

Jan 30 2024

Since the combination of the equation for quantum and relativity give us a quadratic with an answer for Energy being $\pm E$ why doesn't this make sense mathematically.

$$E = \frac{1}{2}mv^2$$

$$-E = \frac{1}{2}mv^2 \rightarrow v^2 = -3$$

$$[-3]^2 = 9$$

$$\frac{1}{2}m(v^2) = -E$$

how can mass be negative?

$E = mc^2$
alpha proved γ is positive

show can high or mass be negative

Sources - dad - Robert
Thompson

$$E = mc^2 \rightarrow (-2)^2$$

= 4

HOW CHAV

MASS BE

NEGATIVE

↳ www.Mc.gor

$$E = Fd = (m a) d = (1 \text{ kg}) (9.8 \text{ m/s}^2) (1 \text{ m})$$

↳ can't

be
negative

↳ maybe

$$(1 \text{ kg}) (1 \text{ m/s}^2) (1 \text{ m})$$

=

-1 J

Can accelerate backwards

↳ This makes no sense

↳ maybe mass can
be negative

↳ wouldn't say
mass has to be positive

* recorded citations on notes
possible title

why doesn't antinuclear
make the nuclear

sense

Question since the combination
of the equations for relativity
and quantum lead to a
± answer for E why
is it impossible for E
to be negative using other
equations to calculate E
since E is a vector so direction
won't change the value

hypothesis: scientist
 may have come up
 with new equation
 for antimatter of
 antimatters mass is

negative $m = -3$

$E_{kin} = \frac{mv^2}{2} \rightarrow v^2 = 2$

$E_k = \frac{(-3)(2)^2}{2}$

$E_k = \frac{-12}{2}$

$E_k = -6$

$E = -6$

Energy is not a vector

$E = mgh \quad g = 9.81 \text{ m/s}^2$

$E = -E \quad h = 3 \text{ m} \quad m = -3$

$E = mc^2 \quad c = 2 \quad c^2 = 4$

$E = -12 \quad m = -3$

$-E = -12$

*no for $\Delta E_P \neq E_P$
 $\rightarrow mg \Delta H$
 $\rightarrow \ominus$

1928^P and dirac concluded antimatter exists
 but he only proved $E = mc^2$ exists

\rightarrow antimatter

it matters polar opposite then same why can't we apply the same equation we apply to matter

$q = \frac{\Delta V}{t}$

$-q = \frac{\Delta V}{t}$

$\frac{\sqrt{E^2 - m^2 c^4}}{c^2} = 3 \quad \frac{4-3}{2} = \frac{1}{2}$

$\frac{v^2 - 9}{2} = 3 \quad \frac{v^2 - 9 - v^2}{2} = -\frac{1}{2}$

$t = 3$

Tan 31 2024

-25 March 2013*

~~ATRAP~~ antiproton magnetic moment

↳ most precise

27 July 1964**

Cronin and Finch detect

~~another~~ difference

23 April 2013***

LHCb experiment

↳ another difference

~~experiment~~ tripod design

middle explanation of

antimatter (logic and

math) hypothesis

math issues (2 examples)

logical experimental issues

left side experiments

equations

publication / consensus

right side (need more) ways

interview conclusions

how I reached it

↳ looking for new formulas or negative

(more for left + right side)

more formulas

$E_p = \sqrt{p^2 c^2 + (mc^2)^2}$ positive

↳ constant

↳ literally constant

$\Delta E = \Delta m c^2$

$E = pc$

$E_{\text{max}} = q c V_s$

$E = hf$

* energy to change spins

is the same for matter and antimatter

** Kaons

↳ logical problems explain

how the two logical solutions in hypothesis is

→ logical problems

① many differences between matter and antimatter lead to scientist coming up with new formulas (small inconsistency here)

~~xxx~~ for particle decay is falling apart of unstable particles because strong force kills

BOs fell apart down ^{into} a set of particles 20% more than anti BOs
↳ but the more

decay the less of a difference there is
daughter ↳ leads to symmetry particles

No asymmetry at the end

In math on consistency

explain why matter and antimatter missing would mean ~~the~~ equations must remain the same so mass must be ②

for experimental connect the two

Right side was how answered the question

left side is gathering data/existence

don't get too caught to design

2-3 days of research
2-3 days of math
mostly writing

~~more~~ improved by BASTI
↳ improved by 350%
↳ still improved

Feb 1st 2024

Cronin + Finch

↳ Kaons

↳ 1 strange and 1 up or down

decays

into

↳ could be anti

pions

↳ lightest meson

↳ 2 quarks

↳ one quark

one antiquark

Fis (experimental)

↳ measurements for energy

done on antimatter

come out to be

negative

(not calculations)

↳ kaons decay into pions

and this process ~~is~~ when

done with both matter

and antimatter defined

fundamental principles

of physics by short lived

antiparticles being very

into 3 pions rather than two

pions at a rate of 1:560,

this never happens with

matter eventually the

3 pions decay back into 2

pions and balance is restored

ASACUS A measured mass

of antiparticle making

our current measurements

4x more accurate,

↳ 29 July 2011

logical issues

↳ 25 March 2013

↳ AFTERAP investigates

the antimatter

deficiency in the

universe

↳ concludes antiprotons

and protons are polar

opposites

- got a grad school particle

physics book to read

anti vs regular neutrons are
 ↳ short term vs long term
 parts:

↳ short term is 2 pions
 long term is 3 pions

Kaon and pions are
 charged particles that
 can be positive negative
 or neutral

~~xxxx~~
$$\sqrt{x^2 + m^2 c^2} = E$$

sector cons. kinetic

$$v \times m \times c = \frac{E}{c}$$

$$v \times m \times c = \frac{E}{c}$$

$$E = \frac{m^2 c^4}{2} + \frac{p^2 c^2}{2}$$

Let

algebra

- The closer we get to the
 quadratic that leads to
 $\pm E, E$ still can only be
 positive

↳ may need 2 papers
 for formulas after
 all!

~~6x~~ v stop is a controlled
 variable so this equation
 does not apply

$\Rightarrow v$ is a constant
 f cannot be negative
 } refers to light

Qaid Feb 2 2024

started particle physics grad text book

questions

- muons γ -problem - later

Theory of electron-positron annihilation later

xiv

anything in the book wrong
 \hookrightarrow other books

- region of potential difference
 \hookrightarrow charge (maybe?) later

- radio frequency power) 1
and phased

- RF power from a bank of 10^4 2
Fluorons
 30 GeV

- frequency of potential difference
 \hookrightarrow details

Qaid

- angular frequency 18^*
 $\hookrightarrow \omega = \frac{bp}{mc}$

- high energy mass increases 19^*
due to relativistic effect and constant frequency is not longer adequate

- circular frequency 20^*
 $\hookrightarrow \omega_0 = \frac{be}{c}$

- electron becomes relativistic at low energy
 \hookrightarrow why do they have constant acceleration (or velocity)

- $E^2 = \gamma^2 m^2 c^4 + 2 m^2 c^4$
 $\ominus \equiv$ does this work

\rightarrow (much greater?) 22^*

- particles W and Z ? 23^*
 \hookrightarrow heavy
 \hookrightarrow what are they

Qaid

- What are the units GeV? 4^{24}

~~$\sqrt{E^2} = \sqrt{2mE + m^2}$~~

$E^2 =$ available energy

$E =$ energy of particle

$m =$ mass

$v^2 \approx$ mass

$E^2 = \sqrt{2mE + m^2}$

$E^2 = \sqrt{2E}$

↳ why? 4

- ST N/A #26

*27

↳ why does this mean that some charged particles cannot be together

- why do we need large amounts of particles #28

Qaid

R^* - for accuracy?

- what is an incident particle? 4^*

$N_1 = N_p \cdot N_t \cdot \sigma$ \hookrightarrow used particle

- what is the interaction cross sections $\hookrightarrow \sigma$ 4^*

~~q^* - non target particles?~~ \hookrightarrow what was assuming

(useful)

- why is 40 interaction / s / mb 4^* seldom used?

$L = \frac{N_1 N_2}{\sigma} \cdot b \cdot f$ 4^*

↳ what is revolution frequency

- why are Luminosities $\sim 10^{31} - 10^{32} / \text{cm}^2 / \text{s}$ 4^*

↳ what? \hookrightarrow no sense

- why are transverse or helix on 4^* ~~oscillation~~ desirable

Q1d

- what does differ radially mean
↳ assuming it's not \sqrt{x} .

*32

- what is RF acceleration
↳ oscillating cavities (FEL)

- what is a quadrupole magnet

- why does course correction
*33

Require a non-uniform magnetic field
↳ how does the magnet work
↳ diagram please

not

- $V = W_0 n^{1/2}$ *34

$V =$ vertical oscillation

$W_0 =$ circulating frequency

$n =$ number of collisions

- $V_H = W_0 (1-n)^{1/2}$ *36

↳ is it a quadratic?
↳ what... is... that?

