15.6: But This Defies Common Sense

At this stage one may hear the protest: “But this defies common sense!”. One may hear it again as we encounter several predictions of the invariance of the speed of light and of the Lorentz transformations. But, if you have read this far, it is too late to make such protest. You have already, at the end of Section 15.4, made your choice, and you then decided that it defies common sense to suppose that one can somehow determine the speed of a reference frame by some experiment or observation. You rejected that notion, and it was the *application* of common sense, not its abandonment, that led us into the Lorentz transformations and the invariance of the speed of light.

There may be other occasions when we are tempted to protest “But this defies common sense!”, and it is therefore always salutary to recall this. For example, we shall later learn that if a train is moving at speed V relative to the station platform, and a passenger is walking towards the front of the train at a speed ν relative to the train, then, relative to the platform, he is moving at a speed just a little bit less that $V+\nu$. When we protest, we are often presented with an “explanation” along the following lines:

In every day life, trains do not move at speeds comparable to the speed of light, nor do walking passengers. Therefore, we do not notice that the combined speed is a little bit less than $V+\nu$. After all, if V= 60 mph and ν= 4 mph, the combined speed is 0.999 999 999 999 999 5 % 64 mph. The formula $V+\nu$ is just an *approximation*, we are told, and we have the erroneous impression that the combined speed is exactly $V+\nu$ only because we are accustomed, in daily life, to experiencing speeds that are small compared with the speed of light.

This explanation somehow does not seem to be satisfactory – and nor should it, for it is *not* a correct explanation. It seems to be an explanation invented for the benefit of the nonscientific layman – but nothing is ever made easy to understand by giving an incorrect explanation under the pretence of “simplifying” something. It is *not* correct merely to say that the Galilean transformations are just an “approximation” to the “real” transformations.

The problem is that it is exceedingly difficult – perhaps impossible – to describe exactly what is meant by “distance” and “time interval”. It is almost as difficult as describing colours to a blind person, or even describing your sensation of the colour red to another seeing person. We have no guarantee that every person’s perception of colour is the same. The best that can be done to describe what we mean by distance and time interval is to *define* how distances and times *transform* between reference frames. The Lorentz transformations, which we have adopted in order to make it meaningless to discuss the absolute velocity of a reference frame, amount to a useful *working definition* of the meanings of space and time. Once we have adopted this definition, “common sense” no longer comes into the matter. There is no longer a *mystery* which our minds cannot quite grasp; from this point on it merely becomes a matter of algebra as to how a measurement of length or of time interval, or of speed, or of mass, as appropriately defined, transforms when referred to one reference or to another. There is no impossible feat of imagination to be done.