Lesson 23

Thursday, June 03, 2010
2:14 PM

Relativistic addition of Velocities

We can now say that it is impossible to travel faster than the speed of light.

If you travel at a speed of .8c and if you throw an object in front of the moving object with a speed of .3C @ what speed does the speed of the object relative to a stationary observer appear?

$$V = .8c + .3c = 1.1c$$

This doesn't make sence since we can say nothing travels faster than the speed of light.

Einstein derived an equation for relativistic speeds

$$u = \frac{V + u'}{1 + \frac{Vu'}{c^2}}$$

u = velocity relative to Stationary observer

V = velocity of an object relative to the stationary observer

u' = velocity relative to the moving object

refer to the previous problem

$$u = \frac{.8c + .3c}{1 + \frac{.8c \times .3c}{c^2}} = \frac{1.1c}{1 + \frac{.24\cancel{c^2}}{\cancel{c^2}}}$$

$$= \frac{1.1c}{1.24}$$

$= .89\,c$ or $.89 \times 3\times10^8$ m/s $= 2.66\times10^8 \frac{m}{s}$

ex) A student travelling @ .5c towards a stationary observer throws an object .6c backwards what is the velocity of the object relative to the stationary observer

$u = ?$
$v = -.5c$
$u' = .6c$

$$u = \frac{v + u'}{1 + \frac{vu'}{c^2}} = \frac{-.5c + .6c}{1 + \frac{(-.5c)(.6c)}{c^2}}$$

$$= .14c$$ ✓

$$u = \frac{.5c - .6c}{1 + \frac{(.5c)(-.6c)}{c^2}} = \frac{-.1c}{.7c}$$

$$= -.14c$$ ✓

$1 + \frac{\quad}{c^2}$ $\quad 1 -$

$\boxed{\checkmark = -.14c}$ ✓

Pg 386 # 1-7 all

Nuclear Physics

The atom consists of electrons, protons and neutrons, discovered in the early 20th century

when looking at a periodic table of elements

$^{A}_{Z}X$

X - represents the element.
A - represents the # of nucleons (contains neutrons + protons

Z - represents # of protons

ex $^{238}_{92}U$

92 protons
238 - 92 = # neutrons = 146
92 electrons

ex $^{235}_{92}U$

92 protons
143 neutrons
92 electrons

} same element but different # of neutrons

This is an isotope of Uranium. it has different mass #

We all accept the understanding that the nucleus contains protons and neutrons and is packed very tightly. What keeps them together if protons are all ⊕'vely charged and neutrons are neutral? protons packed very closely would want to repel. We will say that there is a "Strong nuclear force" that keeps them together.

There are cases where large electrostatic forces are greater than nuclear force
→ repulsive forces > nuclear force

you will have "Radio activity"

ex) $^{227}_{90}Th \rightarrow \, ^{223}_{88}Ra + \boxed{^{4}_{2}He}$ ← or $^{4}_{2}\alpha$

This is called alpha decay

... or an alpha particle

Parent Nuclei → Daughter

ex $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}\beta$ Beta decay or an electron

here a neutron emits an electron to become a proton

Gamma Radiation - when gamma ray is emmited, electromagnetic radiation of high energy is emitted by the nucleus

chp 31 +/B

Nuclear Reaction - 2 types Fission and Fusion

~~look @ pg 3X for 3 types of Fission reactions~~

notice that neutrons are released in each reaction, these neutrons will strike other U-235 elements

every reaction releases energy.

ex

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{141}_{56}Ba + ^{92}_{36}Kr + 3\,^{1}_{0}n + \text{energy}$$

reactants → Products

Ways to control # of reactions

Ways to control # of reactions
- control rods ←
- heavy water
- ordinary water
- carbon

Run Sim

Nuclear Reactions

Complete these nuclear reactions.

