

Preface, Executive Briefing

Relativity is all about how light behaves, and from that some truth is differentiated from some fiction. Light's behavior is particularly at issue because the cosmos is ever expanding... some of the very distant galaxies are receding from us at near light speed — we find that true while looking in any direction.

Getting right into it, if a fleet ("The Fleet") of spacecraft left Earth and sped away at a significant fraction of lightspeed, then how would light (and/or radio, EM) signals behave between us and them? and how would such signals behave among The Fleet members themselves?

Would a radio signal sent from Earth take extra time to reach The Fleet, because it is receding away? Yet the reverse is not true?? ie. signals from The Fleet will transit only the predetermined distance through Earth's fixed coordinate system? Who is actually receding from whom?? Does it depend on how Earth is moving with respect to a higher coordinate system, some fixed master coordinate system?

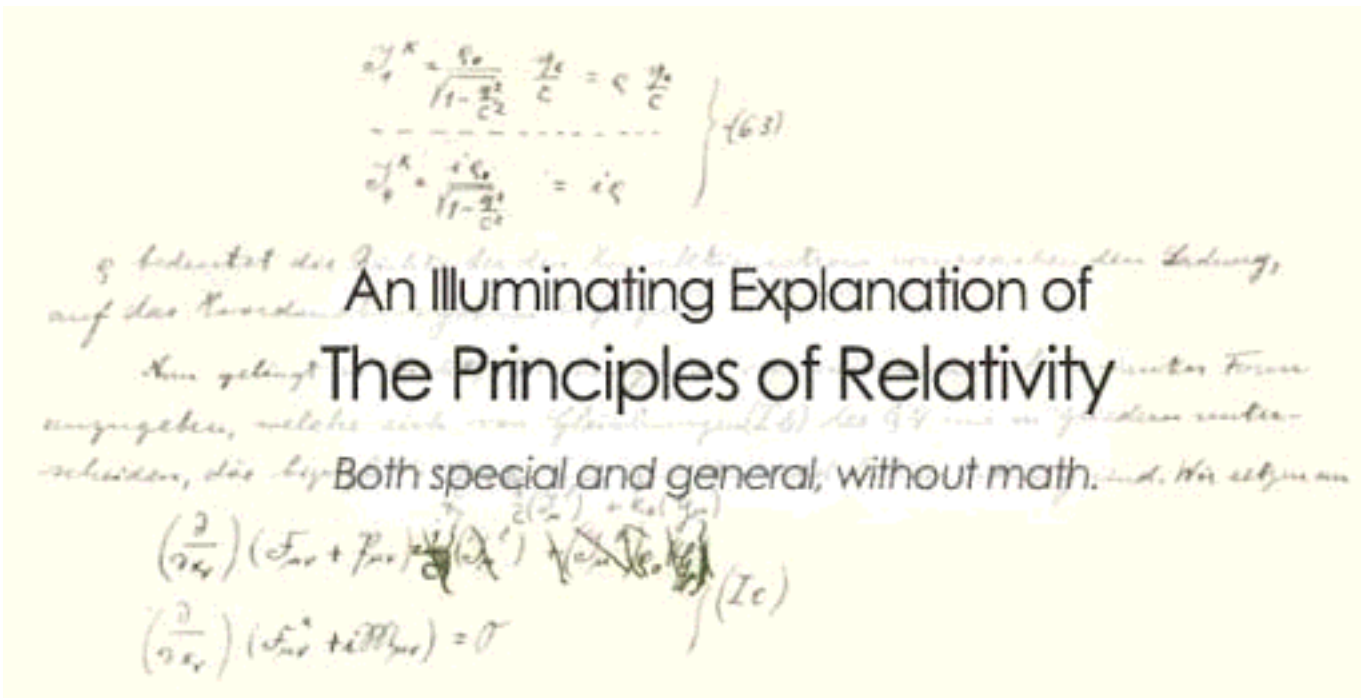
In a word, no, none of that is true. OK, it's all true, relatively true. What's absolutely true is the denial of any master cosmic framework serving as medium for electromagnetic signal transmissions: EM signals find their own way about, somehow transcendent of mortal ciphering. It's uncanny; we don't know the how but we know the how much. We realize now that light behaves relativistically, which means that every clock and every ruler in the world must cede something to accommodate the feat.

In the stated scenario, The Fleet astronauts experience one thing while us Earthbound folk experience something altogether different, something that seems contradictory. By all reckoning, the astronauts witness their Fleet's signals to be moving at fixed lightspeed with respect to The Fleet's native 3D coordinate system — and by native is meant simply, "that x-y-z frame with respect to which The Fleet is stock still in space." Those astronauts... they witness their outgoing signals as requiring extra time to "catch up" to the receding Earth, yet incoming Earth signals need only travel the predetermined distance from their release point. And all the calculations work out... no, there is no incompetence.

And wouldn't you know? Earthlings can make the very same claim. By all reckoning, they witness EM signals behaving as if Earth's native 3D coordinate system is boss. Their outgoing signals require extra time to catch up to the receding space Fleet, yet incoming Fleet signals need only travel the predetermined distance from their release point.

And this relativity carries over to within The Fleet itself: its member craft are able to swap signals with only their fixed separation distance dictating the transmission delay. Light and radio signals don't take longer to transit in one particular direction because of The Fleet's supposed motion "through space" — that element is negated entirely.

And now the final concluding point. Isn't it great that light behaves this way? especially considering that many millions of distant galaxies are flying away from us at tremendous speeds. If light simply moved relative to Earth, or relative to some master cosmic coordinate system (with respect to which Earth is fairly still), then how could those (hypothetical) zillions of aliens who populate those myriad distant galaxies ever live, eh?? they couldn't!! They would live in a giant ever-distorted world, where a simple twisting of the neck would mean drastic changes in their view of the surroundings — all hot and blue-shifted in one direction, pale and red-shifted in the other. They could be burned alive by a single candle flame if its radiations were coming from the wrong side. Find the full treatise next.



