Thursday, 17 Jan

brought to you by the letters C O L L I S I O N S

Bruce Springsteen week

housekeeping

You're ^still doing great!

If you're behind, please see me after class

Questions from QS&BB readings due on the day after the lesson

isp220@pa.msu.edu is working now... thanks for pushing me

- please put "reading notes" in the subject

Any issues with MasteringPhysics? See me!

- The first MP homework will appear on Saturday night
- Refunding instructions are on the blog

You should be on Facebook...I've started announcing things

You should watch the course home page which is a Wordpress blog

- Okay. MSU has broken Feedburner. I'm looking for alternatives

Remember, I'm out of town on 1/24, so no class that day

aaackkk!

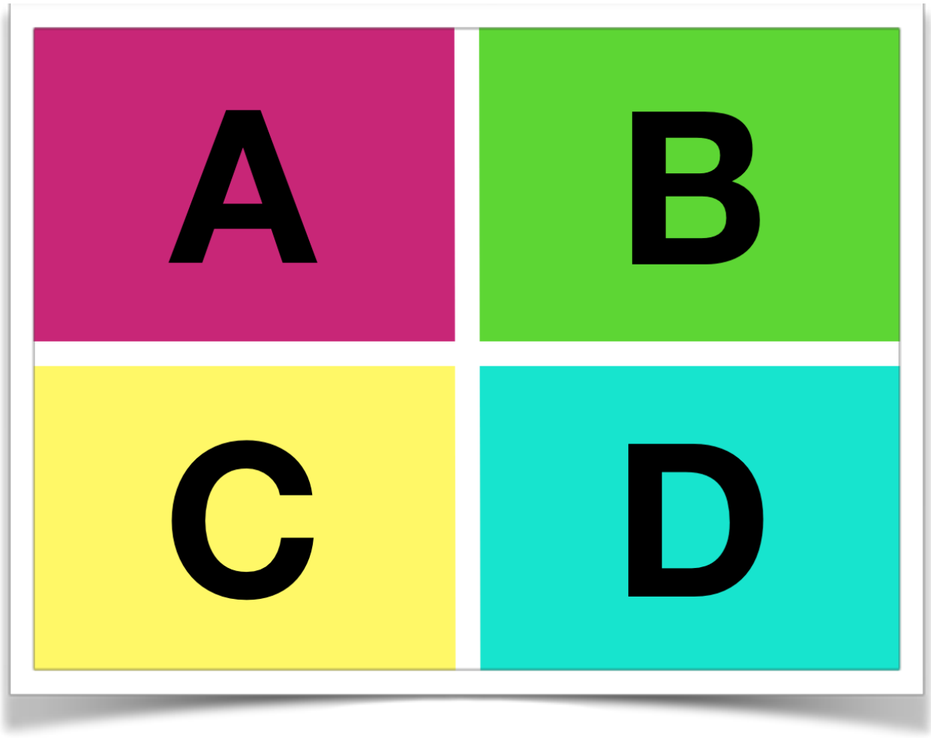
issue with LON-CAPA - hardware

typo in the Lesson 6 example right at 6.1

I'll fix it right after class

my face is red

"CAPER"* cards



The routine:

A

B

C

D

1. I ask a question with responses
2. You fold your card and put it on your forehead
3. Then you defend your answer to the person next to you
4. I might then ask a second time
5. "I don't know?" …show a blank square

Bring it to class or:

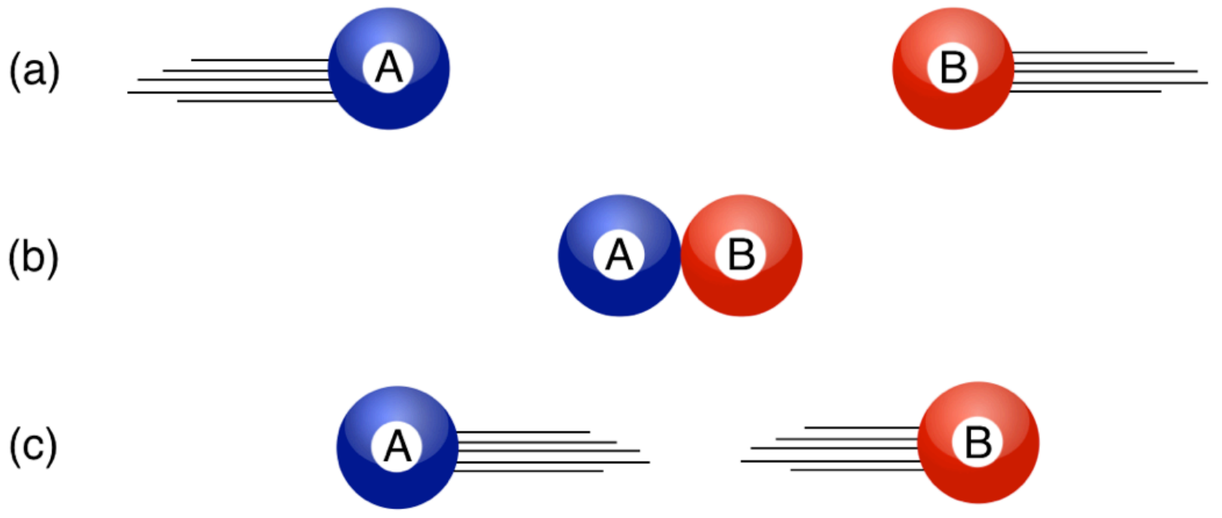
There's an app for that:

https://itunes.apple.com/us/app/capercard/id843445157?mt=8
https://play.google.com/store/apps/details?id=com.hexational.capercard&hl=en

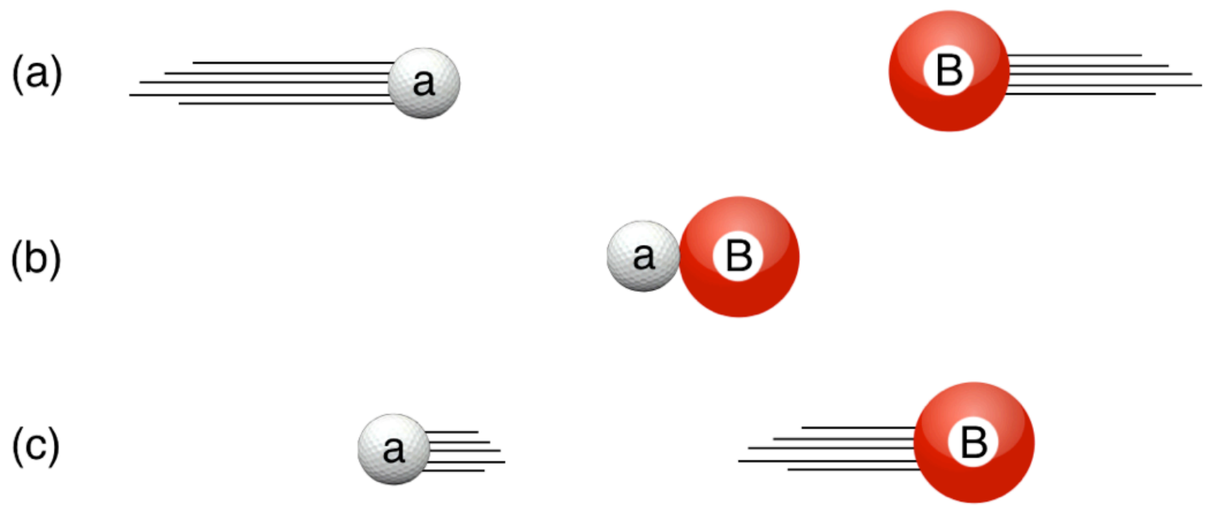
* "Center for Astronomy & Physics Education Research"

