5. THE VACUUM ENERGY FIELD & THE CONTRACTION OF MOVING BODIES

The following are the opening sentences in Encyclopædia Britannica 2000 on the Lorentz-Fitzgerald (L-F) contraction:

> **Lorentz-FitzGerald contraction**, also called SPACE CONTRACTION, in relativity physics, the shortening of an object along the direction of its motion relative to an observer. Dimensions in other directions are not contracted.

The L-F contraction factor, as we may know, is $(1 - v^2/c^2)^{1/2}$, where v is the velocity of the object. The factor is purely ad hoc and has never been derived from first principles. Moreover, the non-contraction along directions transverse to motion is another such article of faith (see, for instance, Born 1965).

We shall quickly investigate here – for the very first time in the history of science – the physical basis for this contraction. IT WILL ALSO SHED FOR US THAT EXTRA LIGHT TO SEE THE UTTERLY SIMPLE MECHANISM WHICH UNDERLIES THE MYSTERY THAT IS THE SPEED OF LIGHT IN MOVING FRAMES.

First, to help relieve ourselves of any apprehensions, the crucial difference that makes it all classical mechanics now for relativity theory is summarized in a few astoundingly plain and simple lines. For convenience here, let us denote $(1 - v^2/c^2)^{1/2}$, the L-F contraction factor, by δ. Thus, the gist of the speculated L-F contraction – central to Einstein's relativity – and that of the contraction that in reality takes place in nature are as follows. Consider the isolated atom (or molecule).

1. The L-F Concept

In inertial space:

(a) The atom at rest has zero contraction: Longitudinal dimension / Transverse dimension = 1/1 = 1.

(b) Under motion at velocity v, the body has zero contraction in the direction transverse to motion: Transverse dimension = 1.

(c) Under motion at velocity v, the body contracts to δ in the direction of motion: Longitudinal dimension = δ.

(d) The contraction of body in the direction of motion with respect to its transverse dimension is thus δ/1, or δ.

2. The Final Concept

In absolute space, the space of the CMB:

(a) The atom at rest has zero contraction: Longitudinal dimension / Transverse dimension = 1/1 = 1.

(b) Under motion at velocity v, the body contracts to δ in the direction transverse to motion: Transverse dimension = δ.

(c) Under motion at velocity v, the body contracts to δ^2 in the direction of motion: Longitudinal dimension = δ^2.

(d) The contraction of body in the direction of motion with respect to its transverse dimension is thus δ^2/δ, or δ, *as in 1(d) above*.

Hence, the L-F Contraction Factor, though empirically correct by virtue of 1(a), 1(d), 2(a), and 2(d) – the reason for the partial success of Einstein's relativity theories – the concept is still *fundamentally flawed* by virtue of 1(b), 1(c), 2(b), and 2(c) – the reason for the limitations of Einstein's relativity theories.

5.1. The velocity of light

Perhaps, man's most important empirical discovery of all time is the fact that light travels at a speed or velocity that is finite – not infinite as he had thought earlier. Moreover, he finds the velocity of light to be amazingly constant even in vacuo – as if the energy was being transmitted, like sound, through a physical medium. And he reasons: maybe the void we see in separating matter is not as empty as we thought it was; perhaps some medium does pervade the seeming emptiness after all.

His gut feeling was not off the mark. To the contrary – *it was dead on target!* As we are now learning, the entire universe of our observation – classical matter and vacuum alike – is indeed a recess-free physical medium. It is an indefatigably vibrant continuum of mass-energy where radiatons conveniently serve us as the ultimate and unique analytical constituents. And, detectably, the radiaton appears at speed c as the per-cycle energy quantum of the photon.

And, perhaps, man's least understood of all physical phenomena is the seeming constancy of that speed of light irrespective of how the source or the observer is moving. It still looks just as ridiculous to us today as it first did to Einstein, Poincaré, Lorentz, FitzGerald, Michelson, Morley, and a host of other leading scientists of more than a century now. How can the speed of light possibly measure the same finite value whether you approach the beam or move away from it? A straightforward and rational answer has remained beyond our grasp even to the present day (Hawking 1988).

But, with the final insight now into the submicroscopic world of mass-energy, we have that simple explanation to the seeming invariance of c in moving (inertial) frames.

5.2. Derivation of the L-F Contraction Factor

The space and time of the CMB radiation serve us respectively as absolute space and absolute time. The reference (or “rest”) frame of the CMB thus becomes to us the absolute and preferred inertial frame of reference. And it is in this unique frame *alone* does light have the absolute velocity of c.

To explain basic principles, consider the basic atom. In isolation and at rest in absolute space, the space of the CMB, the body will thus be in a vacuum energy field that is isotropic. There will be no net transfer of the CMB photons, or radiatons, to or from the atom over its vibrational cycle. And the body would continue its (steady) state of rest with zero net force across hemispheres. That is, the rate of radiaton exchange across a hemisphere would remain equally matched by the rate of such exchange across the opposite hemisphere. This cycle of energy absorption and emission, of course, occurs at the natural frequency of vibration of the atom. The frequency of this cycle, therefore, will measure the same *in all directions* in the rest frame of the body.

Thus, radiatons would impinge the atom at a level corresponding to diameter λ_o [as per equation (3.1), above] and get ejected therefrom at spatial intervals of λ_o, or time intervals of λ_o/c, in every radial direction, where λ_o is the wavelength of the CMB.