There is no new or revolutionary theory espoused herein; just an effort to bring the known concepts of Relativity into clear focus using plain talk.

◆ **Prologue: Something to Think About** Say for example that a crew of astronauts was on the space station orbiting Earth – some inside and some out on space walks, perhaps performing delicate maneuvers of parts and machinery. Suddenly, a huge speeding asteroid comes hurtling out of nowhere and has a very close call with the space station, but misses it. The asteroid weighs countless thousands of times what the space station does, so its gravity abruptly lurches the entire station, crew and all, out of position and onto a new trajectory. What sort of casualties and damages could one expect from this calamity? Well none of course; that's right, none. Except for seeing the asteroid draw close and then veer away at a different angle, the crew on the station wouldn't even perceive a significant event occurring. And what's more, even if the astronauts used an instrument that could measure the local velocity of light, in all directions, and with utter precision; no such instrument could deliver evidence of the asteroid encounter and subsequent lurch off course. That is because gravity affects all things, in a locality, with exact uniformity, and now we've learned that that includes light itself. A human wouldn't sense the lurch in the above example, because the liqueous matter in the brain would be accelerated in perfect harmony with its containing cavity, the skull – not so the lurch of any artificial thrust (eg. cars, rockets). So too, scientific instruments can sense gravitational fluxes only by sampling data over a wider area.

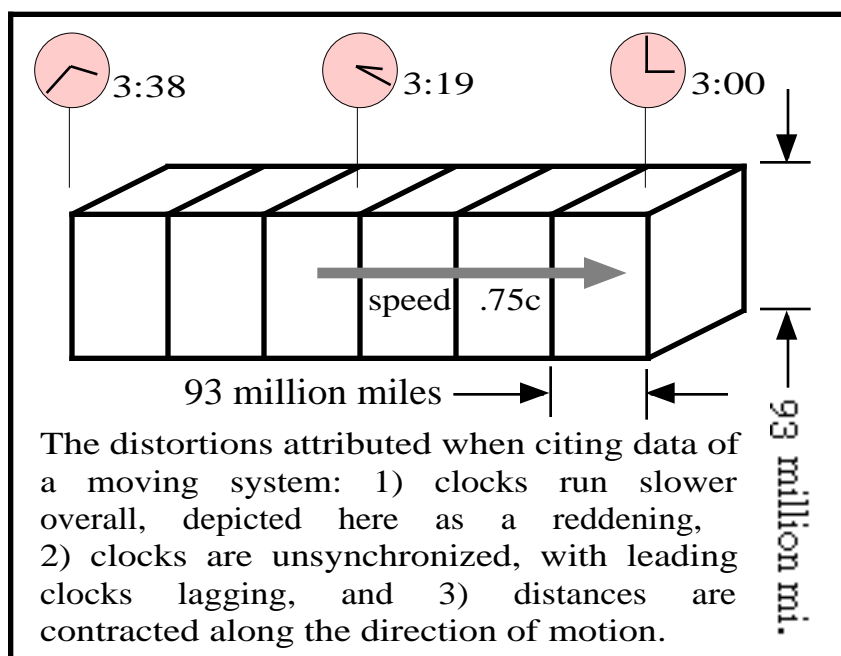
◆ **Minor Qualification** If the asteroid were extremely immense and came very very close, then the space station might creak and groan a bit – or be damaged – by the so-called 'tidal forces'. But for the most part, these effects can be discounted as negligible.

◆ **Relativity in a nutshell** Our universe respects no preferred frame of reference, so there is no such thing as a body's unequivocal motion through space, proper. Indeed any thing, any place, is a proprietary platform *per se*, a basal world of supreme stature, owing deference to no greater realm. And the laws of Physics bestow unerring homage to *each and every* such arbitrarily-defined vantage as if it, and seemingly it alone, constitutes some hallowed special ground.

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- ◇ **The age old quandary** When you look up to the sky you see the Sun going around the Earth. But we're taught that this viewpoint is scientifically incorrect because, in fact, the Earth spins about its own axis once every 24 hours, which more correctly accounts for the Sun's apparent transit. Well, relativity may have changed that, and here's how.
 - ◇ **A venerable proof?** If indeed the Earth is spinning in space, then with our superfine electronic gadgetry we ought to be able to verify this beyond any shadow of a doubt. Consider if you will two towns, some miles apart, each located on the Equator, and each with a prominent high tower. Since the Earth is supposedly spinning in the direction that we know by convention as Eastward, then clearly, an ethereal signal (such as a light or radio pulse), sent from the tower of the Westernmost town to the tower of its Eastern counterpart, would take a fraction of a second *longer* to transit than a signal sent in the opposite direction; because the Easternmost town is **RECEDING** in space from where the signal originates... yet in the opposite case, the tower is actually coming to meet the signal. We now possess the technology, the very precise instrumentation, that could detect such a discrepancy in signal transit time, but **WHOA!** we find that it takes exactly the same time for the Eastbound signal to traverse as the Westbound one. Those results would *seem* to indicate that the Earth is stock still in space, rather than spinning.
 - ◇ **Advisory note** Of course we've known for ages that light does not inherit velocity from it's source, like a ball would if it's tossed about inside a moving vehicle; hence the scenario above examines and debunks the second most likely supposition: that light somehow moves relative to an absolute space/grid.
 - ◇ **Nevermind media** Remember that light can travel through a vacuum, so the above result has nothing to do with the presence of Earth's atmosphere (which is dragged along with Earth's rotation) serving as a medium. For we can do a like experiment on **ANY** spinning body, such as on our Moon, where no atmosphere is present; and the results of *those* time trials, when gauged by instrumentation *there*, would again show no difference between an Eastbound and a Westbound light signal about the Moon's equator. Amazing, huh?
 - ◇ **Light clinches it** So, where's the catch?? Referring to the Sun as the system center, around which all nine planets are slued by gravity, is by far more gratifying than any alternate orientation. But indeed, relativity tells us that one viewpoint is every bit as accurate as another, so long as the behavior of light signals betrays no express bias.
 - ◇ **Closet space is one thing...** Now, how can this be? Well, part of the problem is that 'space' is just a convenient invention of the human mind. In real nature, physically, there is no fundamental set of rectilinear x-y-z axes that we can assign to our greater cosmic reality, and so there truly is no all-encompassing reference frame which can serve as the standard preferred over all others. Not even the pervasive background of seemingly fixed stars, deep in the heavens, can serve as a standard reference... no, because light just doesn't behave that way. The problem crept into our discussion and analysis when we surmised that the Earth spins in SPACE... and there's no such animal.

