Interpretation

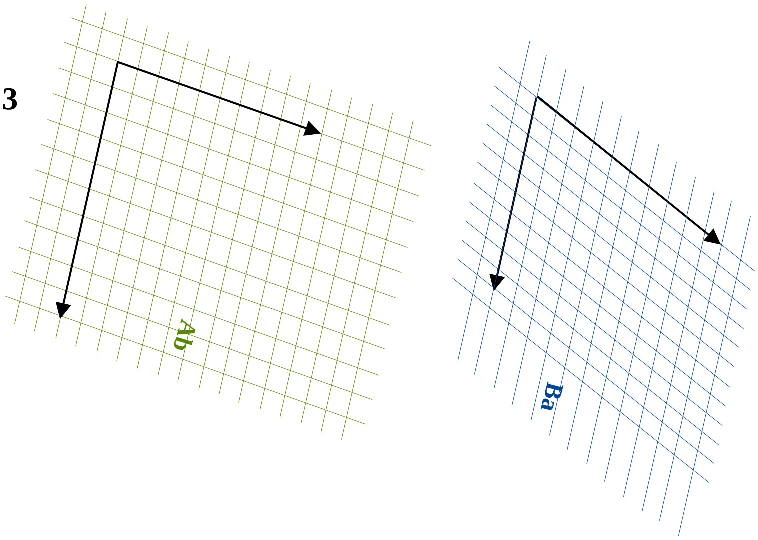
HOME: The Physics of Bruce Harvey

Real observers can only pass each other at small fractions of the speed of the light. To reach a speed of $\frac{4}{5}c$, a starship would need to start off with $\frac{1}{5}$ of it's mass as antimatter and another $\frac{1}{5}$ of its mass as disposable mass to combine with the antimatter. For a there and back journey, it needs four such stages. Even with a fusion reactor which could turn hydrogen into iron a starship would only be able to reach $\frac{1}{100}c$. That puts the distortions caused by the the Lorentz contraction into perspective. The speeds we have used here to produce nice graphics are completely unrealistic, and have only been used to make the effects easy to see.

The next diagram shows the grids Ab and Ba as they would be seen by a camera at rest in the stationary system some distance away on the z axis. Note that they are distorted. We have drawn in vectors of $10\hat{i}$ and $10\hat{j}$. The $10\hat{i}$ vectors are parallel but not of the same length. The two $10\hat{j}$ vectors are of different length and direction. The question is how do A and B both observe each other's $10\hat{j}$ vectors to be equal and how do they both observe each other's $10\hat{i}$ vector to be be contracted by a factor of 0.8215.

The answer is that these diagrams do not show the clock synchronisation errors. They are the view as seen from the stationary system. Observers A and B do not see these views of each other. Each has his own set of synchronisation errors. We have to refer back to Fig.1 in the previous section to see the light green grid of As and light blue grid of Bs. The synchronisation errors are proportional to the x co-ordinates of these grids.

Fig 3



Observers A and B each see the other's vectors move past their own. But each vector has two ends and the clock synchronisation error is different at each end. The observers see the vector smeared through time according to their clock synchronisation errors. It does not make any difference whether they use very local cameras to record the passing of individual points, or take a long range video from far out on their z axis and examine it frame by frame, they will see the same thing. We can take this into account by using the Lorentz transforms between A and B. If we take the moment when the origins are coincident and form a two column matrix containing B's $10\hat{i}$ and $10\hat{j}$ vectors at time zero and multiply by *Ab_Ba*:

$$\begin{pmatrix} 1.217 & 0 & 0 & 0.694 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0.694 & 0 & 0 & 1.217 \end{pmatrix} \begin{pmatrix} 10 & 0 \\ 0 & 10 \\ 0 & 0 \\ 0 & 0 \end{pmatrix} = \begin{pmatrix} 12.17 & 0 \\ 0 & 10 \\ 0 & 0 \\ 6.941 & 0 \end{pmatrix}$$

We find that A will see the point of B's $10\hat{j}$ to be at (0, 10, 0) at time zero, but will see the point of his $10\hat{j}$ vector at (12.17, 0) at time 6.941. In that time, the foot of this vector will have travelled at a speed which A measures as 0.5702 for 6.941 seconds to (3.958, 0, 0), so the length of the vector as seen by A is the difference between these equal to 8.215. We can perform similar calculations for B's view of A's vectors.

Our view of the universe is distorted by the finite speed of light. The further away things are, the further in the past they were when the light we see left them. Most of the scenes we view are local enough for the time light to takes to reach us to vary by only a few microseconds at most which is imperceptible, so we think we see things as they happen. A scenario where the effects of motion and distance smear the image through time are conceptually alien and make these matters hard to understand.

Fig.3 shows the pictures of grids Ab and Ba as seen by a stationary system camera at (0,0,1000). The camera would see them superimposed with their x axes coincident. A camera belonging to A at a similar position on his z axis would show the dark green grid undistorted and the dark blue grid contracted in the x direction. Similarly, a camera belonging to B would show the dark blue grid undistorted and the dark green grid contracted in the x direction. These two camera views automatically add in the synchronisation errors, each consequently seeing their own version of the result of the two motions through the stationary system.