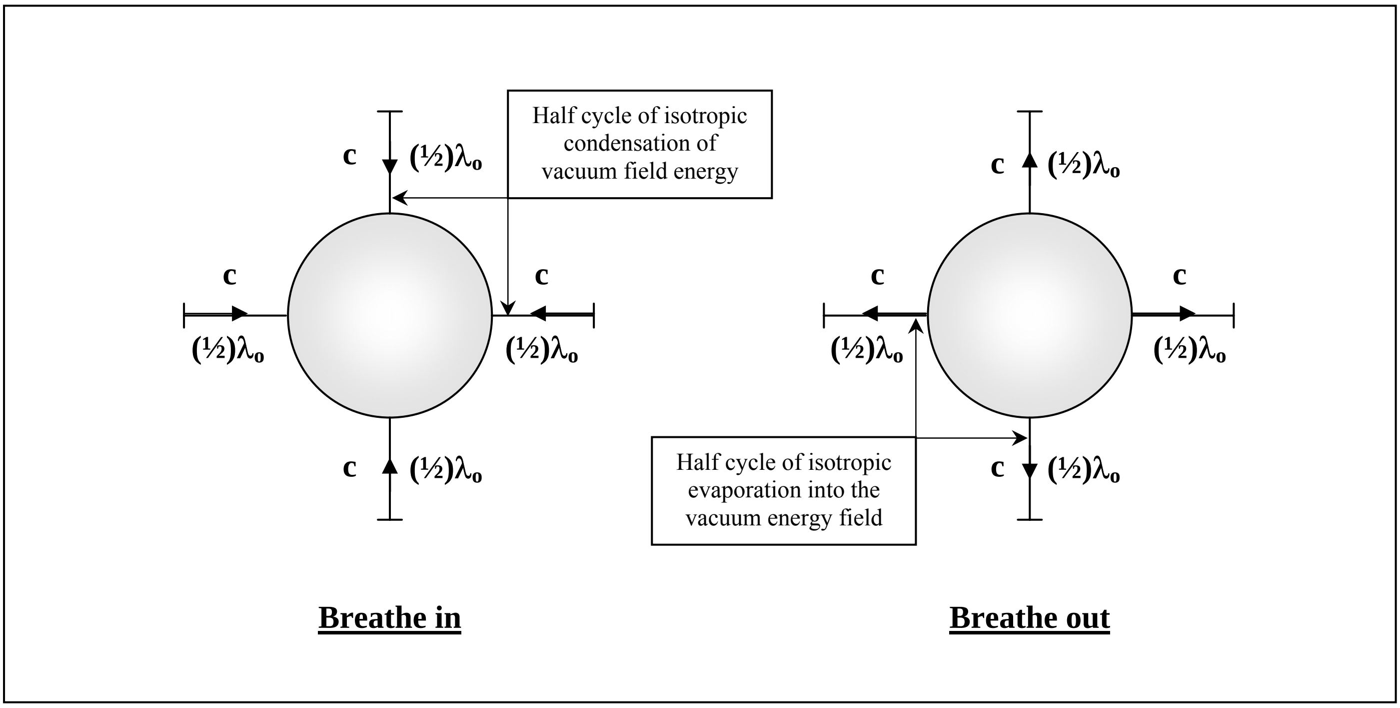

Figure 2. Body at rest. The exchanges between body and the outside vacuum energy field are the same all around. Velocity c and wavelength λ_o are with respect to absolute space, the space of the CMB, in which the body is at rest.

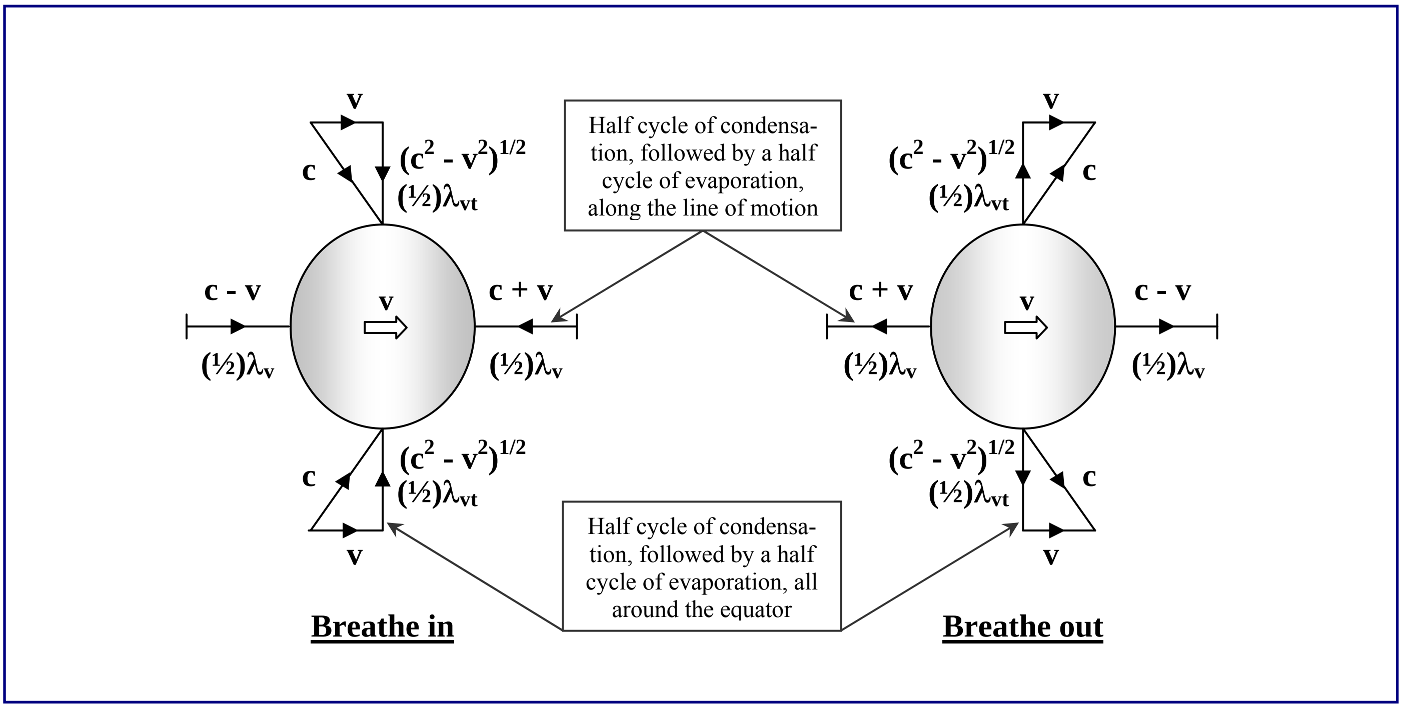

Figure 3. Body at velocity v. And the exchanges become polar. Individual velocities c and v are with respect to absolute space, the space of the CMB; wavelengths and combined velocities are relative to body moving at v.

That is, the radiatons would get absorbed in over a half cycle and get emitted out over the next half cycle, and the cycle would repeat. This, *in effect*, may be considered as the body simply *reflecting* off the radiatons over each cycle at that level. That is, the radiatons would approach the body over a half cycle and get reflected back over the next half cycle (Figure 2), and the cycle would repeat. (Note: Momentum exchanged between radiaton and atom is 2mc whether the atom absorbs and emits the radiaton or simply reflects it.)

Consider next the body in uniform motion at velocity v in absolute space (Fig. 3). The effect of the CMB is no longer isotropic for the body. It becomes polar. In front of the body, the radiatons approach at (c + v) relative to the body and leave at (c – v). At the rear, the situation is reversed: the radiatons approach at (c – v) and leave at (c + v). At uniform velocity, as at rest, there will be no momentum change for the body. (Alternatively, a simple analysis will show the momentum transferred to body by the radiatons fore and aft to cancel out here, too, each cycle.) Hence, the wavelength, say, λ_v, of the particle bombardment will be the same fore and aft in the frame of the body.

Thus, relative to the body, the radiaton will have a vibrational displacement of $\lambda_v/2$ in front as well as in the rear where the radiaton speed will be (c + v) in one direction and (c – v) in the opposite direction (Fig. 3).

Therefore, in the frame of the moving body, the period, t, of the cycle, which is displacement divided by velocity over the two half-periods, will be,

$$t = [(\lambda_v/2) / (c + v)] + [(\lambda_v/2) / (c - v)]$$

or,

$$t = \lambda_v c / (c^2 - v^2) \qquad (5.1)$$

Transverse to motion, a simple vector diagram (Fig. 3, once again) will show the particle to approach and depart at the *same* speed of $(c^2 - v^2)^{1/2}$ relative to the body.

