SPACE AND TIME: IS THAT ALL THERE IS? pdf

1: Spacetime - Wikipedia

The magnitude of this scale factor (nearly , km in space being equivalent to 1 second in time), along with the fact that spacetime is a manifold, implies that at ordinary, non-relativistic speeds and at ordinary, human-scale distances, there is little that humans might observe which is noticeably different from what they might observe if.

References and Further Reading 1. Introduction The word "time" has several meanings. It can mean the duration between events, as when we say the trip from home to work took too much time because of all the traffic. It can mean, instead, the temporal location of an event, as when we say he arrived at the time they specified. It also can mean the temporal structure of events, as when we speak of investigting time rather than space. This article uses the word in all these senses. Philosophers of time would like to resolve as many issues as they can from the list of philosophical issues mentioned in the opening summary. Some issues are intimately related to others so that it is reasonable to expect a resolution of one to have deep implications for another. For example, there is an important subset of related philosophical issues about time that cause many philosophers of time to divide into two broad camps, the A-camp and the B-camp, because they are on the opposite sides of most of those issues. Persons are considered members of the A-camp if they accept a majority of the above claims. Members of the B-camp reject most of the claims of the A-camp and accept the majority of the following claims. This article provides an introduction to the philosophical controversy between the A and B camps, as well as an introduction to other issues about time, for example the philosophical issue of the controversy about how to properly understand the relationship between the manifest image of time and the scientific image of time. This is the relationship between time as it is ordinarily and informally understood and time as it is understood within fundamental physical science, namely physics. The manifest image is a collection of commonsense beliefs, and it is an important part of our implicit model of the world. It is not precisely definable, and experts disagree about whether this or that is part of the image, but it contains the following beliefs about time. The world was not created five minutes ago. Every event has a unique duration which can be assigned a measure such as its lasting so many seconds. Unlike space, time has a direction. Time is continuous; it is analog and not digital. Given any two events, they have some objective order such as one happening before the other, or their being simultaneous. Time flows like a river, and we directly experience the flow. Past events are real in the way that future events are not. Time is independent of the presence or motion of matter. The future is "open" and does not exist. No event could occur both earlier and later than itself. The earlier items on this list are common to both images, but the later items are not features of the scientific image because they conflict with science or are ignored by science. The terms manifest image and scientific image were coined by Wilfrid Sellars in Why would someone reject a feature of the manifest image in favor of the scientific image? We accept that the table is mostly empty space because i the fundamental scientific theory of wooden materials, namely physics, implies the table is mostly empty space, and ii this scientific theory can be shown to account for our experiences that led us to our conviction that the table is wholly a solid substance without empty space, and iii the scientific theory can account for other facts that the commonsense view cannot. Proponents of the manifest image very often complain that their opponent does not succeed with step ii. For example, the physicist Arthur Eddington says, "[T]he process by which the external world of physics is transformed into a world of familiar acquaintance in human consciousness is outside the scope of physics. The answer to this question has been and continues to be controversial in the literature on the philosophy of time. Prior gave one answer when he said that the theory of relativity is not about real time. Other philosophers of time disagree and say that any feature of the manifest image that conflicts with current science is an illusion. Craig Callender views the relationship of the two images differently: In some very loose and coarse-grained sense, manifest time might be called an illusion without any harm done. How Is Time Related to Mind? Physical time is public time, the time that clocks are designed to measure. It is also indicated by signs of our aging. Psychological time is different from both physical time and biological time. Psychological time is private time. It is also called "subjective time" and "phenomenological time," and it is best understood not as a kind of time but rather as awareness of physical time. There is no experimental evidence that the character of physical time is affected in any way by the presence or absence of mental awareness or the presence or absence of any biological phenomenon. For that reason, physical time is often called "objective time. Physical time is more fundamental than psychological time for helping us understand our shared experiences in the world, and so it is more useful for doing physical science; but psychological time is vitally important for understanding many mental experiences, as is biological time for understanding biological phenomena. The existence of repetitive, predictable, cyclic processes within our body is a key reason why we believe time exists. One reason why many people believe time exists is that they notice time by noticing a leaf fall. But if we close our eyes, we still can encounter time just by imagining the leaf falling. What all these encounters with time have in common is that we are having more experiences and accumulating more memories of those experiences. So, the accumulation of memories tends to support a belief in the existence of time. With the notable exception of Husserl , most philosophers say our ability to imagine other times is a necessary ingredient in our having any consciousness at all. We make use of our ability to imagine other times when we experience a difference between our present perceptions and our present memories of past perceptions. Somehow the difference between the two gets interpreted by us as evidence that the world we are experiencing is changing through time with some events succeeding other events. Locke said our train of ideas produces our idea that events succeed each other in time, but he offered no details on how this train does the producing. When we are younger, we lay down richer memories because everything is new. When we are older, the memories we lay down are much less rich because we have "seen it all before. Do things seem to move more slowly when we are terrified? Because memories of the terrifying event are "laid down so much more densely," or richly, Eagleman says, it seems to you, upon your remembering, that your terrifying event lasted longer than it really did. For these events, remembered psychological time is stretched compared to physical time. A major problem is to explain the origin and character of our temporal experiences. Philosophers and cognitive scientists continue to investigate this, but so far there is no consensus on either how we experience temporal phenomena or how we are conscious that we do. Although the cerebral cortex is usually considered to be the base for our conscious experience, it is surprising that rats distinguish a five-second interval and a forty-second interval even with their cerebral cortex removed. However, surely the fact that we know that we know about time is specific to our cerebral cortex. A rat does not know that it knows. It has competence without comprehension. A cerebral cortex is required for this comprehension. Philosophers also want to know which aspects of time we have direct experience of, and which we have only indirect experience of. For example, is our direct experience only of the momentary present, the instantaneous present, as Aristotle, Thomas Reid, and Alexius Meinong believed, or instead do we have direct experience of the "specious present," a present that lasts a short stretch of physical time? Among those accepting the notion of a specious present, the best estimate of its duration in physical time is eighty milliseconds for human beings, although neuroscientists do not yet know why it is not two milliseconds or one hour. There is continuing controversy about whether the individual specious presents can overlap each other and about how the individual specious presents combine to form our unified stream of consciousness. Neuroscientists have come to agree that the brain does take an active role in building a mental scenario of what is taking place beyond the brain. As one piece of suggestive evidence, notice that if you look at yourself in the mirror and glance at your left eyeball, then at your right eyeball, and then back to the left, you can never see your own eyes move. Your brain always constructs a continuous story of non-moving eyes. We all live in the pastâ€”in the sense that our belief about what is happening occurs later than when it really happened according to a clock. This is because our brain takes time to reconstruct a story of what is happening based on the information coming in from our different sense organs. The story-building must wait those milliseconds until the brain acquires all the information from all the sense organs. In the early days of television broadcasting, engineers worried about the problem of keeping audio and video signals synchronized. Then they accidentally discovered that they had around a tenth-of-a-second of "wiggle room. Eagleman, The light from the bounce of a basketball arrives into our eyes before the sound arrives into our ears, but then the brain builds a story in which the vision and sound of the bounce happen simultaneously. This sort of subjective synchronizing of vision and sound works for the bouncing ball so long as the ball is less than feet away. Any farther and we begin to notice that the sound arrives more slowly. For more on these topics, see Eagleman, The "time dilation effect" in psychology occurs when events involving an object coming toward you last longer in psychological time than an event with the same object being stationary. With repeated events lasting the same amount of clock time, presenting a brighter object will make that event seem to last longer. Similarly, for louder sounds. Suppose you live otherwise normally within a mine for a while, and are temporarily closed off from communicating with the world above. Neuroscientists and psychologists have investigated whether they can speed up our minds relative to a duration of physical time. If so, we might become mentally more productive, and get more high quality decision making done per fixed amount of physical time, and learn more per minute. Several avenues have been explored: These avenues definitely affect the ease with which pulses of neurotransmitters can be sent from one neuron to a neighboring neuron and thus affect our psychological time, but so far, none of these avenues has led to success productivity-wise. Do we directly experience the present? But notice how different such direct experience would have to be from our other direct experiences. We directly experience green color but can directly experience other colors. We directly experience high-pitched notes but can directly experience low-pitched notes. Can we say we directly experience the present but can directly experience the past or future? So, direct experience of the present either is non-existent, or it is a very strange sort of direct experience. Nevertheless, we probably do have some mental symbol for nowness in our mind that correlates with our having the concept of the present, but it does not follow from this that we directly experience the present any more than our having a concept of love implies that we directly experience love. To mention one more issue about the relationship between mind and time, if all organisms were to die, there would be events after those deaths. The stars would continue to shine, but would any of these star events be in the future?