reading quiz

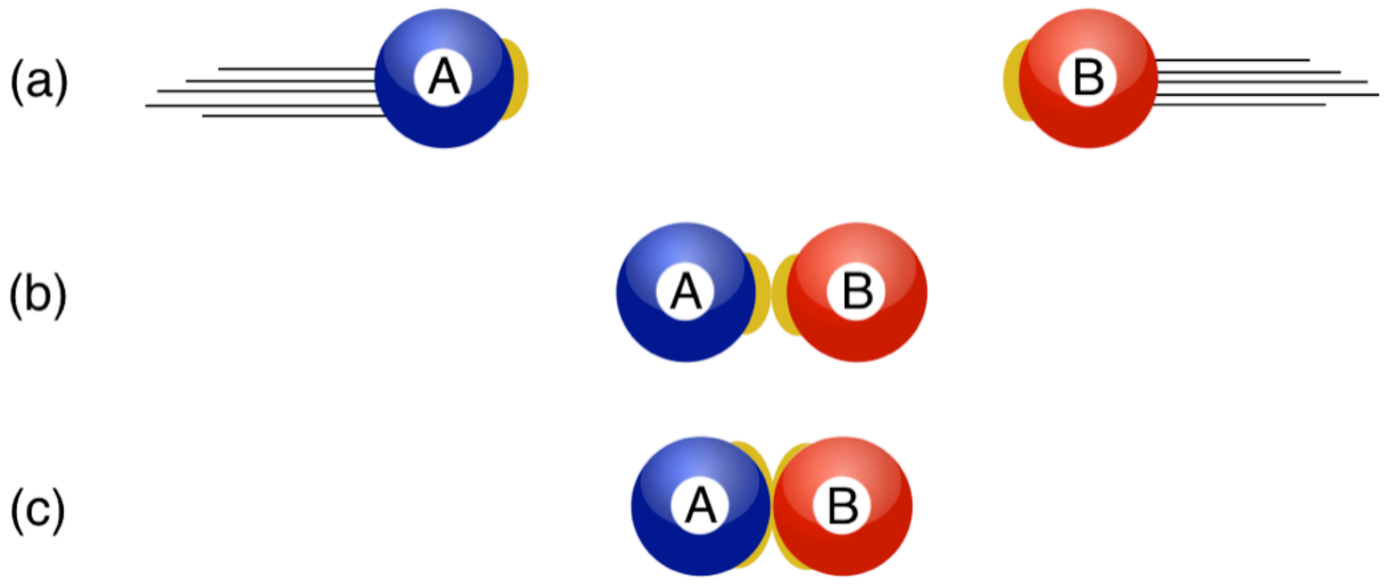
demonstrations



Collision 1: $\mathbf{A} + \mathbf{B} \rightarrow \mathbf{A} + \mathbf{B}$

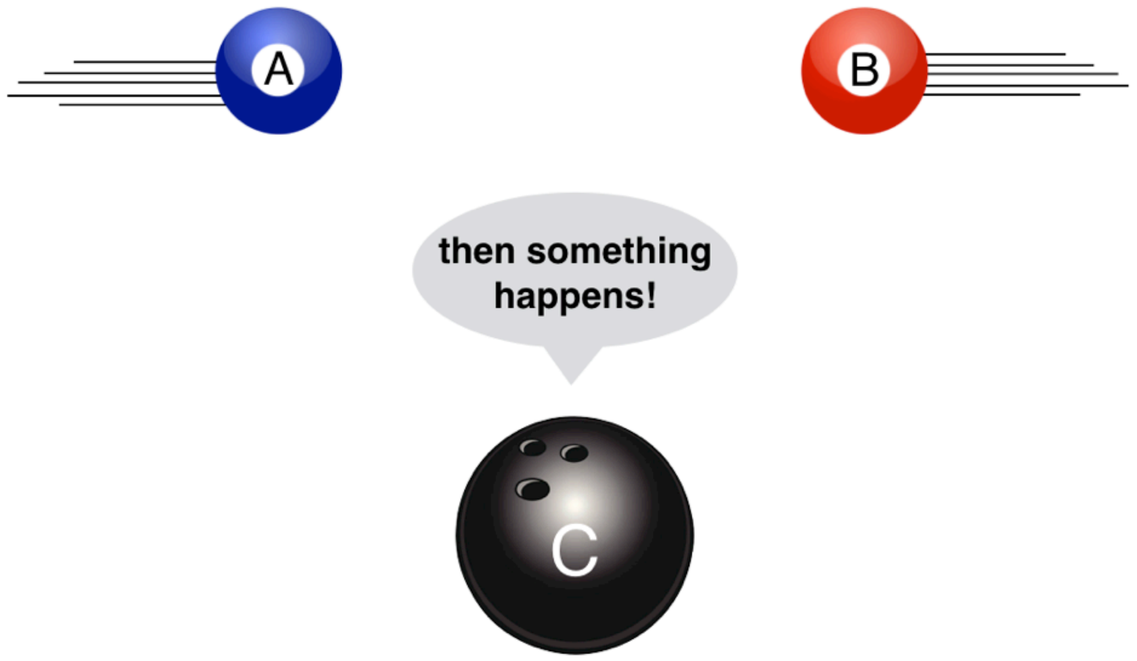


Collision 2: $\mathbf{a} + \mathbf{B} \rightarrow \mathbf{a} + \mathbf{B}$

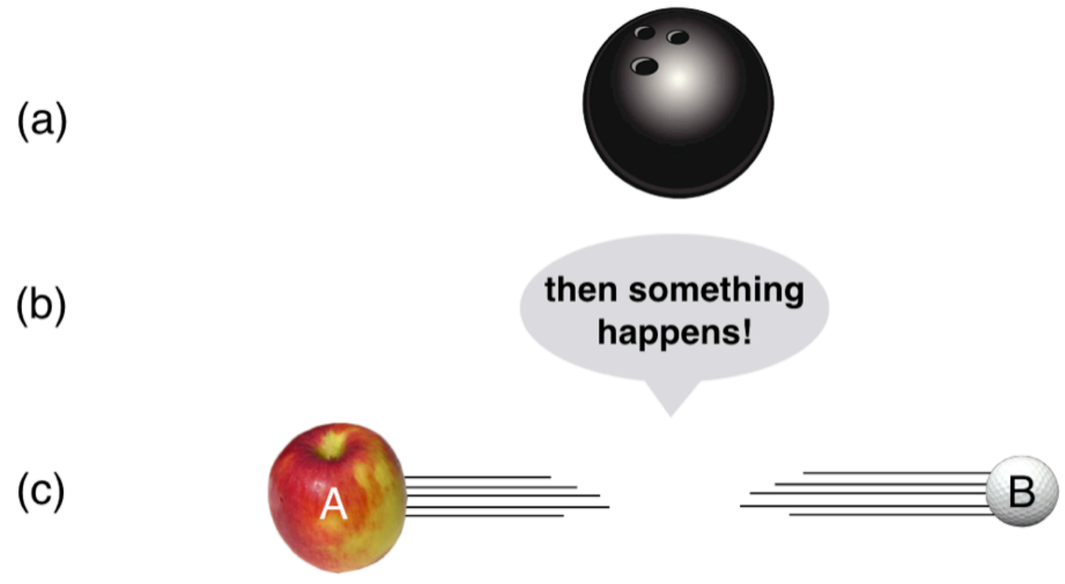


Collision 3 with glue: $\mathbf{A} + \mathbf{B} \rightarrow \mathbf{C}$ The glue is brown.

new physics!

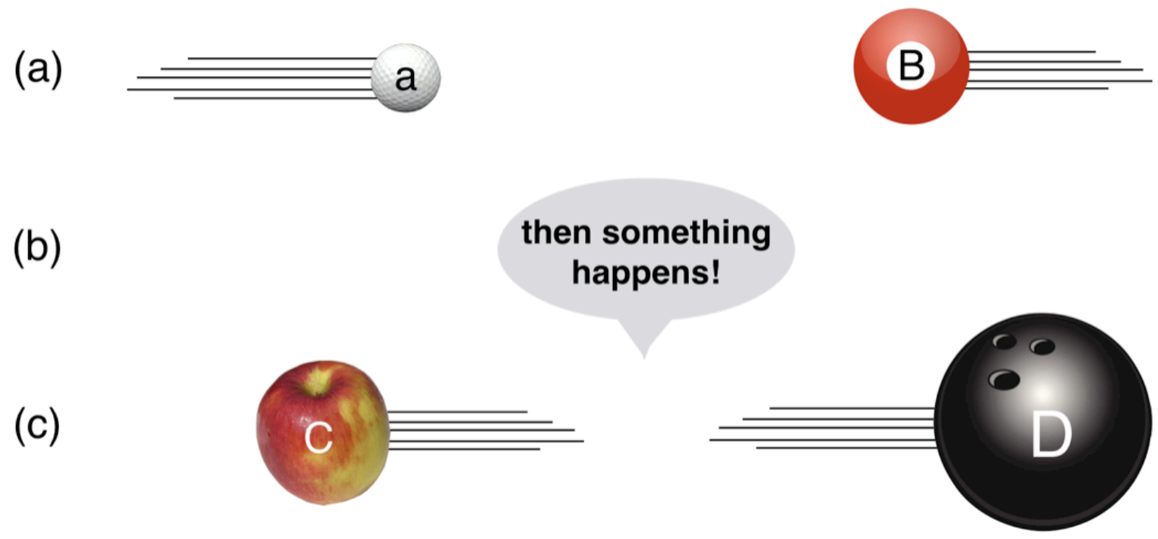


$\mathbf{A} + \mathbf{B} \rightarrow \mathbf{C}$ What you put in may not be what you get out of a quantum collision.



Collision 4: $\mathbf{C} \rightarrow \mathbf{a} + \mathbf{B}$, a quantum particle decay.

