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A Photon Reference Frame and Distant Starlight: Analyzing Ideas from Gerald L. Schroeder's *The Science of God*

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Abstract

This paper reviews claims made by Gerald L. Schroeder in relation to the nature of light and the age of the universe. Schroeder suggests that light does not experience time in its reference frame; although he also believes the universe is billions of years old, something young earth creationists cannot accept. But what are we to make of the first consideration? This is discussed in relation to Lorentz time dilation and the well-known *twin paradox*, and it is noted that *information* is carried in the traveller's reference frame. This may offer some insight to our understanding of space and distant starlight, although it would need to work alongside other creationist cosmological models. It also seems to set up a dual aspect of our understanding of time: one time dilated, the other one not time dilated, which raises theological questions. Theological reflections are then offered from Saint Augustine and Thomas F. Torrance noting that relativity may allow non-naturalistic views of the universe and so develop understandings more in keeping with a Judeo-Christian perspective. However, some caution is needed when theology is linked too strongly to particular scientific paradigms, as the science may be modified in the future.

Keywords: photon, reference frame, relativity, time dilation, Lorentz Transformation, twin paradox, Einstein, Augustine, T. F. Torrance.

Introduction

This paper will review some of the claims in Gerald L. Schroeder's book *The Science of God* (1997). From the postulates of special relativity, Schroeder discussed the significance of a photon's reference frame in relation to the passage of time, believing that the "time of all events becomes compressed into the present…" (Schroeder 1997, pp. 161–164). He sees from this that there are two frames of reference—one is connected to time, the other is connected to eternity. This idea has also been discussed by others (Bondi 1964; Grandy 2001, 2009; Haisch 1999; Wheeler 1990a). However, this does not seem to have been aired in great detail in the creation literature, although DeRemer (2006) has provided a useful overall review of Schroeder's book (see also Humphreys and Samec 2000). Schroeder is quite an influential figure, and was one of the influences upon Anthony Flew's "conversion" to a vague deism, so it is worth examining his ideas in further depth.

Schroeder seeks to harmonize secular cosmology that involves billions of years of cosmic change with the biblical time frame of six days. As an Orthodox Jew he seeks to take the Torah and Genesis creation account seriously, but we may question whether he has succeeded. He suggests that looking forward from the creation perspective only six days passed, but looking back from our perspective, following the stretching of space in the Creation Week, 15 billion years have passed. Seven billion years of this time he thinks should be placed within Day One; 3.5 billion years on Day Two; 1.8 billion years on Day Three; 900 million years on Day Four; 500 million years on Day Five; and 200 million years on Day Six (Schroeder 2013). From this he considers that time, as human beings know it, only began with the creation of Adam at the midpoint of Day Six.

There is only weak correlation between this and the thinking of Christian young earth creationists who use the postulates of relativity to help understand the universe (see for instance Hartnett 2003, 2007; Humphreys 1994, 2008). Schroeder goes much further and seeks to blend big bang cosmology and evolutionary change with the six days. He thinks God works through natural evolutionary processes. He therefore places the dinosaurs and fossil record within the six day Creation account, thus ignoring the whole enterprise of Flood geology. It also places death and decay of animals before the Fall and forces him to adjust the order of events found in the Creation account. Nor is it clear how his harmonization of the six literal days with billions of years of evolutionary change here on earth may work. He seems to suggest physical processes were taking place at a much faster rate in accord with the wavelength of the cosmic background radiation that acted as a universal clock (Schroeder 1997, pp. 50–59). However, according to the secular big bang theory the cosmic microwave background radiation began after the age of recombination, some 380,000 years after the big bang, and this renders

Schroeder's ideas anachronistic. But a literal earth day is dependent upon the spin of the earth upon its own axis, and is not related to light or the stretching of deep space. So Schroeder's claims really are inadequate for those committed to a literal reading of biblical text. This arises out of Schroeder's methodology that accepts uncritically the secular postulates of big bang cosmology and evolution. However, there is one aspect of Schroeder's work that warrants further investigation, as will be discussed below.

Young earth creationists rightly reject claims for an old earth and billions of years of evolutionary change, but there is a need to review Schroeder's other claims about light and sort the wheat from the chaff, which is the aim here. There is a need for creationists to consider the significance and relevance of Schroeder's thinking about light in further depth, even as we would wish to interpret it within a young earth context.

A number of solutions to the distant starlight problem have been proposed by young earth creationists; for instance (Hartnett 2003, 2007; Humphreys 1994, 2008; Lisle 2010; Setterfield 2002; Setterfield and Norman 1987). The distant starlight problem is often stated as follows. How can light from the edge of space arrive at the earth in a young universe? It is assumed that we need to give a solution to the problem from the perspective of an observer in an earthbound reference frame. While I think this is an important question we should note that it is only part of the problem because there are effectively two frames of reference to consider. The earthbound reference frame, and the frame of reference of the traveller, in this case the photon of light. From this, there is also the question of what happens when the two reference frames intersect; that is when a photon of light strikes the retina of an earthbound observer. So the main focus of this paper is to consider what follows for creationist cosmologies, and our understanding of the universe, if it is proposed that a photon of light does have its own reference frame as Schroeder suggests. It is noteworthy that Russell Humphreys has also recently considered the possibility of *achronicity* for sub-atomic particles (Humphreys 2008). He writes that "In a later paper, I hope to explore some of the interesting and possibly useful effects of achronicity for non-negligible particle velocities" (Humphreys 2004) (although I have not yet seen this paper I have waited patiently for it). I will discuss this from a scientific perspective first, and then give some theological reflections.