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2: Time | Internet Encyclopedia of Philosophy

"So life is like a movie, and space-time is like the DVD," he added; "there's nothing about the DVD itself that is changing in any way, even though there's all this drama unfolding in the movie.

July 6, Why is time controversial? It feels real, always there, inexorably moving forward. Time has flow, runs like a river. Time has direction, always advances. Time has order, one thing after another. Time has duration, a quantifiable period between events. Time has a privileged present, only now is real. Time seems to be the universal background through which all events proceed, such that order can be sequenced and durations measured. The question is whether these features are actual realities of the physical world or artificial constructs of human mentality. To appreciate time is to feel the fabric of reality. I interview physicists and philosophers on my public television series, "Closer to Truth," and many assert that time is an illusion. What do they mean that time is "not real? A present moment that is special; some kind of flow or passage; and an absolute direction. Time is tenseless, all points equally "real," so that future and past are no less real than the present. Time is, was, will be? So, are we being misled by our human perspectives? Is our sense that time flows, or passes, and has a necessary direction, false? Are we giving false import to the present moment? The only reason I feel like I have a past is that my brain contains memories. So, time â€" the time we know since we learned to tell time on a clock â€" seems to disappear when you study physics, until you get to relativity. When you try to discuss time in the context of the universe, you need the simple idea that you isolate part of the universe and call it your clock, and time evolution is only about the relationship between some parts of the universe and that thing you called your clock. Time is only a reflection of change. From change, our brains construct a sense of time as if it were flowing. As he puts it, all the "evidence we have for time is encoded in static configurations, which we see or experience subjectively, all of them fitting together to make time seem linear. But not all physicists are ready to demote time to second-class status. John Polkinghorne, a quantum physicist and Anglican priest, believes that the flow and direction of time are real and relentless. And, therefore, that argument focuses on the way observers organize their description of the past and cannot establish the reality of the awaiting future. When I clap my hands, it happened. To many physicists, while we experience time as psychologically real, time is not fundamentally real. At the deepest foundations of nature, time is not a primitive, irreducible element or concept required to construct reality. But many ideas about how the world works that humanity had taken for granted have required a complete rethink. Is time irreducible, fundamental, an ultimate descriptor of bedrock reality? Or is our subjective sense of flowing time, generated by our brains that evolved for other purposes, an illusion? Opinion is divided, but many physicists and philosophers now suspect that time is not fundamental; rather, time emerges out of something more fundamental â€" something nontemporal, something altogether different perhaps something discreet, quantized, not continuous, smooth. The alternative, of course, is our common intuition: The views expressed are those of the author and do not necessarily reflect the views of the publisher. This version of the article was originally published on Space.

3: Einstein's Theory of General Relativity: A Simplified Explanation

Philosophy of space and time is the branch of philosophy concerned with the issues surrounding the ontology, epistemology, and character of space and www.enganchecubano.com such ideas have been central to philosophy from its inception, the philosophy of space and time was both an inspiration for and a central aspect of early analytic philosophy.

