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## Postscript on Time and Space and the Speed of Light

by

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The speed of light decouples systems and allows them to operate sequentially and in different locations, using their own physical components and the established relationships of energy, time and distance. It is a Universal and constant parameter, which encompasses systems throughout the whole of time and space. If this were not so, identical reactions under the same physical conditions would be observed to occur at different rates in different places, which would undermine the fundamental principles of science. In effect it is the constant velocity of light *in vacuo* which determines the nature of time and space as we know them.

A main plank of the preceding analysis is that time and distance must be independent, orthogonal variables for Newton's mathematics to be applicable. If they interact statistically, that is if time contains any part of distance, and if distance contains any part of time, then the equations of his physics become invalid. However, there is one fundamental physical parameter which links them indissolubly, as surely as it links all things: the constant velocity of light *in vacuo*.

Newton himself is quoted as saying that "absolute, true, and mathematical time, in and of itself, and of its own nature, without reference to anything external, flows uniformly", and he referred to "absolute space, of its own true nature without reference to anything external, always homogeneous and immovable". Setting aside the metaphors, and ignoring the assertions that there is no need to refer to anything external i.e. no need for a degree of freedom, my analysis shows that time and distance are not phenomena but simply intervals between events in the case of time, and intervals between objects in the case of distance. Time is not a flow; it runs as smoothly as the clock used to measure it, whether the clock is of our making or not. The same is true of distance, and so space.

If we define a time-interval as the time that elapses between two specified events, we also need to define what we mean by an 'event'. In common usage the term 'event' describes a series of happenings or something 'eventful', but here it means a snapshot of a process at particular instant. Processes bring about change, which is what distinguishes them from lists of items, and so the state of a process changes systematically from one instant to the next. A process, any process, is therefore a continuous series of events like the frames of a movie, but each event is infinitely short like a point on an axis.

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Every process is linked to other processes which provide it with inputs and into which it delivers its outputs, to use systems terminology. No process or system can operate in complete isolation from other systems, because its functioning consumes its inputs; that is its *raison d'être*. Starved of inputs, the process comes to an end. Even if the supply of inputs were maintained, it would choke itself on the outputs it produced, if it could not also deliver them into the environment that surrounds it, which is in fact composed of other systems. In short, every system must draw its sustenance from somewhere, and every system must have somewhere to send its outputs or it must cease to operate. Such an isolated system is called closed, and its fate is to die of entropic degradation.

These general points may be illustrated by an example, for instance the Sun. We see the Sun in the sky every day, at least to some extent, and so there is nothing particularly eventful in that. What usually concerns us is the modulation of insolation on any part of the Earth by night and day, which is the rotation of the Earth on its axis, and by seasons, which are the orbiting of the Earth with its inclined axis around the Sun.

However, the Sun is a body consisting largely of hydrogen, which it is burning to form helium by thermonuclear fusion. The Sun is changing by the minute. Every time hydrogen nuclei or protons come together to form a larger nucleus, an event occurs, even if it is not evident to us. Such a process is not continuous, because it requires the participation of discrete particles, and either they are fused or they are not. One snapshot would show the particles as separate, and the next would show them fused; it is a step change. However, the Sun is so vast that a single fusion passes unnoticed, even though it is the basis of the body's existence as a star. It is rather like a nuclear clock ticking away inside it. One result of this process is that the Sun radiates light, or more precisely electromagnetic radiation, into space i.e. light is one of the outputs of the thermonuclear process. The part of this radiation which reaches Earth is a key input, and ultimately the only significant input, of energy into all the processes of life on the planet, that is all living systems.

The mass of the Sun is so great that consumption of a 'noticeable' quantity of its hydrogen would take far longer than we can comprehend on our human timescale, and so we may be misled into thinking that we see the Sun as it really is. One fusion event between hydrogen nuclei is much the same as the next, and so we cannot tell the snapshots apart. However, periodically a sunspot appears on the surface of the Sun as a notable event, and we may be deceived into thinking that we see it too as it occurs. This cannot be true, because light has a definite and constant speed in space, or more scientifically *in vacuo*. The Sun is about 150 million kilometres away from Earth, a distance which can be measured trigonometrically, and light travels through space at about 300,000 kilometres a second, a velocity which can be measured on Earth. Thus light from the Sun takes about eight and a half minutes to reach Earth. We cannot see the sunspot as it is; we see it as it was eight and a half minutes ago. Nor can we see the stars in the night sky as they are; in fact the starlight that we see now, may well have left them a billion years ago.

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The same is true of everything we see. If you have glanced at your watch while reading this, you will have seen the reading on the dial after it occurred. Light from the watch, which is what you see, takes time to travel through space and reach the eye, a very short time to be sure, but a definite time which is determined by the speed of light. However, the time taken for light to travel the distance from the dial of the watch to the lens of the eye is only part of the story. The light then has to initiate the process of seeing on the retina of the eye itself, the output from the retina has to find its way to the brain and the brain has to register the signal or input into it.

