

Length scales in Nature

1 mm



Grain of sugar, small insects, etc

1 km



Brooklyn bridge

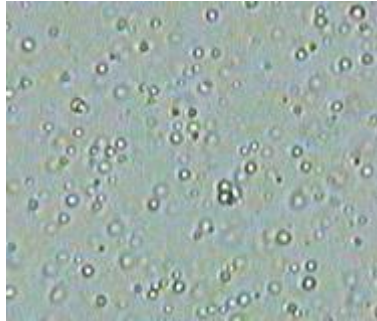
10^{-3} m

1 m

10^3 m

1 micron ($1\mu\text{m}$)

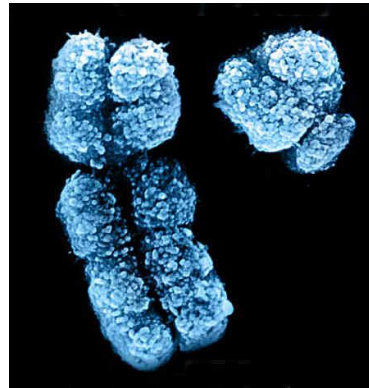
Particles in smoke, milk, etc
($1\text{--}20\mu\text{m}$)



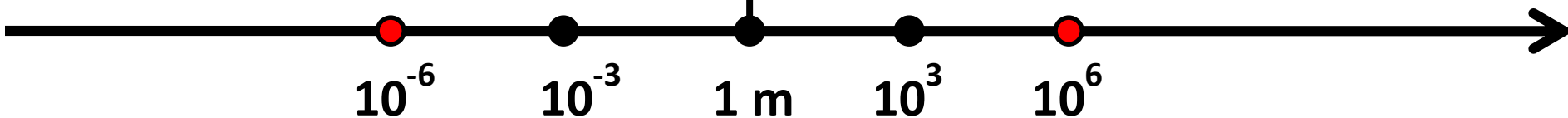
Bacteria
($1\text{--}10\mu\text{m}$)



Human Chromosome
($2\text{--}10\mu\text{m}$)



1000 km



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

a

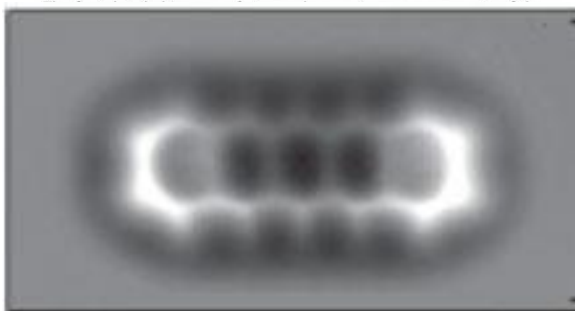


b

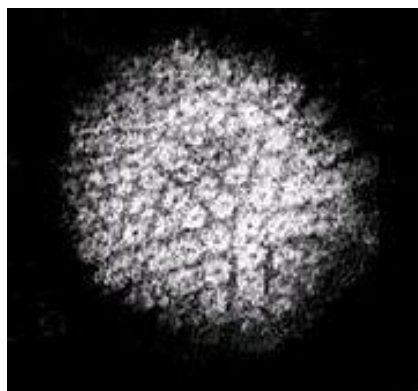


Atom (1 Å)

**Molecule
(1nm)**



Virus (>10 nm)



1,000,000 km
(3 light seconds)