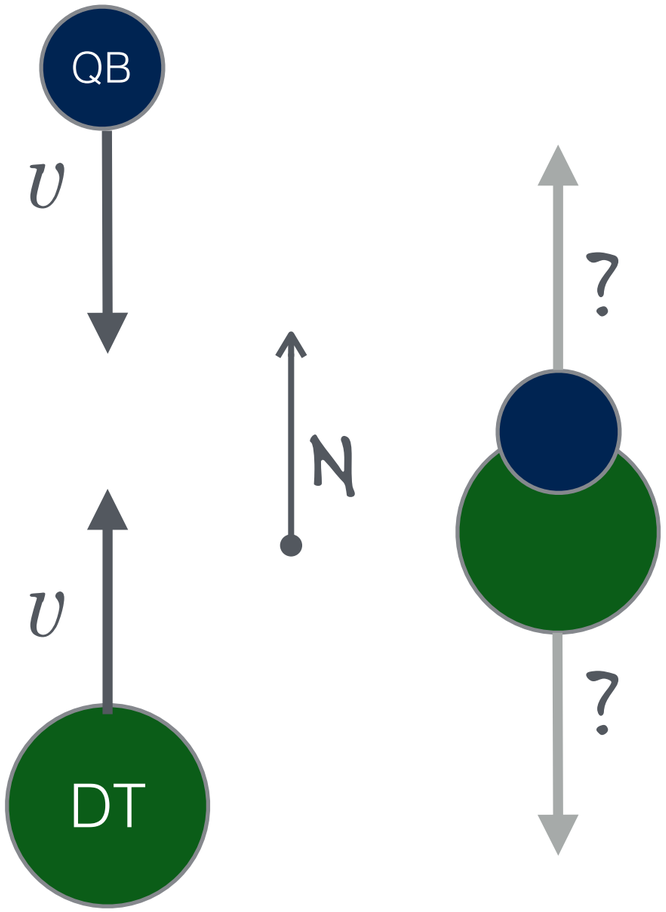
new physics!



Collision 5: $\mathbf{a} + \mathbf{B} \rightarrow \mathbf{c} + \mathbf{D}$, a very standard quantum particle collision.

some questions for all of us

answer, defend



A defensive tackle of mass 2 moving North tackles (and holds) a quarterback of mass 1 running at him with the same speed moving towards the South. What happens?

A they stop dead (no pun intended)

B The DT-QB mass moves North

C The DT-QB mass moves South

D don’t know

answer, defend

Same problem.

DT

mass, DT: $m_D = 2$

v_0(DT) = 2 North

QB

mass, QB: $m_Q = 1$

v_0(QB) = 2 South = -2 North

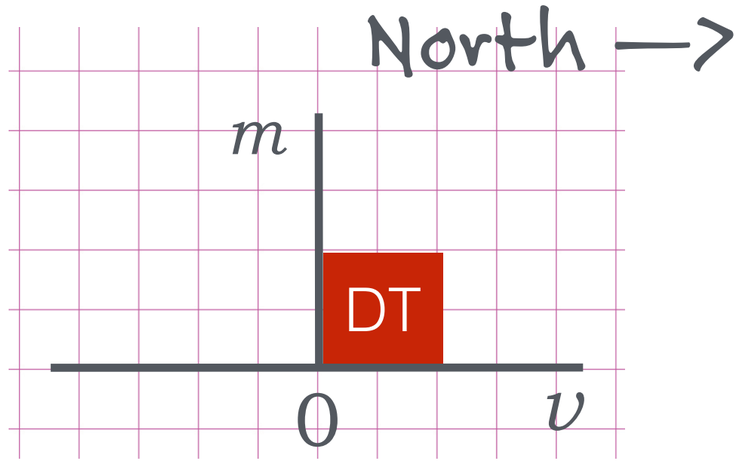
The initial DT momentum is best represented by:

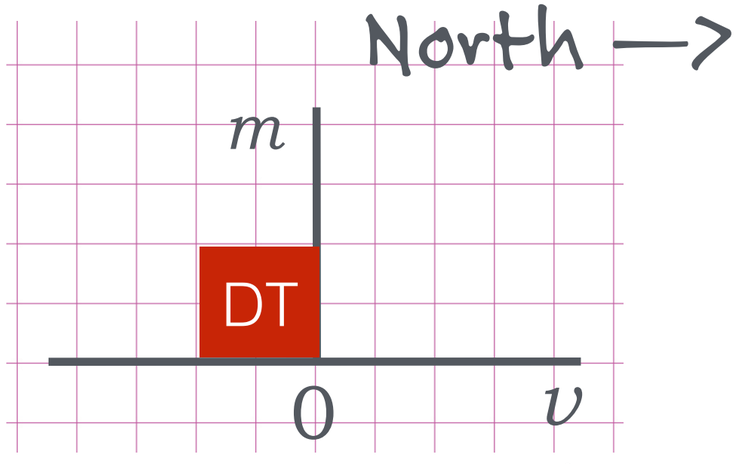
A

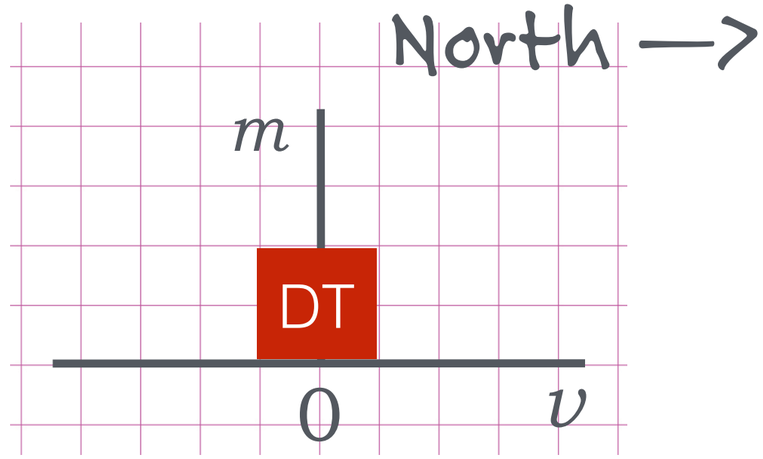
B

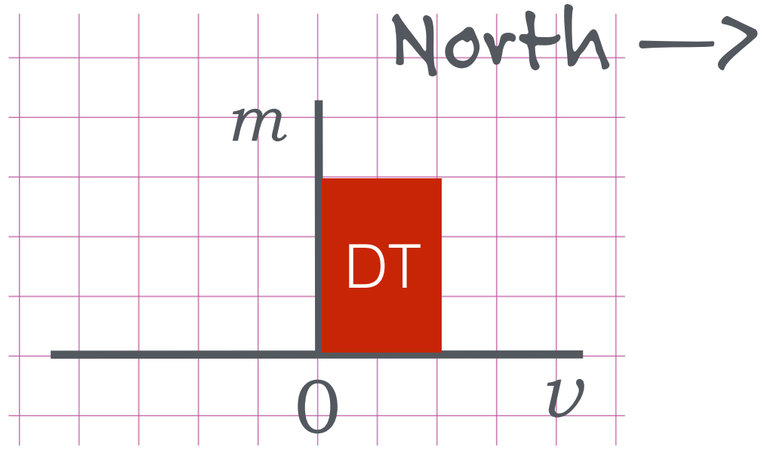
C

D









answer, defend

Same problem.

