

### Answer on Question #37640 – Physics - Electrodynamics

**Question:** two electron beams travel along the same straight line but in opposite directions with velocities  $0.9 c$  relative to the laboratory system. Find the relative velocity  $v$  of the electron as measured by an observer at rest in the laboratory and also by an observer moving together with one of the electron beams.

**Solution:** velocities of the electron beams relative to the laboratory system are  $v_1 = 0.9 c$  and  $v_2 = -0.9 c$ .

- 1) Relative velocity  $v$  of the electron as measured by an observer at rest in the laboratory can be calculated using formula

$$v = \frac{v_1 - v_2}{1 - \frac{v_1 v_2}{c^2}} = \frac{0.9c + 0.9c}{1 + 0.81} = \frac{1.8}{1.81} c = 0.99 c.$$

- 2) Relative velocity  $v$  of the electron for an observer moving together with one of the electron beams is the velocity of the second beam relative to the system bounded with the first beam. This system moves with velocity  $v_1$ . The relative velocity (using relativistic velocity addition) is thus ( $V$  is the velocity of reference frame):

$$v = \frac{V - v_2}{1 - \frac{V v_2}{c^2}} = \frac{v_1 - v_2}{1 - \frac{v_1 v_2}{c^2}} = 0.99 c.$$

**Answer:**  $v = 0.99 c$ .