Thus, the period t (common for the selfsame vibrant, or breathing body), which here is simply wavelength divided by velocity, will be,

$$t = \lambda_{vt} / (c^2 - v^2)^{1/2} \qquad (5.2)$$

where λ_{vt} is the wavelength of transverse particle bombardment in the frame of the body.

From Eq. (5.1) and (5.2), we then get,

$$\boldsymbol{\lambda_v / \lambda_{vt} = (1 - v^2/c^2)^{1/2}} \qquad (5.3)$$

The right hand side of Eq. (5.3) is clearly less than unity for nonzero v. Thus, since λ_v and λ_{vt} also directly correspond to atomic radial levels, as per Eq. (3.1), the atom's effective dimension λ_v along the polar axis has become less than its equatorial dimension λ_{vt} by virtue of motion.

In other words, the atom's "thickness" λ_o at rest has, by virtue of motion at v, contracted[5] to λ_v along the line of motion and to λ_{vt} along the transverse direction. And Eq. (5.3) gives the relative contraction, THAT IS, THE CONTRACTED ABSOLUTE DIMENSION IN THE DIRECTION OF MOTION IN REFERENCE TO THE ALSO CONTRACTED ABSOLUTE TRANSVERSE DIMENSION.

[5]Equation (5.3) tells us that λ_v is always less than λ_{vt} for nonzero v. However, when v = 0, we will have, $\lambda_v = \lambda_{vt} = \lambda_o$; and when v tends to c, λ_v, being equal to $\lambda_{vt}(1 - v^2/c^2)^{1/2}$, would tend to zero. These show the body under motion to be always contracted transverse to motion and to be even further contracted along the line of motion.

Equation (5.3) is directly identifiable with the famous L-F contraction hypothesis. AND, FOR THE VERY FIRST TIME IN PHYSICS, THE EXPRESSION IS DERIVED HERE FROM FIRST PRINCIPLES.

It may also be noted that:

a) The L-F hypothesis, though empirically sound, is still fundamentally flawed for want of a theoretical basis. That is, neither Lorentz nor FitzGerald was aware that the transverse dimensions, too, contract absolutely; and that it is based on this diminished transverse dimension does the longitudinal dimension further contract by the factor of $(1 - v^2/c^2)^{1/2}$.
b) Every atomic level exchanges energy with the outside vacuum field (which breathing sustains the atom; see section 3, above). Hence, the contraction under motion takes place at every atomic level and layer of the body, that is, by the same L-F factor.
c) With increase of speed, body mass decreases (contrary to current notions) by partial "squeeze-off" from every atomic level; however, all levels between λ_o and λ_v along the direction of motion and those between λ_o and λ_{vt} transverse to motion get totally evaporated off into the outside vacuum field; the process reversing under speed drop for the resilient atomic constituents. And,

fundamentally, it is these mass transfers that cause the inertial and centrifugal effects on the moving body.

d) An imbalance in the longitudinal effect of the vacuum field on (every atomic level of) the body is what gets manifested as an effect due to the body's so-called inertia: The forward effect of the vacuum field on the moving body is the inertial drive; the counter effect is inertial resistance; acceleration of body causes a net inertial resistance; deceleration causes net inertial drive; and uniform motion sees a counterpoise between inertial drive and inertial resistance, as at rest; any reference frame in which the body experiences no net effect from the vacuum field is thus termed an inertial frame of reference (Sittampalam 1999, sections 4.02 and 7.01).

e) An imbalance in the transverse effect, brought about by non-rectilinear motion of body, is what causes the centrifugal effect; the agent causing the non-rectilinear, or curvilinear, motion of body being the centripetal force (Sittampalam 1999, section 7.05).

f) Without exception, it is momentum and momentum *alone* of the radiaton that is fundamentally transferred in any and all interactions in nature, be it gravitational, electromagnetic, or nuclear (Sittampalam 1999, chapter 2).

Hence, a contraction of body occurs not only along the direction of motion but also (to a lesser extent) transverse to motion. In the moving frame of the body, however, this absolute dipole asymmetry will not be verifiable by any physical means, as we shall see next.

5.3. The velocity of light in moving frames

The velocity c is absolute. It is in reference to an absolute inertial frame, the frame of the CMB. Therefore, in reference to any other frame moving relative to this unique and preferred frame, the velocity of light will generally be something other than c in magnitude. It also follows that even within a moving *inertial* frame the velocity of light will not be the same in magnitude in all directions. In other words, the velocity of light propagation will *not* be isotropic in *any* frame that is moving in absolute space, the space of the CMB.

But for physical verification, man is left with only physical means – his rods and clocks. These measurement instruments of man all consist basically of atoms. And it is at this basic level of the atom that the distortions all start.

In the frame of the atom moving at velocity v, let the effective velocity of light along the polar axis be c_v; and that along a radius through the equator be c_{vt}.

Velocity is wavelength divided by time period. Hence, from Eqs. (5.1) and (5.2) we will get, respectively,

$$c_v = \lambda_v/t = c(1 - v^2/c^2) \quad (5.4)$$

and,

$$c_{vt} = \lambda_{vt}/t = c(1 - v^2/c^2)^{1/2} \quad (5.5)$$

Dividing Eq. (5.4) by Eq. (5.5), we then get,

$$\mathbf{c_v / c_{vt} = (1 - v^2/c^2)^{1/2}} \quad (5.6)$$

Clearly, from Eqs. (5.3) and (5.6), it is not only the atom's wavelengths of energy transfer along and transverse to motion that are affected by the L-F factor but also the velocities of the transferring energy along those directions – *by the very same factor***.**

Further, we have up to now considered only the polar and equatorial points of the atom. The radiaton exchange normal to the surface at any other point, too, will have an effective wavelength and velocity. However, their magnitudes will only be intermediate to their polar and equatorial counterparts, but with the all-important (and scalar) time period, t, remaining common for all points from pole to equator. That is to say, the wavelength of transfer divided by the velocity of transfer will be equal to the constant period of transfer, t, with both wavelength and velocity tending from a minimum at the poles to a maximum at the equator.

Hence, we may summarize that in any inertial frame where the light source and detector are at rest:

(A) By virtue of Eqs. (5.3) and (3.1), the wavelength of light and the material instrument that measures it are both subject to the same factor of change. In other words, the wavelength of light will physically measure the same in *any* direction from the source and irrespective of the frame velocity.

(B) Energy from an atomic level is its energy of vibrant emission from that level. As such, in the source frame, the energy will register the same constant frequency in *any* direction of propagation. But, from (A), the wavelength, too, is observed a constant for the energy in any direction in the source frame.

THUS, AS A RESULT, WE HAVE BEEN WRONGLY CONCLUDING TO DATE THAT (ESSENTIALLY) FREQUENCY OF LIGHT TIMES

WAVELENGTH OF LIGHT, WHICH PRODUCT IS THE SPEED OF LIGHT, IS ABSOLUTE AND ISOTROPIC IN ALL INERTIAL FRAMES, THAT IS, IN CONTRAVENTION OF EQS. (5.3) AND (5.6).