So, there are several reasons why this discussion is of interest and relevance to creationists. To summarize:

First, as a leading proponent of old earth creationism Schroeder's work needs to be reviewed and questioned by those committed to a recent creation. A few articles have appeared in this regard in the creationist literature (DeRemer 2006; Humphreys and Samec 2000), but Schroeder's approach to the characteristics of light has not really been examined in depth in regard to our understanding of the order and timing of distant cosmic events.

Second, as many young earth creationists accept relativity, it is necessary to follow through and consider how it affects scientific understandings of the geometry of space, the age of the universe, and our place in it. This is the counterflow of ideas; the less glamorous "back-office" work that needs to be carried out. It is considered that the ideas from Schroeder that are discussed in this paper may shed some light on the distant starlight question, but they will not fully resolve the problem and the proposals will still need to work with other creationist models.

Third, it is necessary to consider theological aspects of Schroeder's position. Some of his ideas may have benefit in that they may lead us to view the universe in a way that better reflects a Judeo-Christian worldview as opposed to a naturalistic one; that is where the universe is no longer seen as a rigid, mechanistic container-box with God excluded from the Creation. The Newtonian-Kantian view potentially leads to deistic views of God, and from there, to metaphysical naturalism and to atheism. This will be discussed in relation to the work of Thomas F. Torrance (1980a, 1980b) who developed useful theological understandings on the relationship between science and theology, partly through the influence of the work of Albert Einstein and Michael Polanyi. However, care needs to taken so that theological positions are not built too strongly upon scientific paradigms that may change in the future. This paper will touch only briefly on the type of arguments discussed by William Lane Craig (1979, 1994) that relate God and time. Instead, the main interest here is to consider the relationship between human observers and photons of light in the universe.

It is stressed that this paper will deal with these questions in the context that distant starlight was brought to the surface of the earth within the *recent* Creation Week and that the Creation account should be read as an accurate historical narrative. Although consideration is given to the usefulness of some of the work of old earth creationists such as Schroeder, Torrance, and Craig, this paper does not follow their commitment to long ages.

It may be noted that secular as well as creationist cosmologies face difficulties in relation to understanding time and space. However, if a photon of light does have its own reference frame then we may experience *light* and *time* in two ways; one

arises from the photon's reference frame, the other from an earthbound reference frame. The Lorentz transformations in fact set up this dual aspect of the apprehension of time for travelling particles and distant observers. So, this paper will consider what follows if a photon of light does have its own reference frame, particularly in relation to the *twin paradox* thought experiment. This will lead to consideration of how *information* might be carried by photons (or sub-atomic particles) in such a reference frame, and what that means for the human observation of the universe in the present time.

A Photon Reference Frame

Schroeder has discussed the possibility and significance of a photon's reference frame in relation to the passage of time. He writes that "At the speed of light…time ceases to flow altogether. The time of all events becomes compressed into the present…" (Schroeder 1997, pp.161–164). He also suggests that *information* is carried in such a reference frame (Schroeder 1997, p.186). This also corresponds with John Wheeler's remark that because of the nature of light there are "zero-interval linkages" between distant and near events (Grandy 2001, 2009, p.68; Wheeler 1990a, p.43). Wheeler also believed that information is foundational to our experience of the universe, which he believes is participatory with the observer (Wheeler 1990b). These ideas concerning the nature of light are supported by Hermann Bondi (1964, p.108) who commented that "light does not age; there is no passage of time for light"; and Bernhard Haisch (1999, p.31) who wrote that in the "…reference frame of light, there is no space and time…to a beam of light radiating from some star…the transmission from its point of origin to our eye was instantaneous" (quoted in Grandy 2001).

However, a photon's reference frame is not really a new idea and was discussed in the early 20th century by cosmologists such as Einstein. Polanyi for instance shows that it was this type of thought experiment that led Einstein to develop his theory (and not the Michelson-Morley experiment as is often claimed. Polanyi has also suggested that the Michelson-Morley experiment of 1887 did not in fact disprove the ether, but that an ether drift of 8 to 9 km/s was evident from their results (Hicks 1902; Polanyi 1962, pp.12–13). Einstein considered what would happen to his apprehension of the Maxwell equations if he could travel at the speed of light.