Insofar as time is something different from events, we do not perceive time as such, but changes or events in time. But, arguably, we do not perceive events only, but also their temporal relations. So, just as it is natural to say that we perceive spatial distances and other relations between objects I see the dragonfly as hovering above the surface of the water , it seems natural to talk of perceiving one event following another the thunderclap as following the flash of lightning , though even here there is a difficulty. For what we perceive, we perceive as presentâ€”as going on right now. Can we perceive a relation between two events without also perceiving the events themselves? If not, then it seems we perceive both events as present, in which case we must perceive them as simultaneous, and so not as successive after all. There is then a paradox in the notion of perceiving an event as occurring after another, though one that perhaps admits of a straightforward solution. When we perceive B as coming after A, we have, surely, ceased to perceive A. In which case, A is merely an item in our memory. In this wide sense, we perceive a variety of temporal aspects of the world. We shall begin by enumerating these, and then consider accounts of how such perception is possible. Among these we may list the experience of i duration; ii non-simultaneity; iii order; iv past and present; v change, including the passage of time. It might be thought that experience of non-simultaneity is the same as experience of time order, but it appears that, when two events occur very close together in time, we can be aware that they occur at different times without being able to say which one came first see Hirsh and Sherrick We might also think that perception of order was itself explicable in terms of our experience of the distinction between past and present. There will certainly be links here, but it is a contentious question whether the experience of tenseâ€”that is, experiencing an event as past or presentâ€”is more fundamental than the experience of order, or vice versa, or whether indeed there is such a thing as the experience of tense at all. This issue is taken up below. Finally, we should expect to see links between the perception of time order and the perception of motion if the latter simply involves perception of the order of the different spatial positions of an object. This is another contentious issue that is taken up below. Duration One of the earliest, and most famous, discussions of the nature and experience of time occurs in the autobiographical Confessions of St Augustine. He died in As a young adult, he had rejected Christianity, but was finally converted at the age of Book XI of the Confessions contains a long and fascinating exploration of time, and its relation to God. During the course of it Augustine raises the following conundrum: It cannot be what is past, since that has ceased to be, and what is non-existent cannot presently have any properties, such as being long. But neither can it be what is present, for the present has no duration. For the reason why the present must be regarded as durationless, see the section on the specious present, below. In any case, while an event is still going on, its duration cannot be assessed. From this he derives the radical conclusion that past and future exist only in the mind. While not following Augustine all the way to the mind-dependence of other times, we can concede that the perception of temporal duration is crucially bound up with memory. It is some feature of our memory of the event and perhaps specifically our memory of the beginning and end of the event that allows us to form a belief about its duration. This process need not be described, as Augustine describes it, as a matter of measuring something wholly in the mind. Arguably, at least, we are measuring the event or interval itself, a mind-independent item, but doing so by means of some psychological process. That there is a close connection here is entailed by the plausible suggestion that we infer albeit subconsciously the duration of an event, once it has ceased, from information about how long ago the beginning of that event occurred. That is, information that is metrical in nature e. The question is how we acquire this tensed information. It may be direct or indirect, a contrast we can illustrate by two models of time memory described by Friedman. He calls the first the strength model of time memory. If there is such a thing as a memory trace that persists over time, then we could judge the age of a memory and therefore how long ago the event remembered occurred from the strength of the trace. The longer ago the event, the weaker the trace. This provides a simple and direct means of assessing the duration of an event. Unfortunately, the trace model comes into conflict with a very familiar feature of our experience: A contrasting account of time memory is the inference model. According to this, the time of an event is not simply read off from some aspect of the memory of it, but is inferred from information about relations between the event in question and other events whose date or time is known. The inference model may be plausible enough when we are dealing with distant events, but rather less so for much more recent ones. In addition, the model posits a rather complex cognitive operation that is unlikely to occur in non-human animals, such as the rat. In this, a given response such as depressing a lever will delay the occurrence of an electric shock by a fixed period of time, such as 40 seconds, described as the R-S response-shock interval. Eventually, rate of responding tracks the R-S interval, so that the probability of responding increases rapidly as the end of the interval approaches. See Mackintosh for a discussion of this and related experiments. It is hard to avoid the inference here that the mere passage of time itself is acting as a conditioned stimulus: In this case, the strength model seems more appropriate than the inference model. Clay, but the best known characterisation of it was due to William James, widely regarded as one of the founders of modern psychology. He lived from to , and was professor of philosophy at Harvard. His definition of the specious present goes as follows: How long is this specious present? There are two sources of ambiguity here. So we could define the specious present as: If James means the first of these, that would certainly explain his suggestion that it could last up to a minute. But this does not seem to have much to do specifically with the experience of presentness, since we can certainly hold something in the short-term memory and yet recognise it as past. James may be thinking of cases where we are listening to a sentence: But it is clear that the words are not experienced as simultaneous, for then the result would be an unintelligible jumble of sounds. What is in fact taking place at different times is presented as happening in an instant. But this is not standardly what is meant by the specious present. Besides which, as Kelly points out, we might think it odd to suppose that past parts of the interval could be directly perceived. That leaves us with 4: The real or objective present must be durationless for, as Augustine argued, in an interval of any duration, there are earlier and later parts. So if any part of that interval is present, there will be another part that is past or future. But is it possible to perceive something as extended as a present? If we hear a short phrase of music, we seem to hear the phrase as present, and yet â€" because it is a phrase rather than a single chord â€" we also hear the notes as successive, and therefore as extending over an interval. If this does not seem entirely convincing, consider the perception of motion. That leads to the following argument: What we perceive as present occurs over an interval. Still, there is more than an air of paradox about this. If successive parts of the motion or musical phrase, or whatever change we perceive are perceived as present, then surely they are perceived as simultaneous. But if they are perceived as simultaneous, then the motion will simply be a blur, as it is in cases where it is too fast to perceive as motion. The fact that we do not see it as motion suggests that we do not see the successive parts of it as simultaneous, and so do not see them as present. But then how do we explain the distinction to which Broad directs our attention? One way out of this impasse is to suggest that two quite distinct processes are going on in the perception of motion and other kinds of change. One is the perception of successive states as successive, for example the different positions of the second hand. The other is the perception of pure movement. This second perception, which may involve a more primitive system than the first, does not contain as part the recognition of earlier and later elements. Le Poidevin , Chapter 5. Past, present and the passage of time The previous section indicated the importance of distinguishing between perceiving the present and perceiving something as present. We may perceive as present items that are past. Indeed, given the finite speed of the transmission of both light and sound and the finite speed of transmission of information from receptors to brain , it seems that we only ever perceive what is past. However, this does not by itself tell us what it is to perceive something as present, rather than as past. Nor does it explain the most striking feature of our experience as-of the present: The passage or apparent passage of time is its most striking feature, and any account of our perception of time must account for this aspect of our experience. Here is one attempt to do so. The first problem is to explain why our temporal experience is limited in a way in which our spatial experience is not. We can perceive objects that stand in a variety of spatial relations to us: Our experience is not limited to the immediate vicinity although of course our experience is spatially limited to the extent that sufficiently distant objects are invisible to us. But, although we perceive the past, we do not perceive it as past, but as present. Moreover, our experience does not only appear to be temporally limited, it is so: Now, there is a very simple answer to the question why we do not perceive the future, and it is a causal one. Briefly, causes always precede their effects; perception is a causal process, in that to perceive something is to be causally affected by it; therefore we can only perceive earlier events, never later ones. So one temporal boundary of our experience is explained; what of the other? There seems no logical reason why we should not directly experience the distant past. We could appeal to the principle that there can be no action at a temporal distance, so that something distantly past can only causally affect us via more proximate events. But this is inadequate justification.

