

Relativity Assignments

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1 Einstein's velocity addition

In this problem, you will derive the velocity addition rule in relativity using Lorentz transformations. Consider a particle A in the frame B. Her velocity w.r.t frame B is V_{AB} . In another frame C moving w.r.t B with a velocity V_{CB} . Show that the velocity of A w.r.t to the frame C using **Lorentz transformation**:

$$V_{AC} = \frac{V_{AB} + V_{BC}}{1 + (V_{AB}V_{BC}/c^2)} \quad (1)$$

(**Hint** : You can use consider the velocity to be $u = \frac{dx}{dt}$ in the frame B and then write the lorentz transformation equations for dx and dt to the frame C where these become $d\bar{x}$ and $d\bar{t}$)

2 Superluminal Motion

Astronomers observed radio galaxies moving with velocities exceeding the velocity of c! M87 is an example in the Virgo cluster The distance to this galaxy, M87, is about $D = 62$ million light years. One can use this distance to convert angular separations into linear separations across the line of sight.

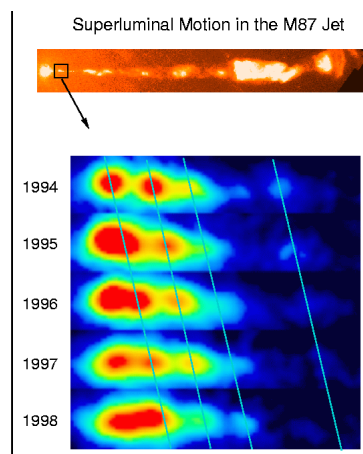


Figure 1: Blobs

Now, look at one of the blobs: the innermost one, which appears most clearly in 1996 and 1997. Calculate the velocity of the blob. It looks like it is moving more than $10\ c$! Hold on a minute! Isn't this against special relativity postulate 2 ?