBhvDjuy0>

With the help of those movies and the included lecture notes, prepare yourself for a quiz about the length scales of various stuff in nature.

Problem 2.

Water molecule can be approximated as a sphere of radius 2 \AA ($1 \text{ \AA} = 10^{-10} \text{ m}$, is called Angstrom). Estimate, how many molecules is there in 1 cm^3 of water.

Formula for the volume of a sphere of radius R is: $V = 4\pi R^3/3$