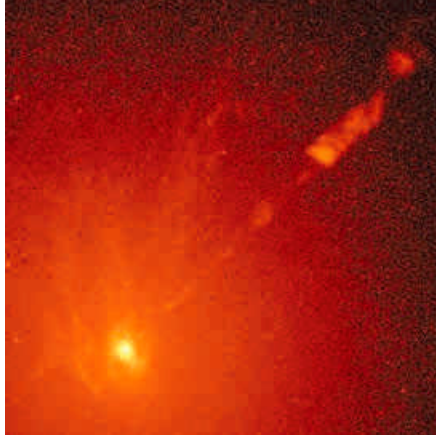


LUMS School of Science and Engineering  
PHY201 Modern Physics – Assignment # 2

Q.1 The figure below shows a jet of material (at the upper right) being ejected by galaxy M87 (at the lower left). Such jets are believed to be evidence of supermassive black holes at the center of a galaxy. Suppose two jets of material from the center of a galaxy are ejected in opposite directions. Both jets move at  $0.750c$  relative to the galaxy center. Determine the speed of one jet relative to the other.



Q.2 A red light flashes at position  $x_R = 3.00 \text{ m}$  and time  $t_R = 1.00 \times 10^{-9} \text{ s}$ , and a blue light flashes at  $x_B = 5.00 \text{ m}$  and  $t_B = 9.00 \times 10^{-9} \text{ s}$ , all measured in the S reference frame. Reference frame  $S'$  moves uniformly to the right and has its origin at the same point as S at  $t = t' = 0$ . Both flashes are observed to occur at the same place in  $S'$ . (a) Find the relative speed between S and  $S'$ . (b) Find the location of the two flashes in frame  $S'$ . (c) At what time does the red flash occur in the  $S'$  frame?

Q3. How much work must be done to increase the speed of a particle of mass from  $0.2c$  to  $0.3c$ ? From  $0.8c$  to  $0.9c$ ? In each case the increase in speed is the same amount, so why is the work done different?

Q.4 Do question 29 of Serway, pg 1180.

Q.5 Do question 49 of Serway, pg 1180.

Q.6 Do question 51 of Serway, pg 1181.

Q.7 Do question 52 of Serway, pg 1181.