1. ${}^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$ or α

2. ${}^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}e$ or β

3. ${}^{234}_{91}Pa \rightarrow {}^{230}_{89}Ac + {}^{4}_{2}He$

4. ${}^{220}_{86}Rn \rightarrow {}^{216}_{84}Po + {}^{4}_{2}He$

5. ${}^{216}_{84}Po \rightarrow {}^{216}_{85}At + {}^{0}_{-1}e$

6. ${}^{216}_{84}Po \rightarrow {}^{212}_{82}Pb + {}^{4}_{2}He$

7. ${}^{210}_{83}Bi \rightarrow {}^{210}_{84}Po + {}^{0}_{-1}e$

8. ${}^{1}_{0}n + {}^{10}_{5}B \rightarrow {}^{7}_{3}Li + {}^{4}_{2}He$

Conceptual **PHYSICS**

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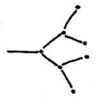
Name Period Date

Concept-Development Practice Page 40-1

Nuclear Fission and Fusion

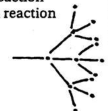
1. Complete the table for a chain reaction in which two neutrons from each step individually cause a new reaction.



EVENT	1	2	3	4	5	6	7
NO. OF REACTIONS	1	2	4	8	16	32	64

transmutation

2. Complete the table for a chain reaction where three neutrons from each reaction cause a new reaction.



EVENT	1	2	3	4	5	6	7
NO. OF REACTIONS	1	3	9	27	81	243	729

3. Complete these beta reactions, which occur in a breeder reactor.

$^{239}_{92}U \rightarrow ^{239}_{93}Np + ^{0}_{-1}e$

$^{239}_{93}Np \rightarrow ^{239}_{94}Pu + ^{0}_{-1}e$

4. Complete the following fission reactions.

$^{1}_{0}n + ^{235}_{92}U \rightarrow ^{143}_{54}Xe + ^{90}_{38}Sr + 3(^{1}_{0}n)$ + energy

$^{1}_{0}n + ^{235}_{92}U \rightarrow ^{152}_{60}Nd + ^{80}_{32}Ge + 4(^{1}_{0}n)$ + energy

$^{1}_{0}n + ^{239}_{94}Pu \rightarrow ^{141}_{54}Xe + ^{97}_{40}Zr + 2(^{1}_{0}n)$ + energy

5. Complete the following fusion reactions.

$^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He + ^{1}_{0}n$ + energy

$^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$ + energy

Conceptual **PHYSICS**

In all Fission reactions the reactants have greater mass than the products. What happened to the small difference in mass?

A) converted to Energy

recall $E = mc^2$ small amounts of mass can create large amounts of Energy

Nuclear Fusion **Fusion**

Splitting of atoms can create great amounts of energy, well when two small nuclei (nucleus-protons + neutrons) fuse together this also creates energy.

ex On the sun, there are fusion reactions

ex of reaction

neutron

$$ {}^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n + \text{energy} $$

How can we get 2 positively charged particles to fuse together?

A) lots of kinetic energy, we basically smash them together @ very very high velocities

Half life - the time required for half of the atoms in any given quantity of radioactive isotope to decay

ex) half life of ${}^{212}_{82}Pb$ is 10.6hrs

If we have 100g of ${}^{212}_{82}Pb$, how much do we have after 10.6 hrs?

A) 50 g

ex) how much time has elapsed if

we have only 6.25 g

guessing and checking

after 10.6 hrs	50 g
10.6 hrs	25 g
10.6 hrs	12.5 g
10.6 hrs	6.25 g

42.4 hrs

ex ? 6.00g

Hw pg 395 - 399 odd No answer key for even #'s Sorry :(

Next class Unit test - Review pack for final given out

Tue - Review for Final

Thur - Final Exam 40-50 m/c Q's

Periodic table bring tmrrw

Pg 301 #11, 12, 13

311 # 9, 10,

335 40, 42, 43, 44, 45

Relativity W/S #1

1) 4.835
2) 5.6 min (assume 2ND train stationary)
3) 23.9 s
4) 1323 m
5) 154 m
6) 2.8×10^8 m/s
7) a) 4.8 m
   b) 4.8 m
   c) No Ans
8) No Ans

W/S #2

1) 5134 kg
2) .866 c
3) 2.56×10^6 kg
4) 1268 $\frac{kg}{m^3}$ (Density) $\frac{\text{mass}}{\text{Volume}}$
5) .8 c
6) 0
7a) .75 c
   b) .625 c
   c) .887 c

w/s #3 1a) 1.395×10^{14} J

b) 7.1° C ☆

c) 442352 W

3) a) .846 c

b) .93 c