4: Philosophy of space and time - Wikipedia

Physicists do not regard time as "passing" or "flowing" and time is not a sequence of events which happen: the past and the future are simply there, laid out as part of space-time.

Is it a substance in its own right, a property of some substance, or perhaps neither? Is it somehow dependent on the relations among objects, or independent of those relations? What is the relationship between space and the mind? And finally, how do these various issues intersect with one another? The passage from the Inaugural Dissertation hints at five distinct questions or issues concerning space and time. First, there is the question of the ontology of space and time considered within the framework of what Kant would regard as the dogmatic metaphysics of the seventeenth century. This framework might suggest that if space and time are to exist, or to characterize the physical world, they must be considered either substances in their own right, or else properties of some substance. Neither option seems particularly attractive. Space and time seem distinct from substances because they are causally inert, causally inaccessibleâ€"their aspects or properties cannot be altered by interacting with any other substanceâ€"and imperceptible. However, it is also difficult to think of space and time as properties of any substance, for then they would presumably be dependent on that substance for their existence. If we regard them as dependent on any contingent substance, it seems that we would be committed to the idea that space and time could fail to exist, or could disappear, depending on the happenings of that contingent substance. One might think instead that space and time depend on the one necessary substance, but this obviously raises a host of other issues. To think of space and time as properties of God is potentially to regard God as spatiotemporal, which is verboten from the point of view of many seventeenth-century thinkers Janiak , chapter five. A second topic arises if we consider the ontology of space and time independently from the substance-property metaphysical framework, viz. Leaving aside questions about ontology, there is a distinctâ€"or at least potentially distinctâ€"issue regarding space and time: This third issue arises from the sense in the early modern period that our idea or representation of space and time must somehow be importantly distinct from our idea or representation of ordinary physical objects. Many believed that space and time are causally inert and therefore imperceptibleâ€"how then are we are able to represent space and time at all? Few are willing to deny that we have a representation, not merely of spatial and of temporal objects, but also of space and time themselves, so there is a genuine puzzle lurking here. The fourth topic follows on the heels of the third: Alternatively, we might be able to consider the origin of a representation as providing us with a clue as to what its content might be. In the case of space, there may be reason to think that the content of our representation must somehow reflect what we know about space from Euclidean geometry. The fifth and final topic is closely connected with the third and fourth, and indeed, connects all four previous topics with one another: This question obviously cries out for clarification. Part of what this question might mean can be characterized by the third and fourth questions above: It may be that some kind of dependence is suggested by the originâ€"or by the contentâ€"of our representation of space and time or perhaps by these two jointly. But Kant also seems to think that a view recognizing the dependence of space and time on the mind might offer advantages in addressing the ontological problems mentioned above. As we will see below, part of the difficulty in interpreting Kant arises from the fact that he evidently transforms various aspects of the early modern debates concerning space and time through the perspective presented in the first Critique Allison , Within the context of the first issue raised above, the view that space and time are real may mean that space and time are substances in their own right, rather than merely properties; yet within the context of the absolutism-relationalism debate, if space and time are real, they exist independently of all objects and relations. But Kant uses the terms real and ideal to express views concerning the relation between space and time and the mind, leaving aside any views concerning objects and relations. This entry aims to clarify matters by separating these various considerations. Kant mentions this debate frequently throughout the Critique see, e. In the beginning of the Transcendental Aesthetic, Kant frames his view by contrasting it with the failures of the Leibnizians and the Newtonians to conceive of space appropriately: Now what are space and time? Are they actual entities [wirkliche Wesen]? Are they only determinations or also relations of things, but still such as would belong to them even if they were not intuited? Or are they such that they belong only to the form of intuition, and therefore to the subjective constitution of our mind, without which these predicates could not be ascribed to any things at all? The view that space and time are actual entities is meant to represent the Newtonian position, and the view that they are determinations or relations of things, the Leibnizian position but cf. First, how does Kant understand the Leibnizian and the Newtonian conceptions of space and time? Does Kant regard himself as needing to undermine either, or both, of these prior conceptions in order to support his conclusion that space and time are transcendentally ideal? These questions will help to guide the discussion below. The fact that Kant focuses on the debate between the Leibnizians and the Newtonians is perplexing given his evident lack of interest, within the context of the Critique, in problems concerning motion. So the very idea of absolute or mathematical space helps to express what true motion is. Instead, Kant tackles issues concerning physical motion in the Metaphysical Foundations, where he contends that one can distinguish true from relative motion by determining the center of mass frame of the solar system 4: But what if we abstract away from questions of physical motion Janiak ? What if we consider motion within a much more abstract context: Kant makes it clear that this remains empirical because the concept of motion itself is empirical, and so should still be deferred to the Metaphysical Foundations. Indeed, the latter begins with a consideration of motion in abstraction from various physical questions like the mass of the objects and then slowly progresses by adding further physical or empirical elements. Is that kind of motion under discussion, perhaps implicitly, in the context of