RELATIVITY AND IMPERIAL CLOTHES

The theories of relativity have had profound impact on me and those with whom I have grown old. Professor Einstein let us know that we live in a much weirder universe than the one we daily perceive. His theories have become an accustomed part of our daily dialogue -- they are integral to the modern quantum age -- but they are theories we don't spend much time examining. Space-time continua and travelling twin paradoxes animate the shadowy world that only theoretical physicists and mystics call home: a world that is perhaps irrational, that we relegate to that part of our consciousness that acknowledges that something is going on, even if we're not quite sure what it is.

So it's hard to argue about relativity, or think critically about the theories. We so often begin with the idea that it's "math", and has to be hard, maybe even unintelligible.

And for those gifted few for whom math and physics are intuitive and beautiful, for whom there is a calling to the mystic field, it can be a badge worn proudly, a mark of being in the know. To be able to say that "I get relativity" basically means that you are as bright as they come, highly educated, and, probably, having trouble getting dates. All badges of a certain kind of honor.

Now, I don't count myself as one of the initiated (though I'm sure my wife would argue that I'd definitely have trouble getting dates). But here's the point: You're probably in one or the other of the camps. You either say to yourself: It's too hard, and, really, who cares? It's a problem for scientists and nerds. Or, you say: I get it, and therefore understand the universe better than most of my fellow men. Neither position is one that encourages introspection about the theories. You either don't think about them at all, or you've digested them and moved on.

Well, I'm in a third camp. I think I get it, but, at least with respect to one reported paradox, I think it's wrong. So maybe I don't get it, and I need somebody to explain to me why I'm wrong. You, for example.

In truth, I'm somewhat reticent to bring my questions up. Have I become a crank? Who am I to question Einstein and some of the best thinkers of our time? Nobody, really. A writer cum attorney; an occasional volleyball coach. I haven't spent my life in the lab, haven't published in the professional journals. But, I'm a fairly rational guy and the emperor seems to be lolling around with no clothes. And, maybe, because I'm in neither of the broad camps, and don't stand to lose any (more?) social standing by asking these questions, I'm going to have to be the one to ask the questions.

So, here goes.

The special theory of relativity essentially consists of the deep insight that measuring distance and time depends on one's frame of reference. In short, it's relative.

If you are on a moving train with no windows you will think of yourself as sitting still. You only know that you are moving fast because you remember going fast when you were on the train and could see outside. If there weren't a lot of bumps, and rolling, and sounds, you couldn't really tell you were moving. Which is the position we are in when sitting in our armchairs at home on Sunday night. Basically, we're still -- but we're ignoring the fact that the earth is rotating, that we're orbiting the sun, that the Solar System is part of a galaxy spiraling about its own distant center, and so on. Within the frame of reference of our living rooms, we are still, but others, hovering in space, would see us as moving. It depends, in other words, on what we define as the "system". Is it the totality of all objects and energy encompassed within the walls of our home? If so, I seem to be still. But, if the frame of reference is, say, that of an observer on the moon, then I am wheeling around in a complicated dance of spirals at the speed of a point determined by my distance from the equator. The same facts, different measurements. It's relative.

What Einstein pointed out -- well, one thing he pointed out -- is that the measurement of time is relative also. We measure time by how fast things move. One second is the length of time needed for the second hand on an old-fashioned clock to move from here to there, for a beam of light to travel some predetermined distance, for electrical signals to travel tiny distances a multiple number of times, etc. So, if two people don’t agree on what is moving, they may measure time differently. And even if the two people agree on what is moving, their observations of the same measuring device -- of a clock, say -- may differ.