All these processes are much slower than the speed of light. To be more specific, whatever moves in these processes, moves much more slowly than the speed of light, and that does not take account of the time the brain needs to interpret in some way the signal conveyed to it i.e. their input into it, which is the mysterious process of cognition, the recalling of memories and comparisons which must take place to make sense of the current event. The same is true of all our senses, not just sight.

The same is also true of all receptors on Earth of light coming from the Sun; it is not just living things which are affected. Light from the Sun warms and changes everything on the Earth's surface, and eventually everything below. It takes just as long for light from the Sun to reach, say, the oceans, but it also takes time for the electronic structures of atoms and molecules of inanimate materials to adjust to the radiation and absorb it. Then it takes time for these electron shells to convey their newly agitated states to their neighbours, which manifests itself to us as warming of the water.

In fact all physical processes are slower than the speed of light, and most of those with which we are familiar are very much slower. It may seem to be simply a philosophical, even tiresome point, but a moment's reflection suggests that all this is a very good thing. If light did not have a velocity, but was received instantaneously at the same time as it was emitted from a source, there would be no time-intervals. Everything in all processes would happen synchronously, which implies that everything going on in the Universe could be captured in a single snapshot. No room for the unexpected there, no room for surprise!

To put flesh on the bones of these bald statements, if electromagnetic radiation were transported through the medium of space infinitely fast i.e. instantaneously, there would be no time-interval between events. All the processes of the Universe would be geared together; any change in one system would be immediately felt in another. In effect the Universe would one large event. Emission from the source would provoke an immediate response in the receptor, cause and effect would be simultaneous and effect would itself become a source, so that there would be no independent response. There would be no time for accumulation of energy or lags. If all acceleration produced electromagnetic radiation, as my new model proposes, it would be immediately felt at a receptor in a form of Universal equalisation. There would be no stochastic redistribution of electromagnetic radiation, and none of the mixing of all component parts needed to defy entropic degradation. Entropy would already have taken its toll.

Moreover, the velocity of light *in vacuo* is exactly the same as the velocity of propagation of gravitational attraction between masses and the velocity of transmission of electrostatic and magnetic attraction and repulsion, because these phenomena are similar interactions with the common medium of space. If their velocities through the medium of space were different, it would raise the possibility of actions occurring before they were detected by electromagnetic radiation; what was seen would lag behind what happened, which would be rather problematical. If transmission of these forces was instantaneous, all masses would be locked in permanent gridlock without possibility of change, which is not what we observe.

We naturally think of all this in relation to systems on the human-scale, but every system is itself composed of systems which interact, and so the same reasoning applies at all levels of decomposition down to fundamental particles. We know that processes at this level require accumulations of energy to initiate reaction, the energy of activation. Chemical processes need heating to specific temperatures to excite atoms and molecules to react with each other i.e. overcome the repulsion of electronic shells and form new, stable configurations. In my model a similar activation energy applies when electrons are accelerated along bonds between atomic nuclei. When they attain sufficient energy i.e. velocity, they generate rotating electromagnetic dipoles in the medium of space. These leave the bond and are propelled into space as particles of light with frequencies of rotation which are characteristic of the bond. This activation energy of emission is the electromagnetic susceptibility of the medium of space itself. It is activation energies which determine rates of change of systems at this level. Transport of electromagnetic radiation through the medium of space as a result of this activation permits the co-ordination of processes and systems which is necessary to produce change of the whole.

The other half of the parameter for the constant velocity of light *in vacuo* is distance. If light travelled between source and receptor at infinite speed, i.e. instantaneously, it would take no time to cover the distance between them. Not only would there be no time-interval, but neither would there be any distance-interval. Under these postulated conditions there would be no way of detecting whether systems or processes were separated or not. Everything would effectively be in the same place or location, as well as all processes being geared together at the same instant of time. The result would be that the Universe was one gigantic process, even if were allowed to change, which would be impossible according to this hypothesis because of the absence of time-intervals.

Thus it is the process of emission of light and its velocity *in vacuo* which allow different processes to occur in different places at rates determined by the energy characteristics of their components. The velocity of light *in vacuo* determines the maximum rate at which interactions occur between systems i.e. the transfer of energy and materials between them. Energy is transported through the medium of space by electromagnetic radiation. The rate at which this occurs is the speed of light, which must therefore be a Universal constant, otherwise identical processes would operate faster in one location than in another. This would negate the whole paradigm of science. Materials are transported through the medium of space at a rate which is limited by the constant velocity of light *in vacuo* for the reasons explained in previous papers; the acceleration of mass through

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space generates the emission of electromagnetic radiation, the energy of which increases hyperbolically with the velocity of the source, according to the Inertial Resistance Factor  $R$ , until at the velocity of light *in vacuo* all the energy applied to cause acceleration is dissipated as radiation, making it the absolute limit.