◇ **Textured Space** Out there in the Cosmos, instead of plain-jane space, and far more pertinent, we find a complex web of interwoven gravitational fields. Also note that, except in the human mind, there is no specific reality as a 'straight line'. Modern science has discovered that light follows no 'absolute' straight line on the large scale, such as when traversing intergalactic spans. Specifically, light is bent, diverted by gravitational pulls – only a minuscule amount normally, mind you, but significant nonetheless. With the myth of rectilinear space exploded, and the myth of light following a straight course exploded, we are left with only a few cornerstone assumptions about the physics of our world.

◇ **Relativity Rudiments** When an object, such as a star or planet or spaceship, drifts along impelled only by gravity, it is said to be in freefall, also known as a geodesic trajectory. Every object on a geodesic trajectory lays claim to a consistent (regular) space/time continuum uniquely all its own – the place is a veritable 'Terra Firma' and can rightly claim to be stock still, The Unmoving Center of All. From the perspective of such an observatory, any object in motion – regardless if that motion be toward, away or transverse – is *literally moving somewhat toward the past*; as moving clocks are unsynchronized along the direction of travel, with leading clocks lagging in time. Of course, the moving object, though



moving *toward* the past, never actually moves *into* the past because the clocks are ticking, so that by the time the object reaches any point ahead, the clocks there have progressed to what has become the future. The effect is telling however, such that clocks on board moving objects progress more slowly overall with respect to the presumed still observer. [By 'clocks run slow' it is meant, in fact, that time itself is slowed, and applies to all temporal processes.] But realize that this effect is mutual, ie. covariant: according to the perspective of the moving party or object, it is *he* who is still and it is the *first* party whose clocks go slow

and who is moving somewhat toward the past. And finally, there is one last mutual distortion at play between observers moving relative to one another: distances in the moving frame are shortened – only along the direction of movement – by the reckoning of a presumed stationary observer. These covariant effects are hard to grasp, but may be thought of as akin to viewing an apartment building askew, say, from diagonally away across an intersection. Because of perspective, the individual windows, or units, are not quite as long or as wide as they would appear face on. The distortion is mutual, equally affecting viewers from that building looking at your own. This analogy may however be less than satisfactory.

◇ **A better analogy** But a similar seeming paradox is grasped in everyday life: one man hails another from a couple hundred yards away. To each man, the other one's stature appears small, and the other man's voice seems muffled. This is not so much an illusion as it is a mutual (or covariant) warping of physical measures. And so it is in relativity.

◇ **Contradictory it's not** But one might well ask, "If the other fellow's clock is running slow simply by virtue of his relative motion, then when he should return to me, his clock will show less time elapsed... and how can that be covariant? either his clock shows less time elapsed or mine does! how can my time be slowed to him and his time slowed to me, both??" Not to worry: the answer lies in the fact that each body on a

geodesic trajectory has its own proprietary and perfectly valid time continuum. The clock that will show missing time upon reunion is the clock on board the spacecraft that purposely fired its rocket engines to take leave of its own freefall reference frame and come to join up with the other party's trajectory. What is propelled by rocketry is no longer in freefall! The effect of thrusting toward that other craft is unequivocal: it speeds up the distant freefalling craft's time – as reckoned by the thrusting one – which more than compensates for the otherwise accrued discrepancy. This should dispel any seeming paradox about, say, two spaceships drifting past one another deep in space.

- ◇ **Again, texture** Yet, in such a case, if a reunion should occur without rocket propulsion, induced solely by the two ships' mutual gravitational pull, then the two clocks would agree on the time elapsed, as no specific force breaks the symmetry. In the real world though, there's never perfect symmetry – distant heavenly bodies will add their subtle bias. This is clarified below, under Equivalent Pseudo-Forces.
- ◇ **Simultaneity is moot** Truly, under Relativity, no unerring truth can be asserted how two differently moving clocks compare until there's a reunion. Synchronicity between disparate frames works out to be a moot point; undefined, nebulous.
- ◇ **The Key Thrust** This warping of clockworks and measures in one reference frame as cited by another (moving) one, is precisely such that it results in light *being assessed* as traveling at the fixed speed of 186,282 miles per second, by all observers, irregardless (diagramed as an appendix below). So in essence, light and similar electromagnetic (eg. radio) messages DEFY the relativity of motion: their motions are distinctly absolute. Material objects dance only in relative motion, while ethereal signals move only at absolute light speed (unless they interact with matter).
- ◆ **The Vital Truth** Scientists assert that no material thing can ever reach or exceed the speed of light. But they're not talking about an object's ABSOLUTE speed, such as relative to a hypothetical macro scale set of x-y-z axes of our universe/space, which is a myth... NO, they mean that no object can move as fast as light *as assessed* from another object's reference frame. This perhaps is an even greater constraint than the first, because it means that every single object in the world must comply in relation to every other possible citing object! and in relation to any conceivable vantage or trajectory. Another way to phrase this particular rule of Relativity Principle is: no object can OUTRUN being viewed by others. That truth is inviolate and universal.
- ◇ **Example** Consider Earth, and a spacecraft takes off from it moving at three quarters the speed of light (.75c). From the other side of Earth another spacecraft takes off also moving at three quarters the speed of light, but in the opposite direction. Doesn't then craft A outrun any possible light transmissions from craft B and vice versa?? Crazy, no! and B is not moving at one and a half times light speed relative to A either. Here's why: A has only Earth's word for it that B is moving at .75c (in relation to Earth) but Earth's measurements are SUSPECT to A, because Earth is undeniably a reference frame in motion relative to craft A. In order to cite the velocity measurements supplied by Earth and make them viable in A's perspective, A must employ a specific complex transformation computation based on the known speed of the frame being cited. After applying that formula, craft A will conclude that the velocity of craft B, relative to Earth, is NOT .75c as claimed, but rather it is only about .21c. That then, when added to the .75c that Earth is known to be moving, yields a sum of around .96c for the speed of craft B in craft A's frame. It's unbelievable, but true! The scenario is fully diagramed as an appendix below. Remember, in relativity, the observer's frame of reference is the one presumed to be stock still, in any computation... it's the other guy who's moving.

