THE PRIMARY SOURCE OF STELLAR ENERGY

It is a self evident fact that the level of technology is affected by the level of science. The more advanced our state of science, the greater the probability of advancing our technology. What is not so evident is that the state of science in one area can potentially be affected by the degree of advancement in another area of science. An example to illustrate this is as follows. Let's work within the parameters of a hypothetical scenario and assume we are oblivious to the following scientific facts. Specifically, $E = mc^2$ and nuclear reactions (specifically, nuclear fusion). If this situation prevailed, what would be our theoretical perspective about the source of stellar energy? Presumably, we would still advocate a theory which we once believed in. Specifically, the gravitational theory proposed by Hermann Helmholtz. This theory entails that stars are gradually shrinking in diameter. An incremental decrease in volume was believed to account for the energy emitted by a star. In the case of the sun, if its diameter shrank by 200 feet per year, this would explain its energy output. However with the development of new scientific principles, ($E = mc^2$ and fusion) we were able to realize that it was fusion which provided an energy source for stars. In a similar way, new scientific material has been developed at this web site which will advance our level of science in other respects. In that vein, in order to comprehend the nature of the primary source of stellar energy, it is imperative that the reader first read the paper on light in the physics section. The place where the reader can stop reading the paper and proceed to this paper will be stated within the paper on light itself. In other words, it is not necessary to read the entire paper on light in order to comprehend this theory.

This paper will now proceed with the presumption that the reader has read the initial part of the paper on light. Since a new theory has been presented adopting the position that light is not only a form of energy but also a source of energy, this must be factored in to stellar dynamics. Is it possible that light itself could be responsible for generating at least a portion of a star's energy output?* The very existence of the solar neutrino problem would provide a strong evidentiary foundation to indicate that this position is tenable. When calculating the number of neutrinos that the sun should emit, we have, of course, worked on the assumption that fusion was the primary/only source of stellar energy. We had no choice in adopting this position as our scientific framework did not indicate that there was another viable source of solar energy. However, if a viable alternative source of stellar energy is outlined then this may solve the solar neutrino problem. Namely, there are fewer neutrinos being emitted by the sun than theory predicts as a result of fusion functioning in the capacity of a secondary source of stellar energy. There is another source of energy which is the primary source for stellar energy. This other source would be light, or more specifically, photons (as opposed to entire waves of light).

If the reader has comprehended the initial part of the paper on light, he may be wondering how the principles outlined there could possibly be extrapolated to stellar dynamics in such a manner that photons could constitute a source of energy for stars. In that paper, it was stated that photons could no longer contain their intrinsic energy if the frequency of the photon became phenomenally high. Specifically, the spatial dimensions of the photon would become sufficiently small that the energy could no longer be contained within such small dimensions and the photon

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* Prior to proceeding any further, the following should be pointed out. The underlying concepts behind this paper were developed years ago. To be specific, well before the Sudbury experiments seemingly solved the solar neutrino problem. Therefore, if the results of the Sudbury experiments are reinterpreted (thereby causing the solar neutrino problem to once again constitute a problem) this paper will provide a possible solution. Consequently, the paper will remain as written prior to the results of the Sudbury experiments.

would, for all intensive purposes, explode, thereby releasing its internal energy. In accordance with general relativity, a photon might achieve this state if it were subjected to an enormously strong gravitational field, or the equivalent thereof (thereby dramatically increasing its frequency). The reader may feel that this last sentence would automatically render this entire concept (photons constituting the primary source of stellar energy) useless as there is no scenario under which photons, within the sun (or any star), could be subjected to the requisite forces to achieve this effect. The rest of this paper will outline how this scenario does take effect and what pre-conditions must be in effect for a photon within the sun/star to "explode" and release its energy.

For the sake of the physicists who may be reading this (and have not taken an astronomy course for a substantial period of time), one small aspect of astrophysics will be briefly reviewed. Within a stellar interior, an emitted photon may only travel the tiniest fraction of a centimetre before it is re-absorbed. A low frequency photon would not have a sufficient "opportunity" to be subjected to the requisite forces (whose precise nature will subsequently be outlined) to enable it to gain a sufficiently high frequency to induce the previously described effect. Therefore, the photon, *at the time of its emission* must fall within the following parameters. The photon must be ultraviolet and of *very high* frequency. This latter sentence introduces the question, precisely what *kind* of photon would this be? This is not an easy question to answer with precision given the fact that the energy levels between X-ray photons and gamma ray photons can, at times, somewhat "overlap". As an example, it is possible that a high energy X-ray photon could potentially be labelled a low energy gamma ray photon and vice versa. Therefore, for the time being, it will suffice to state that the photon may be a high energy X-ray photon or a low energy gamma ray photon.