Interactions between systems co-ordinate their energy levels. Control of these interactions by the velocity of light *in vacuo* preserves the Universe as a whole in a steady-state, while permitting processes of change to occur in its parts. Processes then take place in different locations in the Universe at rates which are determined by their local assets or machinery i.e. they are decoupled. Time and distance are orthogonal because they vary independently within the limits imposed by the Universal constant velocity of light. Thus it is the constant velocity of light *in vacuo* which keeps systems apart in space and sequential in time. Without it, there would be no time or space, as we know them. In effect the constant velocity of light *in vacuo* is the basis of time and space.

The model which results from this analysis is summarised as follows:

- Myriads of processes are taking place in different locations around the globe and the Universe.
- Each process draws inputs of energy and materials from myriads of processes, and delivers outputs to myriads of processes, occurring in other locations.
- The rate at which these electromagnetic interactions occur is the velocity of light *in vacuo*, which is a Universal constant.
- The maximum rate at which these interactions occur by the exchange of materials is the velocity of light *in vacuo*.
- The cause of this limit on the rate of transfer of materials is the increasing losses of energy in the form of electromagnetic radiation as they are accelerated.
- This electromagnetic radiation is conducted away from the materials at the speed of light.
- The losses of energy from accelerating masses increase with the velocity of the source at the instant of emission.
- Thus the velocity of light *in vacuo* is the basis of all exchanges through the medium of space.

The steady-state model is incompatible with the theory of an expanding Universe. If the Universe is in a steady-state as far as we can see i.e. 14bn light years, why should it change beyond that? The velocity of light does not change, and processes do not change because they are determined by energy differences, and these do not change unless the rules of science are torn up completely.

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The steady-state model of this paper depends on the existence of a medium of space with electromagnetic properties, a hypothesis which demystifies much of the theory of light generation and transmission, the velocity characteristics of particles through space and the orbits of electrons in atoms.

If this is accepted, the corollary of the expansion model must be that the medium of space was created along with mass at the instant of the first explosion, in which case how has it grown in quantity since then? It could not be postulated to have arisen like mass from some interchangeability with energy, and even this is dubious if the Theory of Relativity is not valid, which my arguments on time suggest.

The expansion theory requires that the whole Universe goes through a period when the transmission of light is prevented. Now there may be locations in the Universe where this happens, for instance black holes, but why should this happen simultaneously throughout the whole Universe? What co-ordinates it in time and space throughout the whole Universe, except of course the velocity of light *in vacuo*, and what event triggers the change throughout the whole system which is in the form of discrete particles?

Every part of the Universe can be described as a system. This paper is an exposition of how interactions occur in and between these systems, which are the parts of the Universe. Thus it is not feasible that the whole Universe which is composed of interacting subsystems is not itself a system. The expansion model is not a good system.

The conclusion from these arguments is that the Universe is infinite in time and space in a steady-state, stochastically regenerated and redistributed part by part, as proposed in the first paper in this series. On this basis and using the principle of Occam's razor, outstanding questions are seen in quite a new light. Observations which are at present considered to be proof of expansion must be caused by some other unknown phenomena. Candidates are emerging as more measurements are made.

Processes are much more widespread than usually conceived. In fact everything is involved in a process of some sort, even if it seems at first sight to be a static situation. Rainbows in the sky are processes, living is a process. Light shining on a piece of paper is a process, not least when we observe it. Gravitational attraction between bodies is a process, because every body is constantly moving with respect to all others, and so a moving mass is constantly readjusting its gravitational links with all other masses in the Universe, to different extents according to location. Chemical reactions are processes that occur at rates determined by the interactions of the electronic structure of their atoms and molecules, which depend on temperature. In fact they play the part of the smooth-running clocks which Newton's observation required.

There is even a process occurring at still more fundamental levels at what is called absolute zero temperature. As a material is cooled, the atoms of which it is composed become progressively less agitated, because heat is the movement of atoms, until at some point they cease to move entirely with respect to each other, which is called 0°K or

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absolute zero. It might seem that there can be no process occurring at this temperature; indeed it is practically a definition. However, this 'absolute' temperature is thermodynamic i.e. it applies to heat energy. No one suggests that the structure of atoms disappears at this temperature, and so electrons must be continuing to orbit their static nuclei. They orbit in perfectly constant, undisturbed orbits, because otherwise they would shake their nuclei and so the whole atom, which would count as heat, and their velocity is possibly linked to the speed of light. The atoms are at absolute zero, and yet they move!

To return to the quotation from Newton at the beginning of this paper, it is indeed true that the Universe does not require 'reference to anything external'. It has its own internal yardstick, its own degree of freedom: the constant velocity of light *in vacuo*, which is determined by the nature of the Universal medium of space.

The explanation given here of how the components fit together, demonstrates that the model is internally consistent. What is more, it matches what is actually observed.

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13 March 2008