Physics UN2802 Professor Christ
due 01/28/2021

Assignment #13

Reading:

Jan 26 Purcell Chapter 4.5-4.11, 5.1-5.3
Jan 28 Purcell Chapter 5.6-5.9

Problems:

104. Purcell 1.33

105. Purcell 2.18

106. Purcell 2.19

107. Purcell 2.20

108. Purcell 3.10

109. Purcell 3.11

110. Purcell 4.3

111. Purcell 4.5

112. Purcell 4.7

113. Consider two reference systems Σ and Σ' with parallel coordinate axes and Σ' moving with velocity v in the $+x$ direction with respect to Σ. Recall that the coordinates (x,t) and (x',t') of the same event as located in Σ and Σ' are related by the Lorentz transformation:

$$\begin{aligned} x' &= \gamma(x-\beta ct) \\ ct' &= \gamma(ct-\beta x) \end{aligned}$$

with $\beta = v/c$ and $\gamma = 1/\sqrt{1-\beta^2}$. Consider a scalar function $f(x,t) = f'(x',t')$ and show by explicit use of the chain rule that the pairs:

$$\left(\frac{\partial f(x,t)}{\partial x}, -\frac{\partial f(x,t)}{\partial ct}\right) \quad \text{and}$$
$$\left(\frac{\partial f'(x',t')}{\partial x'}, -\frac{\partial f'(x',t')}{\partial ct'}\right)$$

are related to each other by exactly the same equations as those written above connecting (x,t) and (x',t'). (Note the all-important minus sign appearing in front the derivatives with respect to t and t'.)