Physics UN2801 Professor Christ
due 12/3/2020

Assignment #10

Reading:

Nov 24	Kleppner and Kolenkow Ch 8
Dec 1	Purcell Ch. 1.1-1.8
Dec 3	Purcell Ch. 1.9-1.15

Problems:

77. Kleppner and Kolenkow 14.1

78. Kleppner and Kolenkow 14.2

79. Kleppner and Kolenkow 7.4

80. Kleppner and Kolenkow 7.8

81. Kleppner and Kolenkow 7.13

82. Kleppner and Kolenkow 7.17

83. Kleppner and Kolenkow 7.18

84. Kleppner and Kolenkow 7.21

85. The reference system Σ' moves with respect to the system Σ with velocity $\vec{v}$ parallel to the x-axis. Consider a particle of mass m which moves with velocity $\vec{u}'$ in Σ', also parallel to the x-axis. Its four-momentum $\underline{p}'$ in Σ' has components $\underline{p}' = \gamma_{u'}(mu', 0, 0, mc)$, where $\gamma_{u'} = 1/\sqrt{1 - u'^2/c^2}$.

    (a) From the definition of four-momentum, we know that the four components of the momentum transform as a four-vector. Use the transformation properties of a four-vector to write down each of the components of the particle's four-momentum as seen in the system Σ in terms of those listed above in the system Σ'.

    (b) A particle's velocity can be easily obtained from its four momentum by taking the ratio of the spatial and time components of the four momentum. Use this fact and your result from part (a) to relate the velocity of the mass m in Σ to that in Σ'. (You should obtain the familiar formula relating the velocities u and u' of m in these two reference frames.)

    (c) Begin with the formula expressing the four-momentum in Σ in terms of the velocity $\vec{u}$ and use the result from part (b) to replace the velocity u by its expression in terms of the velocity u'. Show that the resulting equations expressing p_x and p_4 in terms of m and u' agree with agree with those determined in part (a).