6

5

Q1d

10^8 - kinda get it now (please read) (these)

- clarity defocusing *37

~~Bobatka~~

- pp collider *38

↳ minus later

- how do collision with protons produce anti protons?

*39

- what is a pickup electrode

- why does a charged particle which suffers acceleration emit electromagnetic radiation?

*40

↳ frenking energy loss !!!!!
↳ still why

*41

- how does E_{lost} relate to antineutrons
neg +ve energy

- why is β velocity? *42

7

Q_a1d

Just a note

$$\Delta E_{loss} = \frac{4\pi e^2 \beta^2}{3} \frac{E^4}{R_m^3}$$

velocity: |||||

if electrons don't have mass how is this equation possible?
↳ Hendro

what is a linear accelerator?
↳ using RF linearly

what is RF acceleration?

what is the unit? $\frac{V}{m}$

why do focus magnets focus?

↳ getting too focused?
↳ de focus + focus one after the other

what is elliptical - cross sections
*43
↳ what are cross sections
↳ accelerators?

what is RF? $\frac{V}{m}$

now how much should I read

Q_a2d

why does (FODO) repeat 108 times around the ring? *44

what is frequency swing during acceleration? *45

what is a proton linear accelerator
↳ use RF linearly

what are proton booster rings? *46

fixed target operated protons extraction
*47
↳ what

What is well timed bubble growth + bubble chambers
↳ later

what does 2×10^{13} protons per pulse mean? *48

compressed in momentum and transverse dimensions *49
↳ what?

Qa1d

- what is stochastic cooling? *50

- what is the unit GeV/c *51

- what is frequency swing *52

↳ 0.44%

- what is design pressure 3.10^{-7} torr *53

- what does the bending magnets being powered mean you cannot achieve a high magnetic field *54

↳ conflicting fields?

- what does pulse operation mean? *55

↳ regular acceleration?

- what exactly is a fixed target experiment

↳ using a target instead of another

- what is a momentum bit? *56

↳ something to do with area maybe

↳ this feels like in reading Qa1d shakespear

- what does a beam produced by a target mean? *57

~~why do we identify the particles before they go through~~

- what is a particle beam? *58

- how do we use a DISC counter? *59

- what is a bubble chamber? *60

- what is an electronic experiment? *61

↳ why is it better

↳ is it a pure beam?

- what is a target? *62

↳ how can it be outside of the vacuum chamber?

- what is Σ and μ ? *63

- how can they decay into electrons

- Σ *64

↳ how do we ever see it *65

↳ why is it?

Qa'd

Σ⁻ *65

- what are Σ⁻, μ⁻ and ν⁻ *66
 - ↳ how to pronounce
 - ↳ what are they
- what is primary for go t *67
 - ↳ is it a time?
 - ↳ maybe?
- what is a hyperon *68
 - ↳ what is this
- if π are pions why *69
 - are they good at
 - rejecting protons and pions
 - ↳ same for p⁺ and n⁰
- why do beam experiments need to deflect p⁺ and π (maybe)
- what are collimators *70
- what is electrostatic and *71
 - radio frequency separation

Qa'd

- what is a separator system? *72

- what is momentum? ↳ p = MV

- what is (potenti) differential? ↳ high charges spread

- what is a transverse force end *73

$$\theta = \frac{\Delta T}{p} = \frac{E \ell v}{p B}$$

↳ constant

↳ what is transverse momentum
↳ exactly

- so |v|

$$A \theta = \frac{E \ell v}{p} \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

*74

- just nothing

$$B^2 = \frac{p^2}{a^2 \mu^2 v^2}$$

p = beam momentum

Qa'd



*75

$$= \frac{1}{\beta_1} - \frac{1}{\beta_2} = \left(1 + \frac{m_1^2}{p_1^2}\right)^{1/2} - \left(1 + \frac{m_2^2}{p_2^2}\right)^{1/2}$$

$$\approx \frac{1}{2} \left(\frac{m_1^2}{p_1^2} - \frac{m_2^2}{p_2^2} \right)$$

↳ so many question

$$\frac{1}{2} \left(\frac{m_1^2}{p_1^2} - \frac{m_2^2}{p_2^2} \right)^{1/2}$$

how

$$\left(\frac{m_1^2}{p_1^2} - \frac{m_2^2}{p_2^2} \right)$$

↳ explain

↳ why relative

- also this

$$\Delta O = \frac{E \cdot L}{p} \left(\frac{1}{\beta_1} - \frac{1}{\beta_2} \right)$$

$$\Delta \theta = \frac{L e L}{2 p^3} B (m^2)$$

*76

- how do angular separators work
↳ magnets

Qa'1d

*77

- is m mass of momentum
↳ mass

- why is it for electrostatic systems? the momentum p_3

means you can't achieve sat's factory separation above 7 GeV/c

13

↳ something with math and variables

- what is a transverse deflection

- what is the RF cycle

↳ isolation

- what does phase of the

cavities mean ~~part of~~ pull of RF

↳ ~~about~~ stop particles

- why does deflecting an unwanted particle double a wanted particle

*79

- what is a beam stopper

Why? :

↳ specific things that would stop a beam

Qa'd

*80

- why is the cancellation formula

$$\frac{L}{bc} = \frac{1}{f}$$

f = frequency

L = length

B = velocity

c = ?

↳ what's known

14

- what is c

↳ speed of light

- why does a discrete series allow for other multiples of 1/2 work *81

- what are superconducting RF cavities

↳ what are RF cavities

↳ what are RF cavities

↳ what

↳ particle physics

$$p = \frac{peB}{c} \rightarrow 14 * 82$$

c = charge
p = some constant
p = beam momentum

or view speed of light as max speed

Qa'd

↳ what is r(B)

↳ includes on track

*14

↳ what's

B = magnetic flux density

P = radius of curvature

↳ also what?

↳ guess it

(= speed of light)

↳ max speed

14

- what is the sagitta *84

- what is

- how does a particle lose all of its energy

↳ decay?

↳ does decay cause separation

↳ why can't it be studied

↳ why can't it be studied

↳ why can't it be studied

- what is coherent radiation? *86

*85

*87

Qa'd

- what is ionization) 14

- what are muons and "nuons" ~~*88~~ ^{with others?}

- why don't muons produce ~~*89~~ nuclear interactions
Lemo nucleus?

- what is bremsstrahlung ~~*90~~

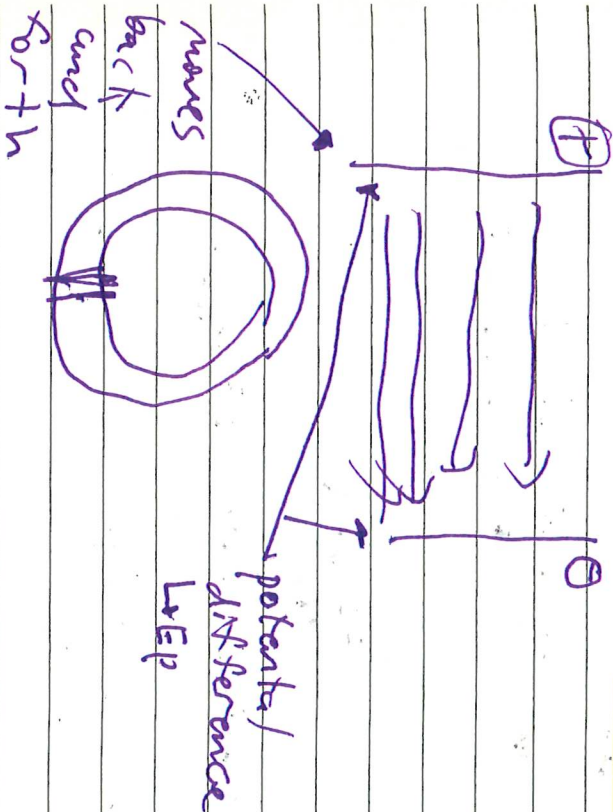
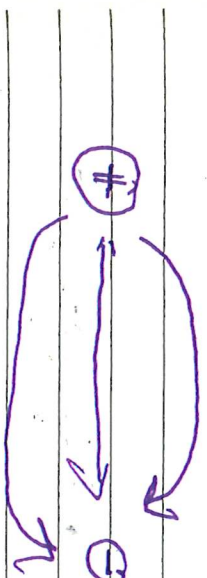
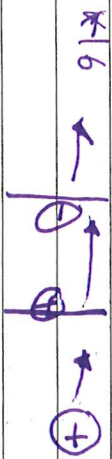
- what is electromagnetic showers ~~*91~~

- what is direct calorimetry

fig 1.6 ~~*92~~

- what is d?