the Aesthetic? In what follows, then, one goal is to specify why Kant remains focused in the Aesthetic on the views of Leibniz and Newton and their respective followers. Throughout the pre-critical and critical periods, Kant evinces considerable interest in various attempts to reconcile certain aspects of Leibnizian metaphysics with the Newtonian view of nature Friedman , Kant regards an intuition as a conscious, objective representationâ€”this is strictly distinct from sensation, which he regards not as a representation of an object, property, event, etc. Each represents properties, objects, or states of affairs, but they do so distinctly. Unfortunately, there is no consensus on the right way to understand this idea. Thus it represents X as, for instance, that there. Suppose that I want to represent my desk, at which I am sitting right now. To represent my desk in intuition is to represent it as something I point to, as that there. This does not indicate, of course, that this is a desk, my desk, a piece of furniture, made of wood, etc. It does so immediately at least in the sense that it makes use of no other representation. To represent my desk with a concept is to represent it as a desk, or as a piece of furniture, or as a wooden thing, etc. But it is surely surprising to hear that intuition, which in some regards is akin to perception Parsons , ; Allais , ff , can also be empirical or a priori in character. Here it helps to recall that Kant distinguishes sensation from intuition. There remains a question, however, of how we are to understand the very idea that we can have pureâ€”or a priori, i. This means, as we have seen, that we have non-empirical, singular, immediate representations of space and of time. One goal of this entry is to clarify this idea. By a concept Begriff in this context I take Kant simply to mean a representation. Space is not an empirical concept which has been derived from outer experiences. One might wonder what type of view is at issue here. One potential target is a classic empiricist account of our idea of space, such as that found in Locke. It seems that for Locke, we begin with an idea of the distance between any two bodies; this would presumably involve an idea of these two bodies as being in different places. Kant may be contending that in order to represent objects as in different places from one another, I must represent them as in space. But if this were true, then I would already have, as it were, the representation of space, and could not obtain it in the way Locke outlines. Daniel Warren clarifies this argument in an especially helpful way Warren ; cf. Warren gives a useful example: I could do so: But I need not do so: I could simply represent A and B themselves, and represent A as brighter than B, as I might do with two lights Warren , ff. The suggestion is that in order to represent A and B as bearing a spatial relation with one anotherâ€”say, to represent them as being some distance apartâ€”I must represent A and B as in space. In that sense, the representation of objects as spatially related may presuppose the representation of space. The problem for Locke is that he begins with my perception, or idea, of a distance between two objects, and then proceeds to construct my idea of space from that initial point. But if my representation of a distance relation between any two objects already presupposes a representation of those objects as in space, then the former cannot be the beginning point of a process that issues in the latter. At some moments, Leibniz seems committed to the view that the representation of space is constructed from particular perceptions of distance relations and the like. For instance, in a famous passage in his final letter to Clarke, Leibniz claims that in order to obtain a representation of space, one can consider a system of objects, some of which are in motion, and abstract the notion same place from that system. Space is what encompasses all such places. Space is a necessary a priori representation that underlies all outer intuitions. One can never forge a representation of the absence of space, though one can quite well think that no things are to be met within it. It must therefore be regarded as the condition of the possibility of appearances, and not as a determination dependent upon them, and it is an a priori representation that necessarily underlies outer appearances. This point would undermine Leibnizian relationalism if the relationalist claim that space is not independent of objects is, at least in part, founded on the claim that the very idea of space existing independently of objects is incoherent. If one held such a view, one could raise doubts about relationalism by contending, as Kant does, that we can in fact conceive of space to be devoid of objects. The view that space cannot exist independently of objects at any given instant does seem to entail that space cannot be utterly devoid of objects. Leibniz thinks that space is the order of the actual and possible relations among objects, so he has the resources to say that space can contain empty sectorsâ€"see New Essays, , and L 5: Yet this view seems perfectly compatible with the idea that we can conceive of empty space. Leibniz himself makes repeated and explicit use of the thought of such a situation when attempting to undermine the Newtonian view that space is absolute. Instead of arguing that the very idea that space could be independent of objects is incoherent, Leibniz contends that it violates the principle of sufficient reason see L3: The idea that God could place objects within a pre-existing absolute space with one orientation rather than another is evidently not incoherent; rather, God would lack a reason for doing this. Similarly, Leibniz contends that absolutism violates the principle of the identity of indiscernibles L4: He thinks that we must not be fooled by the fact that we can think of space as empty of objects into concluding that space itself is something independent of objects and their relations. As with all mere abstractions, we must not reify space. Kant claims that we cannot represent the absence of space, but that we can represent space as empty of objects. His point may be that empiricist philosophers who contend that the representation of space is obtained from the perception of objects must bear the burden of explaining how it is possible for us to conceive of space as empty of such objects.

SPACE AND TIME: IS THAT ALL THERE IS? pdf

5: NASA - Time in Space, A Space in Time

For this to be true, space and time can no longer be independent. Rather, they are "converted" into each other in such a way as to keep the speed of light constant for all observers. (This is why moving objects appear to shrink, as suspected by FitzGerald and Lorentz, and why moving observers may measure time differently, as speculated by.