> …after ten years' reflection…from a paradox upon which I had already hit at the age of sixteen: If I pursue a beam of light with the velocity c (velocity of light in a vacuum), I should observe such a beam of light as a spatially oscillatory electromagnetic field at rest. However, there seems to be no such thing, whether on the basis of experience or according to Maxwell's equations. From the very beginning it appeared to me intuitively clear that, judged from the standpoint of such an observer, everything would have to happen according to the same laws as for an observer who, relative to the earth, was at rest. (Einstein 1949, p.53; Polanyi, 1962, p.9)

The problem that Einstein saw was that Maxwell's equations for electromagnetic radiation would collapse if light were brought to a standstill. It would be reduced to a circle perpendicular to the direction of travel, which he thought is a physical impossibility. Instead he adopted the Lorentz transformations of time dilation and length contraction in his work to overcome the dilemma. The more relevant time transformation equation is given as follows

$$T^* = \frac{T}{\sqrt{(1-\frac{v^2}{c^2})}} \qquad (1)$$

(where c is the speed of light, v is velocity, T is time, and T^* is time adjusted by the Lorentz factor).

Einstein came to see intuitively that the same laws of physics must apply for different reference frames; i.e. they are invariant across all inertial reference frames. Polanyi commented further on Einstein's work on general relativity that "…its postulates [were] chosen as to produce invariant expressions with regard to all frames of reference assumed to be physically equivalent." The result of such postulates is that the "trajectories of masses follow geodesics, and light is propagated along zero lines" (Polanyi 1962, p.16). So, according to Einstein's work on relativity light travels along zero geodesic lines, or null geodesics; that is they do not experience time and space.

However, a few physicists seem to have questioned whether a photon of light can have its own reference frame. Perakh has suggested, in response to Schroeder's work, that if it is held that the Lorentz transformations of length contraction and time dilation were applied to a photon's reference frame then the dimension of space would exist as a dimensionless point for that photon, and time would be dilated to infinity. Such a state he thinks would be difficult for physics to cope with, and thus he rejects it (Oppy 1998; Perakh 2001). Perakh writes

> A frame of reference which can be attached to photons simply does not exist. If it existed, the photons would be at rest in such a system. However, photons cannot be at rest. According to the special theory of relativity, photons always move with the same speed (in vacuum) *in every frame of reference*. If a frame of reference wherein photons are at rest existed, time would stop in such a frame. Since, though, no such frames of reference are possible, Schroeder's concept is meaningless.

Perakh here seems to be referring to an *inertial* frame of reference. By definition, an inertial reference frame is non-accelerating, and exists with a velocity less than *c*. Such a reference frame requires that light travel at *c* from the perspective of observations measured by clocks and rulers in that reference frame. As such a photon of light cannot have an *inertial* reference frame by definition. If it did it would be a degenerate frame because it is impossible to make measurements of time and space. However, that doesn't mean that a photon of light cannot have a non-inertial reference frame. The Lorentz transformations would still apply to it with length contracting to zero and time dilating to infinity. Effectively, photons of light would exist in two dimensions not four.

There is also another possible scenario to consider. Julian Heeck (2013), a physicist at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany, and Luo et al. (2003) also discuss the possibility of a photon rest frame, but in the context of it having its own very small rest mass, estimated at 10^{-54}kg. A photon would then travel at a speed very slightly less than the absolute theoretical speed for massless particles. This would give a time dilation factor of 10^{15} for the photon. Given 15 billion light years distance to the edge of visible space, a photon in transit would experience only 473 sec. travel time in its rest frame (7 min. 53 sec.). As such, photons of light travelling in actual space may experience a very small amount of time. We may then denote a theoretical maximum speed limit for massless particles as *c* and the actual speed of light in the vacuum of space as *c**.

The interest of this for those who hold to a recent creation is that these concepts may offer some insight towards our understanding of time and space for earthbound observers. We may see that *information* is carried in the photon's reference frame with absolute, or near absolute, time dilation, even though interpreted differently in an independent observer's reference frame.

A Photon Reference Frame and The Twin Paradox

Schroeder discusses the identified temporal paradox in the context of a real supernova explosion 1987A, which is believed to lie 170,000 light years distance from earth (Schroeder 1997, pp. 161–164). He then assumes and describes a history on earth that he believes took place in those 170,000 years, even though for the photons no time has passed. How are we to deal with this from a young earth perspective? One may ask whether such a long earthbound history is necessarily real if the information carried by the photons exists completely independently of earthbound observers prior to the interaction of the two different reference frames. However, this is not satisfactory, and another solution is required. So, although a photon reference frame may solve the problem of distant starlight in the travelling reference frame, it does not on its own resolve the young earth distant starlight problem for the earthbound reference frame. We then need to work with other creationist models to overcome this difficulty.

To help explain Schroeder's proposal it is useful to discuss here what follows when we apply the Lorentz transformations to photons of light. The contention is that *information* about distant events, such as a supernova explosion or solar flare, is carried in the frame of reference of the traveller, whether astronaut, proton, electron, or photon. Furthermore, the intrinsic content of *information* is not affected by the Lorentz transformations because it is a non-material conceptual quantity. However, earthbound observers in their own reference frame may interpret such information without taking into account the time dilation of the carrier of the received message.

