Electricity and Magnetism

- Recap:
  - Fundamental Forces
  - E.S. Induction
  - Coulombs law (qualitative)
- Coulombs Law (quantitative)
- Induction (Demos)

What we learned last time (II)

- Strength of Electrostatic Force (qualitatively):
  - If distance gets larger, force gets weaker
  - If charge gets bigger, force gets stronger
- Coulomb's Law (1780):
- Electrostatic Induction
  - Force on (globally) neutral objects by redistributing balance of positive and negative charges

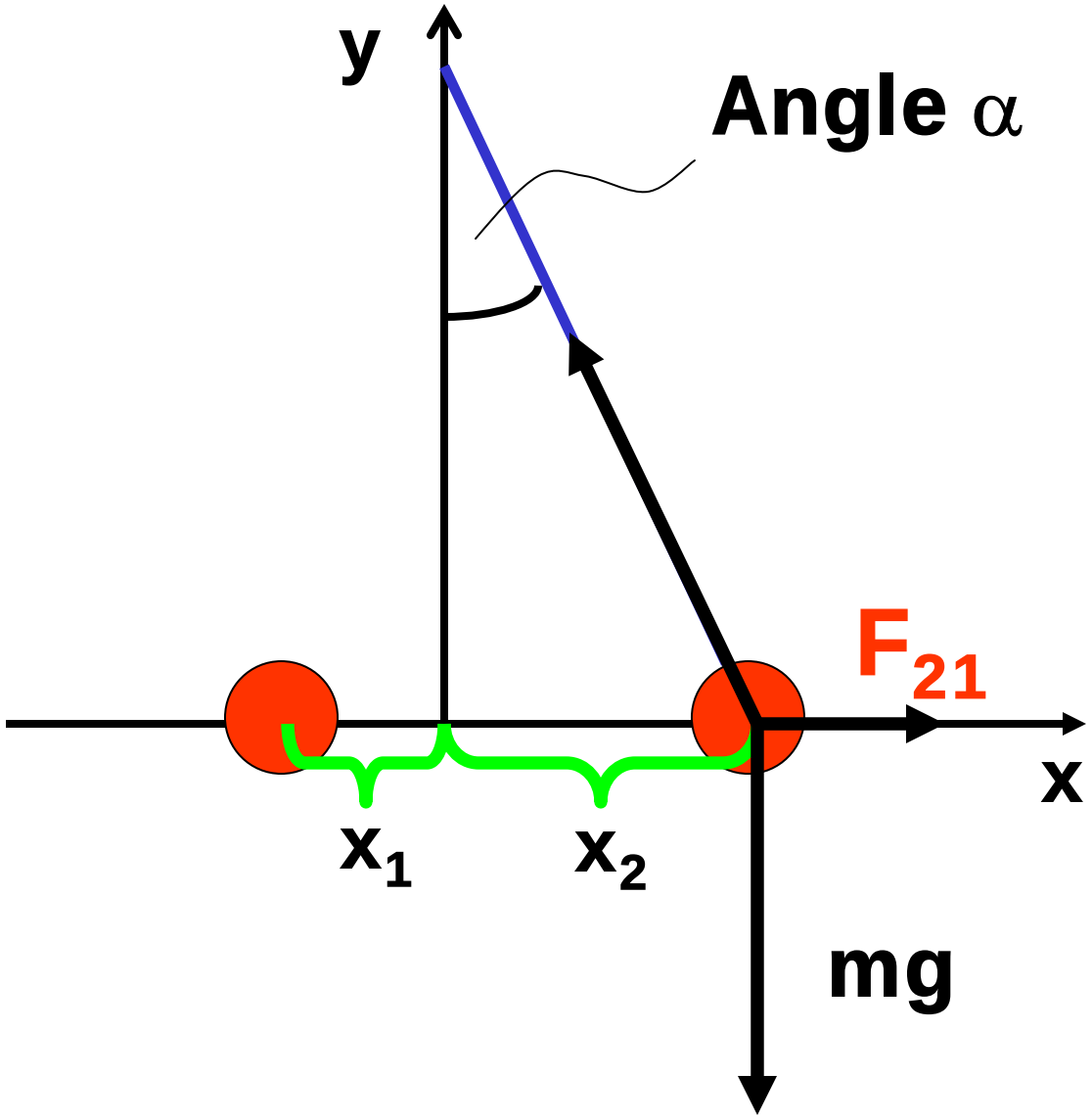
What we learned last time (I)

- Four fundamental forces
  - Weak, Strong, Electromagnetic, Gravity
- All mediated by Exchange Particles
- Exchange particle for E.M. Force is Photon
  - mass m=0 -> Long Range
- E.M. Force dominates from 10^{-10} to 1 m
- E.M. Force is much stronger ($x10^{35}$) than Gravity

Today

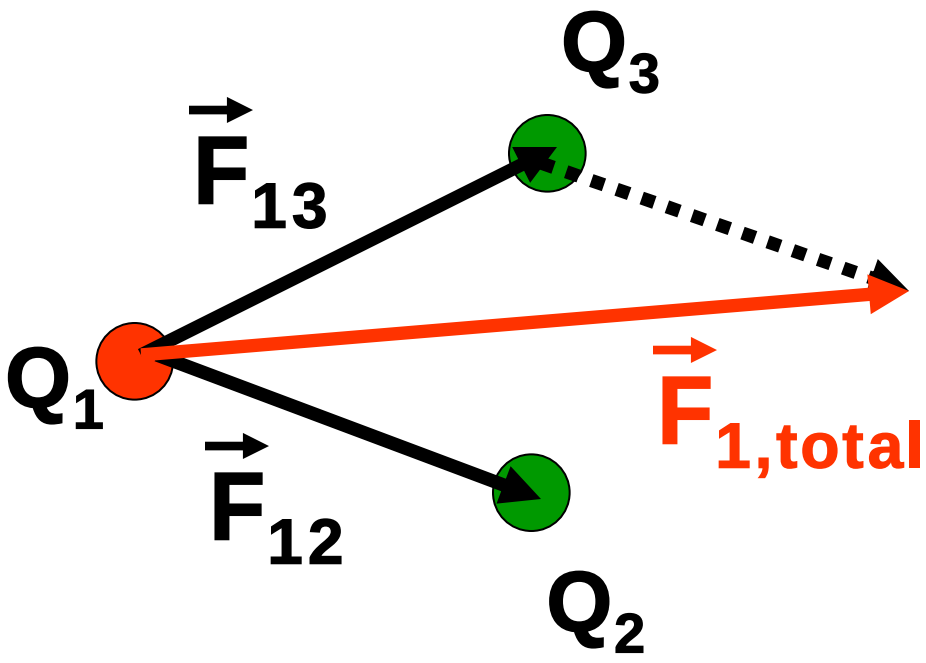
- Study Coulomb's Law
  - Check 'Inverse square law' ($F \sim 1/r^2$) experimentally
- Superposition principle
  - What happens when there are many charges?
- 'Challenge' Demo on E.S. Induction
  - Summarize what we know about E.S.

Coulomb's Law



Superposition principle

- Just add the forces on Q_1!



Superposition principle

- Just add the forces on Q_1!
- Works for arbitrary number of charges:

$$\vec{F}_1 = \sum kQ_1Q_i / (\vec{r}_i / r_i^3)$$

Superposition principle

- What to do for many, many charges?
  - 10^9 e^- on glass rod...
- Calculus makes life easier (for a change)!
- Replace sum with integral!