We live in a physical world with its four known space-time dimensions of length, width, height or depth and time. However, God dwells in a different dimensionâ€"the spirit realmâ€"beyond the perception of our physical senses. Our lives are but short and frail, but God does not weaken or fail with the passage of time. In a sense, the marking of time is irrelevant to God because He transcends it. Peter, in 2 Peter 3: The Lord does not count time as we do. He is above and outside of the sphere of time. A second is no different from an eon; a billion years pass like seconds to the eternal God. Though we cannot possibly comprehend this idea of eternity or the timelessness of God, we in our finite minds try to confine an infinite God to our time schedule. And in so doing, we describe Him as a God without a beginning or end, eternal, infinite, everlasting, etc. He always was and always will be. So, what is time? To put it simply, time is duration. Our clocks mark change or, more precisely, our timepieces are benchmarks of change that indicate the passage of time. We could say, then, that time is a necessary precondition for change and change is a sufficient condition to establish the passage of time. We see this as we go through life, as we age. And we cannot recover the minutes that have passed by. Additionally, the science of physics tells us that time is a property resulting from the existence of matter. As such, time exists when matter exists. But God is not matter; God, in fact, created matter. The bottom line is this: Before that, God was simply existing. Since there was no matter, and because God does not change, time had no existence and therefore no meaning, no relation to Him. And this brings us to the meaning of the word eternity. God has no beginning or end. He is outside the realm of time. Eternity is not something that can be absolutely related to God. God is even beyond eternity. Scripture reveals that God lives outside the bounds of time as we know it. In other words, the physical universe we see, hear, feel and experience was created not from existing matter, but from a source independent of the physical dimensions we can perceive. Time was simply created by God as a limited part of His creation for accommodating the workings of His purpose in His disposable universe see 2 Peter 3: Upon the completion of His creation activity, including the creation of time, what did God conclude? Indeed, God is spirit in the realm of timelessness, rather than flesh in the sphere of time. As believers, we have a deep sense of comfort knowing that God, though timeless and eternal, is in time with us right now; He is not unreachably transcendent, but right here in this moment with us.

SPACE AND TIME: IS THAT ALL THERE IS? pdf

6: Albert Einstein and the Fabric of Time

Combining space and time into space-time in this way would be rather trivial, if one could disentangle them in a unique way. That is to say, if there was a unique way of defining the time and position of each event.

In science fiction, space and time warps are a commonplace. They are used for rapid journeys around the galaxy, or for travel through time. So what are the chances for space and time warps. The idea that space and time can be curved, or warped, is fairly recent. For more than two thousand years, the axioms of Euclidean geometry, were considered to be self evident. As those of you that were forced to learn Euclidean geometry at school may remember, one of the consequences of these axioms is, that the angles of a triangle, add up to a hundred and 80 degrees. However, in the last century, people began to realize that other forms of geometry were possible, in which the angles of a triangle, need not add up to a hundred and 80 degrees. Consider, for example, the surface of the Earth. The nearest thing to a straight line on the surface of the Earth, is what is called, a great circle. These are the shortest paths between two points, so they are the roots that air lines use. Consider now the triangle on the surface of the Earth, made up of the equator, the line of 0 degrees longitude through London, and the line of 90 degrees longtitude east, through Bangladesh. The two lines of longitude, meet the equator at a right angle, 90 degrees. The two lines of longitude also meet each other at the north pole, at a right angle, or 90 degrees. Thus one has a triangle with three right angles. The angles of this triangle add up to two hundred and seventy degrees. This is greater than the hundred and eighty degrees, for a triangle on a flat surface. If one drew a triangle on a saddle shaped surface, one would find that the angles added up to less than a hundred and eighty degrees. The surface of the Earth, is what is called a two dimensional space. That is, you can move on the surface of the Earth, in two directions at right angles to each other: But of course, there is a third direction at right angles to these two, and that is up or down. That is to say, the surface of the Earth exists in three-dimensional space. The three dimensional space is flat. That is to say, it obeys Euclidean geometry. The angles of a triangle, add up to a hundred and eighty degrees. For them, space would be curved, and geometry would be non-Euclidean. It would be very difficult to design a living being that could exist in only two dimensions. If there were a passage right the way through, like we have, the poor animal would fall apart. So three dimensions, seems to be the minimum for life. If the sphere were very large, space would be nearly flat, and Euclidean geometry would be a very good approximation over small distances. But we would notice that Euclidean geometry broke down, over large distances. As an illustration of this, imagine a team of painters, adding paint to the surface of a large ball. As the thickness of the paint layer increased, the surface area would go up. If the ball were in a flat three-dimensional space, one could go on adding paint indefinitely, and the ball would get bigger and bigger. However, if the three-dimensional space, were really the surface of a sphere in another dimension, its volume would be large but finite. As one added more layers of paint, the ball would eventually fill half the space. After that, the painters would find that they were trapped in a region of ever decreasing size, and almost the whole of space, was occupied by the ball, and its layers of paint. So they would know that they were living in a curved space, and not a flat one. This example shows that one can not deduce the geometry of the world from first principles, as the ancient Greeks thought. Instead, one has to measure the space we live in, and find out its geometry by experiment. However, although a way to describe curved spaces, was developed by the German, George Friedrich Riemann, in , it remained just a piece of mathematics for sixty years. It could describe curved spaces that existed in the abstract, but there seemed no reason why the physical space we lived in, should be curved. This came only in , when Einstein put forward the General Theory of Relativity. General Relativity was a major intellectual revolution that has transformed the way we think about the universe. It is a theory not only of curved space, but of curved or warped time as well. Einstein had realized in , that space and time, are intimately connected with each other. One can describe the location of an event by four numbers. Three numbers describe the position of the event. They could be miles north and east of Oxford circus, and height above sea level. On a larger scale, they could be galactic latitude and longitude, and distance from the center of the galaxy. The fourth number, is the time of the event. Thus one can think of space and time together, as a four-dimensional entity, called space-time. Each point of space-time is labeled by four numbers, that specify its position in space, and in time. Combining space and time into space-time in this way would be rather trivial, if one could disentangle them in a unique way. That is to say, if there was a unique way of defining the time and position of each event. However, in a remarkable paper written in , when he was a clerk in the Swiss patent office, Einstein showed that the time and position at which one thought an event occurred, depended on how one was moving. This meant that time and space, were inextricably bound up with each other. The times that different observers would assign to events would agree if the observers were not moving relative to each other. But they would disagree more, the faster their relative speed. So one can ask, how fast does one need to go, in order that the time for one observer, should go backwards relative to the time of another observer. The answer is given in the following Limerick. There was a young lady of Wight, Who traveled much faster than light, She departed one day, In a relative way, And arrived on the previous night. So all we need for time travel, is a space ship that will go faster than light. Unfortunately, in the same paper, Einstein showed that the rocket power needed to accelerate a space ship, got greater and greater, the nearer it got to the speed of light. So it would take an infinite amount of power, to accelerate past the speed of light. It also indicated that space travel to other stars, was going to be a very slow and tedious business. If the space ship went very near the speed of light, it might seem to the people on board, that the trip to the galactic center had taken only a few years. So writers of science fiction, had to look for ways to get round this difficulty. In his paper, Einstein showed that the effects of gravity could be described, by supposing that space-time was warped or distorted, by the matter and energy in it. We can actually observe this warping of space-time, produced by the mass of the Sun, in the slight bending of light or radio waves, passing close to the Sun. This causes the apparent position of the star or radio source, to shift slightly, when the Sun is between the Earth and the source. The shift is very small, about a thousandth of a degree, equivalent to a movement of an inch, at a distance of a mile. Nevertheless, it can be measured with great accuracy, and it agrees with the predictions of General Relativity. We have experimental evidence, that space and time are warped. The amount of warping in our neighbourhood, is very small, because all the gravitational fields in the solar system, are weak. However, we know that very strong fields can occur, for example in the Big Bang, or in black holes. So, can space and time be warped enough, to meet the demands from science fiction, for things like hyper space drives, wormholes, or time travel. At first sight, all these seem possible. For example, in , Kurt Goedel found a solution of the field equations of General Relativity, which represents a universe in which all the matter was rotating. In this universe, it would be possible to go off in a space ship, and come back before you set out. Goedel was at the Institute of Advanced Study, in Princeton, where Einstein also spent his last years. It also had a fairly large value for a quantity called the cosmological constant, which is generally believed to be zero. However, other apparently more reasonable solutions that allow time travel, have since been found. A particularly interesting one contains two cosmic strings, moving past each other at a speed very near to, but slightly less than, the speed of light. As their name suggests, they are like string, in that they have length, but a tiny cross section. Actually, they are more like rubber bands, because they are under enormous tension, something like a hundred billion billion billion tons. A cosmic string attached to the Sun would accelerate it naught to sixty, in a thirtieth of a second. Cosmic strings may sound far-fetched, and pure science fiction, but there are good scientific reasons to believed they could have formed in the very early universe, shortly after the Big Bang. Because they are under such great tension, one might have expected them to accelerate to almost the speed of light. What both the Goedel universe, and the fast moving cosmic string space-time have in common, is that they start out so distorted and curved, that travel into the past, was always possible. God might have created such a warped universe, but we have no reason to think that He did. All the evidence is, that the universe started out in the Big Bang, without the kind of warping needed, to allow travel into the past. I think this is an important subject for research, but one has to be careful not to be labeled a crank. If one made a research grant application to work on time travel, it would be dismissed immediately. No government agency could afford to be seen to be spending public money, on anything as way out as time travel. Instead, one has to use technical terms, like closed time like curves, which are code for time travel.