To highlight this it is appropriate to consider the scenario in the context of the known *twin paradox* thought experiment (Mackintosh 1997, pp. 28–29). Einstein discussed this in 1905 in relation to two synchronized clocks in the same location. One clock is accelerated to a distant location, and then brought back to the starting position. Einstein's contention was that time would progress more slowly for the clock that had changed its inertial frame (Einstein 1905). And he thought this also applicable to living organisms such as human travellers (Einstein 1911). However, this works only if the two frames of reference, the stationary frame and the travelling frame, are treated as being asymmetrical to each other (Resnick 1968, p. 201). Otherwise, both frames of reference would see the other aging more slowly. Einstein later found it necessary to privilege one frame of reference, and accepted the Lorentzian view of the aether (Craig [1994] calls this the neo-Lorentzian view). Einstein wrote that

> …reflection shows that this denial of the aether is not demanded by the special principle of relativity. We can assume the existence of an aether; but we must abstain from ascribing a definitive state of motion to it. (Einstein 1920, pp. 7–9)

The findings of special relativity seem to have been verified by Caesium clocks flown around the world on airlines in different directions (Hafele and Keating 1972). And some work has also been conducted with muons where the particles are found to reach the earth's surface in greater numbers than would be expected without applying relativistic effects. For the muon, length contraction effects reduce the distance to the earth's surface (Chitwood, et al. 2007).

As an example of the *twin paradox* thought experiment consider a hypothetical spacecraft able to travel close to the speed of light at 0.99c. The onboard astronaut decides to travel 88 light years into space to the star *Gamma Crucis* (one of the nearest Red Giant stars to earth) at this speed (0.99c), taking a message for any possible aliens, and perhaps a daily newspaper dated January 1, 2013 and her birth certificate dated January 1, 1993. Her twin sister stays behind, and lives for another 78 years. From the frame of reference of an observer on earth it would take 88× 1/0.99 years (88.9 years) to arrive. But because we can apply the Lorentz time dilation transformation of equation (1) our astronaut assumes she can make this journey in only 12.5 years inside the spacecraft. She knows as well that she can make the return journey in the same time and bring back any messages she receives (whether she could survive such a journey is another question). However, she does not meet any aliens, and brings a message of disappointment. However, upon return she realizes her twin sister has died some 100 years previously. For observers on earth 178 years would have passed in the 25 years she has travelled in her reference frame. It is as if the space traveller has moved forward in time due to time dilation, and contracted space. The significance is that the *information* carried out and back, and her travelling experience, only covers a period of 25 years, even though for earth based observers a much longer period has passed. The information content of the newspaper and birth certificate would not have changed in that period.

When secular scientists measure the two-way speed of light on earth, the time taken to send a beam out and back across a known distance is interpreted in the earthbound reference frame and a speed of light derived, but how the photon of light experiences time and distance in its reference frame is not considered. When this speed is extrapolated across the distance of the universe a conclusion is drawn that the universe is some 10 to 15 billion years old. But if the time dilation equation is applied to a photon of light then little or no time passes for it. If that is the right way to proceed given the Lorentz equation, then light may be seen from the edge of the universe at the same time (or near same time) it is emitted because of absolute, or near absolute, time dilation and length contraction. But there are then two views of the passage of time. If that is so, because the *information* is carried in the photon's reference frame, not the receivers, the universe may effectively be viewed in real time or near real time when the photon of light reaches the retina. That is, when the separate reference frames intersect and an observer experiences the photon. To use the earlier example, consider a photon of light travelling at the speed of light received from *Gamma Crucis*. It is believed that it would take 88 years to arrive because it is measured in the receiver's reference frame, and not in the travelling reference frame. However, when it is considered that a photon of light has its own reference frame then no, or very little, time would pass for it, and observers interacting directly with it may receive *information* that has not aged in its reference frame from the time of transmission.

An objection to this proposal may arise from the way time delays are experienced in radio or TV interviews conducted via geo-stationary satellites (about 35,000 km [21,748 mi] from earth). The information is passed back and forward to the satellite and a short time delay is experienced in the dialogue between interviewer and interviewee. However, within the context of the present proposal, it may be held that this delay is down to interpretation in the earthbound frame of reference and that the photons of light do not experience such a delay.

What about Distant Starlight and Earthbound Observers?

There remains, however, the different, but related, question that involves distant starlight and the age of the earth from the perspective of earthbound observers measuring the speed of light. For a human observer, light does seem to have a finite speed when measured, therefore there appears to be a real history to address from the perspective of observers on earth. This consideration does however seem to open up two views or apprehensions of time, one time-dilated; the other not time-dilated. So how might the speed of light and the passage of time for earthbound observers be accounted in a young universe? The following few paragraphs represent an overview of possibilities and creationist proposals, although there is insufficient space here to critically review them in a thorough manner. Therefore the question is left open as to which is the preferred option here.

A possible solution to the problem might be related to Setterfield and Norman's (1987) reducing speed of light through the history of the universe as measured by earthbound observers, and supported by some theoretical work. This work examined measured light speeds over the past 300 years that seemed to show a record of decrease. However, even if the identified anomaly is accepted as a signal beyond instrument or observational error, or "tracking," it is not clear what curve to fit if the data is extrapolated further back in time. An exponential decay rate function would however suggest a much faster speed of light in the past. Setterfield (2002) has also postulated that an increase in the tension of the vacuum of space through time has led to a decrease in light speed; therefore he believes that this helps to overcome

some of the objections to his work. The energy field in the vacuum of space then acts as a speed limiter to light.

