7.6 MOMENERGY: THIS IS NOT YOUR MOM'S ENERGY 7.6 DIAGRAMS

Momenergy is a word used by Edwin Taylor and John Wheeler to describe the blending of energies and momenta for colliding relativistic particles. Momenergy can be expressed as a 4-vector, or as a simple series of vectors that add.

space-like part:	momentum of the object (p)
time-like part:	energy of the object. (E)
magnitude of the resultant :	the mass of the particle. (m)

$$E^2 - p^2 = m^2 \qquad E = m\gamma \qquad v_1 = \frac{p_1}{E_1} \qquad \gamma = \frac{1}{\sqrt{1 - v^2}} \qquad p = mv\gamma$$

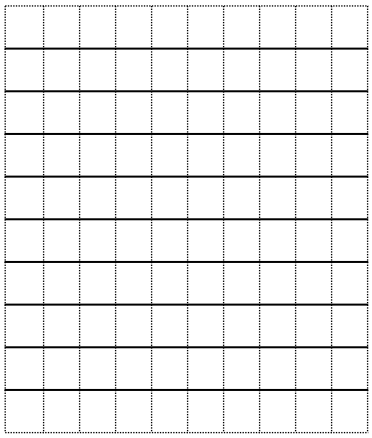
"ENERGIES ADD, MOMENTA ADD, MASSES DO NOT ADD." -Spacetime Physics, pg 224.

Let's look at a system of two colliding relativistic particles , one traveling at a velocity of .88c with a mass of 8 units and the other with a mass of 12 units and a velocity of -.38c.

Input the following values into the appropriate spaces on momenergy simulation.

Momentum of particle 1 =	15
Momentum of particle 2 =	-5
Mass of particle 1 =	8
Mass of particle 2 =	12

Draw the momenergy diagram here. Give the energy and momentum of each particle.



BEFORE

Energy of particle 1: _____

Momentum of particle 1: _____

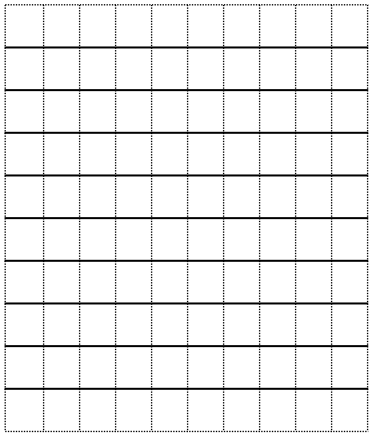
Energy of particle 2: _____

Momentum of particle 2: _____

Use $m = \sqrt{E^2 - p^2}$ to calculate the momenergy of each particle. Now use $m_{total} = \sqrt{E_{total}^2 - p_{total}^2}$ to find the total momenergy of the system of particles.

Notice that the momenergy of the individual particles is equal to their mass. How about for the system? Does the momenergy of the system equal the total mass? Explain.

Press play on the simulation. Draw the momenergy diagram of the particles after the collision. What do you notice about the total momenergy?



AFTER

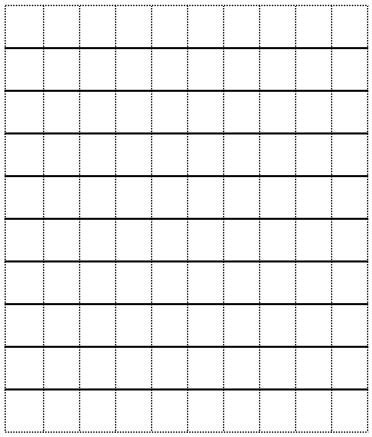
Energy of particle 1: _____

Momentum of particle 1: _____

Energy of particle 2: _____

Momentum of particle 2: _____

Now choose new values for the momentum and masses of the particles. Remember that in order to keep these particles as actual particles, their momentum can never be greater than their energy. Otherwise they would be moving faster than light.



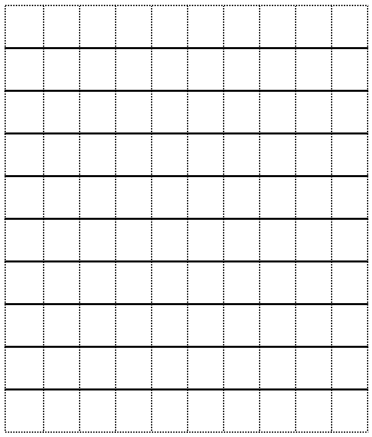
BEFORE

Energy of particle 1: _____

Momentum of particle 1: _____

Energy of particle 2: _____

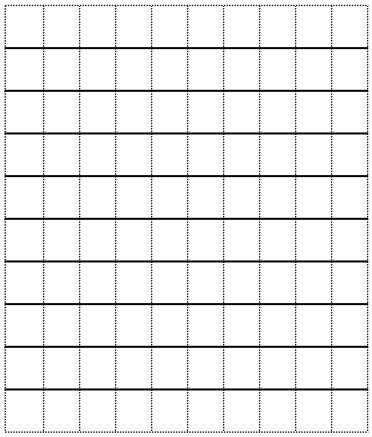
Momentum of particle 2: _____



DURING

Total Energy: _____

Total Momentum: _____



AFTER

Energy of particle 1: _____

Momentum of particle 1: _____

Energy of particle 2: _____

Momentum of particle 2: _____