SPACE AND TIME: IS THAT ALL THERE IS? pdf

Although this lecture is partly about time travel, I felt I had to give it the scientifically more respectable title, Space and Time warps. Yet, it is a very serious question.

7: Is the Universe Finite or Infinite? - Universe Today

Einstein changed this picture by unifying space and time into a single 4-D entity. But even Einstein failed to challenge the concept of time as a measure of change. In Barbour's view, the question.

November 7, Gravity Probe B showed this to be correct. NASA In , Albert Einstein determined that the laws of physics are the same for all non-accelerating observers, and that the speed of light in a vacuum was independent of the motion of all observers. This was the theory of special relativity. It introduced a new framework for all of physics and proposed new concepts of space and time. Einstein then spent 10 years trying to include acceleration in the theory and published his theory of general relativity in In it, he determined that massive objects cause a distortion in space-time, which is felt as gravity. The tug of gravity Two objects exert a force of attraction on one another known as "gravity. The force tugging between two bodies depends on how massive each one is and how far apart the two lie. Even as the center of the Earth is pulling you toward it keeping you firmly lodged on the ground , your center of mass is pulling back at the Earth. But the more massive body barely feels the tug from you, while with your much smaller mass you find yourself firmly rooted thanks to that same force. Albert Einstein , in his theory of special relativity , determined that the laws of physics are the same for all non-accelerating observers, and he showed that the speed of light within a vacuum is the same no matter the speed at which an observer travels. As a result, he found that space and time were interwoven into a single continuum known as space-time. Events that occur at the same time for one observer could occur at different times for another. As he worked out the equations for his general theory of relativity, Einstein realized that massive objects caused a distortion in space-time. Imagine setting a large body in the center of a trampoline. The body would press down into the fabric, causing it to dimple. A marble rolled around the edge would spiral inward toward the body, pulled in much the same way that the gravity of a planet pulls at rocks in space. How To See Spacetime Stretch] Experimental evidence Although instruments can neither see nor measure space-time, several of the phenomena predicted by its warping have been confirmed. Light around a massive object, such as a black hole, is bent, causing it to act as a lens for the things that lie behind it. Astronomers routinely use this method to study stars and galaxies behind massive objects. The quasar is about 8 billion light-years from Earth, and sits behind a galaxy that is million light-years away. Four images of the quasar appear around the galaxy because the intense gravity of the galaxy bends the light coming from the quasar. Gravitational lensing can allow scientists to see some pretty cool things, but until recently, what they spotted around the lens has remained fairly static. However, since the light traveling around the lens takes a different path, each traveling over a different amount of time, scientists were able to observe a supernova occur four different times as it was magnified by a massive galaxy. Although the white dwarf is more massive, it has a far smaller radius than its companion. Changes in the orbit of Mercury: The orbit of Mercury is shifting very gradually over time, due to the curvature of space-time around the massive sun. In a few billion years, it could even collide with Earth. Frame-dragging of space-time around rotating bodies: The spin of a heavy object, such as Earth, should twist and distort the space-time around it. The electromagnetic radiation of an object is stretched out slightly inside a gravitational field. Think of the sound waves that emanate from a siren on an emergency vehicle; as the vehicle moves toward an observer, sound waves are compressed, but as it moves away, they are stretched out, or redshifted. Known as the Doppler Effect, the same phenomena occurs with waves of light at all frequencies. In , two physicists, Robert Pound and Glen Rebka, shot gamma-rays of radioactive iron up the side of a tower at Harvard University and found them to be minutely less than their natural frequency due to distortions caused by gravity. Violent events, such as the collision of two black holes, are thought to be able to create ripples in space-time known as gravitational waves. It is thought that such waves are embedded in the cosmic microwave background. However, further research revealed that their data was contaminated by dust in the line of sight. LIGO spotted the first confirmed gravitational wave on September 14, The pair of instruments, based out of Louisiana and Washington, had recently been upgraded, and were in the process of being calibrated before they went online. The first detection was so large that, according to LIGO spokesperson Gabriela Gonzalez, it took the team several months of analyzation to convince themselves that it was a real signal and not a glitch. A second signal was spotted on December 26 of the same year, and a third candidate was mentioned along with it. While the first two signals are almost definitively astrophysicalâ€”Gonzalez said there was less than one part in a million of them being something elseâ€—the third candidate has only an 85 percent probability of being a gravitational wave. Together, the two firm detections provide evidence for pairs of black holes spiraling inward and colliding. As time passes, Gonzalez anticipates that more gravitational waves will be detected by LIGO and other upcoming instruments, such as the one planned by India.