- what does it mean behaviour ~~*93~~ is not sensitive to mat.?



phased means + over -
swap sides and this
makes sure that the
particle goes through

* Rlyshons focus/compressing
electrical power to accelerate
particles

note w units/c

$$\frac{De}{2cs}$$

force/straight

magnetic fields

are related to c

$$F = m_{\text{rel}} a$$

particle stationary = m_0

moving particle mass is m (velocity v)

$$m = \gamma m_0 = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$\sqrt{1 - \frac{v^2}{c^2}}$$

v increases

m_0 increases

$$T = S^2/A$$

$w = \text{Dressy (lower case)}$

*20 circular frequency is time around the circle per S

*21 for c it takes less time for v to approach c

low v approaches c

relativistic

*22 \ll is much more than (Naturally)

*23 nuclei are held together by weak force (W-boson)

(gluons) - (gluons) decays

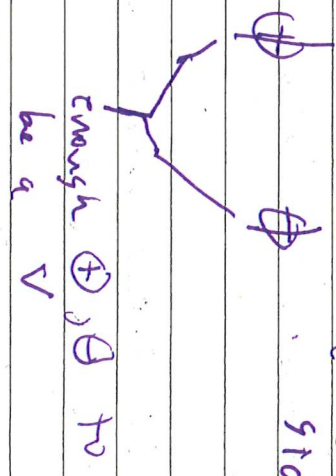
(gluons) - (strong) holds protons together

(photons) - checks together magnetic

subatomic particles decay to become more stable

* - add equations theories

24* potential difference for left and experiments



5 eV
 energy gain by particle crossing a volt
 prefix

(yiqn) * works for negative energy

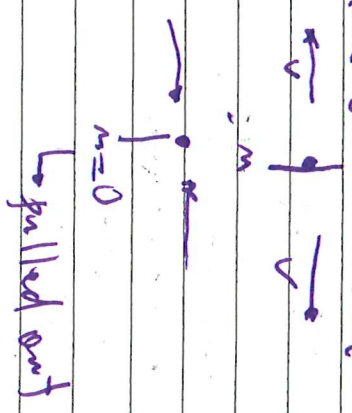
$$\sqrt{E^2} = \sqrt{m^2 + 2mE}$$

$$\sqrt{E^2} = \sqrt{2E}$$

↳ improves negative mass

↳ Per paper cut and math set to explain particle physics in the middle

frame of reference



$$5000 \text{ GeV} = E'$$

#26

#27 because they need to collide

*28 a single collisions can have

many outcomes, when we look for rare particles we need ~~more~~ more options so more particles

↳ 0 signs
 ↳ cross section → measured in area
 ↳ larger = more likely for rare reaction

Feb 3 2024

32x moving radially mean closer of far than

from the center
 ↳ perpendicular means moving away or down

33x uniform would push all of the particles
 ↳ non-uniform would push specific density particles

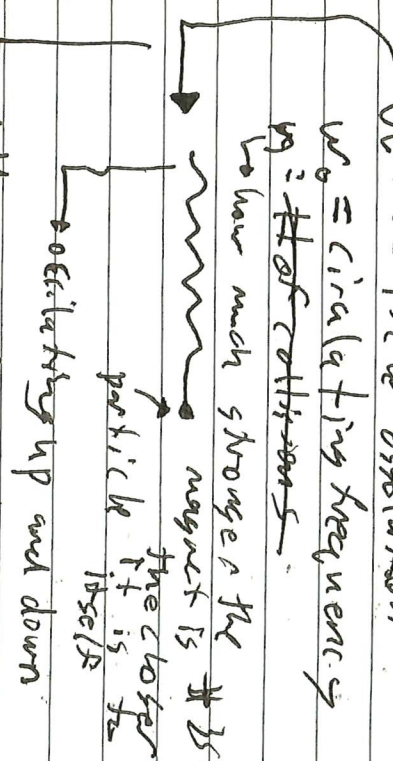
34x $V_L = v_e n_e$

$V_u =$ wave oscillation

$\omega_0 =$ circulating frequency

$n_p =$ # of cathions

↳ how much stronger the magnet is #B



$V_u =$ how frequently it goes up and down

29 10^{10} in./s/mb
 ↳ areq
 ↳ too small (for 1890s)
 ↳ now looking smaller (mostly)

30 $f =$ revolution frequency
 ↳ how many times a beam goes around loop (1/s)

B = # of sets of bunches

31 $L = 10^{30} - 31 / \text{cm}^3/s$ N_B
 $N_B = L \cdot 0$

32 $10^{-3} - 10^{-2} = N_p$

↳ events you want

35* for the source correctly
 magnets

36* $V_H = \omega \omega_0 (1 - \nu) \frac{V_z}{c}$

↳ opposite of feet
 to V_z

↳ if V_z is stronger

V_H is weaker

↳ vice versa

37* If you compress in one
 direction they expand

in the other so they

"defocus" the other

direction for a net

focusing

↳ opposite directions

being affected

38*

pp
 ↳ multiproton

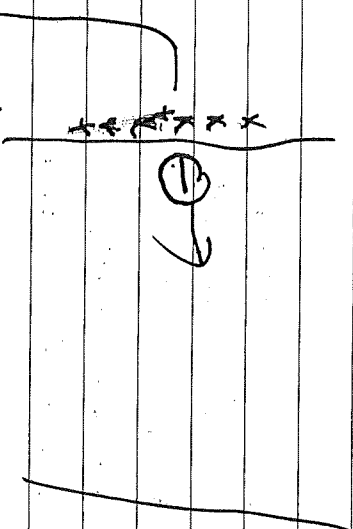
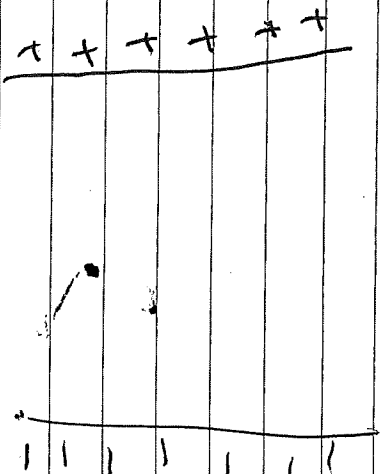
↳ protons

↳ protons and antiprotons with -

naturally orbit in opposite

directions

39*



↳ stochastic

↳ quickly

charging space

tells the pickup electrodes a charge is

↳ what lets us know about the charge particles

#40# acceleration is achieved by emitting radiation

magnetic

causing them to accelerate ~~accelerate~~ towards the center

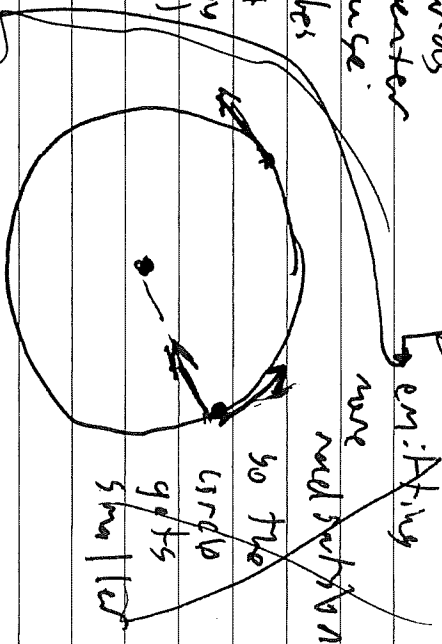
because

particles

to emit

radiation

(photons)



light by shooting

radiation to the

front part

photons take

speed with them

#41 in room

friction between

matter and matter

go boom

antimatter on

antimatter is negatives would cancel out

#42 $v > c$ velocity vector

magnitude + velocity

$$\beta = \frac{v}{c}$$

β closer to one

the more that

special relativity

is needed

#43 to fit in the magnets the

acceleration pipes are elliptical

cross section

#44 FODO

focusing and turning

magnets

108 turns

Smoothes circle means less loss due to corrections

*45 Mini proton accelerators that get the protons to the speed to travel in the big accelerator

*45 only need to accelerate to 0.5% above the main accelerate

↳ over two particles collide they release kinetic energy and slow down releasing more energy

*47 hit a fixed target instead of another beam

*48 how many protons are in one proton group

*49 (compress spatially (transverse dimension) opposite dimensions)

from circular motion and momentum (spread in velocity)
↳ velocity going the wrong way

Reading cont.

how can there be unassociated particles in collision

↳ do the still accelerating particles interact

with the already reached particles

*95 - what is ionization and excitation of atoms

↳ why not particles

- in MeV/gm^{cm}²

↳ what is gm

*97 - why is the energy loss in Pb (lead/plumbum) greater than most materials
↳ I know its special

Qa'd

- why is it that the amplification process depends on a semi-stable condition detector mat. *108

- why does ~~charge~~ ~~charges~~ ~~form clouds~~ and nuclear form a chemical

↳ I think I know something with

- why is there ionization in solids and gases if particles accelerate mostly deal with particles and solids

↳ for detectors *109

- what is a launch formation *100

- what does particle velocity being greater than the light's velocity when passing through the particles medium mean