Again, from Encyclopædia Britannica 2000:

time dilation, also called TIME DILATATION, in the theory of **special relativity**, the "slowing down" of a **clock** as determined by an observer who is in relative motion with respect to that clock.

There is no more need for recourse, therefore, to space contraction or time dilation (to hold c absolute in moving inertial frames). Space and time are absolute in the radiation field of the CMB. And it is in this unique space of the CMB *alone* does c remain an absolute constant. (The phenomena attributed to time dilation, too, naturally, have much simpler explanations in the real quantum world; see Sittampalam 1999, sections 1.21, 4.10, and 4.11; and Sittampalam 2003, Relativity.)

5.4. The Final Theory of Relativity

In the absolute reality, it is light's travel time that remains the only invariant for a given distance in an inertial system. That is, if two points A and B are at rest in an inertial frame, then light's travel time between the fixed points A and B will remain the same absolutely irrespective of the frame velocity v or the orientation of the line AB with respect to v. Under any given change in v, in magnitude and/or direction, it is the distance AB and the velocity of light between A and B that change absolutely, *and they both change by the very same factor*. And since velocity equals distance divided by travel time, the factors of change cancel out in the equation to give us the illusion of the invariance of the velocity of light in moving inertial frames. This, as we saw above, is the direct consequence of bodies contracting not only in the direction of motion *but also* transverse to motion (by factors related to the L-F hypothesis). *And this reality of matter has made all the difference in bringing relativity down to earth from its abstract perch*. Hence, however sophisticated the instrument and advanced the technique, any experiment in an inertial frame may now be deemed to be in error should it find a difference in light's travel time between two fixed points at different orientations of their connecting line with respect to the frame velocity[6].

[6]Basically, these were the empirical facts that were most conclusively verified for us in the famous Michelson-Morley experiment of 1887 – which led to Einstein's Special Relativity. The final interpretation of the experiment, though, is now a very simple one (if not superfluous). It is given in Sittampalam 1999, chapter 10 (anyway!). It is also important to note that these results need not be any different at all in *noninertial* frames where actual experiments are performed, as was the Michelson-Morley experiment. (A reference frame is a noninertial one when its velocity is not fixed in magnitude or direction in absolute space, the space of the CMB.) This would only and simply mean that the effect of the *change* in the frame velocity (v) – in the fleeting time the photon takes to traverse the experimental distance (AB) – is beyond detection.

The following illustration should help us further understand these profound, yet simple, facts of the submicroscopic world brought to light here.

Imagine yourself on a platform at rest in absolute space, the space of the CMB. There are two identical light sources and a single light detector fixed to the platform. One light source is at a distance in front of the detector and the other at a distance to the side. The wavelength and frequency of the energy you measure from one source are the same as the ones you pivot the detector and measure from the other source. (This also confirms that the two sources are identical in energy emission.)

Next, consider the platform moving you forward at uniform velocity v along with the light sources and detector. You carry out the same measurements as before. The wavelength from each source has contracted by a certain factor and the atoms of the detector, too, have contracted by the same factor in that direction. (For that matter, you, the platform, and everything else moving with you have contracted by that very same factor in that direction!) Hence, you do not detect any wavelength change from your earlier measurements, when the system was at rest. Further, the source and detector atomic levels of energy transfer being always of a common frequency, there is also no frequency change registered by the detector in the various situations. You repeat the experiment (though superfluous) at a different magnitude and direction of v. Again, the results show no variance whatsoever from earlier ones. That is, to material instruments, the wavelength and frequency of energy transfer between emitter and receiver remain the same in all situations.

And you conclude: Velocity is frequency times wavelength ($c = f\lambda$). Since there is no change detected in either frequency or wavelength from any of the (identical) sources, the velocity of light is an absolute constant in all inertial frames and in all directions of propagation irrespective of frame velocity.

Are we correct anymore in drawing these conclusions, that is, to say: $c_v = c_{vt} = c$?
AND WHITHER NOW SPECIAL RELATIVITY?

The similar insight into the phenomenon of (quantum) gravity in section 4, above, would also now beg the question:
AND WHITHER NOW GENERAL RELATIVITY?

6. NEUTRINOS AND GRAVITATIONAL RADIATION

In cosmological discussions, both neutrinos and antineutrinos are referred to simply as neutrinos for brevity's sake. We shall adopt the practice here, making the distinction only when necessary. (See also Sittampalam 1999, section 6.06; and Sittampalam 2003, The Neutrino.)

6.1. Origin of the neutrino

The proton and the electron are the most basic sub-c particles of matter that are stable in nature. Their stability in the mass-energy continuum lies in their intrinsic handedness – a nonvanishing seminal linear momentum coupled with a nonvanishing seminal angular momentum, or spin. (See Sittampalam 1999, section 2.06; and Sittampalam 2003, The Spin.)

The basic sub-c particle of matter breathes. Over exhalation, a mass-energy quantum ejects from the north pole. The south is suddenly thrust against a resistive vacuum energy field (the resistance of inertia; Sittampalam 1999, section 4.02). The combined action at the poles tends to cause the body to bulge at the equator. And a quantum around the spinning equator fully attains speed c and escapes the body, maintaining thereby the critical diameter λ_n at the equator.

The polar and equatorial quanta thus exhaled are complementary and comparable; one does not occur without the other; in the great and vibrant mass-energy continuum, there is no action without reaction – even in directions transverse. The polar transfer is intense since it is one-dimensional (along the polar or spin axis). The equatorial transfer, though, becomes less intense with distance from the spin axis since it is two-dimensional and radially divergent. The polar and equatorial quanta of inhalation are very similar to their respective exhalation counterparts, only reversed in effect on the spin particle.

All four transfer quanta – polar and equatorial influx and efflux – are counter to the seminal motions of the particle: The polar influx (at the leading south) and efflux (at the trailing north) are both opposite to the particle's seminal linear motion; and the equatorial influx and efflux (along the equatorial plane and tangential to the particle surface) are both opposite to the particle's seminal spin. Over a breathing cycle at steady state, for instance, there is null effect on the particle from the four transfer quanta – a change neither in mass-energy nor in momentum for the particle[7].

[7]The spin change over a half cycle is of a constant magnitude ħ, given by $\hbar = h/2\pi$ (where h is Planck's constant), that is, irrespective of the quantum of mass-energy transferred. Thus, over exhalation, nucleons and electrons each gain a unit spin quantum of ħ; over inhalation, the spin gain is lost. The cycle thus gives the particles a statistical ħ/2 – their characteristic "half-spin" – that is measurable. (See Sittampalam 1999, section 5.04, for the derivation of formula, $\hbar = h/2\pi$, *for the first time ever* from first principles.)

