Physics 102 - February 21, 2011

Exam I Wed. regular class time
Hoyt Auditorium

- Formula sheet
- 3x5 index card
- Calculator w/ powers of ten

\[ F \sim \frac{9.9}{d^2} \]

\[ F = \frac{1}{4\pi \varepsilon_0} \frac{9.1 \times 9.2}{r^2} \]
Time dilation

\[ \Delta t = \delta \Delta t' \quad \text{proper frame} \]

Special frame \to event at rest

Proper frame

Length contraction

\[ \Delta \ell \delta = \frac{\Delta \ell'}{\text{proper frame}} \]
Proper Time
1 hour
velma's
\[
\Rightarrow 0.95c
\]

\[ t_{\text{earth}} = \gamma t_{\text{velma}} \]

\[ \gamma = 3.2 \]

3.2 hours
$t_{\text{earth}} = t_{\text{Vela}}$

回 $1 \text{ hr}$

$1 \text{ hr}$

$t_{\text{Vela}} = 3.2$
\[ v_1 = \frac{d_1}{t} \]
\[ v_2 = \frac{d_2}{t} \]
\[ \frac{v_2 - v_1}{t} \approx \alpha \]
Spectrum

Light from many atoms ⇒ continuous \( \nu \)

Light from specific atoms ⇒ discrete \( \nu \)
Emission vs. Absorption

Different Atoms → different discrete frequency pattern

Atomic Fingerprinting

©1996 Saunders Publishing: “Physics for Scientists and Engineers with Modern Physics,” 2nd ed. by Raymond A. Serway
Bohr model of the atom (1912)

- Positive Nucleus
- Electrons orbit in circles
- Only particular "discrete" orbits known as quantization
- Electric (Coulomb) force holds electron on circle as it orbits... attracts electron toward nucleus

Nuclear Atom
- Discrete stable circular orbits

Absorb X - Electron makes transition from low energy orbit to high energy orbit (photon)

Possible orbits for electron
Transition from high energy orbit to low energy orbit → Emission of photon
Standing wave on string

Stable wave

Unstable wave

Standing electron wave in Bohr model
Figure from
http://www.uchicago.edu/classes/physastr/399/PAM99/UCert/Ch06/6.ato-1.htm
Question: if I have 4 energy levels, how many spectral lines do I have?

\[ \text{Diagram: Energy levels } E_1, E_2, E_3, E_4 \]

\[ \text{Number of spectral lines: } 6 \]
Werner Karl Heisenberg
(1901 - 1976)
Nobel Prize in physics -1932
for "the creation of quantum Mechanics"
(Max Born, Pascual Jordan - co-workers)

Erwin Rudolf Josef Alexander Schrödinger
(1887 - 1961) Austria
1933 Nobel Prize in physics
1926 - Paper on Wave Mechanics of Matter
Annalen der Physik
"for discovery of new and productive forms of atomic theory"

\[-\frac{\hbar^2}{2m} \frac{d^2 \psi(x)}{dx^2} + V \psi(x) = E \psi(x)\]  Schrödinger Equation