10^{-9}

10^{-6}

10^{-3}

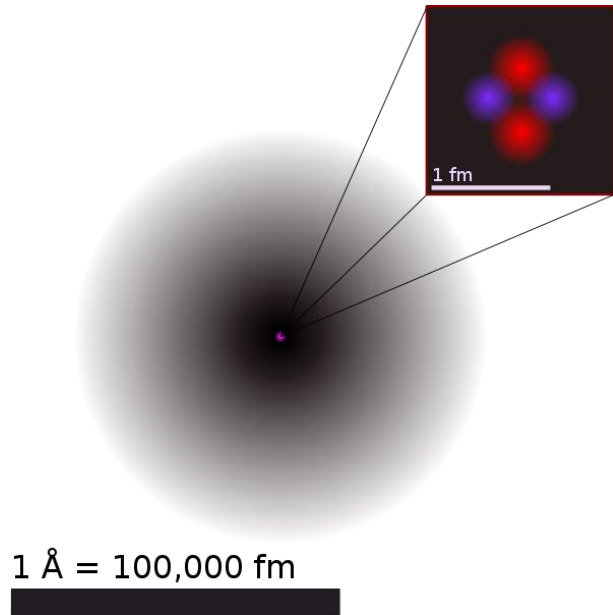
1 m

10^3

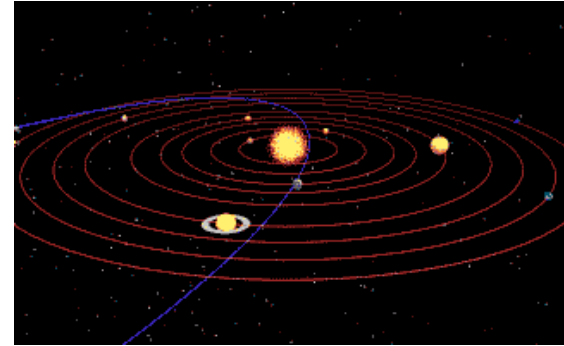
10^6

10^9

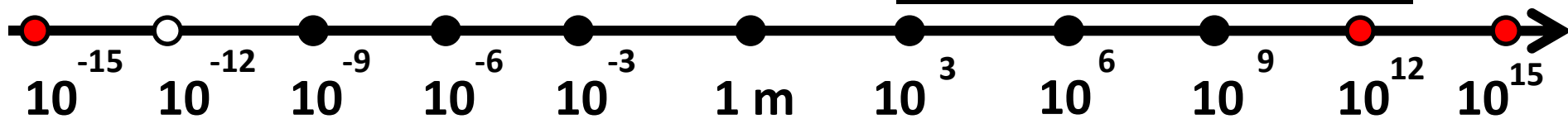
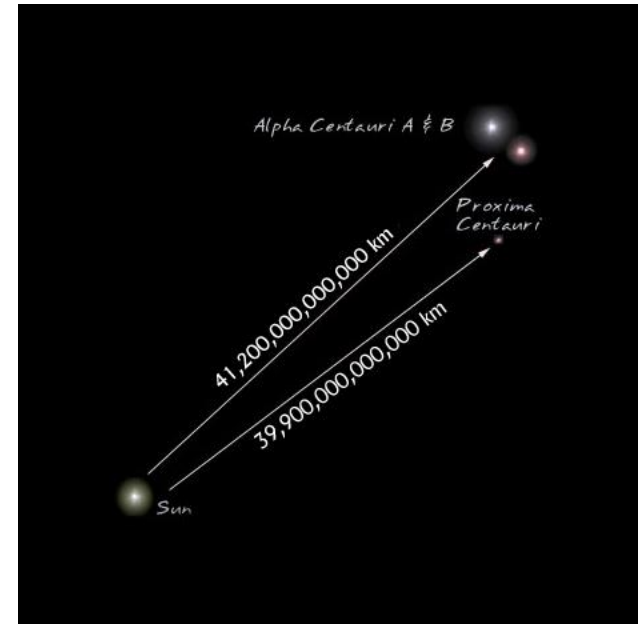
Proton, neutron, atomic nucleus