The transfers always take place at speed c over the natural vibrational cycle of the spin particle. Due to their intensity, the polar quanta are detectable; we now recognize them as magnetic radiation (Sittampalam 1999, section 5.01). The less intense equatorial transfers, though, are unrecognized as such today – but they underlie the electrical effect (Sittampalam 1999, section 5.08).

On the other hand, however, should the polar transfer quantum be unusually large, like the electron emitted in the neutron's final breath, that is, in the neutron decay, the corresponding equatorial quantum heaved, too, becomes unusually large – and detectable. And that's what we detect, though still with some difficulty – as the neutrino. Although the polar quantum here is a sub-c particle (electron), the comparable equatorial quantum (neutrino), being two-dimensional and radiating, or thinning, out, breaks out only as speed-c mass-energy. (See Sittampalam 1999, sections 6.01 to 6.03, for the full mechanics of neutron decay.)

Thus, the neutrino propagates (only) at speed c. (The handedness, or helicity, of this quantum of nuclear recoil is readily reckoned; see Sittampalam 1999, sections 6.06 and 6.08.)

6.2. Detection of the neutrino

There is a misconception today that the neutrino can pass through, say, the Earth without even affecting a single atom (Bahcall 1989). In the renewed light, however, as we have just seen, the quantum that is the neutrino recoils from around the equator of the subatomic particle of origin. It is thus nuclear in origin and, therefore, will be nuclear in effect, like the gamma ray. But, unlike the gamma ray, the neutrino has a two-dimensional and radial spread, which causes the energy packet of radiatons (its analytical constituents; subsection 2.3, above) to drop in intensity with distance. On the other hand, however, this wider field of influence enables the radiatons to intercept much more atoms than would the radiatons of the essentially one-dimensional photon. Since the neutrino possesses energy, it also packs momentum – and transfers it successively, in a radial domino effect, to EVERY SINGLE ATOMIC NUCLEUS AND ELECTRON along its way, subtle and beyond detection though the effect may be on individual atoms, especially with distance.

Nevertheless, in an intense stream of neutrinos, as from a supernova explosion, Earth detectors are now able to register an effect (Bionta 1987; Hirata 1987). As nuclei and electrons of the detection medium recoil from the neutrino impact and successively pass on the effect, certain electrons down the line get a concentrated, or lensed, effect strong enough to knock them off their atoms and thereby cause detection. In other words, the interference of the neutrino wavefronts can, at times, cause a detectable effect even though generally every atom of the medium gets thumped without a seeming whimper.

This model of the neutrino would now explain its seeming elusive nature with which it has been synonymous.

6.3 Neutrinos and the CMB

Again, in principle, the neutrino is no different to the equatorial emission that occurs over the *normal* vibrational cycle of the spin particle. That is, the most intense emissions are the ones we now *recognize* as neutrinos, which emerge from relatively infrequent nuclear processes. (Two such processes are the neutron decay, which produces the electron antineutrino; and the proton-proton fusion, which produces the electron neutrino.) Thus, the classical vacuum is simply a sea of photons and neutrinos of the breathing matter, excited and otherwise. In other words, the long-range radiation field of the cosmos is constituted as much by neutrinos as it is by photons. This implies that neutrinos, too, transfer the gravitational effect, which is indeed a fact of observation today (see, for instance, Dickson & Schutz 1995). Therefore, as also discussed in section 2, above, even the minimal cosmic background radiation flux of E_o would include the prolific contribution also of the neutrino.

7. THE COSMOLOGICAL REDSHIFT

The cosmological redshift is a systematic shift observed in the electromagnetic spectra of all the far galaxies without exception. It is found that the wavelength shift toward the red increases with the distance of the galaxies from the Earth (see, for instance, Peebles 1993).

7.1. The cosmic photon and the age paradox of the Universe

In physics today, it is taken for granted that the energy of the photon emitted is the energy of the photon detected. When the source and receiver are at relative rest the photon wavelength is measured to be unaffected; when the two relatively approach each other the wavelength shortens, or blueshifts; and when the two recede from each other the wavelength extends, or redshifts. These are amply borne out in laboratories. With the near galaxies, too, they seem to hold out well with other observations. Therefore, it was assumed that the wavelength shifts are purely the Doppler shifts due to relative motion and that the intrinsic energy of the photon *is not affected at all* while in transit. And the concept got extended to the far reaches of the cosmos.

The exercise remained unchallenged. The indifference was not something unexpected. With the photon itself not well understood to start with, there weren't much grounds for contest anyway. And so, from astronomical observations, Edwin Hubble in 1929 made the "fundamental discovery" that the universe is expanding – the galaxies are all moving away from each other at a rate proportional to the distance between them. Shifts, or displacements, of spectral lines toward the red end of the spectrum are observed in all spectrograms taken with light from distant galaxies (Peebles 1993, Rees 1997).

But, lately, this picture of cosmic grandeur has become very controversial. The universe is younger than some of the stars it contains, it also seems to imply when viewed in the light of other observations (Bolte & Hogan 1995). Then, again, with the photon ill-understood in the first place, such a paradox, too, should not be something unexpected.

Observations do not lie; neither are they partial to popular or fashionable theories of the day. They reveal, instead, the sublime truths of nature. It is our interpretations of the data that have been in dire want. THE HUBBLE EXPANSION OF SPACE IS A MISCONCEPTION. It is a gross miscarriage of interpretative science that has unnecessarily taken physics into a fantasy world of singularities with so-called Big Bangs and Big Crunches. However, in the light of the ultimate concept now of the photon, the misgivings of the cosmological redshift find a simple and final resolution.

7.2. The non-breathing photon

Consider, first, the single photon. Let its energy be E, frequency f, and wavelength λ. The length of the photon will be λ_o (section 2, above). Within this length, the photon will be constituted (analytically) by a string of radiatons of speed c and, say, n in number. The energy of each radiaton will be e.

Thus, it readily follows,

$$c = f\lambda \qquad (7.1)$$

$$E = hf \qquad (7.2)$$

and,

$$E = ne \qquad (7.3)$$

Whence from equations (7.1), (7.2), and (7.3) we get,

$$\boxed{\boldsymbol{\lambda = hc/ne}} \qquad (7.4)$$

Now, electromagnetic radiation through free space is simply a stream of energy moving at speed c. Analytically, it is a stream of radiatons effecting a vibrational energy transfer through the vacuum field radiatons at speed c. The particles of the stream are not necessarily arranged into lines of definite wavelengths; neither do individual particles maintain specific wavelengths at all time; in other words, electromagnetic radiation is more of a particle soup in flow. Should an instrument that measures, say, wavelength intercept the flux, what really gets detected is simply the *statistical* wavelength(s) at which the particle flow peaks in intensity. That is, at any such wavelength, the effect transferred to the material instrument becomes at least detectably sufficient. And at such a wavelength, λ, the corresponding photon will be made up of n number of radiatons satisfying equation (7.4).