DT

mass, DT: $m_D = 2$

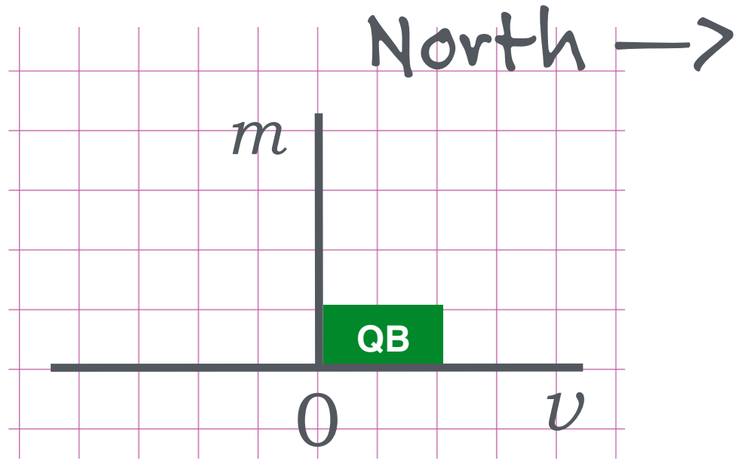
v_0(DT) = 2 North

QB

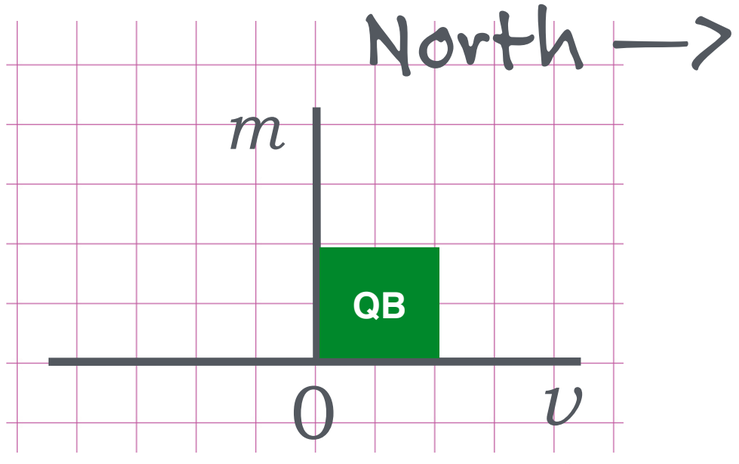
mass, QB: $m_Q = 1$

v_0(QB) = 2 South = -2 North

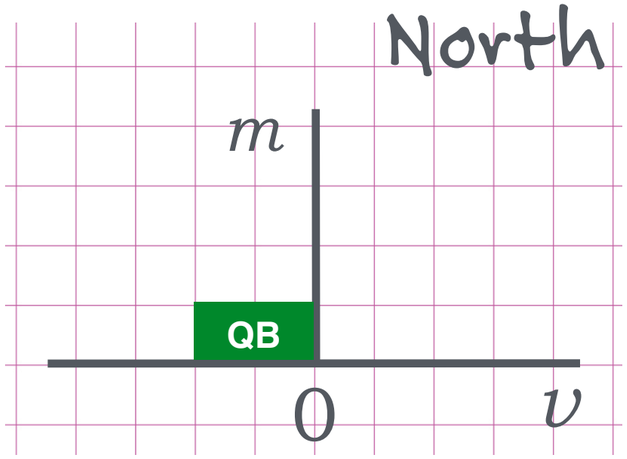
A



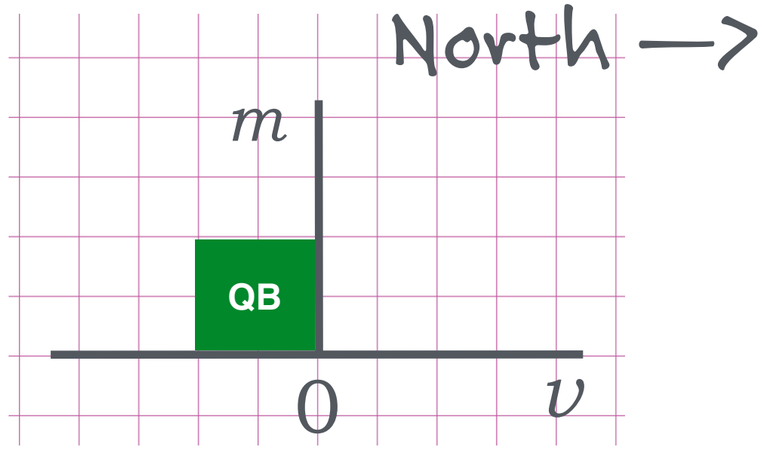
B



C



D



The initial QB momentum is best represented by:

answer, defend

Same problem.

DT

mass, DT: $m_D = 2$

$v_0(DT) = 2$ North

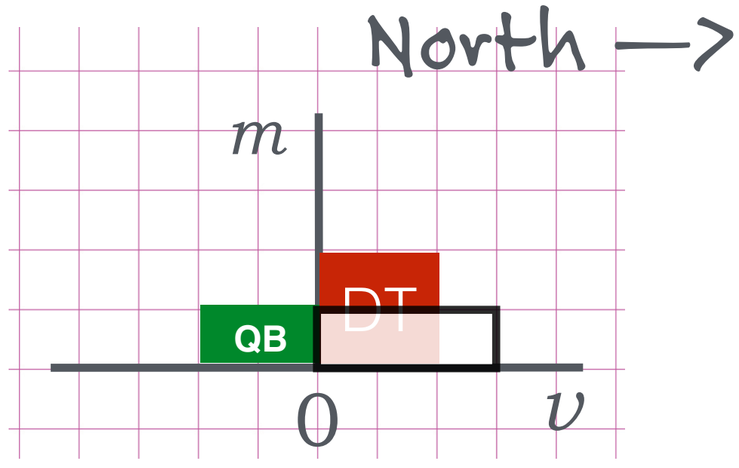
QB

mass, QB: $m_Q = 1$

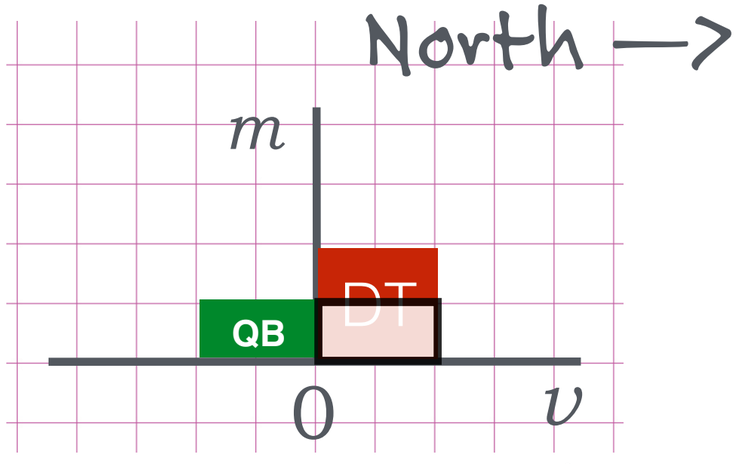
$v_0(QB) = 2$ South $= -2$ North

The combined DT-QB momentum is best represented by ☐ :

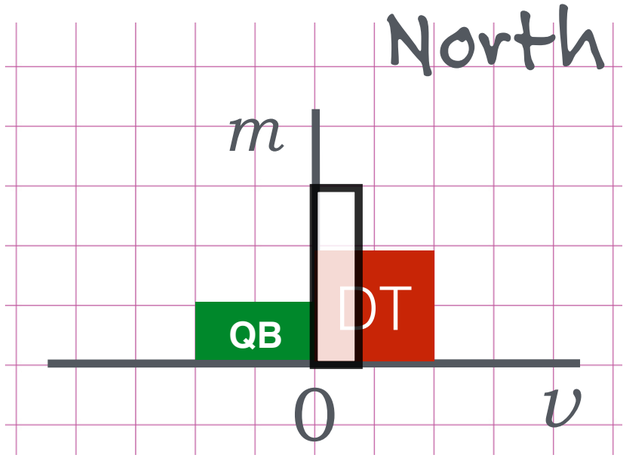
A



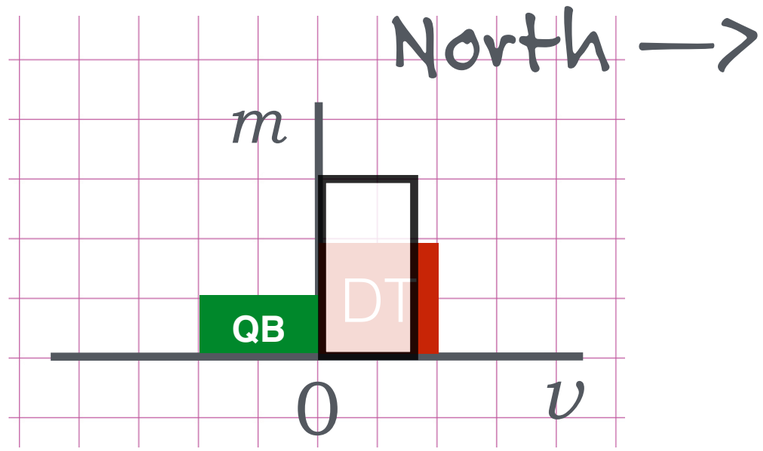
B



C



D



thermometer diagrams

answer, defend

Same problem.

DT

mass, DT: $m_D = 2$

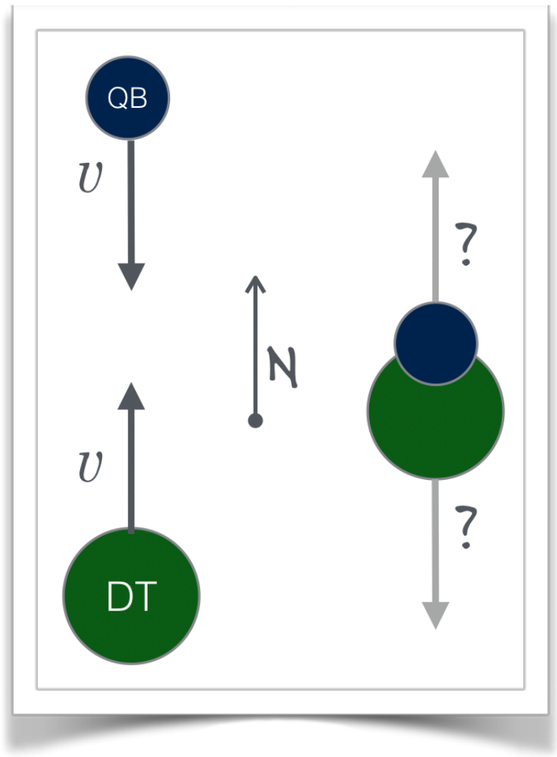
v_0(DT) = 2 North

QB

mass, QB: $m_Q = 1$

v_0(QB) = 2 South = -2 North

The initial momentum situation is best represented by:

