Physics 102 - October 19, 2009

- Exam 1 graded
  - Solns to be posted
  - Grades on BB
  - Hand Back Wed.
  - Regrade Policy

- Recitations Tues - Fri - Mon

- Project
Last Time

House - Quantum mechanics

Analogy

Could imagine making a good guess as to how much time a person spends in a room say 8 hours a day in the bedroom

$p^2 \approx \text{Probability}$

But - at any given moment you can't know where the person is in the house without looking
Projector

Slit

Screen

Shape of slit at projector

Pattern of light on screen

(a)  

(b)  

(c) ||
Image forming as a function of time.
Single e−

Once e− observed
Wavefunction collapses
We know where it is.
Observation collapses the wave function?

Observation of system (even if nondestructive) collapses the wavefunction.
Schrödinger's Cat

nucleus quantum state = \frac{1}{2} \text{(decayed)} + \frac{1}{2} \text{(not decayed)}

cat state = \frac{1}{2} \text{(dead)} + \frac{1}{2} \text{(alive)}
Hugh Everett (1957)

Bryce DeWitt
1960's + 70's

Many Worlds interpretation
EPR Paradox — Einstein, Podolski, Rosen
1935

"Sporry Action at a distance"

Two photons are produced at once — They are correlated.
If one has spin one way the other has spin the other way.
They are in an "Entangled quantum STATE"

When observer A observes the spin of photon — The wavefunction collapses and the spin of the photon observer B will observe is determined.

But collapse instantaneous and observers A, B far apart

Does this mean information conveys faster than speed of light?
The Multiverse of Wishful Thinking

Proponents claim wavefunction collapse caused by conscious observers... and not before.

Is there an external reality?
Is mind entangled w/ wavefunction?

Fun to think about... perhaps open to scientific investigation.

Many worlds + decoherence avoids wavefunction collapse altogether.
Law of Attraction

If you want something, truly believe it is possible, you'll get it.

Four things must be done:

1) Know exactly what you want.
2) Ask the universe for it.
3) Feel, behave and know as if the object of your desire is already yours.
4) Be open to receive it and let go of the outcome.

Somehow the mind chooses the path or causes the collapse so that the universe gives you what you want... so says the proponents.
Heisenberg's Uncertainty Principle

\[ \Delta x \Delta p \geq \frac{\hbar}{2\pi} \]

- Uncertainty in Position
- Uncertainty in Momentum (MV)

\[ \Delta E \Delta t > \frac{\hbar}{2\pi} \]

- Uncertainty in Energy
- Time over which system exists
Quantum Electrodynamics
Richard Feynman

essence of force in quantum field theory is exchange of virtual particles
Vacuum is not empty - fleeting Particle–Antiparticle pairs appear consistent with Heisenberg Uncertainty Principle.

Quantum vacuum polarizability can actually see an effect on atomic spectra (Lamb shift).