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



$10^{16} \text{ m} \approx 1 \text{ light year}$

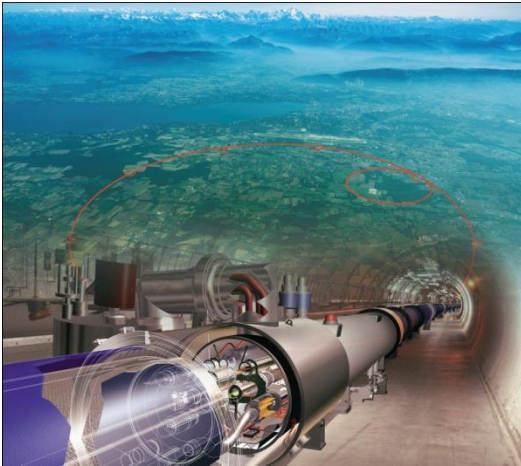


Modern Physics

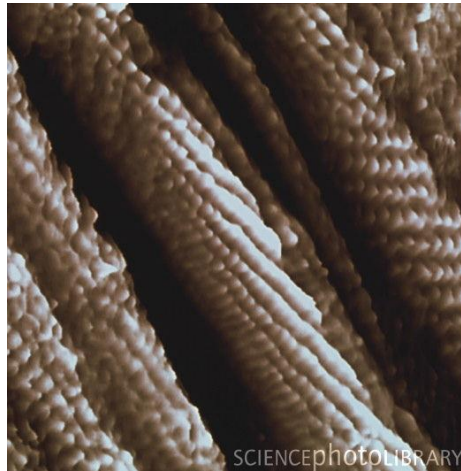
High Energy Physics

Condensed Matter Physics

Astrophysics & Cosmology



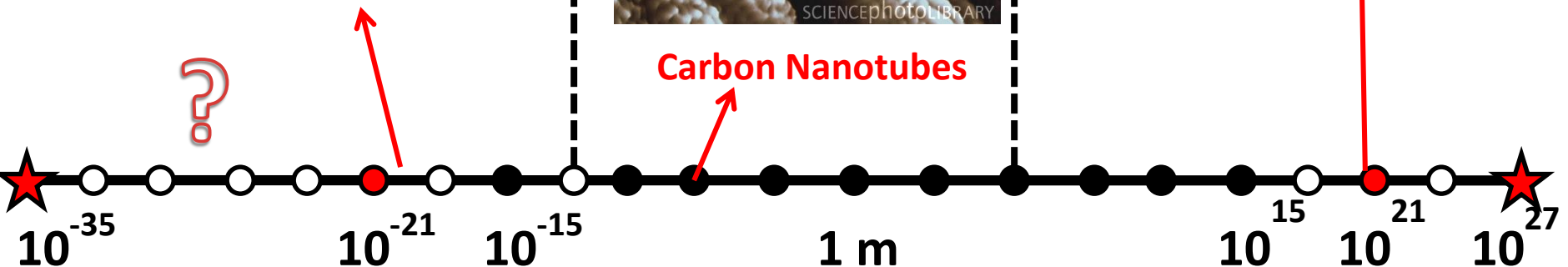
Large Hadron Collider (LHC)



Carbon Nanotubes



Our Galaxy (Milky Way)



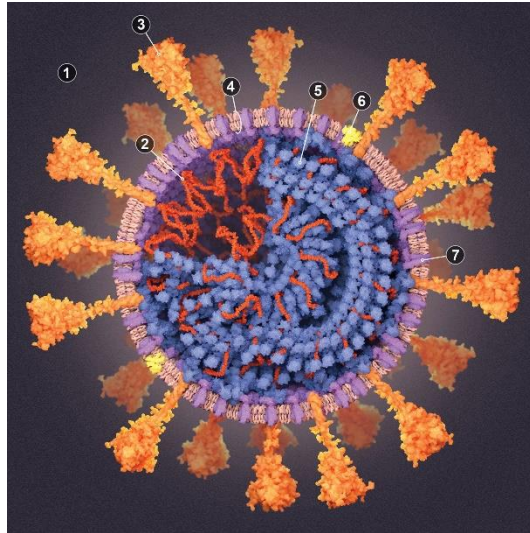
The difference between droplet and airborne transmission

Droplet transmission

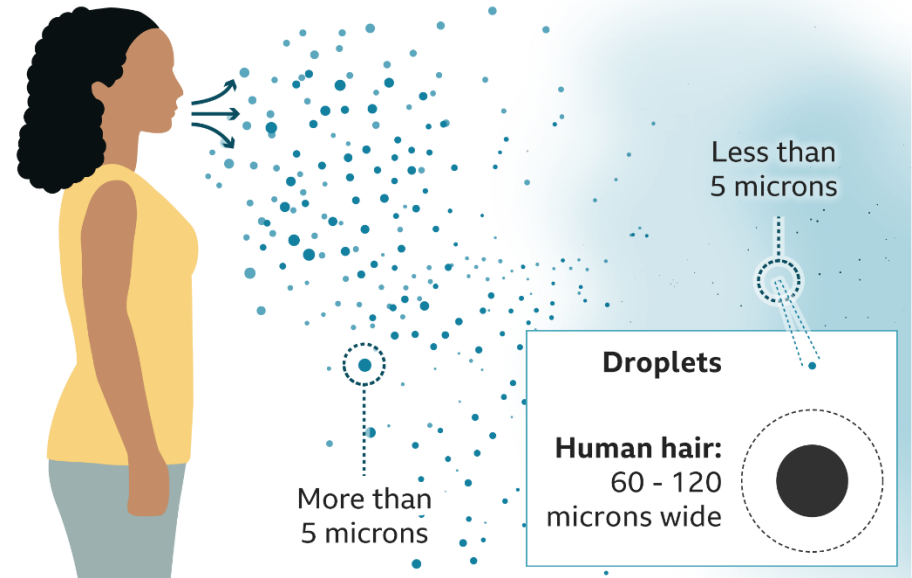
Coughs and sneezes can spread droplets of saliva and mucus

Airborne transmission

Tiny particles, possibly produced by talking, are suspended in the air for longer and travel further



about 100 nm = 0.1 μm



Source: WHO

pore size: $< 0.3 \mu\text{m}$

1..10 μm

about 10 μm

about 100 μm (0.1 mm)



N95



Surgical masks



Cotton masks



Cloth coverings

Homework 1

Problem 1.

Estimate the number of cells in your body, by approximating a single cells as a cube sized $10 \times 10 \times 10$ micron. **Hint:** if you know your mass, you know your volume.

Problem 2.

Once a person is infected with COVID-19, the virus starts multiplying. In approximately 5 days, at the moment of when the symptom of the disease appear, 1 ml of patient's saliva may contain as many as 10^7 viruses.

A single cough can generate about 1000 droplets, each approximately 50 micron in radius (there are also smaller droplets which we neglect). Estimate, how many viruses are carries by a single cough of a patient at the time of the symptom onset .