◇ **Equivalent Pseudo-Forces** Gravity affects clocks just as the equivalent acceleration would – ie, the effect is to slow clocks, relative to any time continuum where gravity is less or absent. G-forces/fields don't actually have a *physical effect* on clocks, rather it's just that a bias needs be applied to such a frame's dynamics, when citing measurements therefrom. Again, it's more of a perspective thing. But unlike the perspective corrections already discussed – those of speed-derived relativity (SR) – the transforms for G-force relativity (GR) won't be covariant between frames but instead have an unambiguous orientation and pitch (distant clocks off in the direction of tug need be assessed slower-ticking; those in the opposite direction faster-ticking, than one's own). Hence we hold the view that gravitating bodies 'shape' the space-time fabric around them.

◇ **Example** An astronaut in a spacecraft drifts in freefall (with rockets idle), so he floats in his cabin... he feels no specific pull, so 'gravity is absent'. He is in freefall and can be rightly assessed as standing stock still... as no local study of the behavior of light would reveal any different. But when he fires his rockets, he and all objects aboard succumb to an inexorable tug in one and only one direction. That tugging is *in every way* equivalent to, and as causative as, what we normally think of as *real* gravity, ie. the pull exerted by massive bodies. If you think hard about accelerating by rocketry, you will conclude that a light beam crossing your path would appear to bend some – and in the same direction that everything else is being tugged. This fact goes to further reinforce the equivalence of gravity and acceleration.

◇ **Such decorum** And by virtue of this equivalence, wouldn't you know – again, each and every observer's frame can rightly claim to be stock still, however jerky it's motion may seem to others. Even though lurches are *felt*, they are no indication of movement; no, those are pulls from some unusual 'passing' gravitational fields. And truly, no study of the behavior of light would reveal any different.

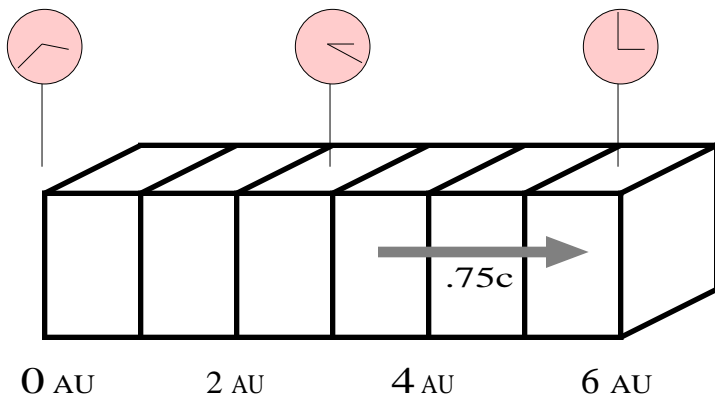
◇ **The Spin Proviso** Relativity is the absence of a preferred reference frame, and this scheme works fine, as we see it confirmed by the behavior of light signals. But relativity does not actually extend unqualified to rotating frames of reference, as was implied earlier. If you sit in your easy chair atop the North Pole, you will see the same heavens pass by, again and again repeatedly, each 24-hour period. That's a pretty fair indication that you *are* spinning. The alternative is: you are still and the world spins. But if that were the case, then you would have the very personal distinction of being situated right on the central axis of cosmological spin – and that can't be, because it unjustly excludes other spinning bodies from sharing the distinction. There are too many other clues as well; hold a bicycle wheel by the axle ends and you can freely orient it to face any direction, but NOT if the wheel is spinning. When it's spinning, forces resist such reorienting. The fact is, spinning objects are so righteously unequivocal in this world that gyroscopes are used to help navigate and orient us.

- ◇ **Relativity Mastered** It is still true that a Westbound and an Eastbound light signal take the same time to cross a given local span (all other things being equal – even the Moon’s proximity overhead skews local time infinitesimally); and this phenomenon serves ideally to spark illumination of the subject, relativity. Yet truly, the metric of rotating frames is not so simple overall: in them, some skewing of clocks and measures is implicit. Similarly, an object hurtling through space in freefall may be mathematically very close to a so-called inertial frame, but never completely so. Yes, every such object rightly lays claim to its own proprietary space/time continuum – *locally* regular and consistent – but as always, accelerations and heavenly bodies contribute some skew. “General Relativity” is a generalized mathematical model for mapping the time/space coordinates of one dynamic system onto any other; it takes every factor into account, and may evidence specific length distortions, time flow distortions and clock dissynchronicities. When you probe deep the math gets thorny, but all the formulations bear out the uniformity of light’s speed and behavior, per any (presumed still) vantage – that’s the crux.
- ◇ **Epilogue** One might well ask, “Are the time and distance distortions of relativity real?” Answer: they are real to the observer, yes. They are not *uncategorically* real, like the hot kiss at the end of a hard fist; but rather they are a function of *perspective*. We run across perspective a lot in life and usually take it for granted. Mankind supposedly went a very long time before noticing the effects of relativistic space-time distortions, because the effects are downright *minuscule* in all but the most extreme cases. Think about the perspective-based mutual voice distortions cited in an earlier paragraph, when two shouters are far separated. The muffling of the voices is not real... certainly not to each shouter himself; yet the effect on the listener is no illusion. So like any effect of perspective, relativistic distortion is “subjectively real”, and as such, it must enter into our plans and computations. A main key to understanding relativity is this subjectivity: time and space measurements cited of a moving/alien frame are flawed unless transformed, but you can employ data collected in your native frame all the day long, without a hitch.