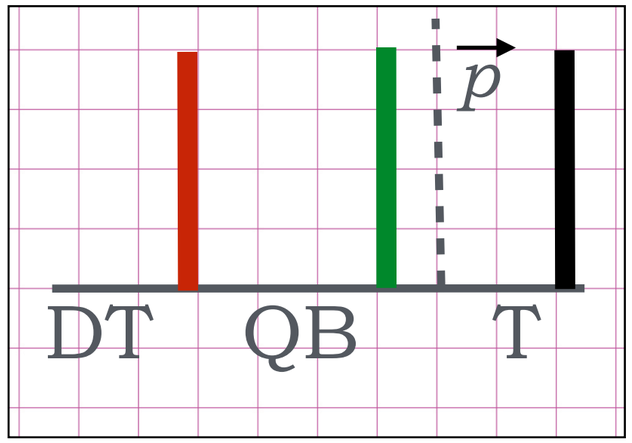


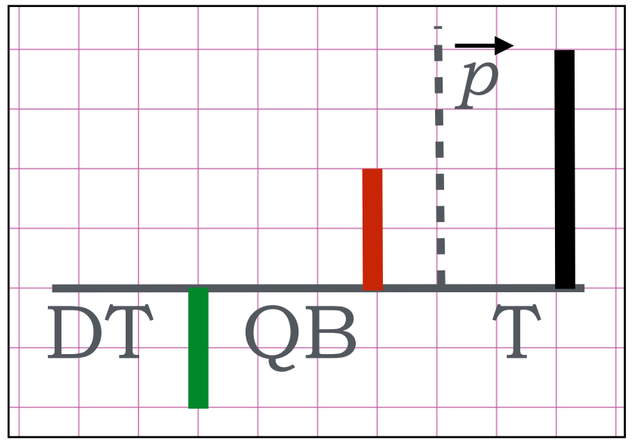
A

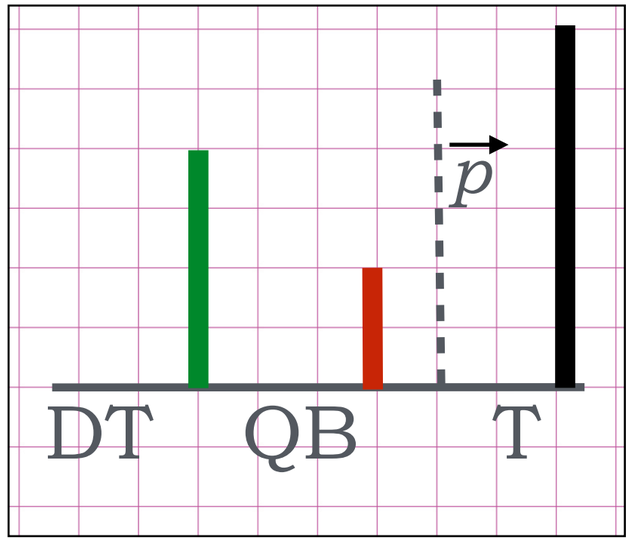
B

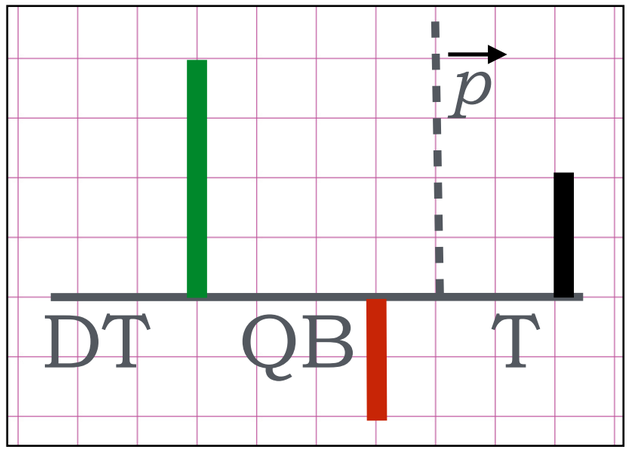
C

D

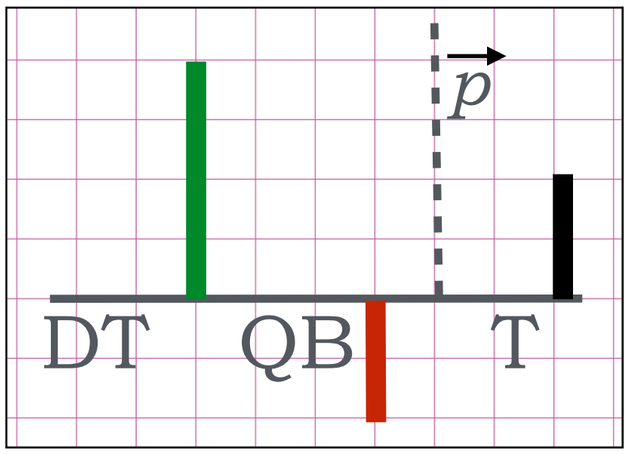








answer, defend



DT

mass, DT: $m_D = 2$

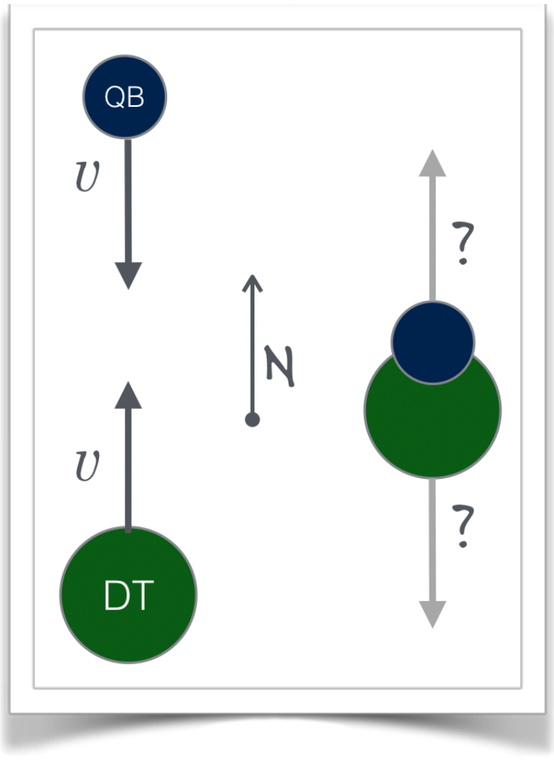
v_0(DT) = 2 North

QB

mass, QB: $m_Q = 1$

v_0(QB) = 2 South = -2 North

So, the momentum of the DT-QB combined object is what:



A 0

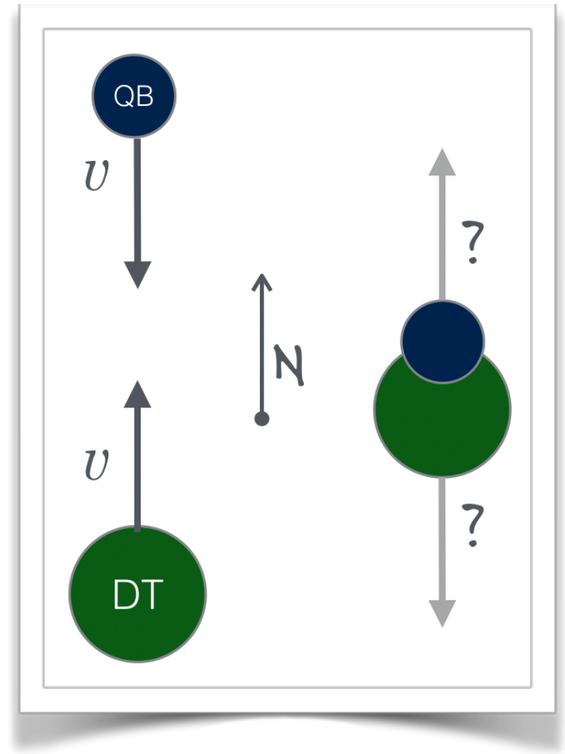
B 2

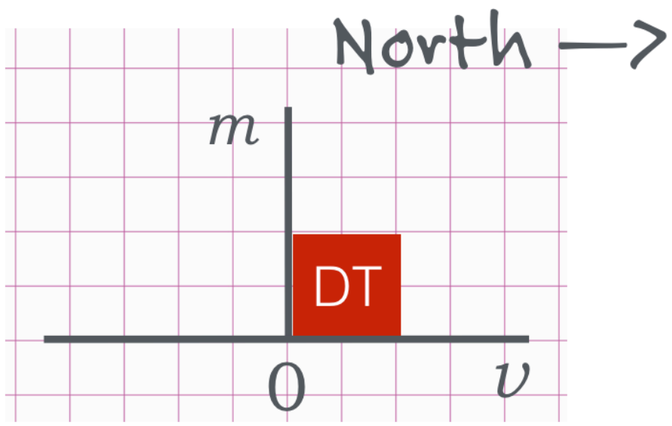
C 4

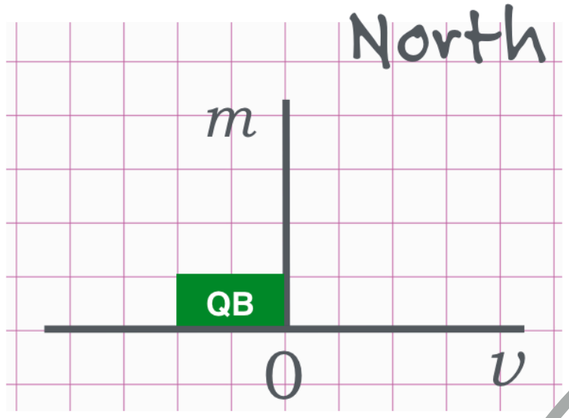
D don't know

what we just did is this:

