

Exercise 10 - TFY4345 Classical Mechanics

2020

1 Velocity addition and Lorentz transformation matrices

Suppose three inertial systems S , S' and S'' are moving with collinear motion along their respective x_1 -axes. Let the velocity of S' relative S be v_1 , and the velocity of S'' relative S' be v_2 . Write down the Lorentz transformation matrices L and L' corresponding to the transformations $S \rightarrow S'$ and $S' \rightarrow S''$. Use these to derive Einstein's addition rule based on the matrix elements of the transformation matrix L'' corresponding to $S \rightarrow S''$.

[See also Exam 2018 (December), problem 3, where S' moves in z -direction and S'' moves in the x' direction.]

2 Light from a fluorescent tube

[Exam 2016]

A fluorescent tube lamp is stationary in a reference frame S , parallel to the z axis. The tube lights up simultaneously (in S) along its entire length L_0 at the time $t = 0$. (ER DET t=0 ELLER t?) The tube has one end at $z = 0$, and the other at $z = L_0$. Consider an observer in a reference system S' moving with a velocity v in the z -axis.

a) We now consider two spacetime events in S , the lighting up of the tube in position z at time t , and in position $z + \Delta z$ also at time t . Use the Lorentz transformation to calculate the spacetime coordinates of these two events in the S' frame, $(z'$ at time $t')$ and $(z' + \Delta z'$ at time $t' + \Delta t')$.

b) For