A4_7 Tipler in my back pocket

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Abstract

This paper determines the speed needed for an observer to travel at for them to believe that the book *Physics for Scientists and Engineers* by Tipler and Mosca could fit into an average sized back pocket, due to special relativitic effects. This value was then compared to the speed needed for the Elizabeth Tower to fit in one's back pocket. The speeds determined were $0.619 \pm 1\times10^{-3}$ c and $0.998886 \pm 2 \times10^{-6}$ c for Tipler and the Elizabeth Tower respectively.

Introduction

Physics for Scientists and Engineers Volume 6 by Tipler and Mosca (from here onward referred to as Tipler) is a core reading book as part of undergraduate study at the University of Leicester [1]. It is a common thought of students to wish to take their books/notes into exams, as to make the memorisation of content easier. In this paper, we seek to determine the speed that one would need to travel in order for Tipler to appear able to fit into one's back pocket. We then compare this to fitting the Elizabeth Tower, of which Big Ben resides in, in one's back pocket. We chose the Elizabeth Tower as a comparison as it is a famous and recognisable building in the UK [2].

Theory

One way for an object to appear smaller is for length contraction to occur. In Einstein's 1905 paper, he stated that when approaching the speed of light, an object would appear to contract [3]. The formula for this shown in equation (1).

$$x' = x\sqrt{1 - \left(\frac{v}{c}\right)^2} \tag{1}$$

Where x' is the length observed in the frame moving relative to the object, x is the length in a stationary frame to the object, v is the speed of the moving observer and c is the speed of light. As we wish to know the speed at which an observer must be travelling in order to belive an object could fit into one's back pocket, we must rearrange equation (1) for $\frac{v}{c}$ (for the fractional speed of light), as is shown in equation (2). We state that the observer would *believe* this to be the case, as if Tipler were moving with the observer, no length contraction would occur.

$$\frac{v}{c} = \sqrt{1 - \frac{x'}{x}} \tag{2}$$

We must know the size on an average sized back pocket, to determine the value of x. This was done by measuring the width and height of different pockets, on various styles of trousers. Note, the same experimenter conducted all the readings, bending down to remove any parallax