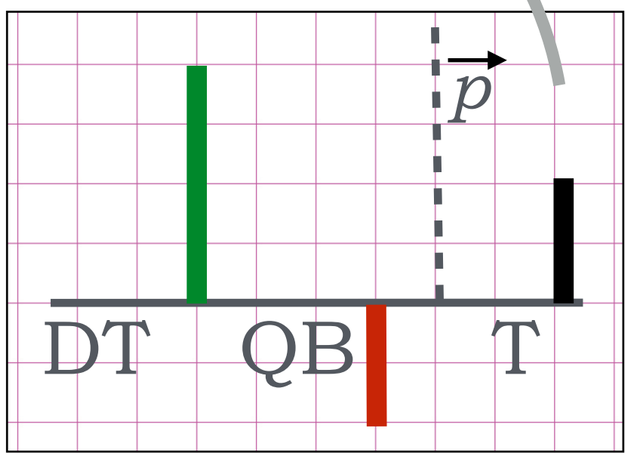
$$p_0(DT) + p_0(QB) = p(DT + QB)$$



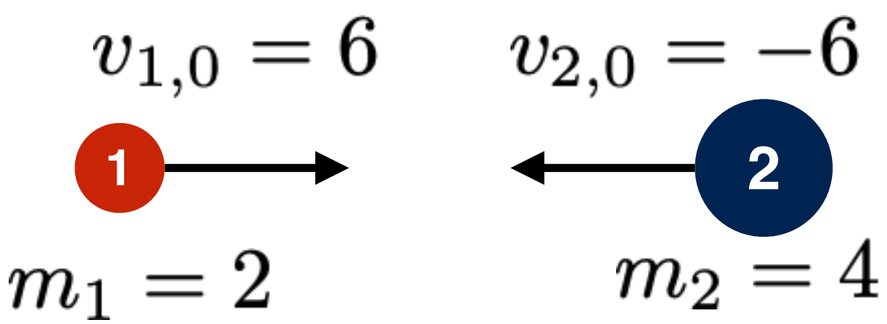




$$4 - 2 = 2 = p(DT + QB)$$



answer, defend



$$p_{1,0} + p_{2,0} =$$
$$(2)(6) + (4)(-6) =$$
$$12 - 24 =$$

The two momenta are:

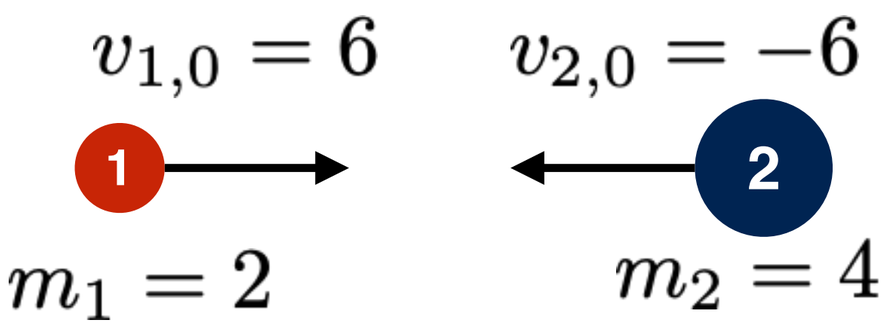
A 12 & -24

B 12 & 24

C 4 & -2

D don’t know

answer, defend



$$p_{1,0} + p_{2,0} =$$
$$(2)(6) + (4)(-6) =$$
$$12 - 24 = -12$$

The total momentum in the initial state is:

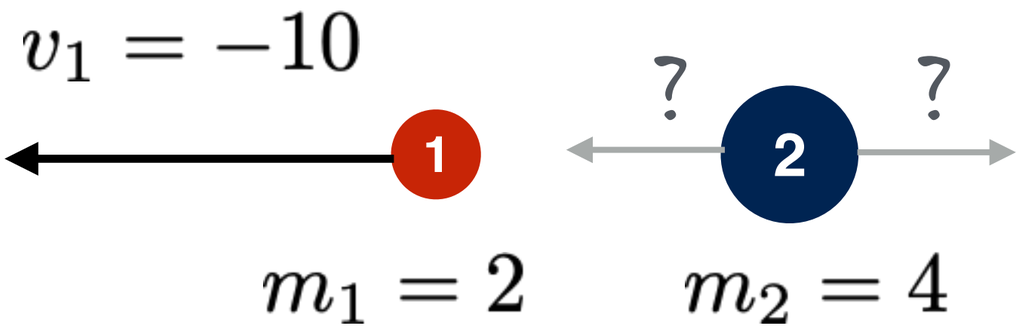
A 0

B 12

C -12

D don't know

answer, defend



this is what happens

The momentum of 1 after the collision is:

A 10

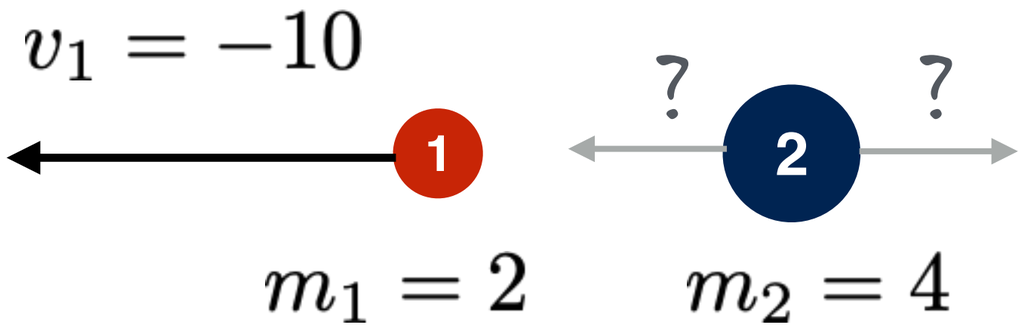
B -10

C -20

D 20

$$p_1 = (2)(-10) = -20$$

answer, defend



$$p_{1,0} + p_{2,0} =$$

$$(2)(6) + (4)(-6) =$$

$$12 - 24 = -12$$

$$p_1 = (2)(-10) = -20$$

The momentum of 2 after the collision is:

