VELOCITY ADDITION: CHASING SPACE PIRATES

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References: Griffiths, David J. (2007), Introduction to Electrodynamics, 3rd Edition; Pearson Education - Chapter 12, Post 4.

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The velocity addition formula in special relativity is (if $\mathbf{v}_a$ and $\mathbf{v}_b$ are parallel):

$$v_r = \frac{v_a + v_b}{1 + v_a v_b / c^2} \tag{1}$$

Example. Suppose some space pirates are fleeing from the solar system police in a spacecraft that is moving at $\frac{3}{4}c$ (relative to the Earth). The police's spaceship is travelling at only $\frac{1}{2}c$ but in an attempt to stop the pirates they fire a torpedo at them. The torpedo's velocity, relative to the police's ship, is $\frac{1}{3}c$. Using the classical velocity addition formula, the velocity of the torpedo relative to the Earth is

$$v_c = \frac{1}{2}c + \frac{1}{3}c = \frac{5}{6}c = \frac{10}{12}c \tag{2}$$

Since this is greater than $\frac{3}{4}c = \frac{9}{12}c$, the torpedo will eventually overtake the pirates' ship.

However, using the relativistic formula 1, the velocity of the torpedo relative to the Earth is

$$v_r = \frac{\frac{1}{2}c + \frac{1}{3}c}{1 + \frac{1}{6}} = \frac{5}{7}c = \frac{20}{28}c \tag{3}$$

This is less than $\frac{3}{4}c = \frac{21}{28}c$ so the torpedo will never catch the pirates.

PINGBACKS

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