A reduction in light speed would allow distant starlight to arrive at earth, as measured in an earth related reference frame, in a substantially shortened period than assuming a constant speed through history. A reduction in light speed has also gained some theoretical support from secular physicists in recent years (Albrecht and Magueijo 1999; Barrow 1999a, 1999b; Davies, Davis, and Lineweaver 2002; Magueijo 2003; Moffat 1993; Webb et al. 1999). While Albrecht and Magueijo proposed that light slowed at the very beginning of the universe (as an alternative to inflation), Barrow has instead suggested that light has slowed down through the age of the universe. Moffat's work went further and sought to develop the concept of a variable speed of light that was Lorentz Invariant. Setterfield also points to observational evidence that demonstrates that the speed of light may increase in a reduced vacuum created by the Casimir effect (Latorre, Pascual, and Tarrach 1995; Setterfield 2002). The creationist sponsored RATE project has also discussed the possibility that a number of so-called "physical constants," such as radiometric decay rates, are not really constant (Humphreys 2005), and this is supported by other recent findings (Jenkins et al. 2009).

A much faster speed of light in the past would allow light to reach the earth from distant events in space in a young universe. Setterfield has also done a lot of work trying to offer a physical mechanism for such a reduction in light speed. He has suggested that changes in tension in the vacuum of space may be the cause if use is made of an alternative approach to quantum mechanics called stochastic electrodynamics (SED) (Setterfield 2002). While claims for a faster speed of light in the past are not without critics (i.e. Humphrey's 1994, Appendix A), these tend to be related to the earlier paper and Setterfield has defended his work strongly against objections. Some secular scientists share similar ideas relating to a scalar energy field in the vacuum of space (Barrow and Shaw 2008; Jenkins et al. 2009). Changes in this energy field may affect the behavior of physical constants.

A number of other creationist physicists have also tried to develop cosmological models to understand how the universe might have been stretched out during the Creation Week based upon general relativity. This would then allow distant starlight to reach the earth in a young universe. Humphreys for instance has developed the concept of white hole cosmology, and has more recently introduced the notion of achronicity to explain how the universe might have expanded through a timeless zone on Day Four of the Creation Week, and also wondered how achronicity might impact upon subatomic particles (Humphreys 1994, 2008).

John Hartnett has also proposed a five-dimensional model, based upon Carmelian physics, with the Milky Way near the centre of a spherical symmetrical universe that has undergone massive expansion. This expansion then allows sufficient time dilation for distant starlight to arrive at the earth in a young universe. Hartnett suggests that the universe therefore appears as a "still photograph" (Hartnett 2003, 2007, pp. 116–118), although how that correlates with evidence of events such as supernovae explosions needs to be assessed.

Jason Lisle on the other hand has proposed an anisotropic synchronicity convention in order to explain the arrival of distant starlight from deep space in a young universe (Lisle 2010). He therefore rejects the isotropic convention favored by Einstein, and postulates that towards the observer light may be infinite, while away from the observer it would need to travel at a speed of $c/2$ to obtain the scientifically measured speed of light. In defence of his argument, Lisle also proposes that the observer is central to our understanding of the universe.

So, one way to resolve the problem of light speed in an earthbound reference frame might be to follow a form of Setterfield and Norman's (1987) position (with theoretical support from Albrecht and Magueijo [1999], Barrow [1999a, 1999b] and Moffat [1993]) in proposing a reduction in the speed of light. Hartnett (2003, 2007) and Humphreys's (1994, 2008) work may also be informative in this regard, but there is insufficient space here to critically assess these proposals further. These solutions may potentially resolve the immediate problem of the age of the earth, although it is largely at a theoretical level. However, bringing together a reducing speed of light in an earthbound reference frame, with Schroeder's idea that *information* from deep space may be carried in a photon's reference frame involving absolute or near absolute time dilation, may offer useful insights for creationist cosmologies. If so, it would mean that we view the universe in the present because *information* is carried in the traveller's reference frame, and also light has time to reach the earth from distant sources in a recent creation for earthbound observers. Furthermore, we may also observe such events as supernovae explosions in real time. However, it is recognised that further work on this is necessary as there is still a paradox relating to the timing of events.

The Theological Aspects

There is the need now to consider the theological aspect of the question of a photon reference frame

and what this might mean for apprehensions of the universe. In terms of more philosophical and theological understandings of time and space, it is noted that relativity involves a move away from the idea that there is a fixed universal reference frame, to one that is related to the perspective of the observer (although in reality Einstein wanted to incorporate Mach's principle to establish a preferred standard of rest).

Thomas F. Torrance has discussed the theological significance of the move to accept relativity where the universe is no longer seen in Newtonian-Kantian terms as a rigid container-box of matter. For Torrance, this ought to lead to views of the universe that are more personal and relational; that is, ones that are non-naturalistic where the characteristics of light bridge directly between human knowing and that which is known (Grandy 2009, p. 66; Torrance 1980a, p. 75). And as noted, Schroeder (1997, pp. 161–164) also sees photons of light existing in the present, as do other philosophers of science such as Wheeler (1990a, p. 43) who believed that, through light, zero time intervals link the observer with distant events (also Bondi 1964; Grandy 2001, 2009; Haisch 1999).