– KJS (The Uncredentialed)

A Simple Example of How Relativity Works

[Some numbers have been rounded for expedience]

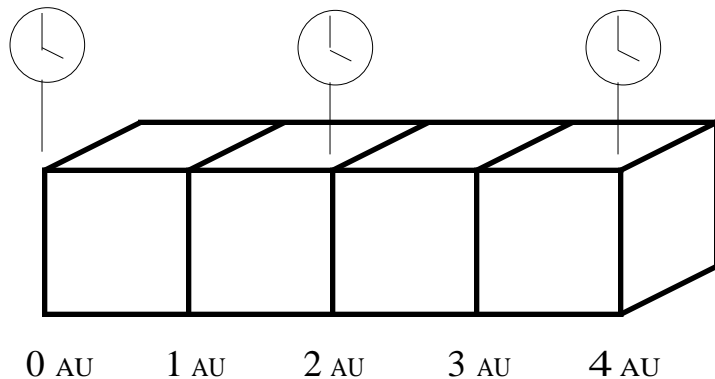


Relativistic distortions attributed when transforming/citing the data of a moving system: 1) clocks run slower overall, depicted here as a reddening, 2) clocks are out of sync, with leading clocks lagging, and 3) distances are contracted along the direction of motion.

Note that the passing light pulse is at 3 AU at time 3:19, by the measures attributed the moving system.

a light pulse →

← a radio pulse

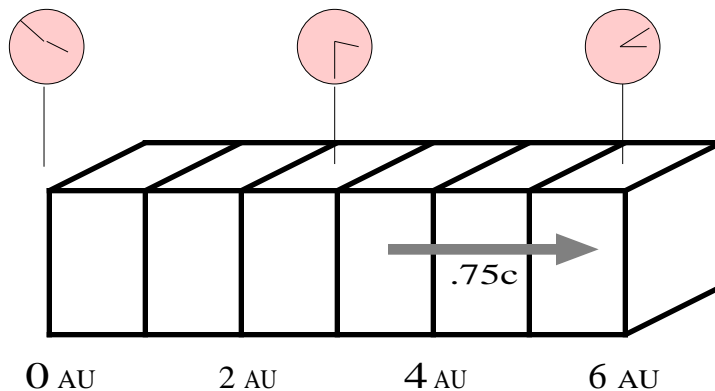


In the presumed stationary reference frame there are no distortions.

Note that the passing light pulse is at 2 AU, at 4 o'clock in this system.

“AU” = one astronomical unit, a distance of about 93 million miles.

some time later...

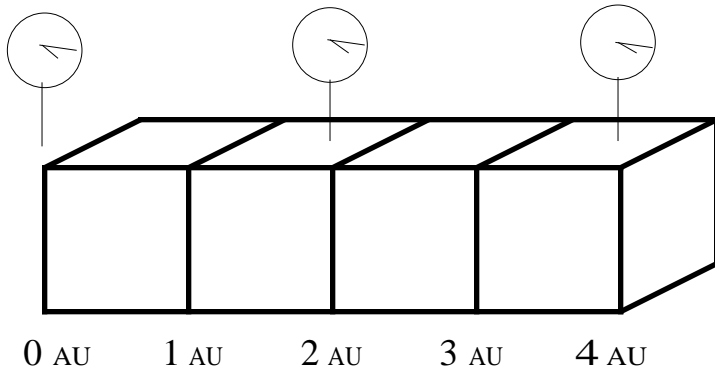


In our presumed moving system, the light pulse has advanced from 3 to 3.75 AU, to where the clock *there* reads 3:25 (trust me). That's .75 AU in about six minutes, just the expected 186,282 miles per second.

It works in any direction: the radio pulse traveled 5.25 AU (from 6 to 0.75), while the time went from 3:00 to 3:43 – also 186,282 mi. per sec.

light pulse, later →

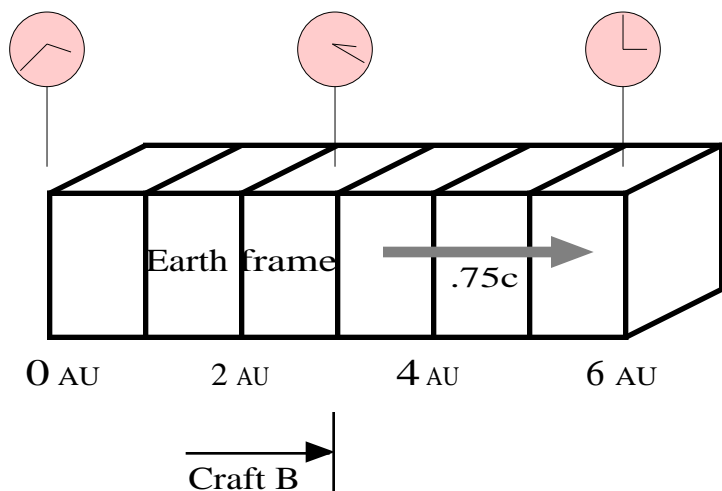
← radio pulse, later



According to our stationary frame, the light pulse has advanced two AU's while some seventeen minutes have elapsed. This also computes out to the expected 186,282 miles per second.