Einstein’s insight about this came while he was in a trolley moving away from the clock on the tower in the town square. He reasoned that light bouncing off the tower would take longer to reach him on the trolley than if he were standing still. (We see things because light bounces off them, and is processed by our eyes and brains.) And he reasoned that the faster his trolley was moving the longer the light bouncing off the tower would take to catch up. And, if he were accelerating, it would take longer and longer for the light to catch up. So, if we were to imagine accelerating to a speed where, say, it took a minute for the light from the clock tower to catch up to Einstein, it could have a bizarre effect. He could look at his watch, on his wrist, and count the seconds beating out. The clock on the tower at home would be counting at the same rate, but the light reflecting toward Einstein would be having trouble catching up to him. If he looks down at his wrist watch, it will be counting out the seconds: beat, beat, beat. But, if he looks back at the town square clock, which is counting at the same rate, but the light from which is only catching up to him slowly, it will look to Einstein as if the town square clock is moving slowly: beat . . ., beat . . ., beat . . . The times told by the watch and the clock tower will differ. If Einstein, looks at his watch it’s 3:15p. But if he looks at the clock tower, it’s showing some time before 3:15p. It’s not that the clock on the tower is not ticking, it’s that the light showing that progress to Einstein, hitting his eyes, gets there at a slower and slower pace. This phenomenon has come to be known as time dilation, and seems to have been empirically demonstrated via a large array of experiments and observations.

This makes a lot of sense to me. It’s the Doppler effect, with light. The Doppler effect generally refers to sound waves. It’s that phenomenon you notice when a car rushes by you. As it goes past the sound of its passage changes: ah-ooom. The “ooom” part consists of lower frequency sound waves. The noise of the car takes longer and longer to get back to you, because the source is moving away too. If the car idles outside, it just goes “aaah”. Nothing changes; the sound waves hit you at the same frequency over and over. But, if it moves away, at each instant a wave has further to go to get back to you. The waves move at constant speed, but the frequency with which they get to you is lower as the car moves away.

At the risk of restating the by-now obvious:

If you stand still, and the car stands still, it looks like this:

YOU ((((((CAR))))))

(Those parentheses are sound waves emanating from the car.)

But, if the car is moving to the right, then the car is catching up to the waves in front of it, and moving away from the waves behind it. It looks something like this:

YOU (((((CAR)))))

Behind the car, coming to you, the waves are arriving at a low frequency (less per second). In front of the car, the waves would be perceived as arriving at a high frequency (more per second). The sound goes from "aah" to "ooom".

Okay. All good. The same thing is happening with light trying to catch up to Einstein in his speedy trolley -- in his spaceship. It will get to him at a lower frequency, more slowly, when he is moving away from the tower clock.

And this can be turned around. If we stand at the clock tower and watch it beat out seconds, it will move at the rate that we think of as second by second. The light from Einstein's watch (if we had a good enough telescope) would be getting back to us at a lower frequency, a slower rate. So we would think Einstein's watch was moving slowly. He'd be in slow motion.

We and Einstein view time differently with respect to one another.

This has led many to posit the travelling twin paradox, wherein we imagine a space-travelling sibling who leaves earth, travelling the galaxy at near light-speed, only to return to find that his or her twin, and perhaps multiple generations of mankind, have in the meantime passed away. Amazing stuff.

But I think clearly wrong.

I accept that there is time dilation. But, it seems to me, by the same reasoning, there also has to be time contraction. We see the travelling twin in slow motion as he moves away from us, but once he turns around, and heads back to us, he's catching up to the light waves bounced towards us previously. The light waves will be getting to us at high frequency. The twin will appear to be in fast motion.

In short, the two systems will not seem to be in synch with one another when one is viewing the other, but the high frequency and low frequencies should cancel one another out; the systems should be in synch once the travelling spaceship actually returns. Time dilates in one direction. Doesn't it have to contract coming back?

Has this particular emperor got some clothes on that others are actually seeing and I'm not?

Send your cards and mail.

By-the-way, modern astronomy confirms that our perception of light will differ depending on the motion of the object we observe. We observe certain galaxies moving away from our own Milky Way. The light they emit is perceived by us as low frequency. What might be white light if we were motionless with respect to the distant galaxy is perceived as light shifted to low frequency, i.e., red. That's the the name of the phenomenon: "red-shift". A galaxy moving away from ours, emitting light that we perceive in low frequency, is "red-shifted". Similarly, a galaxy moving towards ours is "blue-shifted". In short, we actually see the Doppler effect with light.

Presumably, then, if our telescopes were good enough, people in the red-shifting galaxies would appear to us be moving in slow motion, while those in the blue-shifting galaxies would appear to be in fast motion. How the heck could there a red-shifting travelling twin that wouldn't blue-shift on the way back?

I don't know. I'm in that third camp.

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