Torrance was concerned to counter a dualistic mindset that has taken hold of much of modern thinking, and effectively undermines Christian faith because it leads to deism or atheism. This dualism developed through the Enlightenment, for instance with Descartes, and is evident in the scientific revolution that has sharpened the divide between the material and spiritual. In the Middle Ages there had been a move towards an Aristotelian view where sensory experience linked the mind to matter. This was in contrast to the earlier Platonic view where the mind was so focused upon the spiritual realm that science could not develop in any real sense. However, the Aristotelian view presented a view of the world that risked excluding God from human thought altogether, although most leading proponents of this dualistic approach to science, such as Galileo and Newton, retained a belief in God.

The Newtonian model views time and space within a fixed universally accepted frame of reference, with energy and matter contained within space, and creation is seen in mechanistic terms (Craig 1979, pp. 497–503; Torrance 1980a, pp. 11–40, 1980b, pp. 1–27). Newton wanted to view such a universe from God's perspective, although with a fixed and universal understanding of time that even God must be subject to, even prior to Creation. Later Immanuel Kant preferred to view this internally from the human perspective (Craig on the other hand suggests that it was Ernst Mach who popularised this positivist view of time (Craig 1994). However, the Kantian model effectively shuts God outside of the universe, even denying the universe had a beginning, and is well criticised by Torrance (1980a). So, the Newtonian-Kantian view of the universe tends towards deism and even to atheism with God excluded. Torrance believed that this Newtonian-Kantian model sets up a false dualism between geometry and the observer, and is not one that fits with a Christian understanding of the world. Instead, Torrance has pointed out that Einstein's work on relativity effectively brings geometric shape (form) and the observer (being) together, and this breaks down the dualism.

However, others have questioned whether relativity really undermines dualistic mindsets, but instead extends them because of a commitment to mathematical abstraction as opposed to directly testable science (Lovejoy 1960, pp. 4–6). And while Darwin's work tried to remove mankind from having a special status before God, relativity potentially takes away the earth's special place in the universe because it denies a fixed frame of reference; thus extending a dualism between reference frames. But even so, there is a sense that relativity challenges our immediate sensory experience in favor of mental thought experiments that are based upon the reliability of mathematical constructs, and this is perhaps closer to a faith-based view of the universe where we rely upon the validity of revealed Scripture. Torrance points that such intellectual, intuitive, and relational thinking in Einstein's work was influenced by James Clerk Maxwell's approach to explaining the relationship between magnetic and electric forces. For Torrance, each observer then has a personal, relational frame of reference as he/she experiences the cosmos through light (Torrance 1980a, pp. 11–40). Light then has the property of illuminating and relating everything that we see in the universe, even though in itself it remains somehow mysterious (Grandy 2001, 2009; Torrance 1980a, p. 87).

Chronos Time and *Kairos*-Like Time

So relativity and the behavior of light may potentially lead us to view the world from a non-naturalistic perspective as described by Torrance, and may effectively challenge the Cartesian dualism that leads to deism and atheism. Schroeder however does not consider this aspect, but instead takes the characteristics of light and tries to fits them within naturalistic science that involves billions of years of evolutionary change. He suggests that the time frame of the six days of Creation is somehow related to the wavelength of the cosmic background radiation, and overlooks the need for a real history that could be measured in relation to the spin of the earth upon its own axis.

But how do human beings view time in relation to the age of the earth? It is known that memory, written sources, and other persons, and revelation through Scripture, pass on valuable knowledge of historical events on the earth, and they are not passed on directly by light. But in this context the passage of light from distance sources is interpreted in the earth's reference frame. Human observers build up knowledge of such historical events over time. Earth history, then, is a collection of millions upon millions of personal memories and written records, including reliable divine revelations, and it is not linked directly to measurements involving light. Knowledge built up through earth history then takes a different form to knowledge established by direct observation involving light. Although throughout history individual observers receive time dilated information from the edge of space, and may pass it on through written sources. While Schroeder's general idea that light does not experience time and space in its frame of reference may be useful, it would be inappropriate for the properties of the cosmic background radiation to be used somehow as part of a temporal measure of the Creation Week. Instead this earth based measure is built up through records. But there is here the establishment of a paradox, or dualism, that arises in the way time and light are understood because of relativity.

Schroeder (1997, pp. 161–164) suggests that photons of light exist in the "Eternal Now," as does God Who we know from Scripture as the great I AM, and there is the possibility of analogical insight here between God and light. Schroeder's view of God in relation to time is essentially an Augustinian one (although Schroeder links this to Rabbinical teaching) where God is seen to dwell in the eternal present, and yet interacts with the world that exists in time; thus there are two understandings of time; one is eternal, the other temporal. Earth based observers then may have two apprehensions or appreciations of time—one is chronological and linked to revelation, history, and memory, the other is linked to direct interaction with light as it impacts the retina; this with absolute, or near absolute, time dilation. Similar to Schroeder's claim, Augustine held that God dwells outside of time in the eternal present, and that chronological time is a part of Creation for the benefit of life on earth. He writes in the *Confessions* (Book 11, Chapter XI) (Schaff 1886) for instance:

> Who shall hold it and fix it, that it may rest a little, and by degrees catch the glory of that everstanding eternity, and compare it with the times which never stand, and see that it is incomparable; and that a long time cannot become long, save from the many motions that pass by, which cannot at the same instant be prolonged; but that in the Eternal nothing passeth away, but that the whole is present; but no time is wholly present; and let him see that all time past is forced on by the future, and that all the future followeth from the past, and that all, both past and future, is created and issues from that which is always present? Who will hold the heart of man, that it may stand still, and see how the still-standing eternity, itself neither future nor past, uttereth the times future and past? Can my hand accomplish this, or the hand of my mouth by persuasion bring about a thing so great?