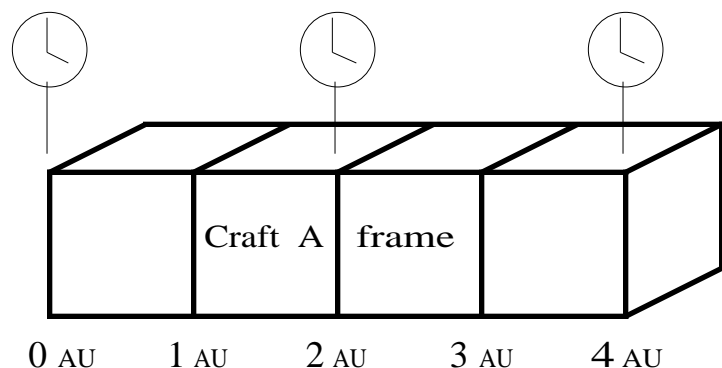
The radio pulse did just the same.

The Same Diagram Illustrates the Scenario Described in the Narrative



In the narrative, at The Vital Truth, Example, we said that Earth would find Craft B to be traveling at .75c, yet the same motion would be assessed as .21c by Craft A; and so light would truly catch up to B from A. If unsure, review.

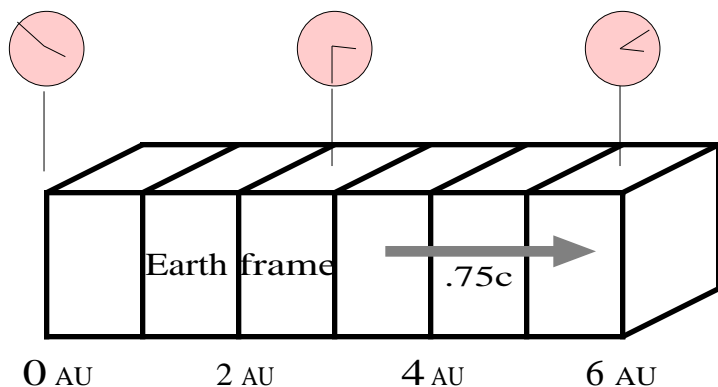
Here, we have the basics diagramed: Craft A is presumed the still frame, while Earth moves at .75c to the right. Craft B moves *even faster* to the right than that.



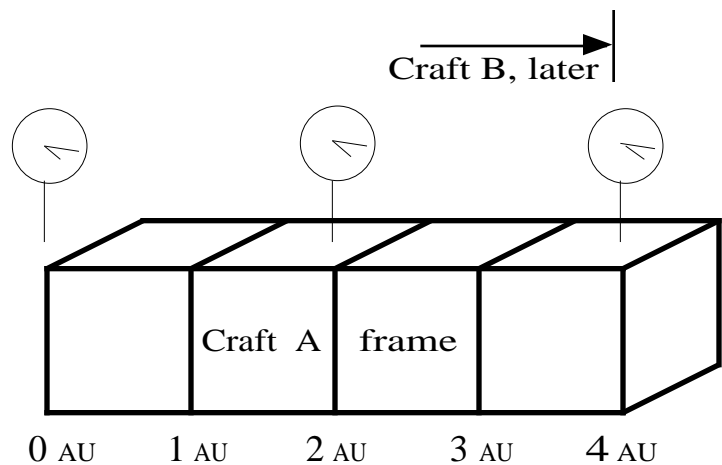
Note, that in this arbitrary snapshot of the action, Craft B starts at 3 AU where the clock reads 3:19, by the measures attributed Earth..

... it's found at 2AU, at 4 o'clock, in Craft A's native system of reckoning.

some time later...



In the moving system, Craft B has advanced from 3 to 3.63 AU, to where the clock *there* reads 3:26 (trust me). That's .63 AU in about 7 mins., which works out to three quarters of light speed.



But the same advance, according to A, is 1.92 AU's during a seventeen minute span (16.6, actually). This computes out to the stated 96 one-hundredths of light speed. Earth is seen moving away at .75c, so Craft B is going just .21c faster than Earth – by A's reckoning.

Stated elsewhere: A asserts that B moved not .63 AU, re Earth, but .42 AU; and not in 7 mins., but in 17... that's .21c!

Addendum I The Number Line Argument

Still need convincing? Perhaps you think that relativity is a purely subjective illusion, lacking in truth... perhaps you suspect that underneath lies a more profound ACTUALITY, wherein two spacecraft each retreating from Earth at $.75c$ in opposite directions DO exceed light speed (thus can NOT communicate with one another). You'd be wrong, and here's why.

When you count the number of grains of sand in a jar, or on a beach, or on a continent, a planet, a galaxy; that Number Line starts with zero, one, two... and can go all the way up to any imaginable zenith. That would be an example of a perfectly 'flat', or unremarkable, numeric continuum.

But *velocity* is a trait constrained by Nature: its range cannot extend to just any arbitrary pinnacle, because then we'd live in a world where objects could outrun being seen, and in a world where objects could ram you with devastating impact before you could even see them coming. No! this is one area where nature has laid down the law with an iron fist: light *is* the quintessential mediator of all that exists and so her unique speed is inviolable, and expressly tantamount to an infinity. Hence, the Number Line representing velocity is not a flat continuum, but is somehow fundamentally skewed – a skew, clearly, that cuts into both the spatial and temporal components of velocity.

So it shouldn't come as any surprise that a special computation needs be employed to add or subtract velocities, to deduce their value per a moving reference frame. However confident we may be that one jelly bean plus one jelly bean equals two jelly beans, it doesn't follow that one MPH plus one MPH equals two MPH. The test results are in, and the findings leave little doubt that relativity is our reality, and not some illusion.