↳ C, particle's velocity $v > c$
↳ especially with β

Qa'd

- how does an atom de-excite to give off light *101
↳ why atoms

- what is a scintillation counter

- how does a photomultiplier work *103

- why are bubble chambers liquid unstable *104

- how does superheating work with a reduction of pressure *105

- what does it mean cameras are wound of before next expansion *106

- what does it mean bubble chambers operate at repetition rates of 20-30 Hz
↳ plot of particle loops

Qa'd

- where are the bubble chambers in the accelerator
↳ where the collisions happen *107
- what are the higher ra to ele than linacs
↳ 7
- what is operating pressure *108
↳ kN/m^2
- what is index of refraction *109
- what does spin 0 mean *110
- what is a hyperfragment source *111

Fob 4 2024

Qa'd

- high magnetic field of thoron a
↳ what *112
- what does it mean parallel to the axis of the camera?
↳ so it see the circular motion 18
- what is holography for bubble chamber photography *113
- what is a large aperture *114
- why study neutrons interactions with a bubble chamber
↳ which is a wetrend *115
- what is camera w/nd-on?
↳ winding in the film
- what is good track separation and resolution of secondary vertices *116
- what does density leave to do with B.O.G *117

Qa'd

- why aren't bubble chambers good for colliding beams

*116

- why is scanning time consuming
↳ takes a long time

19

- why must beam flux be low for charge particles
↳ attraction?

- why is repetition rate measured in Hz
↳ 1/s

- what do high electrical fields have to do with ionization
↳ attraction?

20

- what does the field vary as $1/r$ and attain values of $10^{14} - 10^{15} V/cm$

*119

- what do these have to do with accelerators
↳ the particles are accelerated

Qa'd

- what are sense wires?

*120

- what is a planar detector?

20

- why do all other wires need to have positive electrodes
↳ contact with particles

particles

- what are cathod strips
*121

- what do electrons have to do with the amplifiers

- what are spark and streamer chambers
*122

*122

- what are flash tubes

↳ why must they be more robust than MWPCs
21

↳ what are MWPCs

MWPCs

- why is delay time in μs

*123

↳ what is μs

Qa'd

- what is ion mobility (Kuehly) *124
 - ↳ why measured in ns low hab is ns
- why do ambiguities arise 21
 - ↳ when more than one particle is present *125
- why does Xty become u+v uvis
- what is transistor electron technology *126
- why is the electron field uniform now? *127
- how do drift chambers measure time *128
- why does $\pm 45^\circ$ remove ambiguity? *129
- what is a timing channel? *130 21

Qa'd

- what is uniform field drift? *131
- what is a high field avalanche region? ↳ where avalanche happens
- what is anode wire? *132 22
- how do you get argon hydrocarbon ↳ a gas
- what is the measure p/mys *133
- what is the field of F *134
- how do you control drift distance *135
- what are cathode pads ↳ \oplus pads
- where are these drift chambers ↳ areas around collimators
- how can gases be in an accelerator ↳ part of detector

Q&A

- how do drift chambers detect pulses *136
- how do they reconstruct the data into three dimensions *132
- how can ionisation be sampled many times across the track
↳ it happens a lot
- what is the relativistic rise region *137
- how do organic liquids detect scintillation
↳ how do plastics work *139
- how do suitable activators work *140
- what is the activator center *141
- where are scintillation counters

- how does something decay to produce light?
- what are fluorescent dyes
↳ how do they work 23
- what is a 14 stage tube
- what are drive scalars
- what does actuate coincidence mean?
- why are inorganic crystals so useful
↳ attributes are controlled?
- what is a hv electrode
- what are γ -rays 24
- what are organic plastic scintillator materials
- what matrix of PMMA scintillator counters

- what are lucite light pipes

where is the multiplier off
the accelerators

- what is a wave length shifter
material

$$- p = m\beta\gamma = m\frac{v}{c} \left(1 - \frac{v^2}{c^2}\right)^{-1/2}$$

$$= \frac{mv}{c} \left(1 - \frac{v^2}{c^2}\right)^{-1/2}$$

what is γ , L and t

- what exactly is momentum

- what is 3 σ separation
 \hookrightarrow not a σ

- how can a particles velocity
be greater than light
 \hookrightarrow direction (boosts)

- why are scintillation counters less
sensitive

24

- what is momentum of different
mass } 24

\hookrightarrow exactly

- what is fig 1.13 showing } 25

\hookrightarrow exactly

$$= \gamma \rightarrow \frac{c}{v} = \frac{1}{\beta}$$

what is p

\hookrightarrow what does the
equation mean

- what is the threshold centron
detector

- what is K_{max}

\hookrightarrow what is m

- what does X_0 mean

- what does general purpose
plastic mean

\hookrightarrow like plans

26

- why want the protons register
↳ why kaons in only
one and pions
in both

27

- what is the polarization of molecules along a charged particle track

- how is $<10^{11}$ s rapid

- what is ground state

- what is a coherent wave front

- what is the huygens condition

- what does plane-polarized mean

- what is path light and unit frequency

$$-d^2I = \frac{4\pi^2 e^2}{hc^2} \left(1 - \beta^2 \sin^2 \theta \right) d\Omega d\nu$$

what is $\mu, \nu, d, \theta, d\Omega, d\nu$
↳ and μ

↳ what does θ mean

27

- how do you emit photons in water
↳ using accelerators

- what are differential cerenkov counters
↳ how exactly does the math work

- how exactly do these counters identify kaon particles in beams
↳ how do beams work

- what is chromatic dispersion

- what are DISCs

why is Δv significant

- how is k/π measured
in eV/c

↳ why per c

*50 by using an electric field
they slow down the
front particles and
speed up the back ones
↳ by changing the
charge of the electric
field ~~as~~ as the
group goes through
it

*51 momentum is $m \times v$ (mass \times velocity)

↳ v or c is momentum

velocity does not
increase but mass
does

↳ E gives a small

increase in v

but a big increase in M

*52 as velocity increases as

the particle is accelerated
the frequency swing is
the same correct done
as for each time the
particle goes around

*53 once you suck the air out
of the vacuum the fog
is the air pressure
normally (10^3 Torr)
↳ basic smaller the
number the better
the vacuum

*54 since the particles are
so fast all the magnets
must remain running
↳ lots of power

*55 pulse operation would mean
the magnets would instantly
turn off but magnets
take time to turn off
on on

*56 Very small spread of momentum

*57 all the different product
from all of the collision
in a beam
↳ product beam

*58 a device that allows
separation of
products of a beam
collision

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Date 02/05/24

-how can gas pressure be used in an
accelerator
↳ collisions

28

-how do you get velocity
from cone angles?

-what is a spherical mirror bank
and a ~~granular~~ high granularity
detector

-why does CAF allow for
the transfer of high energy
photons

-where are the RICH on
the accelerator } 29

-how is the pion radius
negative?

-what is ionization and excitation
energy loss } 30

- what is electro-magnetic interacting, pair production and Compton scattering

- what are nucleons and mesons

- what is degradation of energy

- what are neutrons

- how do you measure with electromagnetic processes

- how do you measure with nuclear interaction processes

- what is the Braggstrahlung process

- what is pair production

- what is compound scattering

30

- what is table 1.4 saying?) 30

- what are positive and negative electrons
↳ how are they positive

- $E(t) = E_0 \exp(-t/X_0)$
↳ what

31

- how is energy loss by γ -rays by pair production related to X_0

- what is probability $7/9$

- $X_0 (g/cm^2) \approx 716 \frac{A}{Z^2} \ln(183Z^{1/3})$

- why is lead a high Z mat.

- what is max. energy resolution?

- what is rate of energy deposition

- why is lead and argon considered during electron (and particle)

- why do electro magnetic showers require noble gases (or lead) } 22

- $t_{max} = \ln(E_0/t) - 1.0$
↳ what is \ln

- what is logarithical depth
↳ no measurable increase in signal

- what do they mean by depth in lead

- what does forward peaking mean

- how can a calorimeter measure transverse dimensions

- what are mol.ère units

- $R_m = 2 \ln E \cdot \frac{x_0}{R_m}$

↳ what is t R_m

33

34

- what is sampling fluctuations of the energy deposit in the active mat.

- what is the unit rms

- $\frac{\sigma_b}{E} \propto \frac{1}{\sqrt{Z}}$
↳ what

- what is sampling per electron pair

- what does energy deposit in active vs passive mat. mean

- what does limit $0.05 Z R \geq 0.4$

- what is resolution

- what is in homogeneous fibres rather than ~~fluctuations~~ fluctuations
↳ why now $\frac{1}{\sqrt{E}}$

- what is x in x/\sqrt{E} %

34

- what is Pb MRPC Sander
 (instructions)

*59 If it has enough energy

it will vaporize the liquid

↳ to make the bubble

it loses energy making

its track very radius

smaller

↳ placed near collision

area

↳ tracks in particles

after collisions

↳ they decay \rightarrow ^{can} join

and disperse \rightarrow atoms

or decay

and annihilate

*60 Using other techniques

to measure instead of

bubble chambers

↳ protons can travel through

air briefly

and muon
 or dd + s
 \rightarrow combination

↳ lepton

↳ not

made

of quarks

↳ energy

π^+

*63 muons decay into electrons

because muons are heavier

↳ 2 neutrinos

*64

χ particle

↳ 3 quarks

↳ 1 up/down

↳ 1/3 strange / bottom

↳ 1 bottom

- why do calorimeters require different materials?