There is here a mystery as Augustine notes; that God may dwell in the eternal present, and yet causes events in the past, present, and future. More recently, Craig has argued that God may have existed timelessly prior to creation, but that once creation was established then God was/is able to work in the world through time and be subject to it (Craig 1979, pp. 497–503). This view he thinks is better than the Augustinian view, and better than the Newtonian model where time is seen as a universal entity to which God must also be subject. Craig also suggests that the neo-Lorentzian interpretation of special relativity is preferable metaphysically, but that it may undermine theories that seek to relate divine timeless eternity to physical reality. Therefore he thinks there is much more work for proponents to do in this regard (Craig 1994).

While acknowledging the need to do more work with the type of proposals discussed here, it is relevant to note at this point that the main interest is the way in which human beings observe the physical universe, and not the connection between God, time, and the created order, which is the main interest of Craig (1979, 1994). Clearly when Christ came to the earth he was limited in time, but it is hard for us to envisage how God as a spiritual being (John 4:24) might exist in relation to time. How can we understand time, as part of the created order, in the context of a spiritual reality? As Paul noted, we see the spiritual realm through a glass darkly (1 Corinthians 13:12), and endeavors to use philosophy and science to resolve these questions are going to be inadequate. This is because our minds are so conditioned by time and space, that our insight into the nature of spiritual matters is opaque at best. However, the notion that light may travel without experiencing time may offer some analogical insight. But our understanding of the behavior of light from relativity sets up a paradox with two different time frames to consider.

[1] Incidentally, Dembski seeks to hold to a literal Fall within an old earth framework, and believes that God may apply the effect of Adam's sin retrospectively so that the death of animals, evident in the fossil record, is attributable to the Fall.

William Dembski (2009, pp. 124–126) has recently discussed a theological distinction between *kairos* time and *chronos* time that may offer further *analogical* insight here.[1] For Dembski, *kairos* is concerned with spiritually significant time; that is as God acts his purposes out in time.[2] We may speak of a *kairos moment* for instance. *Chronos* is essentially clock-time as measured on earth. While this is a useful distinction it is less clear that this can be grounded in the teaching of the New Testament Greek. *Chronos* generally indicates a period of time, while *kairos* speaks of a due season. Both can be used for the normal passage of time, or to denote spiritually significant time (Vine 1985, p. 633). There is a useful theological distinction between the two, but it is not clearly set out in the language of Scripture. Instead the meaning comes out of the context. The Bible (1 Thessalonians 5:1) for instance speaks of "time and seasons" (Gk: *chronos* and *kairos*) that have been established by God, both used to denote spiritual significance. Furthermore, the Hebraic thinking is conditioned upon the symbolic significance of events; for instance consider Genesis 1:14–15:

> Then God said, "Let there be lights in the firmament of the heavens to divide the day from the night; and let them be for signs and seasons, and for days and years; and let them be for lights in the firmament of the heavens to give light on the earth"; and it was so.

It is known for instance that the phases of the moon relate to the time of Jewish sacred festivals, thus providing theological significance. As another illustration, consider an event that is recorded in 2 Kings 20:11. Isaiah, through a divine miracle, brought the sundial of Ahaz back ten steps as a sign for King Hezekiah that he could fulfil the Jubilee ten years late and prolong his days. Chronologically 60 years had passed, but it was counted as 50 years. Ahaz's lost time had been redeemed. The distinction between *chronos* as normal time, and *kairos* as spiritually significant time, may then have some usefulness for this discussion, even if it cannot be grounded in the Greek of the New Testament. Instead, the early Jewish Christians observed the momentous events of Christ's life and seem to have understood time as the unfolding of a divine plan. So, there is seemingly a distinction theologically between chronological time and spiritually significant time, but it comes out of the context of Scripture.

However, we need to be careful not to extend the connection between the concept of timeless photons and divine timelessness beyond analogy because of the theological problems that would entail. If we suggest something in creation has a divine property it is close to a form of pantheism (Clouser 2005, pp. 121–122), and this applies as much to the Newtonian view that God is necessarily subject to time. Schroeder (1997, pp. 161–164) suggested a "metaphysical link," although it is not so clear that he was speaking analogically. So it is suggested that there may be an analogy between timelessness in the reference frame of a photon of light and an eternal timelessness within an Augustinian view. Just as God may dwell in the eternal present so approximately might a photon of light in its transit. The effect of this for human observers might be denoted as *kairos*-like time; referring to the way in which creation may be viewed in the present, or near present, as light, with absolute or near absolute time dilation, strikes the retina. This is supported by Torrance's (1980a, pp. 11–40) argument that we should acknowledge a more personal and relational appreciation of the geometry of space and time in our understanding of the cosmos. In effect, it is necessary to consider together several ideas; that photons of light experience little or no time in their own reference frames, that information is carried in such reference frames, and Torrance's position relating to human observers and the geometry of space. This then may enable a non-naturalistic way of perceiving time and space and the created order, unlike the Newtonian-Kantian model that may in effect exclude God from His creation. And this may also offer analogical insights into the relationship between God and the world. However, we need to be careful linking theological reflections too strongly to particularly scientific paradigms because the science may change in the future.