Addendum II

The Perspective Analogy

The sort of perspective one learns in Art class, the famous ‘vanishing point’ and whatnot... well, that system of perspective pertains to all 3-dimensional vistas, whether depicted on canvas as a still life, or seen with one’s own eyes. When you consider a Fourth dimension, that of dynamism; entailing time, energy, movement and gravity – then there’s yet another system of perspective they call Relativity, Special & General. There are parallels between 3-D and 4-D perspective distortions. In both cases, all non-native things are belittled; with the belittlement converging upon a precise totality as the degree of alienation (from the observer) increases.

Looking down a hypothetically long LONG street, the curb lines, though carefully engineered to be parallel, appear to diminish in separation and approach a distinct vanishing point where all such parallel lines converge. The distortions attendant 3-D perspective are a function of spatial measure, being simply the shrinking in *size*, to oblivion, of all things *distant* from the observer. Not surprisingly, the distortions attendant 4-D perspective are a function of dynamic, being essentially the belittlement, to oblivion, of phenomena whose *dynamic* is alien to the observer by virtue of velocity or acceleration (slash gravity). That belittlement is the slowing of clocks (and of course a perceived length contraction as well). And just how is time dilation a belittlement? Simple: any light or signal emanating from a moving object is red-shifted, dulled, less vibrant and just less energetic than the same signal shone from a stationary source. This is a direct consequence of the time dilation thing.

The analogy to the ‘vanishing point’ occurs in relativity when the dynamics of a phenomenon rise to the infinitely alien, or say ‘fully saturated alien’: that being either velocity at full clip ‘c’, or a G-force sufficient to form an Event Horizon (as for example, at Black Holes). As relative motion nears light speed, the resulting time dilation approaches totality. So theoretically, there would be no dynamism, no time passage whatsoever *at* light speed. [To wit light itself is primitive, each photon a bare rudimentary ‘message unit’ which cannot emanate anything at all ‘during flight’.]

Similarly, time dilation approaches totality nearing the event horizon of a Black Hole (from the onlooker’s perspective, of course), and any signals emanating therefrom are weakened, red-shifted and slated to disappear. In general, the observer finds less dynamic attributable to phenomena that come under the bias of alien G-forces. The greater the G-force, the greater is this belittlement, even unto vanishment.

Addendum III Intriguing Posers in Quantum Physics & Relativity

QUANTUM DYNAMICS

In a sense classic physics is now a wrap, if you choose to see it that way. The whole notion behind the science was that our reality is somehow strictly governed by inexorable Laws. But this is not actually the case. True, on the macroscopic (large) scale, everything *appears* to happen deterministically, according to formulas. But at the microscopic or sub-atomic level, it's found that our precious governing laws are actually only lawful *tendencies*, and that variances can be enormous, even huge. But when taken together as a whole, the variances occurring in the sub-atomic kingdom more-or-less even out to produce a predictable norm of behavior seen in the macroscopic world.

RELATIVITY

In the real world, only the 'here and now' can have actual bearing on the unfolding of events and that's why there can never be a universal clock time. There's a distinct sanctity and propriety associated with any particular here-and-now for it being this crux of causality; hence the perspective distortions of Relativity.

For example, you may hear tell that the stars and galaxies we see, because of their great distances and because of the finite speed of light, are really only after-images of what they once were. But relativistically speaking, no! what you see is what you get. We are viewing the distant stars as they *are now*, because now is the only time that's real for us, as gauged by causality. If a distant star blows up and its offshoot radiations eventually affect the Earth, then we are 'under attack' at the moment of their impact, the moment of causation... nothing else is relevant to physics. In a situation such as that, the X-rays and whatnot are attacking us *while we see* the star explode. So causality pretty much defines what *is* real *now*, and any 'deeper' analysis is at best a derivative and at worst a concoction.

Because of Relativity, it is meaningless for an Earthling to ask the question, "What's happening on Pluto at this very moment?" That's because there is no '*this very moment*' on distant Pluto. What constitutes the 'now' is more a function of causality. Any conceivable 'this very moment', anywhere in the world, is best defined by the sum total of causative influences arriving, *converging* upon that time and place. A different time or place means a totally different convergence, and so cannot be a peer under any *universal* metric.

THERE'S NEVER A COP AROUND WHEN YOU NEED ONE

This very sanctity/propriety afforded any particular here-and-now (per causality) also seems to underpin Quantum Dynamics. If one assumes there be deterministic Laws governing our whole physical world... then where might all the law enforcers be, pray tell? *They can't be everywhere at once, for that would be some sort of magic.* So instead, the prime governor is a sort of Murphy's Law or jungle law, catch-as-catch-can: anything that can go anomalous will, given the chance. Specifically, all manner of aberrant sub-atomic phenomena are likely to occur, and will be tempered only when countered by moderating influences in the immediate vicinity.

Addendum IV, Twin Paradox Without Accelerations

The famed "Twin Paradox" is not a contradiction in the Theory of Relativity. A space traveler can leave Earth, travel at relativistic speeds, and return to Earth younger than his homebound twin.

The issue that perplexes most folks is that since Relativity precludes any notion of absolute motion – ie. it's all relative – then how come the space traveling twin seems to benefit from all the time dilation, as if it were he who is *truly* in motion. But there is no contradiction: at any juncture, the Earth can be thought of as the frame in motion instead, and the astronaut twin simply sitting stock still in space. It's not the astronaut's motion that is absolute, it's his modification of course that is inarguable. It's that course modification that allows him to benefit from all the relativistic clock dissynchronicity, time dilation being almost inconsequential to the outcome.

BACKGROUND

According to Relativity's famed Lorentz Transformation, two separated clocks affixed to an elongated frame, that are perfectly synchronized according to a *native* of that frame, are not synchronized to an observer for whom the aforementioned frame is in relative motion along the direction that defines the separation of those clocks. Instead, to such an observer, the front-most clock has a reading earlier than the rear-most clock (yet they both advance at the same time-dilated *rate*). The amount by which the clocks are out of sync is equal to the time it would take light to travel the two clocks' uncontracted separation distance, multiplied by the frame's velocity expressed as a fraction of lightspeed.