35

- what is regeneration and detection of hadron energies

- why more complex than electromagnetic

- what are nuclear disintegrations and excitations

- why do calorimeters require wavelength shifters

- what is the purpose of using a wire chamber plate

- what is nuclear absorption length

36

- $K_0 = [(nucleon \text{ num.} + volume) \cdot \sigma]^{-1}$

- ↳ what length

- what is inelastic nuclear cross section

- what is energy in the region of the nuclear resonances

- why is 2 GeV K_0 almost energy indep.

- how do slow neutral particles and neutrons escape

- what exactly are hadrons

- what is particle back scattering

- what is 238U

- ↳ how does it help with trapping

- how do hadrons develop showers

36

- what is the difference between electromagnetic and hadronic modes

↳ what are they

- what is X_0 (cm)

- what is dE/dx (MeV cm^{-1})
↳ (MeV/cm)

- what is X_0 (cm)

65* Signs -

↳ different quark combo

M^- - antimuon

Ω^- - omega particle
↳ 3 strange

66* Ξ

↳ diff. quark combo

ν - photon

↳ Lambd_b

↳ baryon

↳ up + down + any thing but
up/down

67* if they don't live long and don't have much energy (travel far) they decay close to the fixed target

68* hyperons are hadron

↳ 3 light quarks

↳ one has to be strange

↳ Ω^- Ξ^- Λ^-

↳ u, d, s are light

$6q^+$ n^0 , p^+ , π^+ and π^0
 ↳ most commonly produced

↳ π^0 and n^0 are neutral so

not detected

↳ π^+ and p^+ still need to

be detected

70^* - name of the groups of magnets

71^* - separating particles by

specific mass

↳ electrostatic

↳ pass through

a perpendicular

strong electric

field

↳ different deflection

for different mass

↳ radio frequency



two oscillating field set to
 only let a certain mass
 through

- what is fission compensation

- what is radius of K_0

- why are Fe and Pb absorbing
 mats.

- how do proportional tubes
 do the same thing as a scintillator

- how does the iron and
 yoke of the magnet make
 a hadron calorimeter

- what are nuclear emulsions

- why are they so sensitive

- what are hydrogen flying balloons

- what are grain densities

- what is P in pP

~~what are particles~~

- what is a micron

- what are the emulsions

- what is a microstrip

- what is high spatial resolution

- how are semi conductors used in reverse bias

↳ how does this

create a depleted zone without carriers

- what is small dark age current

37

- how can electron be very fine strips

- what do they mean by active targets

- what are channel or binary mesons

- what are p-implanted strips

- how do # of channels and different reads lead to a pitch
↳ 100 μm

- what is pitch resolution
↳ why 8 μm

- what does different dielectric particles mean
↳ what does it emit
electromagnet radiation

37

- what is a L⁺ or relativistic

- what is a macroscopically varying dielectric constant

- what is transient polarization of the medium

- what is the polarization current

↳ what is transmission radiation

- what exactly is multiple foil interference

- what is $\gamma(L(L - \beta^2)^{-1/2})$ and $\beta = v/c$

- what are Li foils

- what does $Z^{-5.5}$

38

~~Why do very high energy~~

- what does $\gamma \approx 2000$

- what are TDCS

- what are consistent units and complex matrices

- what are section levels

- what is an ρ -meson decay

- what are one line computers

- what is magnetic tape

- what is off-line filtering

- what is geometrical reconstruction

- what does it mean when off-line tasks are formidable

F2 separator system use

39



Momentum to identify
and filter different
mass particles

*73 perpendicular force

*74 θ

↳ theta

↳ angle

↳ two different particles

↳ difference

*75 

*76 angular separation

separate different masses

↳ magnets are placed

the different masses

↳ now only spatially

separated

required for sci fair

*77

$$50V_c = \frac{E}{c} = \text{RF}$$

↳ separation is easier at

lower velocities

↳ in relativistic speeds

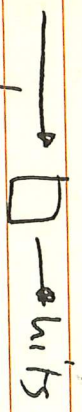
velocity changes very

little

$$\frac{1}{\sqrt{1 - (v/c)^2}} = \gamma$$

*78 transverse = perpendicular

*79



↳ less deflected

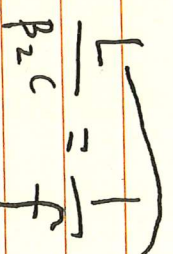
twice by RF

lower the

scintillation means

by doubled

*80



↳ distance between

2 cathodes

↳ frequency

*8 | This method selects a set of σ

↳ cause Z exactly oscillation would

work but so

many 22

↳ it might

alone with

both sets

*82 $P = \frac{PeB}{c}$ — magnet PMN

↳ momentum

↳ making of curve

- what exactly are nucleons
↳ why do they best explain
particle interactions

40

- what was the discovery of
cosmic radiation

- what does quanta are photons
mean

- what are static nuclear properties
and scattering experiments

- what are nuclear forces

(Note) experiments before

hypothesis include (accelerators)
(antimatter) (matrix) (quarks)
forces relativistic and
(collisions)

↳ before

- what is the Coulomb repulsion) 41

- $R = r_0 A^{1/3}$
 ↳ what is R

- why does a repulsive core prevent nucleus collapse to the range of nuclear force

- what are exchange forces

- what is P

- what does the wave function

$\psi(1,2)$ mean

- $P_{12} \psi(1,2) = \psi(2,1)$
 ↳ what

- how can particles

exchange spin charge or position
 ↳ what is spin

41

42

- what does exchange quantum mean

- what does exchange mean
 ↳ what

- why is Coulomb force absent in the scattering of p^+ and n^0
 ↳ what

- why does energy matter so much in scattering

- what is the unit cm

- what does scattering states having orbiting angular momentum greater than 0 mean
 ↳ exactly

- how does 0° and 180° mean exchange and non exchange forces

42

- unit does exchange meson photons or how

- what are mirror nuclei

- how do atom with more neutrons work with columb force

about than p^+

force

- what are n-n p-p forces

- what are nuclear forces

- what are static nuclear properties

- why do n-p combinations lead to charge indep.

42

- what is A

- what are isobars

- why is the nucleon volume = πr_0^3

- what is an alpha particle

- what are point charges

- what are effects of the nuclear size

- what is the distance of approach

- what do alpha particles and gold have to do with cross sections

- why does the absence of the columb effect mean a 2 body situation

42

43

- what is a square well potential

- what is s-state scattering

- what is a $n^0 p^+$ scattering cross section

- what is s-state scattering

- what are singlets and triplets spin states

- why would there be more than 2 parameters

- what do the parameters determine

- what does $V_0, \epsilon, d, V_0, \epsilon, d_s$ mean

43

- what does low energy $p^+ - p^+$ scattering mean

- what is a deuteron

- what is the magnetic moment

- what is a triplet s-state

- $V_0 d^3 \approx \frac{\hbar^2 h^2}{4M}$

↳ what

- why does trine line at high velocities make it relativistically true

- what is the field quantum of mass

- what exactly is quantum mechanical substitution

40

- $E \rightarrow i\hbar \frac{\partial}{\partial t}$ and $P \rightarrow i\hbar \nabla$

↳ what
↳ what

- what is an operator equation

$$-\hbar^2 \frac{\nabla^2}{2m} \psi + V\psi = E\psi$$

↳ what

- what is a field variable

$$-\left[\nabla^2 - \frac{1}{c^2} \frac{\partial^2}{\partial t^2} - \frac{m^2 c^2}{\hbar^2} \right] \phi = 0$$

↳ what?

↳ exactly

- what is a time indep. part of an equation
↳ exactly

- what is a static electric field
↳ exactly

- what is ∇ and ∇^2

$$-\nabla = \frac{\partial}{\partial r}$$

↳ what is e

$$-\phi = \frac{q}{r} e^{-mcr/\hbar}$$

↳ show
↳ what

- what is the unit mcr/\hbar

- what is $e^{-mcr/\hbar}$

- what is $r = r_0 = 1/a$

- what is expanding the exponential

- why is the range of the force $\propto 1/mc$

↳ what

45

- how is $200 \text{ MeV}/c^2$ mass

- what is the coupling constant

↳ what does all this

have to do with

pt and no scattering

- $g^2 \approx hc$

↳ what

↳ what

↳ exact leg

- why are we concerned about ranges

- what is r

- what is the Yukawa

quanta

- why would the exchange of 2 positive mesons be allowed

↳ cancellation?