In the laboratory, the photon makes a straight line from the source to the detector. It hardly suffers a lateral deviation due to any asymmetry of the ambient field. (We minimize material objects very close to the line of propagation to avoid diversion, or redistribution of the energy intensity in space, which we call diffraction.) In the local region of the cosmos, too, any effect caused by variation from a straight-line path is not measurably significant. (Here, too, we avoid those lines of propagation that, for instance, graze the Sun or the stars). But photons from the *far* galaxies get considerably subjected to asymmetries in the exceedingly long intervening space of the intergalactic. We cannot avoid them because *every single line* of radiation reaching us gets affected appreciably by asymmetric fields en route. (A galaxy, for instance, would shield the CMB radiation on one side of the passing energy stream causing the stream to swerve toward the galaxy. On the long haul, the effects of these diversions add up and cannot be ignored.) And farther the source, more are the lateral shiftings and meanderings of the energy streams reaching us.

The radiatons of the stream pack momentum and they move always at speed c. Through long intergalactic space, however, they are pushed from post to pillar by the asymmetry of the regional fields along the way, that is, even in the generally non-material medium of intergalactic space. Thus, *the stream of momentum particles moving at constant speed c is forced to change its state of straight-line motion*. This entails transverse acceleration – and transverse momentum change. And every such momentum change by a lateral "squeeze" in one direction causes the stream to counter that effect by ejecting part of its radiatons laterally in the opposite direction – and out of the mainstream.

A simple illustration here should now help us understand these actions more clearly. An earthbound stream of photons from a distant supernova passes over a galaxy cluster. The photons feel the long-range field to be lopsided due to the galaxies shielding the CMB from below. This is, of course, due simply to the radiatons of the stream getting pelted by the CMB radiatons more from the top than from the bottom. The differential pelting causes the stream to veer down. And, what do you know, on the flip side, the shielding of the CMB by the photon stream similarly causes the galaxy cluster to get drawn up! Absurd though the latter may seem, it is, in principle, true and needs consideration in the context here. (This is akin to the airfoil effect, which lifts jumbo jets against gravity; see Sittampalam 1999, section 7.06.) Now, the momentum of the system – galaxy cluster, energy stream, and the regional field – is strictly conserved. Thus, in *net* effect, the momentum of the cosmic field surrounding the “bubble” containing the system is unaffected. Within this imaginary cosmic bubble: (i) The energy stream veers down by scattering part of its radiatons to the top. (ii) The galaxy cluster draws up by scattering part of its radiatons to the bottom. (iii) The movement of the cluster is also slightly in the forward direction of the energy stream since the latter’s shielding (gravitational) effect is continuously moving in that direction. (iv) The momentum of the original photon stream gets conserved in the surviving stream together with the (additional) forward momentum of the galaxy cluster. (v) The transverse momentum of the original stream being zero, it remains conserved at zero by the opposing movement of the surviving stream and galaxy cluster together with the radiatons they scattered. (Figures for this illustration are given in Sittampalam 2003, The Cosmological Redshift.)

This is the reality of cosmic photons, though unrealized today in astrophysics. The energy scattering from the photon stream is, in principle, the same as synchrotron radiation recognized today in particles of matter undergoing deviation from straight-line paths at high speeds. Such sub-c particles, though, regain lost energy when initial conditions are reestablished. (The net loss and regain are effected over their breathing cycles, as explained in detail in Sittampalam 1999, chapters 2 and 4.) On the other hand, however, photons, non-breathing as they are, do not recoup lost radiatons back into the fold.

Thus, the very much deviated and squeezed-out stream of cosmic photons entering solar space arrives ‘tired’, or lower in energy content per photonic length λ_o, compared to their local counterparts; and *every single wavelength* in the extragalactic energy stream extends and appears redshifted to detectors in solar space. That is, even light from a relatively approaching body will have its Doppler blueshift overwhelmed by this redshift effect after a certain cosmic distance of travel toward us. (Any recessional motion of source, of course, would show up as increased redshift.) See also Rees 1997, p. 36.

In other words, statistically, the number n will always be smaller in *any* photon coming from the far galaxies in relation to a corresponding photon from a local source. And from equation (7.4), we readily see that when n drops, λ extends, or redshifts.

Thus, we may conclude, a spectral redshift *does not* tell us anything specific about a cosmic body's state of motion or its distance relative to us. (Relative distances of the far galaxies may be very approximately inferred, though, from their redshifts, but not their speeds.)

One more illustration here should help to totally elucidate the principle.

There are two persons, A and B, at rest. A fixed distance separates the two. A sends out a light flash every second. B times it and says he is receiving the signals at one per second. A now moves away from B but maintaining the flashes at exactly the same rate. B now notes the flashes to arrive at a longer than the one-second interval due to the extra length the successive flashes have to travel from A to B. This stuff is quite simple and elementary for us to understand in absolute space and time.

Consider, next, two distant galaxies at different points in the sky. Let them be equidistant from Earth. Two identical stars, one in each galaxy, blow up in a supernova. If the galaxies are both at rest relative to the Earth, no difference would be seen in the two events. They would rise and fall in intensity in equal periods.

We now know that galaxies have very large velocities through cosmic space (as they move between their cosmic centers of regeneration; see section 9, below). Therefore, the speed and direction in which our two galaxies move in space will generally be different. Let one galaxy move in our general direction and the other move away. Next, let there be two identical stars, one in each galaxy, and let them both undergo the supernova explosion at the same time.

Now, the bodies are identical in every respect (and, therefore, of the same intrinsic brightness). They are also equidistant from us at this point in time. However, the supernova moving toward us will definitely look brighter and be of shorter duration than the other moving away. That is, being very distant objects, each will show a redshift whatever be its speed and direction relative to us; but the redshift of the one approaching us will be smaller than the one receding from us due to the Doppler effect.

Is this how Earth observers interpret such a happening today? No. The galaxy containing the fainter supernova is interpreted as receding very much faster and, therefore, based on the Hubble law (Peebles 1993), is very much farther. In some cases of such observations recently, they have even come up with the “conclusive findings” that the cosmic expansion is not slowing down or even constant, but – accelerating! (Zimdahl 2001).

Photons, therefore, carry traits of their history, unlike atoms. Hence, whatever be the distant object – moving or not – the farther it is, the greater will be the redshift of any of its energy reaching us. In principle, therefore, the ultimate signals we may receive even from quasars lying at the extremity of our observation will have effectively redshifted only to appear to us as – the CMB. (Even gamma rays originally emitted by such objects will appear thus to us.) Hence, it cannot at all be concluded from any such observation of "emptiness" that we are indeed looking at the edge of space (or a region corresponding to the time of the "Big Bang") where there would be no matter. In other words, our observations have bounds, a physical limit. No matter how advanced our instruments and techniques are now or at any time in the future, all celestial bodies beyond a certain critical distance from us will fail to produce a signal above the CMB.

8. DARK MATTER AND BLACK HOLES

The nature and extent of the dark matter (or missing mass) constitute one of today's major astronomical puzzles. While the conjectured dark matter haunts the outer regions of galaxies and galaxy clusters, the equally murky and speculative black holes lurk at the galactic centers (Peebles 1993, Rees 1997).

