Relative Momentum

Law of Conservation of Momentum

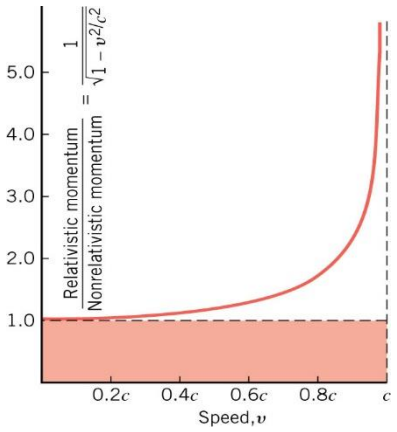
- The _____ momentum of a closed _____ does not _____.

$$p = mv$$

- However, when _____ approaches _____, we must adjust the _____

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

- _____ momentum is always _____ than _____ momentum because
- $\sqrt{1 - \frac{v^2}{c^2}} < 1$
- Since we _____ by the radical in the formula, the result is a _____ number.
- Notice that when the _____ is near 0, the _____ momentum is near the _____.
- When the speed is near c, the _____ momentum increases _____.



In a game of Dom'Jot, a small ball (0.5 kg) is hit across a table. If the ball moving at 3 m/s and the speed of light in a vacuum is 4 m/s, what is the relativistic momentum of the ball?

The nonrelativistic momentum?

Homework

1. Find the momentum of a helium nucleus having a mass of 6.68×10^{-27} kg that is moving at 0.200c. (OpenStax 28.35) $\mathbf{4.09 \times 10^{-19}\ kg\ m/s}$
2. What is the momentum of an electron traveling at 0.980c? (OpenStax 28.36) $\mathbf{1.35 \times 10^{-21}\ kg\ m/s}$
3. What is the velocity of an electron that has a momentum of 3.04×10^{-21} kg·m/s? Note that you must calculate the velocity to at least four digits to see the difference from c. (OpenStax 28.39) $\mathbf{2.988 \times 10^{8}\ m/s}$
4. Find the velocity of a proton that has a momentum of 4.48×10^{-19} kg·m/s. (OpenStax 28.40) $\mathbf{2.00 \times 10^{8}\ m/s}$
5. (a) Calculate the speed of a 1.00-μg particle of dust that has the same momentum as a proton moving at 0.999c. (b) What does the small speed tell us about the mass of a proton compared to even a tiny amount of macroscopic matter? (OpenStax 28.41) $\mathbf{1.12 \times 10^{-8}\ m/s}$**, mass of proton is tiny**