45

- what are mesons

- what is nuclear β decay

46

- in Fig 2.2 what is ρ^0 and ω

- what happens if you can't transfer for mesons

↳ can on of them?

↳ how

47

- (meson $\rightarrow p^- + \nu$)
↳ what

- what meson lifetimes are determined

- what is the uncertainty principle
↳ why

- why does $\Delta E \Delta t \approx \hbar$ and $\Delta E \approx M_{\pi} c^2$ gives us size of pion cloud

- what is the relation is kinetic wave equation

- what is a nuclear magneton

- $\beta \approx N + \pi^+$
↳ why
↳ exactly

- why would the angular momentum of a N^0 and π^+ be L_N
↳ what

47

- why would we assume the π have no spin
47

- $\mu = \frac{e \hbar k}{2m\pi c}$
↳ what

- what is the p-state

- $\mu_p \approx \chi \mu_N + Z(\mu - \chi) \mu_N$
↳ what

- what is a bare state

- does this mean p^+ and N^0 don't exist together

- what is spin dependence

- what is the outer edge of potential

- what is the quantum of the nuclear force

48

What is cosmic radiation?
Why does it create particles

- how (what are cloud chamber + photographs)

- how does the drop in density / change in curve work in a cloud chamber

* 83 large p = large and long turns in

accelerates

small p = slow p turns

magnetic flux density is how strong the magnetic field

* 84 sagittas



48

= 85 all energy is converted

mass

↳ once stationary

it will most likely decay

↳ no longer moving so ~~never~~ no longer can measure

it

↳ time dilation

↳ when

moving

fast time

moves slowly

* 86 charged accelerating particle

must lose energy in

the form of bremsstrahlung

radiation as a cone

pointing toward the center

*B7 ionization is when you know an electron off a neutral of + particle making + or more +

- what is p
↳ how a function of particle no more turns
↳ exactly
 - what is turbulence in the cloud chamber
 - what exactly is non uniform sensitivity
- 49

Note: probably start writing for

- what change with cosmic rays at mountain altitude
↳ what does this have to do with an inter medinary particle between p^+ and e^-
 - why do neutral particle inject non neutral particles
- 49

- what is the unit $K\text{rA/m}$

- how can e^- ionise

- how was lifetime of mesons measured by gigas counters

- how do cosmic ray showers have e^-

- what is X rays
↳ Higgs boson?

- what is a soft component

- what is a hard component

- why does the energy spectrum change at different altitudes for e^-

*88 hadrons are anything made up of multiple quarks

*89 μ may just be unlikely ^{will} get ~~more~~ hadrons are likely ^{back} to this

*90 type of radiation

↳ Cerenkov like

caused by electrons slow down

by collision

↳ since e^-

are lighter

they travel

faster

↳ give off

more radiation

*91 collision create daughter

particles that are unstable

which create more daughter

particles and so on

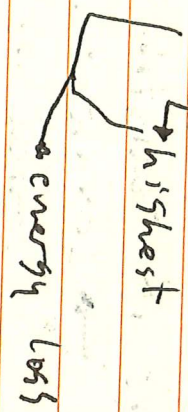
↳ electromagnetic showers

include photons

*q2 rate at which

energy lost as a function of momentum

↳ $\pi + K + p$
↳ lowest



↳ point of momentum where energy loss is lowest

*q3 did the measurement with

~~He~~ and H_2 but it should be true for other mixes

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*q4 background cosmic rays can be confused for exotic

collisions

↳ but because cosmic rays happen so often they are easy to discard

*q5

excitation lead to electrons

Jumping to a higher energy level and when it goes

back it emits a photon

↳ the way we detect particles is by looking at interactions with atoms

*q6

$g \approx g$ rams

↳ not a cause of gravity
↳ amount of lead in an exp

*q7 very dense (PB)

↳ very unlikely that particle can get ~~born~~

through without colliding
with a nucleus

↳ time slow to cause
major collision
because they aren't
the accelerated
particle

*Q8: if lost only its stable
but even a small
disturbance could
cause a relatively
large reaction

*Q9: one event triggers
a sequence of many
more events

*K100: photon going through
refractive object
is n
↳ refractiveness
of surface



when a photon

when light is refracted is
slower but particles don't
react like that and
this means particles can go
faster than light

↳ faster than the photons
they emit
↳ light cavilient of
a sonic boom

↳ when goes fast
enough resonator
radiation is
emitted

*K101: when an electron jumps
back it gives off a photon

*K102: scintillator is the mat.
that gets excited

*K103: photons hit a photosensitive
mat. with which releases
an electron
↳ an electron hits a metal



at a high speed and
the energy liberates more
electrons

Started working on

what is antimatter

↳ started record
citations on google docs

↳ what is CP
symmetry

↳ concept that

reversing stuff

doesn't change the

physics

Finished first draft of

what is antimatter
document

New outline explains merits

then hypothesis then math

practical maths and

experimental problems

they explain particle physics
relativity and accelerators

↳ they more case studies
then solving

started writing

started how was antimatter
discovered

relativity equation

$$E^2 = p^2 \times c^2 + m_0^2 \times c^4$$

- why would thickness have anything to do with absorption

- why do soft components have to be eliminated for proper counters

- what is radioactive decay
↳ what does this have to do with air + carbon

- how does this yield a life time of 2 milliseconds

- what does a anticoincidence of further counters mean

- what is why charged particles leaves the iron block

- what is the interaction

cross section of these particles with nuclei

51

- why would strong interactions lead to less mesons on the ground

- why are mesons part of the fundamental forces

- why didn't the mesons decay in iron?

- what is the wait milliseconds

↳ what does this have to do with cross sections

- why can't we use magnetic fields in cloud chambers

- what is nuclear emulsion
↳ exactly

- what is emulsion nuclei

- why are π observed at ground level

51

52

~ what is barium #0

~ what is a $\bar{p}p$ pair

~ what is a micron

53

*104 by dropping the piston decrease

so it should be a gas but it need something to cause the change

*105 talking about winding up film w the film

*106 20-30 pulses per second

↳ lines up with proton beams

*107 linear accelerators

↳ electrons are light

So they accelerate faster

↳ linear means more pulses

*108 pressure $F/\text{unit area}$

*109 how much light slows down

*110 if a particles spin

they generate a magnetic field spin-0, generates

no spin and non dip atoms spin

↳ doesn't react with magnetic fields

*111 many tiny bubbles

/ Feb 13 2024

- what exactly's bombarding energy

- what is invariance

- what does taken C=1 mean

- what does center of mass in Cms quantities by dashed symbols

- why does $p' = 0$

↳ what

- what is a cyclotron

- why is the nucleus moving

- why does CMS increase in head on collisions

- what is nuclear emulsion

54

55

- how does comparing the p^+ and μ get messy

↳ exactly

- what is a mesic K-ray

- what is a meson

↳ exactly

- what is the bohr formula

- what is the relativistic equivalent

- what exactly is fig 2.7

↳

arrange the magnetic field

so the particle goes in a circle within the view of the camera

↳

using multiple cameras to create a 3D image

↳

aperture it how big the hole that lets light

55

*115 neutrons are smaller &

least reactive particles

↳ determining whether they

have mass

↳ determining how frequently

they oscillate between

the three types

*116 sufficiently ~~get~~ sensitive

so you can tell the

different interactions/

decays from different

particles

- what does π decay

require one extra

particle for e and

μ conservation

56

- why must electrons be

present if a photon

was released

- why does a non unique

spectrometric value lead

to more than 1 neutral

particle being formed

*117 $\beta = \frac{V}{c}$

↳ gets to high in

energy masses

can't be ~~det~~

identified

- why is it that for a

neutral decay the

mostly likely candidate

is a γ -ray

57

- what are hard and soft

showers

- what are μ -rays

- what are cosmic rays

- what is a secondary
prong with nuclear
reactions

- what is a coordinate
system

- what is a nuclear nucleon

- what is cms

- what is nuclear excitation

- what is the cross
section of γ -rays
production in which

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- what do protons have
to do with γ radiation
in which

57
- what exactly is
a spectrum shape

- what exactly is incident
proton energy

- what can't this describe
the origins of photons

- why would p^+ come
from γ -ray $\times 2$ and
a nuclear meson

- what's a γ -ray

- what does fit to
the observed spectrum
mean

- why does e^- and e^+
pairs produce γ -rays

- why wouldn't the γ ray have passed through the star if the it traveled

- what are ligands of short redshifts length

58

- why do both γ -rays have a possibility to produce pairs

- what does mono energetic in absorption mean

- what is a low energy transformation
↳ how does it work

- what does fig 2.8 mean

- what does uniform motion description of γ -rays mean

- $\Delta E_{\gamma} = E_{\gamma}(\text{max}) - E_{\gamma}(\text{min})$

$$= 2m_0\beta_0 c^2 (1 - \beta_0^2)^{1/2} = p \pi^0$$

- why is p of π^0 the same as p of $q \pi^0$

59

66

- what is the Primakoff effect

- how does a incident γ

γ and a virtual γ / γ colliding cause a decay

- what is the Coulomb field of a nucleus

- what is the function P
↳ π^0 conversion?

