Electricity and Magnetism

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

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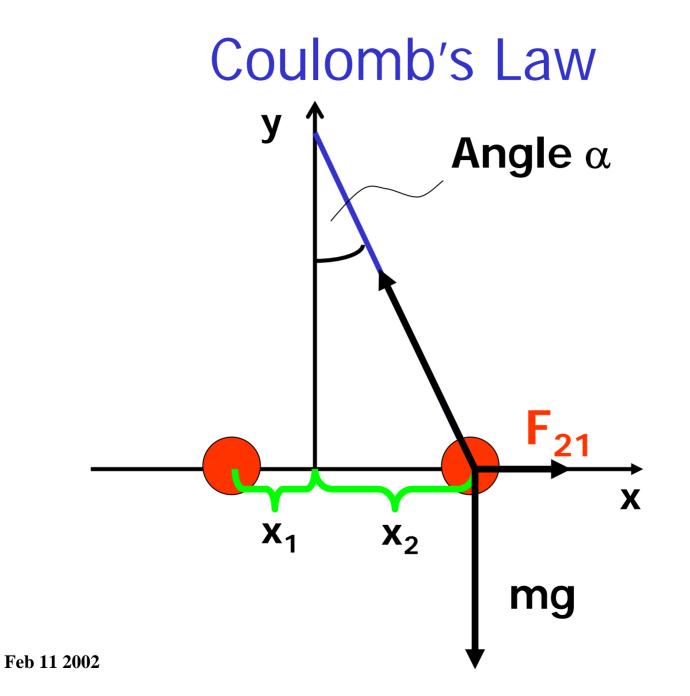# What we learned last time (II)

- 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

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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
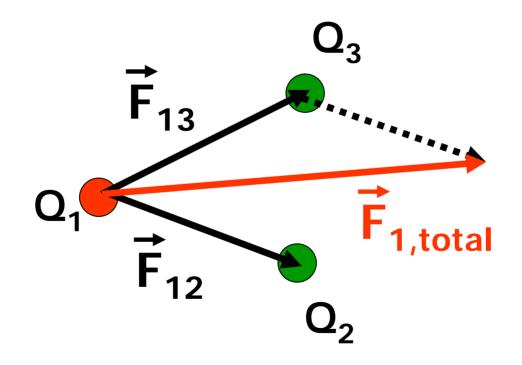
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Today

- 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.

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Coulomb's Law

Angle α

F_{21}

x_1

x_2

mg

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Superposition principle

- Just add the forces on Q_1!

Superposition principle

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

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

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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!

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