At what general area of the star is there the highest probability of achieving photons that conform to these parameters? At the core of the star. The rationale behind this is as follows. When dealing with free electrons, the frequency of an emitted photon is directly proportional to the acceleration of an electron. Since it is hottest at a star's core, the magnitude of an electron's acceleration would be greatest at the core. Consequently, the following has been established. It is hottest at a star's core. This is where the magnitude of acceleration for free electrons would be greatest. Therefore, it is at a star's core that there would be the highest probability of an inordinate number of high frequency photons being present (even if these photons are present only for a fraction of a second before they are absorbed).

The reader is still vehemently opposed to considering the possibility of photons constituting any kind of energy source for the sun (let alone the primary source) since at the sun's core there doesn't exist the requisite gravitational force to increase a high energy photon's frequency any further. However, the reader must give due consideration to the following. It would require a gravitational force, *or the equivalent thereof* to increase a photon's frequency. General relativity's principal of equivalence states that an object being subjected to an acceleration is the equivalent of an object being subjected to a gravitational field. The reader is no doubt still opposed as a preliminary analysis indicates that photons could not be accelerated. A *preliminary* analysis is indicative of this. A deeper analysis dictates the following.

The sun is in a state of constant motion in various respects (the following analysis will apply to other stars as well). Firstly, the sun, like the earth, is rotating on an imaginary axis. Secondly, the sun is orbiting the galactic centre. Thirdly, the entire galaxy (and consequently all stars in that galaxy) is moving at a very rapid rate. Therefore, there are at least three different states of motion that the sun is constantly subjected to. The reader is still opposed as there is no acceleration involved in any of these states of motion. The rotation about the axis, the orbiting of the galactic centre, and the motion of the entire galaxy are all constant. (The only exception would be the orbiting of the galactic centre since there would be times when, like the planets of the solar system, this orbital rate is slightly faster or slower. Nevertheless, in all probability, this particular motion would not possess the requisite rate of acceleration.) This, of course, is true. However, there is a critical element that has been overlooked in a criticism of this nature when considering the possibility of "exploding" photons within stellar cores.

Since the principal of equivalence was originally predicated on the concept of an elevator in outer space, we shall adhere to this example in order to illustrate the desired precept. We only feel an acceleration when an elevator *initially* starts. Subsequent to that initial start, the elevator is in constant motion. Let's assume that the elevator is moving upwards in a state of constant motion and the following hypothetical scenario takes effect. A ball "magically appears" in the middle of the elevator. The ball would hit the floor as the elevator proceeds upwards. This would be the equivalent of an acceleration/gravitational field. Therefore, if an entity "appears" within a second entity that is in a state of constant motion, even though the second entity is not accelerating but, instead in a state of constant motion, the first entity would be subjected to the equivalence of an acceleration by virtue of its "appearance". Furthermore, if a certain action is equivalent to an acceleration, this would be equivalent to a gravitational field.

Photons do appear within stars. When an electron is accelerated within a star, a photon will be emitted. If certain conditions prevail, the photon will be subjected to an acceleration (by virtue of the various states of motion a star is subjected to) and its frequency will be increased. The pre-conditions which must prevail in order to achieve a state whereby a photon releases its energy are as follows.

Firstly, as has already been stated, the photons must be ultraviolet and of very high frequency. Therefore, our analysis will be implemented via high energy X-ray photons and low energy gamma ray photons. (It goes without saying that high energy gamma ray photons would also conform to the parameters outlined in the following analysis.) Secondly, the various states of motion a star is subjected to must be properly analyzed. (In the following equation, the velocities are to be computed via a vector addition.)

$$v_{\text{(galaxy)}} + (w \cdot r)_{\text{(of an individual star)}} = v_{\text{(final of an individual star)}} \qquad (1)$$

This equation is applicable to stars regardless of their precise orbit around the galactic centre. To be specific, equation number one is germane regardless of whether the star’s orbit is perfectly circular (a steady orbit), or whether the star’s galactic orbit varies via a smaller or greater radius. The second term, $(w \cdot r)$, ensures that both types of motion are incorporated into the equation.

In the above equation, the reader may feel that certain critical factors have either been omitted, or not given appropriate consideration. Firstly, the reader may feel that the star's rotation about its own axis has not been taken into consideration. Although I am cognizant of a star's rotation about its own axis (as was stated in the last paragraph on page two) this has not been factored into the equation for the following reason. A star's rotation about its own axis is minimal *when compared* to the velocity of the galaxy or a star's orbital velocity about the galactic centre. Consequently, it would have virtually no influence on the final effect of a photon releasing its final energy. An analogy will serve to render this slightly more lucid.

Let's assume a company wanted to ascertain the effect on a wall if a car smashed into it. The car travels at a velocity of 80 kilometres per hour and has one 50 kilogram dummy in it. If we placed a second 50 kilogram dummy in the car, would the final effect on the wall be *substantially* different? Obviously not. This is for the simple reason that the combination of the car's mass and velocity greatly prevails over the addition of the second dummy (when attempting to ascertain the final effect). This analogy can be (loosely) extrapolated to stellar motions. The combination of a galaxy's velocity and a star's orbital velocity *greatly* prevails over a star's rotation about its own axis. Consequently a star's rotation about its own axis is negligible in achieving the final effect and should be omitted from the equations. (The only justification for including it, would be if one is striving to ascertain the final sum to several decimal places.)