- how does Primakoff effect cross section help with lifetime
↳ what

- what does forward peaked mean

- what is fig 2.9 saying?

- what does coherence and incoherent photo production mean

↳ exactly

6D - what does a cross section of the sum of Primakoff and nuclear processes mean

- what does photoproduction in lead mean exactly

- what is a steradian

- what is anti-coincident

- what is the important angular region

- what is a pulse height

- what is an oscilloscope

- what is fig 2.10 saying

- how did the cross section lead to lifetime what

- what is the cross section the reciprocal of stop life time

- what is JT spin

- what is intrinsic importance

- what is the principle of detailed balance

$$-\frac{2\pi}{k} |M|^2 \frac{dN}{dE}$$

what is d

- what is order perturbation theory

- what is a matrix element

what is spin

- what is equally probable

- what is a cross section

- what is the $\frac{dN}{dE}$ factor

62 - what is statistical mechanics

- no questions) 64

- what is isotropic in case for spin

- why would the particles be polarized what

- what is a zero spin particle beam

- what is resonance

- what is parity

- what does ψ mean

- what does eigen have to do with this

63

65

66

- why must $|\Psi\rangle^2$ be invariant

↳ what

- what is the transformation that leads to conserved quantities

↳ what

- what is an intrinsic particle

- what is the 2.11 saying

- what is a wave function
↳ orbital angular momentum

- what is ϕ

- what is angular momentum
↳ quantum #

- what is a detector

- what is a J^z -detection

- what is K-orbit

66 - what is the possible principle

- what is u^3 , state
↳ why forbidden

- why an odd-parity
↳ what

67

- wrote about my hypotheses and method

- finished (logical) problems with anti-matter

- what is the observed neutron mass

↳ units ↳ what does it mean

- why does a spin parity of 0^- lead to a pseudo-scalar particle 68

- what exactly is spin and parity

- what is 2 photon decay

- what does circularly polarized mean

- what does $J \gg 2$ mean

- what does conserving J and J_z mean

- what is a spherical harmonic

- what does $\gamma_j = (0)$ mean

↳ exactly

69

- why is 2 photon decay forbidden for vector and pseudo vector particles

↳ what

do particles have to do with this

- why are RR LL sometimes eigen and sometimes not

- what does min spin mean

- what does spin of 0 mean

- why is 0- odd

- why do we reject higher spins

- what is field theory

69

- what exactly is parity

- what is a wave function

- what is the complex conjugate

70

- how does pion spin of zero affect (scalarability)

- how do scalars and pseudo scalar relate

- what is the difference between even and odd pairs

71

- what is the difference between even and odd pairs

- what does the plane of pairs say

- what is an isotopic spin triplet

- what is an s-state

- how does something decay into ν

- what is an l-spin

- why exactly is the n^0 charge negative

- how exactly does $2l+1=3$ tell us spin

$2l+1=3$ tells us spin

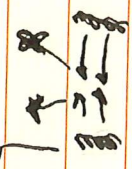
- how does $Q=1/3$ tell us spins can be different in nucleons

- what is an ad hoc manner

- what is a nucleon

- what is a quantum #) 72

*116 too many collision m a beam collision



*117 low amount of particles would prevent that low beam flux

*118 electric field supplies the kinetic energy

*119 strength of electric field

*120 Planner means 2d detector but all direction comes from one direction

*121 set up in sputter strips

↳ get one D

specific spacial information

↳ 3 layers

learn for 3D

*122 flash chamber cause a lightning bolt
↳ is completed faster

↳ high potential difference

flash tubes may be used to excite electrons

Feb 21 2024

*123 100 picoseconds for the signal to appear and

20 nanoseconds for the signal to reset to 0

Signal to reset to 0

*124 based on density and

mass the ion mobility changes

↳ means \oplus mobility \ominus ion

*125 so you can angle of the wire layers to

determine which particle is which

↳ particles can't zig zag

- what is l-spin

- why is l-spin $3/2$ or $1/2$

- what is an l-spin wave function?

- what is the corresponding notation

- what is the Clebsch-Gordan Coef.

- what are the last 2 equations saying

*126 - faster than vacuum tubes

↳ handles electrical signals

*127 same direction with same force, easy to calc.

*128 measure how long after the collision the avalanche starts

*129 - the change in the angles helps chart the particles
↳ that

*130 with a drift tube it's easier to measure ~~specific~~ specific particles because timing is more precise



Feb 23 2024

- how did the algebra get 1-spins

↳ what

- $0 \leq \ell \leq \ell_{max}$

74

↳ WHAT!!

- what is a matrix element

- what is $J^T - p^+$ elastic scattering

- what does A mean

- what is charge-exchange scattering

- what are the special cases saying

↳ what exactly is a J -meson

75

- what does non electric beam mean

↳ rotation to elastic $J^T - p^+$ scattering?

- what is an mb

- q.l:2 on this what are the parts

- how is $L = 3/2$ in states

- what is resonance

- what is not apparent

76

/ / Feb 24 2024

Worked on mathematical problem
 ↳ finished first draft

Started explaining experimental antimatter

↳ finished first draft

↳ may need to add more

Started explaining particle physics

↳ finished first draft

Mark started my own diagram for the standard model of matter

/ / Feb 25 2024

what are differential equations

- what does second order of time mean

↳ why 2 for sol.

77

- what is $L = TV$

↳ why momentum

↳ exactly

$$p_i = \frac{\partial L}{\partial q_i}$$

- what is the last equation saying

need to remember to fix particle model image

Started working on relativity document

- how did we get the third equation

- why is pi constant

- what is \hat{p} 78

- what does invariant to an axis mean

- what is $Px = m\dot{x}$

- what does system invariant mean

- what is an operator (U)

Relativity

See extra notes as well
 $\hookrightarrow \#V$

- what is the hermitian conjugate 79

- what is $-i\hbar(\partial/\partial x)$

- what is an unitary operator

- what does $\langle A \rangle$ is invariant mean

- what does $H(\psi) = E\psi$ mean

- what is the hamiltonian operator

- what is the energy eigenvalue

- why does $\psi(-v) = k\psi(v)$
 $\hookrightarrow k = \pm 1$ 80

- what does $i\hbar \frac{dP}{dt} = [P, H]$ mean

- what is potential V mean

- how do operators commute
- what does parity have to do with it

80

- what are unitary transformations

- what is the operator \hat{Q}

- how are the y and z coordinates the same

81

- what is relativistic frames (27)

- what is Taylor's theorem

- what is the 4th to last equation

- why does a being small matter

- what are we solving for (81)
- *131 geometry that makes the field uniform over a given area

- *132 in Thod's position the wire anode = negative wire

- *133 $\mu\text{m/nanosecond}$

- *134 gases \vec{v} won't be affected effect by field strength

- *135 controlled by pressure and type of gas
 - low pressure - lower drift distances

/ / Feb 27 2024

*136 - know the time

↳ by measuring
timing of pulse
third dimension
is measurable

*137 get back to this

*138 when electric current
produce a glow in
certain substances
↳ organic and
inorganic mats

/ / Feb 28 2024

*139

crystals are very stable

↳ doper up on a crystal
by replacing an atom
of a crystal
↳ so e^- aren't stable
↳ leads to e^-
being freed

*140

where the electrode
collects the freed
 e^-

*141

crystals are excited
and release photons
which are collected
by scintillation
counters