SPACE AND TIME: IS THAT ALL THERE IS? pdf

8: Consent Form | Popular Science

So there are all kinds of space and time distortions near black holes, where the gravity can be very intense. In the past few years, some scientists have used those distortions in space-time to think of possible ways time machines could work.

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9: The Experience and Perception of Time (Stanford Encyclopedia of Philosophy)

Nola Taylor Redd, www.enganchecubano.com Contributor. Nola Taylor Redd is a contributing writer for www.enganchecubano.com She loves all things space and astronomy-related, and enjoys the opportunity to learn more.

Time May Not Exist Not to mention the question of which way it goes In his lab at the Max Planck Institute of Quantum Optics in Garching, Germany, he has clocked the shortest time intervals ever observed. Krausz uses ultraviolet laser pulses to track the absurdly brief quantum leaps of electrons within atoms. The events he probes last for about attoseconds, or quintillionths of a second. For a little perspective, attoseconds is to one second as a second is to million years. But even Krausz works far from the frontier of time. There is a temporal realm called the Planck scale , where even attoseconds drag by like eons. It marks the edge of known physics, a region where distances and intervals are so short that the very concepts of time and space start to break down. Planck timeâ€"the smallest unit of time that has any physical meaningâ€"is second, less than a trillionth of a trillionth of an attosecond. At least for now. Efforts to understand time below the Planck scale have led to an exceedingly strange juncture in physics. The problem, in brief, is that time may not exist at the most fundamental level of physical reality. If so, then what is time? And why is it so obviously and tyrannically omnipresent in our own experience? One consequence is that the past, present, and future are not absolutes. Some four decades ago, the renowned physicist John Wheeler, then at Princeton, and the late Bryce DeWitt, then at the University of North Carolina, developed an extraordinary equation that provides a possible framework for unifying relativity and quantum mechanics. It may be that the best way to think about quantum reality is to give up the notion of timeâ€"that the fundamental description of the universe must be timeless. Nevertheless, a sizable minority of physicists, Rovelli included, believe that any successful merger of the two great masterpieces of 20th-century physics will inevitably describe a universe in which, ultimately, there is no time. Vying for second place is this strange fact: As far as we can tell, though, time is a one-way process; it never reverses, even though no laws restrict it. Physicists believe that the universe started as a very simple, extremely compact ball of energy. As the universe expands, it becomes ever more complex and disorderly. The growing disorderâ€"physicists call it an increase in entropyâ€"is driven by the expansion of the universe, which may be the origin of what we think of as the ceaseless forward march of time. Time, in this view, is not something that exists apart from the universe. There is no clock ticking outside the cosmos. Most of us tend to think of time the way Newton did: NIST is the government lab that houses the atomic clock that standardizes time for the nation. They define the time standards for the globe: Time is defined by the number of clicks of their clocks. Moreover, their point of view is consistent with the Wheeler-DeWitt equation. If you say this object moves, what you really mean is that this object is here when the hand of your clock is here, and so on. We say we measure time with clocks, but we see only the hands of the clocks, not time itself. And the hands of a clock are a physical variable like any other. So in a sense we cheat because what we really observe are physical variables as a function of other physical variables, but we represent that as if everything is evolving in time. Instead of introducing this fictitious variableâ€"time, which itself is not observableâ€"we should just describe how the variables are related to one another. The question is, Is time a fundamental property of reality or just the macroscopic appearance of things? As of now there is no physical theory that completely describes what the universe is like below the Planck scale. One possibility is that if physicists ever manage to unify quantum theory and general relativity, space and time will be described by some modified version of quantum mechanics. In such a theory, space and time would no longer be smooth and continuous. Rather, they would consist of discrete fragmentsâ€"quanta, in the argot of physicsâ€"just as light is composed of individual bundles of energy called photons. These would be the building blocks of space and time. Where would the components of space and time exist, if not in space and time? As Rovelli explains it, in quantum mechanics all particles of matter and energy can also be described as waves. And waves have an unusual property: An infinite number of them can exist in the same location. If time and space are one day shown to consist of quanta, the quanta could all exist piled together in a single dimensionless point. There are just quanta kind of living on top of one another without being immersed in a space. Together they have developed a framework to show how the thing we experience as time might emerge from a more fundamental, timeless reality. But this is what fundamental physics is about: I think that when Galileo said that the Earth was spinning crazily around, it was utterly incomprehensible in the same manner. Space for Copernicus was not the same as space for Newton, and space for Newton was not the same as space for Einstein. We always learn a little bit more. People like us, who believe in physics, know that the distinction between past, present, and future is only a stubbornly persistent illusion. When the dust settles, timeâ€"whatever it may beâ€"could turn out to be even stranger and more illusory than even Einstein could imagine.

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