The second factor which the reader may feel has not been given appropriate consideration pertains to the velocity of the galaxy. What is specifically being referred to is the cosmological constant. The reader may feel that as a result of the cosmological constant, the velocity of the galaxy should be expressed in the equation. However, this has not been implemented for the following reason. I don't feel that it's appropriate to introduce one aspect of science (specifically, the cosmological constant) until we are far more certain about the accuracy of this scientific principle. Furthermore, before incorporating the cosmological constant, we should gain a greater comprehension of the rate of acceleration and at what times this acceleration takes place (assuming of course that the universe is actually accelerating). To express it succinctly, our knowledge and comprehension of the cosmological constant is far too simplistic to effectively incorporate into the equation. Consequently, a galaxy's velocity has not been expressed with consideration to the cosmological constant.

The foundation for a photon to release its energy within the core of a star (and subsequently function in the capacity of the primary source of stellar energy) has now been established. Firstly, a star's final velocity must be ascertained via the presented equation. Secondly, an abundance of high energy photons (either high energy X-ray photons or low energy gamma ray photons) must be continually emitted within the star (as already stated, this would obviously be at the core of the star). If the requisite photon is emitted in a direction *opposite* to the *final state* of motion of a designated star, its frequency will be increased. Or, to express it in terms of the precepts stated in the paper on light, the photon's dimensions will be reduced. Consequently, the internal energy can no longer be contained within this reduced area, thereby causing the photon to "explode" and liberate its energy.

Now that the preconditions for a photon to release its energy has been established, it would be appropriate to incorporate another factor into this analysis. A photon would not necessarily have to be of a very high frequency *at the time of its emission* in order to (eventually) have its dimensions reduced and its energy released. This can be explained via the following.

According to the tenets outlined in this paper, a violet photon (or for that matter, a low energy X-ray photon) would not have its energy released at the time of its emission even if it were travelling in a direction opposite to the final velocity (as computed via a vector addition) of the star. This is for the simple reason that it will be reabsorbed within a fraction of a second of its emission and will not have the requisite time to have its dimensions sufficiently reduced. However, in accordance with high frequency photons having their dimensions reduced, a violet photon (as an example) *would* have its dimensions reduced if it were emitted in a direction opposite to the final velocity of the star. Since its dimensions are reduced, its energy would increase (in accordance with the precepts stated in the paper on light) and it may become a low energy X-ray photon. If this process were to transpire again, it may then "acquire" the requisite energy to "explode" and liberate energy. *In principal*, even an infrared photon could (eventually) achieve the requisite energy levels if it was successively emitted in this manner. However, this is true only in principal. The actual probability of such an event is quite low. The probability of this process is far greater with violet photons or low energy X-ray photons. Consequently, not only would high energy X-ray photons and gamma ray photons (regardless of whether the gammas are high energy or low energy) function in the capacity of a source of stellar energy, but violet photons and low energy X-ray photons would function in the same capacity *if* they were *successively* subjected to the forces outlined in this paper.

Although the mechanism of a photon constituting the primary source of stellar energy has been outlined, other principals should be briefly addressed. Photons functioning in the capacity of an energy source could only be expected within the core of a star (barring mankind's ability to dramatically increase our level of scientific understanding and our technological capabilities). The rationale is as follows. As the reader should be able to see from the preceding analysis, various precise factors must come into play for a photon to release its energy. At the exact time of its emission, the photon must be of very high frequency and its direction of propagation must be *directly opposite* to the star's final state of motion (which, as already stated, is dictated via a vector addition of the star's orbit around the galactic centre and the galaxy's overall state of motion). The probability of this transpiring with any degree of regularity is extremely low unless there are an inordinate number of high energy photons within the designated area. When photons are emitted, they could potentially assume any direction of propagation. Only a tiny fraction of them would propagate in a direction exactly opposite to the star's final state of motion. Therefore, the only place where there would be a *truly inordinate* number of high energy photons being released is within the core of a star where it is hottest and free electrons are constantly being accelerated to a very high speed. Although it would be possible for this to transpire anywhere within the star, the probability of it transpiring in other areas (at least with any degree of regularity) is extremely low. The second principal that should be addressed is that fusion is not to be eliminated as a source of stellar energy. It is merely to be relegated as a secondary source of stellar energy, not the primary source.

Is there any evidence to substantiate photons constituting the primary source of stellar energy? Whether or not there is evidence is contingent upon whether the Sudbury experiments are reinterpreted or not. However, *if* they are reinterpreted, then I will only state this. My analysis of light was developed when I was much younger and I started studying physics. I simultaneously recognized that since I was outlining a new source of energy, the principal must be extrapolated to stellar dynamics. At the time of the development of these concepts, I was completely oblivious to the existence of the solar neutrino problem. After I learned of this problem, I eventually came to the realization that what has been outlined in this paper would solve the problem.