8.1. Dark matter

The basic evidence for dark matter is that the stars and gas clouds around galaxies move surprisingly fast. Astronomers expected to find any gas swirling in the outer fringes of a galaxy to move more slowly than the gas closer to the center. Their reasoning, naturally, was that a body of matter should slow down as one went farther from the orbital center if it is to survive as part of the system, that is, without getting thrown out under the centrifugal effect. (In our solar system, for instance, Pluto travels slower than the Earth.) Much to their surprise, they found the velocity of the gas to be a constant, whether it was near the rim of the galaxy or well inside. At first, they thought this peculiar result was unique to the Andromeda galaxy (our closest neighbor) where the phenomenon was first detected. Then they systematically began to analyze hundreds of galaxies and found the same curious result. It prompted theorists to speculate a heavy invisible halo to surround the galaxy (just as we would have to infer a heavy invisible shell outside the Earth's orbit but inside Pluto's if the two bodies were to have the same orbital speed). This constancy of velocity of a rotating galaxy is now a universal fact of galactic physics. And the conclusion today: dark matter is here to stay!

Another piece of evidence for dark matter comes from galaxy clusters. It is now confirmed that speeds of individual galaxies are so high that the clusters they constitute would fly apart unless they were being held together by a considerably greater force of attraction than the gravitational pull of their visible masses; this being the case even if each galaxy were to have the mass required to hold itself together as it rotates. And the conclusion here: there is *extra* dark matter present in galaxy clusters!

In drawing such inferences, we use our standard theory of gravity, which, in this context, reduces to Newton's inverse-square law. This law, which assumes that gravitational action springs from inside matter, has been directly tested *only within our diminutive solar system*. It is a sheer leap of faith, therefore, to apply it on scales several orders of magnitude larger. And this is where our renewed universal perspective comes in to beautifully simplify matters again: THERE IS ABSOLUTELY NO SO-CALLED DARK MATTER ANYWHERE IN THE UNIVERSE. Nuclear fission is the primary energy-producing reaction in all stars and galaxies; and fusion, though considerable, is only the consequential secondary. (Fusion *does* rule supreme – but at a much greater level of mass centers from which quasars are born – as we shall see in section 9 below.)

In every star, galaxy, galaxy cluster, and galaxy supercluster, the net nuclear decay of matter increases from a dense center, through a sparse halo, to a final peak in a corona. And it is the *backpressure*, or inward radiation, from this radioactivity that pushes in any orbital matter and keeps it in check within – mimicking an increased gravitational tug from the center. The outward radiation drives the stellar or galactic wind of subatomic particles; from the Sun, we call it the solar wind[8].

[8]In the Sun, typically, the intensity of radioactivity, predominantly the final-stage neutron decay, peaks at the outermost region of the halo, effectively forming a shell, or corona. The sub-c exhaust from the solar corona will thus consist mainly of the neutron-decay mass particles, protons and electrons. The speed-c exhaust of electron antineutrinos from the same decay process together with the electron neutrinos from the secondary fusion reactions (that take place under the backpressure of decay) will thus predominate the Sun's countergravitational field. It is the momentum of these outward neutrinos that rapidly accelerate and sustain the supersonic speeds of their own siblings, the sub-c mass particles, to the ends of the heliosphere. The backpressure from this strong and ubiquitous coronal discharge goes also to contain and regulate, over the eons, the fission reactor within.

The inward winds from our local star cluster and the Galaxy predominate the (sub-c) cosmic rays that we now detect. Thus, in general, cosmic rays have their origin in the halos of stars, galaxies, and clusters thereof. The photons and neutrinos associated with the origin of these mass particles contribute to the CMB in the long range. In the short range, though, they tend to cause subtle variations in this otherwise isotropic CMB field.

The proton and the electron discharged from the corona go eventually to combine and form the atom of hydrogen – to make hydrogen the most abundant element in the cosmos. Hydrogen is thus the main *exhaust* product of stars and galaxies and not their prime fuel as posited today.

8.2. The physics of galaxies

Low ambient pressures promote nuclear fission just as much as high pressures aid fusion[9]. In the galactic halo, pressure and density drop with increasing radius. The drop in pressure steps up radioactivity but the drop in material density tends to nullify any increase in the decay intensity. Consequently, the vast outer region of a galaxy tends to be more of an energetic, dense, and homogeneous plasma medium than what we have come to believe this "empty" space to be. At these great distances, of several orders of light years from the galactic center, the gravitational effect (that is, from CMB shielding) is small in relation to the net inward push of the decay radiation. The latter being also a pro-gravitational influence, stable orbital speed, too, becomes correspondingly large for the region (see also Sittampalam 2003, The Galaxy).

[9]As experiments continue to confirm, atomic properties, including radioactivity, *do* depend on the environment. This hard empirical fact would also now call into question, to say the least, the premise on which measurement standards are based today (Golub & Pendlebury 1979; Kerr 1999).

Furthermore, orbital bodies of the galaxy are created by the "*lawn-sprinkler effect*": The core spews out stellar matter (periodically, as in the nova) while at the same time spinning about its axis. As such, the gases and stars streaming through an essentially homogeneous outer medium will have the same (terminal) speed irrespective of individual masses – just as much as electrons and nuclei of vastly differing masses have the same speed in the solar wind near Earth space (see Sittampalam 1999, section 4.03, where this is also discussed quantitatively). En route from the birthing ground to the outer regions, of course, the bodies would be decelerating (toward terminal velocity) from the high (escape) velocity attained at ejection. The galaxy cluster and the galaxy supercluster evolve in very similar ways but from much larger nuclear centers, as we shall see in section 9, below.

8.3. Black holes

The black hole is a well-known prediction of general relativity. As physicists today believe, it is the ultimate state of a massive, dying star collapsing under its own gravity – to an infinitesimal point particle. Not stopping with itself, the black hole also sucks in everything else, including photons, from the region around. The exceptionally high outpouring of intense radiations observed today from quasars and other active galactic nuclei (see section 9 below) are often cited as the “unequivocal evidence” for the existence of black holes. (Otherwise inexplicable today, such prolific energies from a source are considered the radiation from matter heating up as it spirals into a central black hole; see Hawking 1988.)

The insatiable hole may now be completely filled with the very same observational facts that now suckle it. The black hole thereby shall remain buried and outlawed from the nonfictional cosmic range for all time.

As we saw above, the high orbital speeds observed in the outer fringes of galaxies have now a simple and straightforward explanation. It also tells us the *absolute* force field of the classical vacuum, and thereby pressure, to be much higher in the outer regions of any galaxy than conventionally reckoned. Therefore, since pressure is transmissible, the absolute pressure of the vacuum in the inner regions, too, will be that much greater for the galaxy. Consequently, nuclear fusion of matter in the galactic hub becomes considerably high, making the total radiation (from fission and fusion) *and* body speeds to be much greater in the innermost regions as well. (This also makes the *net* nuclear breakdown of matter to be least at the galactic center, where fission and fusion would peak alternately over a cycle; Sittampalam 1999, section 1.15). Not surprisingly, astronomers today are perplexed at the sheer intensity of the radiation, including gamma rays, emanating from such centers. But their popular interpretation today: A black-hole monster – feeds at the center! (Kaku & Thompson 1995).