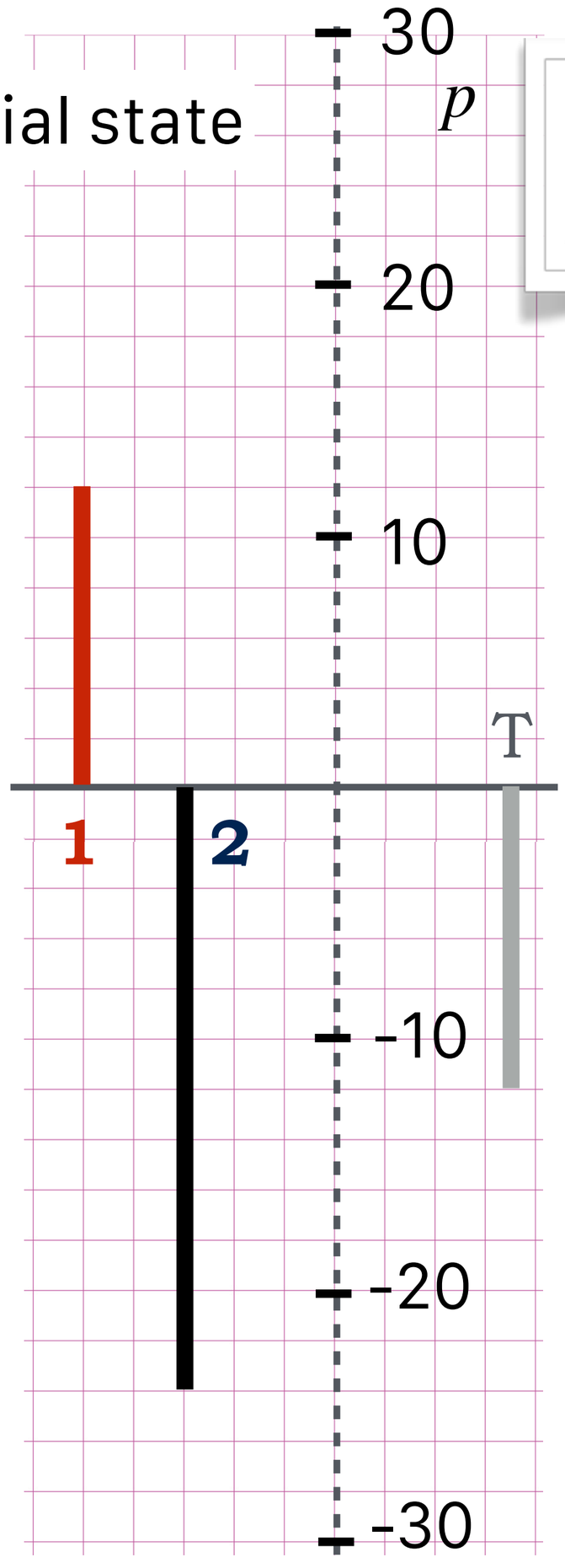
A 8

B -8

C -32

D 32

initial state



$v_{1,0} = 6$ $v_{2,0} = -6$

1 2

$m_1 = 2$ $m_2 = 4$

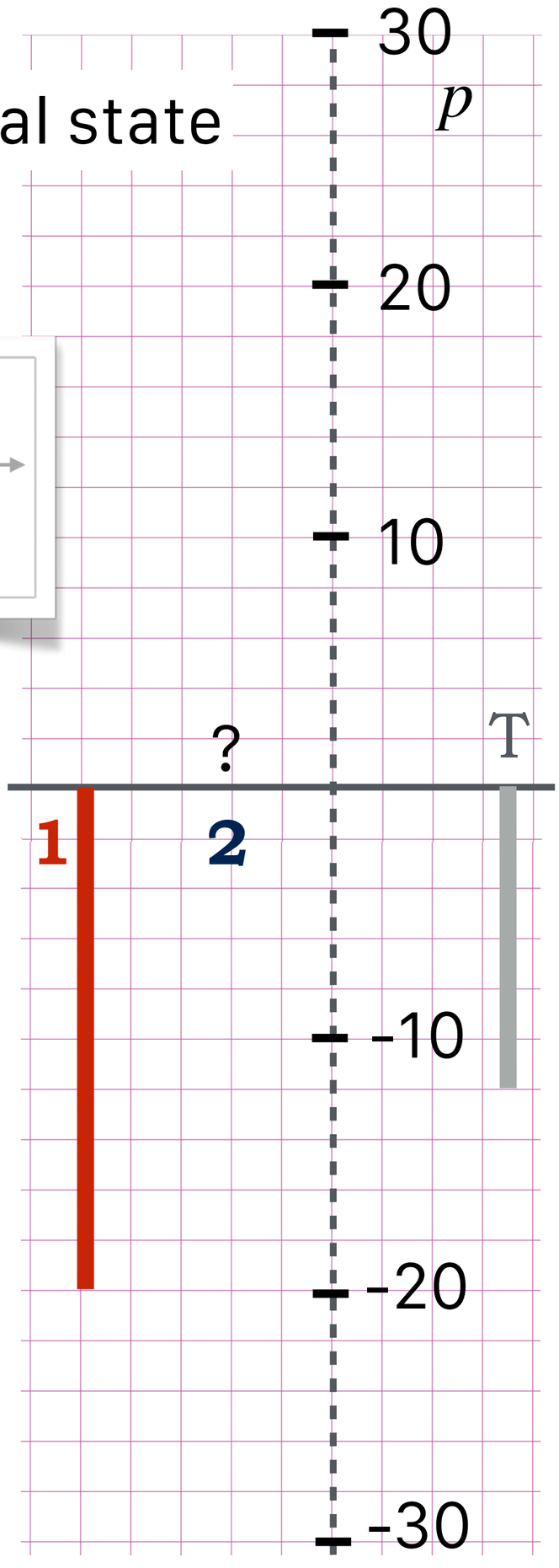
$v_1 = -10$

? ?

