Electricity and Magnetism

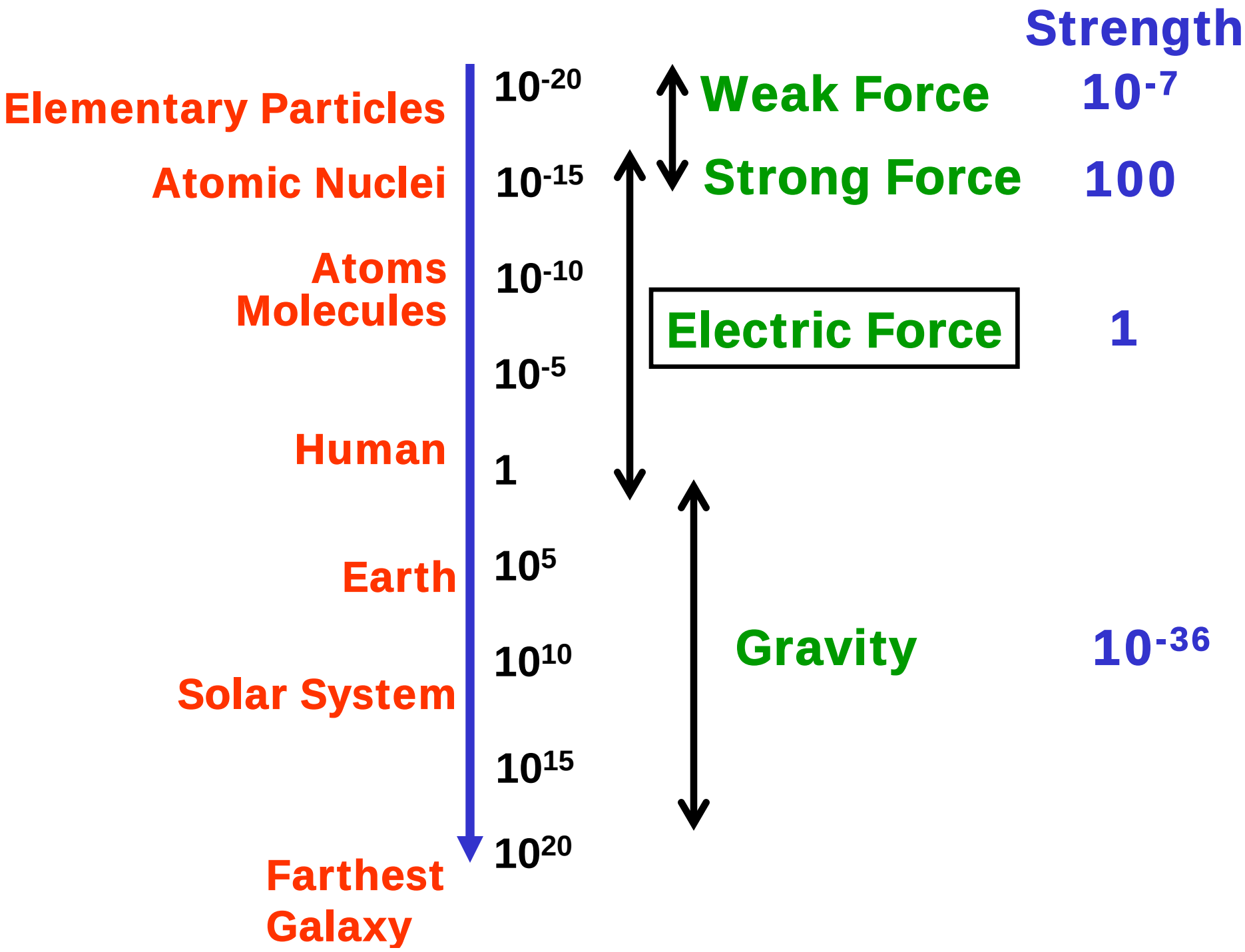
i. i. Recap: Electric Charge and Electrostatic Force
ii. Fundamental Forces
    i. Strength and Range: Coulomb's Law
iii. Electrostatic Induction

i. Recap: Electrostatic Force

- New Property of Matter: Electric charge
  - comes in two kinds: '+' and '-'
  - connected to a force
- Electrostatic Force
  - attractive (for '+ -') or repulsive ('- -', `+ +')
- Charge is conserved

ii. Fundamental Forces cntd.

- How does the Electric force compare to the other fundamental forces?
  - Gravity
  - Strong force (Atomic nuclei)
  - Weak force (Radioactivity, Star ‘fuel’)
- **How strong?**
- **What Range?**


Strength
Elementary Particles
Atomic Nuclei
Atoms
Molecules
Human
Earth
Solar System
Farthest
Galaxy
10-20
10-15
10-10
10-5
1
105
1010
1015
1020
Weak Force
10-7
Strong Force
100
Electric Force
1
Gravity
10-36

Some Questions:

- What determines the range of the interaction?
- How can one have ‘Action at a distance’?

In-Class Demo

Modern View (>1930)

- Interactions ‘mediated’ by exchange of particles (‘gauge bosons’)
  - Weak interaction: Vector bosons (m large)
  - Strong interaction: Gluons (m=0)
  - Electric Force: Photons (m=0)
  - Gravity: Graviton (m=0)
- For infinite range (e.g. Gravity,EM)
  - Exchanged particle must be massless!

Strength of Electrostatic Force

- How does it depend on charge?
- How does it depend on distance?

Charles Augustin de Coulomb (1736-1806)

Coulomb's Law (1780)