TWIN PARADOX, NO ACCELERATIONS

The standard version of the twin paradox has an astronaut twin – call her Stella – accelerating away from her Earthbound twin sister, Terra. Stella rockets through the cosmos at relativistic speeds, then later turns around and flies home, eventually landing back on Earth.

But in order to eliminate pesky accelerations, we'll say that the astronaut twin, Stella, was *already* in motion as she passes over Earthbound twin Terra. At the pass-by, their clocks each start at zero. Then, instead of later turning around, Stella eventually passes another astronaut, Alf, moving equally fast in the opposite direction, who adopts Stella's clock reading and continues back toward Earth. When Alf arrives at Earth, he passes over homebound Terra without slowing, at which time their clock readings are compared. Thus there are no accelerations and the scenario can be examined with the simplest (SR) arithmetic, like what's been shown in diagrams thus far.

In order to make things clearer, we'll say that there exists a space buoy, unmoving with respect to Earth, exactly one light-year distant from Earth, and that it has a clock on it that is synchronized with Earth's clock. It is at that space buoy that Stella will pass by Alf. We'll say that Stella, and later Alf, each have a velocity of $.75c$ relative to Earth, which makes the relativistic gamma factor compute out to 1.5, almost exactly. At that gamma factor, a moving clock will tick off only two thirds as much time as the observer's clock does; and moving collinear distances will be like foreshortened.

TERRA'S RECKONING: It's Stella and Alf that move

According to Earthbound Terra's point of view, Stella, traveling at $.75C$, will reach the distant buoy in 1.33 years. Terra predicts that Stella will witness the buoy clock to display that precise reading upon her arrival there. And Alf's return leg will take the same again, another 1.33 years; so a total of 2.67 years should elapse on Terra's clock. *But*, deduces Terra, relativistic time-dilation must be ascribed to the traveling clocks (of Stella-cum-Alf), so instead of 2.67 years, Alf's clock is expected to read only 1.78 years upon his arrival.

STELLA-CUM-ALF'S RECKONING: No, it's Terra that travels

According to Stella's viewpoint, stock still in space, the "real estate" consisting of Earth-to-buoy is a moving frame, and so is length-contracted to 0.67 light-year. And since it has a velocity of $.75C$ with respect to her, the distant buoy should arrive when her clock reads 0.89 year. Upon its arrival, Stella figures that Terra's clock back on Earth, being time-dilated from motion, must read only 0.59 year. But the buoy clock reads 1.33 years. However, this is as expected due to the clock dissynchronicity: the buoy clock has a reading 0.75 year *later* than Earth's.

When Alf takes over Stella's clock reading of 0.89 year, *to him* the Earth-to-buoy frame is moving in the opposite direction. Alf notices that the buoy clock reads 1.33 years and computes, per relativistic dissynchronicity of moving separated clocks, that Earth's clock must be at 2.09 years. Under Relativity, Alf cannot adopt Stella's evaluation of Earth's then-current clock reading because differently moving observers will not reckon distant clock readings the same. But Alf can and does take at face value the reading on the buoy clock as a valid indicator, since it is right then and there local to him and Stella both.

The remainder is simplicity: Alf's clock advances another 0.89 year, just as Stella's clock had, as he sits stock still in space awaiting the arrival of the speeding Earth. Terra's Earthbound clock is presumed time-dilated, and so advances only another 0.59 year, to add to the 2.09 reading Alf had reckoned for it when he was at the buoy. So when Earth gets to Alf, Terra's clock will read 2.67 years, while Stella-cum-Alf's time is $0.89+0.89$, or 1.78 years.

CONCLUSION

By either reckoning, Terra's Earthbound clock aged the greater, and by the same amount... so there is no disparity. And more importantly, it corroborates the core concept of Relativity, that any observer can rightly claim *his* vantage to be stock still: it's the *other guy* who's moving.

Glossary of Terms

acceleration: Technically, this is any instance of changing speed or direction; and as in a passenger car, you sense it by the lurch, by the tug. Yet gravity causes a wholly different kind of acceleration, freefall, not betrayed by sensory clues, as when coasting ever faster downhill.

continuum: A continuous succession, no part of which can be distinguished from neighboring parts except by arbitrary division.

covariant: Loosely, this means simply ‘mutual’, that is, varying according to one observer’s vantage point to the same manner and degree that the observed entity finds the first to be variant.

dissynchronicity: A deviation from perfect synchronicity.

ethereal signal: This term refers to any of the myriad forms of electromagnetic radiation, most notably visible light, but also including X-rays, radio waves, microwaves, gamma rays and infrared radiation. The word “ethereal”, meaning insubstantive or without mass, ought not be confused with the pre-relativity notion that light waves travel in an unseen medium termed “The Ether”.

G-force: The force of gravity, or an equivalent tugging resulting from a vehicle’s acceleration.

gyroscope: A device consisting of a spinning mass, typically a disk or wheel, mounted on a base so that its axis can turn freely in one or more directions and thereby maintain its orientation regardless of any movement of the base.

inertial frame: A hypothetical frame of reference whose motion, if any, is utterly straight, steady and unaltered by external forces. Because gravity is everywhere, such an ideal frame of reference can exist only in the mind.

metric [noun]: an ordered system of time and space coordinates for the mapping of events.

perspective: The skewed ways in which remote things might ‘come across’ depending on how they be situated, and the observer’s vantage.

proprietary: exclusive to one owner.

rectilinear: This means “characterized by straight lines”, most notably ones that are at right angles to each other and thus form the familiar 2D or 3D Cartesian coordinate system for the precise mapping of spatial locations.

Terra Firma: Solid ground; a characterization of our Earth, implying a place of absolute stability.

time dilation: the perceived expansion of time spans, notably, the apparent slowing down of moving clocks.