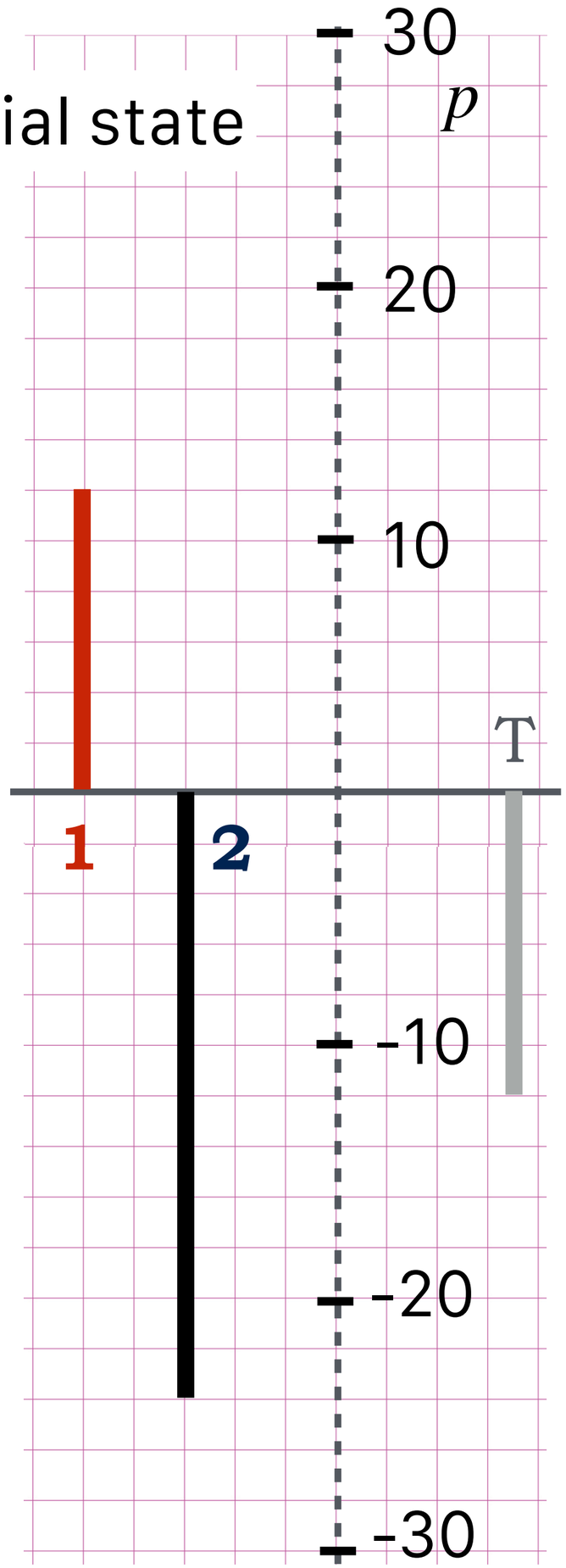
1 2

$m_1 = 2$ $m_2 = 4$

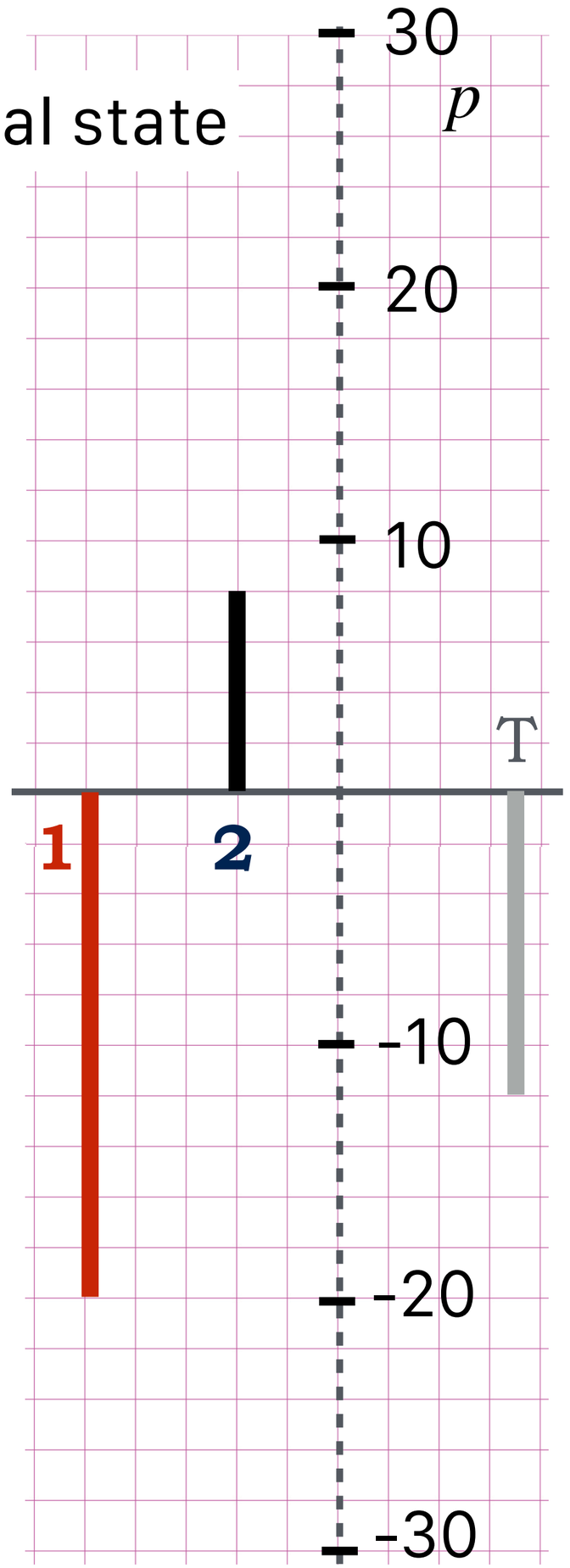
final state



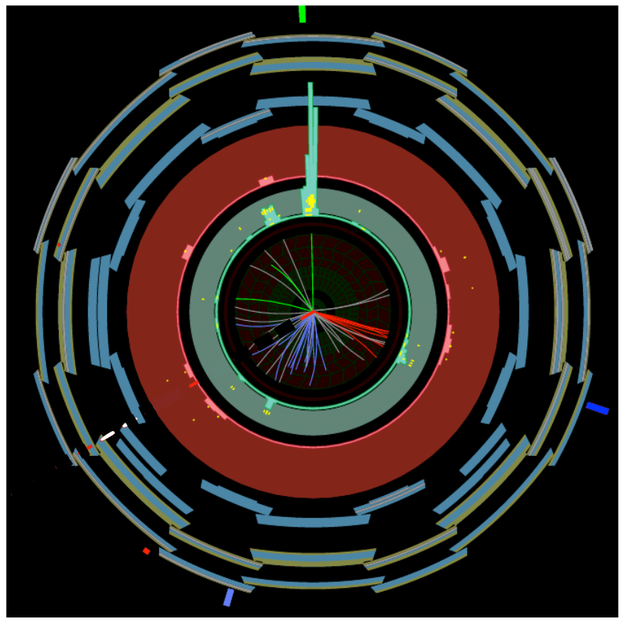
initial state

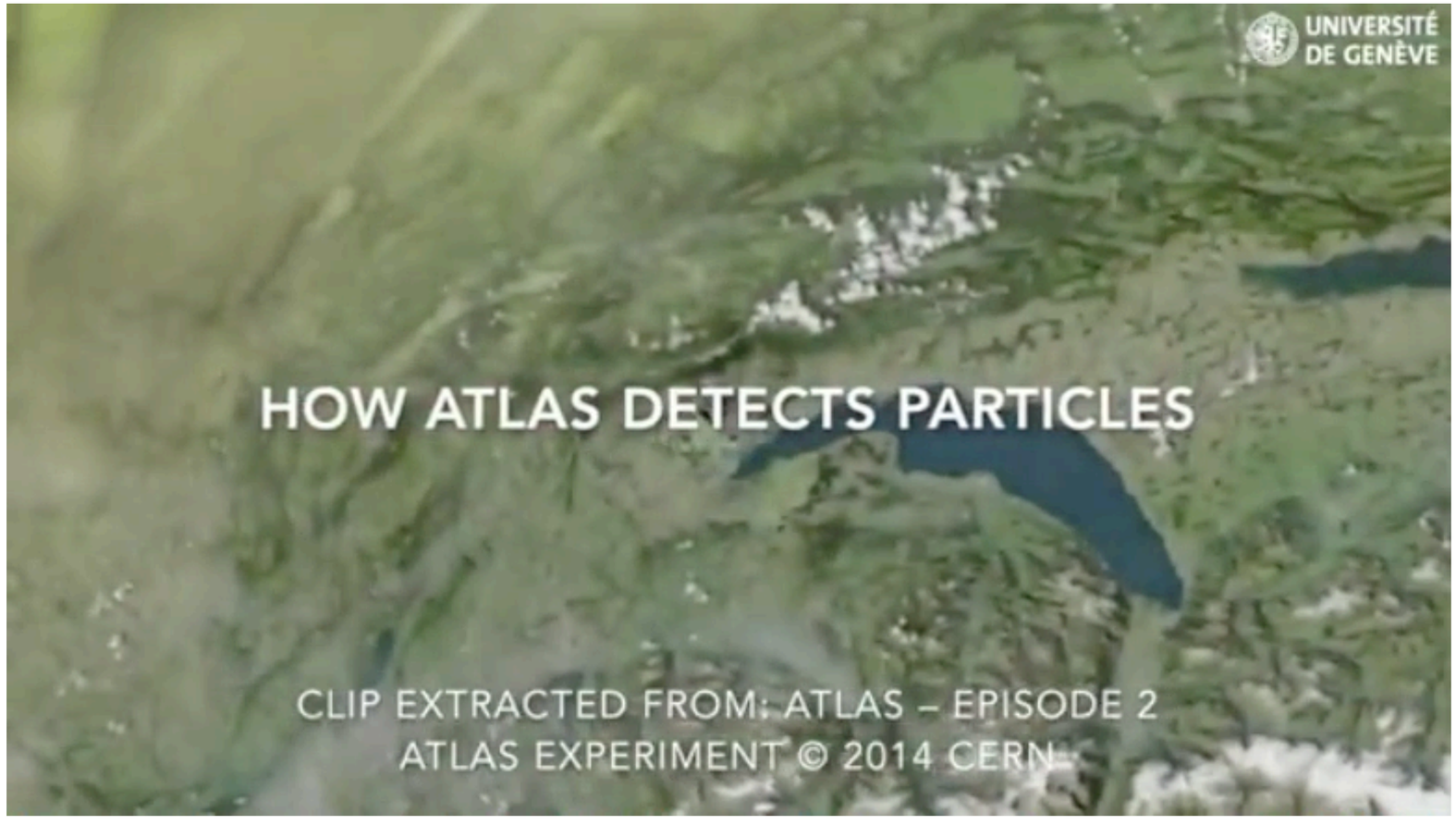


final state



ATLAS detector at CERN

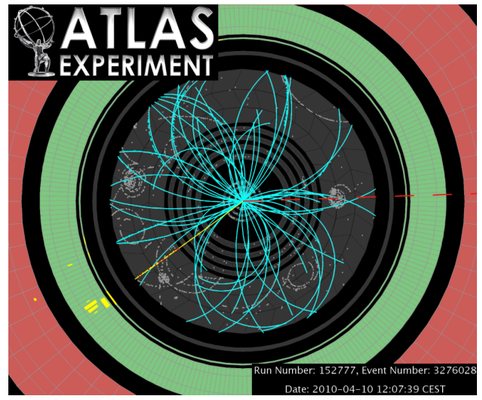




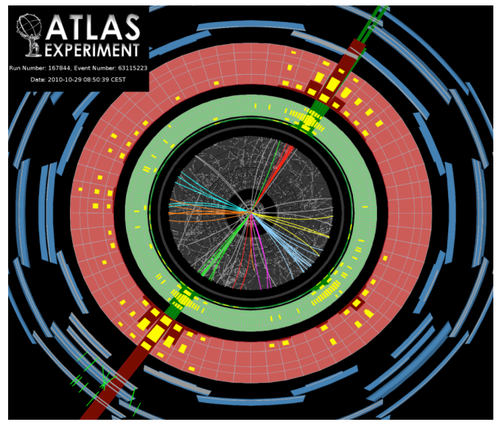
answer, defend

Which ATLAS event picture shows **momentum balanced** in the perpendicular plane?

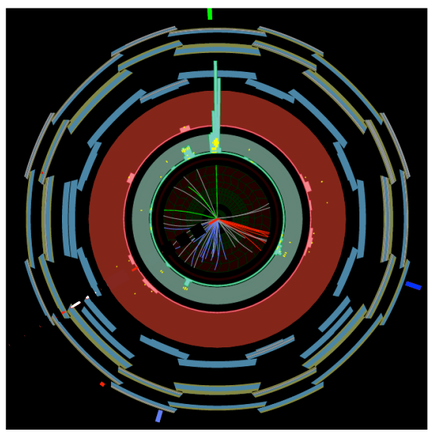
A



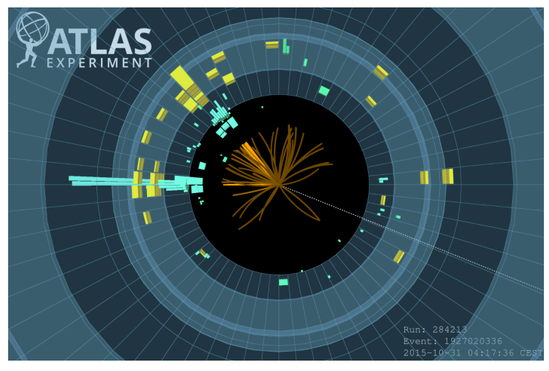
B



C

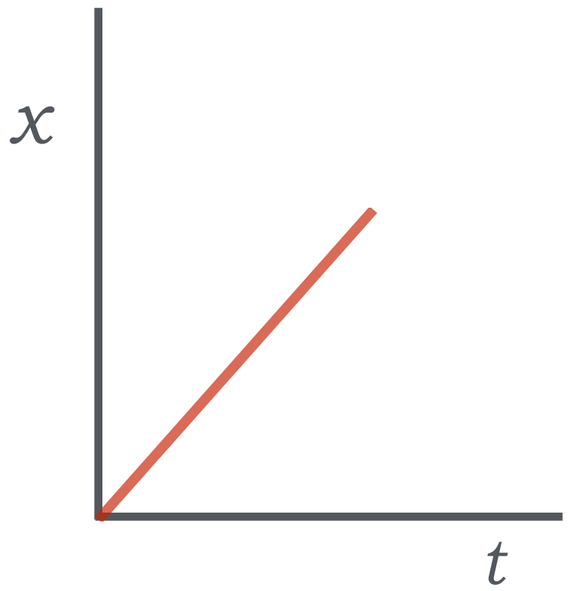


D



project

airplanes are not involved



A

B

C

D