When we measure the speed of light scientifically we do so in normal or *chronos* time; when we perceive light we do so in *kairos*-like time. To try and understand the difference use may be made of a weak analogy in the way light is distorted as it passes through the water of a swimming pool. That is; the pool may be viewed differently when empty and when full because of two different speeds of light. Because the light speed is slowed as it enters the water the bottom is seen to be higher than when it is viewed empty, but it is an illusion caused by the water. The finite, and sometimes different, *chronos* speed of light then may distort personal views of the world.

But as noted that there is a theological problem in that there is still a dualism or disjunction between *chronos* time and *kairos*-like time. So, while relativity may resolve one dualism, as Torrance suggests, it opens up another. Scientifically this appears to arise out of the theory of special relativity as different observers may disagree about the order and timing

[2] In Mark 1:15 Jesus announces that the *kairos* is fulfilled at the start of his ministry.

of events. Theologically the disjunction may arise as a result of the Fall; and perhaps it is the Fall that inevitably opens up dualisms in natural philosophy and human understandings of the world. Out of this discussion it is suggested that prior to the Fall *chronos* time and *kairos*-like time may have been identical, or near identical, and light from distant stars arrived at earth within the Creation Week in both frames of reference. This disjunction could be resolved if it is postulated that prior to the Fall the speed of light (the *chronos* speed of light) as measured by remote observers (Adam and Eve) was much faster, to the point where it was identical or near identical to the *kairos*-like speed of light. In other words, it would cohere *theologically* with the idea that the speed of light was much faster in the past as measured by earthbound observers. The *chronos* speed of light may have decayed exponentially to its present rate at or following the Fall. From this it may be noted that humanity now lives in fallen time as if fallen into a temporal well. The proposed solution would allow distant starlight to arrive at the earth as measured in both *chronos* time and *kairos*-like time in a young universe.

There is a sense though that the passage of time, as measured by observers on earth today, is subject to error. This error corresponds with a long held Augustinian doctrine known as the noetic effect of sin. It means that sin has rendered natural human knowledge about the Creation unreliable, and it was one doctrine that led Francis Bacon and the Royal Society to develop the scientific method of rigorous experimentation (Harrison 2007). But science at times still relies upon theoretical and mathematical constructions that are at times hard to cohere with directly testable methodology, and this leads science into dualistic positions and paradoxes. But it may be argued that if one measures the speed of light in the present then scientific calculations about the age of distant stars are subject to the Fall and are potentially unreliable.

Summary

This paper has considered what happens if we follow Schroeder (1997) and allow photons of light to have their own reference frames. This was then discussed in relation to the well-known *twin paradox*. This solution may offer some insight towards the distant starlight problem because *information* from the edge of space would be able to travel in the photon's reference frame without, or nearly without, the passage of time. This would happen as the frame of reference of the observer and the photon intersect. Observers are then always viewing the universe in the present time when the importance of the observer (*being*) is recognized in interpreting the *form* of the universe, as Torrance (1980a) suggests. It was noted that this solution helps to overcome a naturalistic view of the universe that sees only a rigid container-box of matter, time, and space, and potentially no place for the Creator to relate to, or interact with, Creation. There is perhaps the need for creationists to do more work on the concept presented here.

However, this discussion doesn't solve the speed of light problem for earthbound observers and other solutions need to be utilized to overcome this difficulty. The proposal then needs to work with some other creationist model; one solution would be a reducing speed of light such as that proposed by Setterfield and Norman (1987). But other solutions from the work of Hartnett (2003, 2007), Humphreys (1994, 2008), and Lisle (2010) may be applicable; for instance Humphreys's (2008) suggestion that the universe expanded through a timeless zone during the Creation Week.

Consideration has also been given to the theological aspect of Schroeder's thinking, and it was noted that it seems to cohere analogically with an Augustinian view of God's timeless existence. The Augustinian view seems to be part of orthodox thinking, although it is not the only view. However, we should be careful not to extend Schroeder's link beyond analogy. For the present discussion it is sufficient to note that it may offer a non-naturalistic way of perceiving the universe for Christians as discussed by Torrance (1980a, 1980b). But while Torrance's theological position towards relativity closes one dualism between observers and the form of the universe, it opens up another in relation to our dual aspect appreciation of time.

Another concern with this discussion is that the inherent paradox in special relativity may eventually force a rethink of the theory, which would undermine the discussion presented here, although it is not the aim to argue for that. However, it may be noted that creationists should not be faulted for having an incomplete scientific picture of the age of the earth and universe when the best current understanding in secular science contains unresolved paradoxes and contradictions.

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