Feb 29 2024

$$- Q = \frac{1}{i} \frac{\partial}{\partial x}$$

what does it represent

82

- what is a linear momentum operator

- what is the t-axis

- what is H

- what is eigen values considering \hbar in various wave number displacement

- what is Taylor theorem

- what is δD

$$- \text{if } \psi = \begin{bmatrix} a \\ b \end{bmatrix} ?$$

83

- what is the standard linear operator

- what is the Pauli spin matrices

83

- why do we use the half value of the operators

/ / March 1 2024

- what is a dirac tomic function

BS4

- why are p^+ $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$ and

$$n^0 \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

- how does $(\gamma_4 + \gamma_3) n = 1$ work

- what is an operator

- what are spin operators \hbar multiples

- what is 4d space

- what is a pauli matrix

BS5

- what does invariance

- what is a hamiltonian

- what is a rotation operator

- what is the colomb force

- what is a "strong" force
↳ exert fly

- why are there 2 eigen values

- what is a charge operator

- what is ψ

- what is a baryon #

- what is a neighborhood
isobar

- why is an l -s pm doublet
Li and Be

Mar 2 2024

- I wrote up the document on relativity's speed

March 3 2024

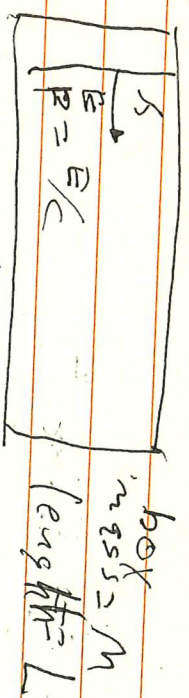
- worked on further procedure document

- Finally did dirac equation

$$E = h\nu$$

$$p = \frac{h\nu}{c}$$

$$E = pc$$



classical p

for box

$$p_{box} = M v_{box} = -p = \frac{-E}{c}$$

$$v_{box} = \frac{-E}{Mc}$$

after time Δt

box has moved $\Delta x = v \Delta t$

$$\frac{-E}{Mc} \Delta t = \frac{-E \Delta t}{Mc^2}$$

Center of mass

$$M_{\Delta X} + m_{eq}L = 0$$

$$M \left(L - \frac{EL}{Mc^2} \right) + m_{eq}L = 0$$

$$L = D \quad (m_{eq} \sim \frac{E}{c^2}) \quad L = D$$

$$E_{med} = \frac{E}{c^2} \quad E = mc^2$$

$E = cp$ $E = mc^2$
classical physics momentum

$$p = mv \quad \text{or} \quad m = \frac{p}{v}$$

$$E = \frac{c^2 p}{v}$$

$$\frac{\Delta E}{\Delta X}$$

$$F \Delta x = \Delta E \quad \Delta P$$

$$\frac{\Delta E}{\Delta x} = \frac{F \Delta x}{\Delta x} = F = \frac{\Delta P}{\Delta t}$$

$$F \Delta t = \Delta P \quad \frac{\Delta E}{\Delta x} = \frac{\Delta P}{\Delta t}$$

$$\Delta E = \frac{\Delta x}{c t} \Delta P$$

$$E = \sqrt{\Delta P^2}$$

$$\Delta E = \sqrt{\Delta P}$$

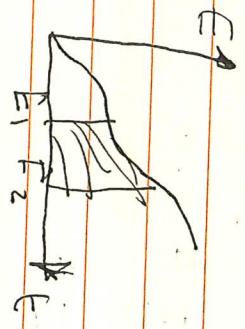
$$\Delta E = \sqrt{\Delta P} \frac{c^2 p}{c}$$

$$E \Delta E = c^2 p \Delta P$$

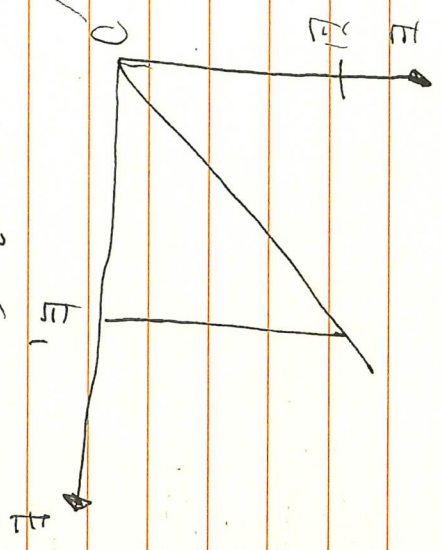
now evolve many ΔE 's \rightarrow intensity
 $\frac{1}{2} E^2 = \frac{1}{2} c^2 p^2 \rightarrow \frac{1}{2} E_0^2$

$$E^2 = c^2 p^2 + E_0^2$$

$$\int E dE = c^2 \int p dp$$



$\int E dE$



work done $\int E dA E = \frac{1}{2} E^2$
 comes from $\int p dp = \frac{1}{2} p^2$
 (obeyative)

$$E^2 = p^2 c^2 + E_0^2$$

$$E = \frac{c^2 p}{v}$$

$$E v = p c$$

$$E^2 = E^2 \left(\frac{v}{c}\right)^2 + E_0^2$$

$$E^2 - E^2 \left(\frac{v}{c}\right)^2 = E_0^2$$

$$E^2 \left(1 - \left(\frac{v}{c}\right)^2\right) = E_0^2$$

$$E^2 = \frac{E_0^2}{\left(1 - \left(\frac{v}{c}\right)^2\right)^{1/2}}$$

$$E_0^2 \left(1 - \left(\frac{v}{c}\right)^2\right)^{-1/2}$$

what is E_0

math rule from calculus
 for small x , $(1+x)^n \approx 1 + nx$
 small x

$$0.99^3 = (1 + (-0.01))^3$$

$$0.97 \approx (1 + 3(-0.01))$$

$$\approx 0.97$$

$$E^2 = \frac{E_0^2}{\left(1 - \left(\frac{v}{c}\right)^2\right)^{1/2}}$$

$$(1 + 8)^n \approx 1 + 8n$$

$\pm E_0 \left(1 - \left(\frac{v}{c}\right)^2\right)^{-1/2}$ using diff from

$$E \approx E_0 \left(1 + \left(-\frac{1}{2}\right) \left(-\frac{v}{c^2}\right)\right)$$

$$\approx E_0 \left(1 + \frac{1}{2} \frac{v}{c^2}\right)$$

but classically $E = \frac{1}{2} m_0 v^2$

$$\frac{1}{2} E_0 \frac{v^2}{c^2} = \frac{1}{2} m_0 v^2 \quad \gamma = \sqrt{1 - \frac{v^2}{c^2}}$$

$$\frac{E_0}{c^2} = E_0 = m_0 c^2$$

$$E = m_0 c^2 = \gamma m_0 c^2$$

$$\text{but } E = m_0 c^2$$

$$m = \gamma m_0 = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$E^2 = p^2 c^2 + m_0^2 c^4$$

$$E = \sqrt{p^2 c^2 + m_0^2 c^4}$$

This allowed me to finish

my ~~next~~ how on + in a few
was discovered sections

- will look at filling

out 10 pages

on case studies tho

look at conclusions

+ interview

Mar 4 2024

Date

ideas for case studies

- Cronk and Finch discuss
between matter and
antimatter

- ASACUSA weighs antimatter
 L_0 one part in a billion

- ATRAP experiment makes
worlds most precise measurement
of magnetic moment

- LHCb experiment observes
new matter antimatter
differences

- BASTe experiment compares
 p^+ with \bar{p}^+ with
high precision

~~BAARE~~

- LHCb see a new
flavour of matter
anti asymmetry

- ALPHA - G and
gravity

- maybe 3 more?

March 5 2024

Date

At trap and magnetic moment
notes

- traps individual particles
and puts them through
intense magnetic fields

- looking into matter and
antimatter imbalance.
↳ challenging CPT
symmetry and standard
model

- trapped in an electro magnetic
box suspended between
iron electrodes, copper
electrodes sandwiched
↳ manipulates properties

- concluded that matter
and antimatters magnetic
moment is exact
opposites

March 6 2024

- did the write up on APPRAP magnetic moment

March 7 2024

- what does T represent 86
- what is the Dirac theory

- why does the Pauli principle only apply to fermion antisymmetrical systems 87

- what are the last two symbols

- what are quantum #'s

- what does anti parallel mean
↳ what does l-spin have to do with this

- what is the Lagrangian

- what is baryon conservation

- @ meson produced?

- what is fermi motion



- wrote about CHCl₃ experiment
↳ differences

- wrote on ALPHA and alkyl hydrogen charge

- also wrote on crown and finches work

- finished ALPHA and crown and finch documents
↳ also filled out the declaration on CYSF.org

- finish CHCl₃
↳ finally...

- wrote about the ASACUSA experiment

- wrote about alpha-g
↳ and alpha 2 and 1 with spectroscopy

- wrote a summary

- finished CPT symmetry and quantum papers

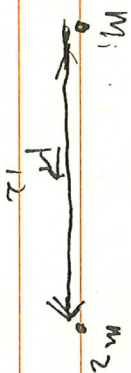
Now time for the conclusion.
↳ 8:52pm

- are the Notes the classical formalisms incomplete?
↳

- energy could be a vector

GRAVITY → gravitational
consider

$$F_{m_1 m_2} \approx G \frac{M_1 M_2}{r_{12}^2} \left(\frac{\vec{r}_{12}}{r_{12}} \right)$$



~~Newton's~~

$$E^2 = m^2 c^2 + \frac{m^2}{1 - \frac{v^2}{c^2}} c^2$$

$$E = m^2 \left(v^2 c^2 + \frac{1}{1 - \frac{v^2}{c^2}} c^2 \right)$$

$$m \rightarrow \frac{E^2}{\sqrt{v^2 c^2 + \frac{1}{1 - \frac{v^2}{c^2}} c^2}}$$

$$E = E$$

/ / Mar 11

- possibility for conclusion
 - ↳ rearrange drive equation for negative mass
 - ↳ to symmetry reversal
 - for antineutrinos
- wrote both parts of the conclusion
 - ↳ interviewed Jim Freese and Pojia
 - ↳ wrote on that
- wrote the conclusion