

[finish lec 1 notes]

ANNOUNCE

- > ADAM'S NOTES
- > CANVAS

> particle content

STRET HW

↳ HUMAN MASS $\sim 6 \times 10^{25}$ GeV

PIZZA: hydrogen atom

"PARTICLE COLLIDERS ARE MICROSCOPES"

↑ (like "telescopes are time machines")

• see p.3 of lec 1

KINEMATICS (SR)

how things move

↔ cons laws
"on shell"

DYNAMICS (GR)

how things interact

SCATTERING AMPLITUDES $\sim \psi$

↑

why scattering?

to PROBE SUBSTRUCTURE
of RUTHERFORD

KINEMATICS

• conservation of (E, \mathbf{p})

TIME TRANSL INV.

SPACE TRANSL INV.

(NOETHER THM)

⊙ "on shell"

$$E^2 = m^2 + \mathbf{p}^2$$

in fact, even better:

$$M^2 = E^2 - \mathbf{p}^2$$

↑

PROPERTY OF
PARTICLE

KINEMATIC
QUANTITY

P^μ

4VECTOR

INDEX: (ALMOST) ALWAYS
MEANS CONTINUOUS
SYMMETRY

$$P^\mu P_\mu = \mathbf{p}^2 = E^2 - \mathbf{p}^2$$

EINSTEIN SUM. CONV.

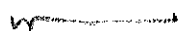
> see REST of Lec 1 notes

↳ EINSTEIN SUM
INDICES (no indices = invariant)
ROTATIONS
in lifetime

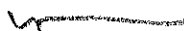
FIRST FEYNMAN RULES

"THEORY A"

RULES:



A PARTICLE



VERTEX of 4 A's.

- can use any number of these
- can move, rotate
- connect vertices w/ lines
- can bend lines (only topology matters)
... try to straighten out to make it look clean.

GAME: make scattering process

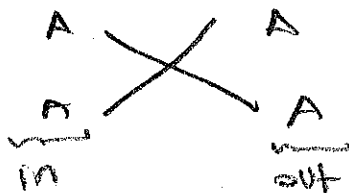


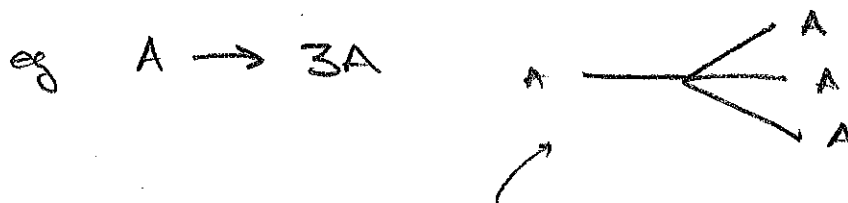
this is: an "in state" on the left
set of lines

on "out state" on the right

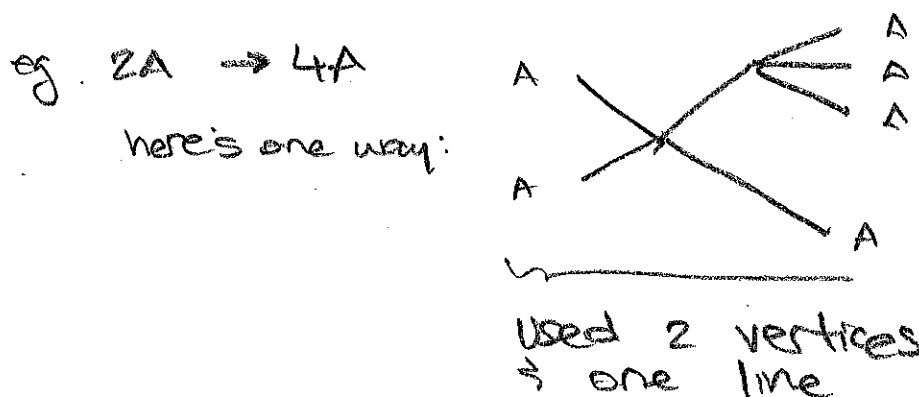
eg: $2A \rightarrow 2A$

easy! just use vertex





same vertex, but we can tug at the lines in different directions



Q: there are 3 other topologies w/ 2 vertices and 1 line

Q: there are more diagrams w/ more vertices & lines.

... so many! (turns out, we're doing perturbation theory... in what? in the vertex!)

DISC :

CAN YOU:

$A \rightarrow 2A$?
$2A \rightarrow 5A$?
$3A \rightarrow 10A$?
$4A \rightarrow 50A$?

} you have discovered a conservation law!

what do these diagrams mean?

→ AMPLITUDE for a process

$$P(2A \rightarrow 4A) = |AMP|^2 \sim |\sum \text{DIAGRAMS}|^2$$

ea diagram is code for a #