A huge, diffuse cloud of gamma radiation surrounding our Galaxy, too, is another well-verified fact of observation today (Dar & Shaviv 1995). But how can such energy get produced in what looks like empty space? Yes, it now affirms nuclear decay, and subsequent nuclear encounters, of galactic matter in these seemingly desolate outbacks. (The gamma-ray bursts from outer space, another great enigma to astronomers and astrophysicists today, can thus have their origin partly in our Galaxy's vast halo; see, for instance, Briggs 1996. The highly redshifted ones, suggesting enormous distances, are generally due to source recoil away from us as the photons get beamed toward us; see, for instance, Mészáros 1999.)

The effective diameter of the galaxy can thus be several times larger than that of its opaque aggregation, like the overall atom with respect to its nucleus and orbital electrons.

With such pieces of the grandest jigsaw puzzle all in hand, we venture next to piece the final cosmic picture together.

9. THE STRUCTURE OF THE UNIVERSE

Man, through his microscopes, perceives in the atom a semblance of his solar system. Through his telescopes, he also observes a likeness of that solar system in his galaxy; his galaxy as a miniaturization of the local spiral group of galaxies; and so on, as worlds within worlds within worlds...

And through his logical reasoning, which is but a consequence of that same natural order of things of his universe, it should not seem incongruous to the average human mind that our own locale of the cosmos, too, is yet another extended image of that lowly atom.

This cosmic region of ours, one among many in the observable universe, would thus have a proportionate central matter as 'nucleus' and layers of galaxy superclusters as 'electron' cover or shells. (See also Sittampalam 2003, The Cosmos.) There is evidence in abundance today to support such a model; but it is in the form of a giant jigsaw puzzle in disarray. The pieces, nonetheless, are all there now; but the picture, the ultimate structure and form of the universe, is not that readily recognizable; it is even fuzzy to astrophysicists.

Here, we shall fit all those pieces together systematically. Some essentials of the overall and final image have already been glimpsed at in sections past. Here, we shall also fully complement and substantiate them. The exercise, though, should seem but a high-school project in physics.

9.1. The latticework of the observable universe

Astronomical observations reveal the fact that the large star ends its active life in a spectacular supernova. The ejected matter from such exploding nuclear bodies then go to form a new generation of smaller stars. All these star types we are able to directly observe as discrete bodies in the firmament and thereby make these correct inferences (see, e.g., Peebles 1993).

It is also not inconceivable, therefore, that the large stars we see today were themselves once ejected from even larger nuclear entities – the galactic cores. But it is not possible even with the best of instruments to observe the galactic core directly to ascertain this process. Whereas the supernova debris eventually clears to reveal a core, the fog around the galactic center never lifts. As a result, the nucleus of our own

Milky Way Galaxy, for example, remains obscured at all time by the stars and the gas clouds of what we call the central bulge. This shroud never dissipates due to the relentless activity within, which feeds and sustains it. Nevertheless, recent endeavors have revealed to refined instruments and observational techniques enough evidence to show that the region of the galactic core is indeed a hub of violent activity of *sustained* star formation (Serabyn & Morris 1996).

Not so long ago, the central bulge was commonly thought to consist mostly of very old stars. But, now, there is also convincing evidence to suggest that star formation has been occurring near the center of the bulge throughout the lifetime of the Galaxy. Thus, the most energetic of expulsions from the galactic core are what we see mostly as stars and star clusters outside the bulge today.

Extrapolating back in time, a very close or contiguous union of such galactic cores (that is, in their extremely active and formative years) is what we observe, in time lapse now, as the quasar. Quasars and their ilk, collectively known as active galactic nuclei, or AGN, are the greatest cosmic powerhouses known today. The AGN, in turn, would evolve from even larger and denser mass centers. The existence of such super centers, though, is not presently recognized, suspected, or even speculated.

Let us here refer to these ultimate mass centers, dispersed across observable space, simply as – COSMIC CORES.

Due to the cover provided by the AGN outside, Cosmic Cores, too, remain out of direct view like galactic cores. But here, too, indirectly, there is ample evidence to support such centers in our observable universe. For example, the Cosmic Cores would possess most of the mass in our universe (like atomic nuclei do in a body of matter); and it is only such extremely massive and compact bodies (in the foreground) that could possibly account for the otherwise enigmatic gravitational lensing of (distant) quasars (Fischer et al. 1994).

But what would be the true function of Cosmic Cores?

To astronomers and astrophysicists, especially, the function of Cosmic Cores should not seem something that is at all new. Even this aspect of the cosmic process is seen today in miniature down the line.

We say that large stars die in the supernova and generate new stars. But the first part of this statement we also know is not generally true. That is to say, the remains of a so-called dead star would live again – for a repeat death performance another day – if the environment is right: The dense and extinct core, typically, a neutron star, exerts an enormous gravitational pull on all that is around in the vicinity (Sittampalam 1999, section 1.03) and grows by accreting matter; in time, it would eject matter in a nova- or even a supernova-like event once again. In principle, therefore, there is no end to these epochs for the selfsame stellar core – if sufficient matter is (cyclically) provided. In the case of the Cosmic Cores dotting our universe, however – there just happens to be sufficient matter around, from an initial condition, to keep the process going indefinitely. (This critical initial condition relates to the more familiar triple point in physics today; the submicroscopic origin of which we had a glimpse of in section 3 above.)

9.2. A Universe of Steady State

In actual fact, the Cores of the cosmic latticework feed each other. That is, they accrete matter, fuse them together, and toss them out at each other. Matter, from the galaxy supercluster to the atom, is thus continually recycled in our observable universe. And the cosmic species of the heavens continue to live on in their eternal splendor.

Evidence for this grandiose and cyclic mass transfer through cosmic space, too, is very well established now, though it remains a challenge to today's standard model: The periodicity of birth of galaxy cluster groups and the uniformity of their spacing and speed are truly breathtaking that they even make the observers to double-check their instruments in disbelief! (Smoot & Davidson 1993; Matthews 1996).

It is thus plainly seen that galaxies are not scattered more or less randomly through space as had once seemed the case. Indeed, galaxies are aggregated as sheets of clusters and superclusters. It is like a cosmic foam where the walls of the bubbles are concentrations of galaxies. As a balance to these huge concentrations, immense voids also exist between sheets (Saar et al. 2002).

Furthermore, as NASA's Hubble Space Telescope (HST) continues to confirm only too overwhelmingly, galaxies abound even at the deepest levels of observable space. Not only did the HST capture new galaxies in earlier "empty" space, but it also got a better look at some of the lumpy ones that had been seen before. Seen in the infrared, they look more like "normal" galaxies, like those in our own cosmic neighborhood. Clearly, cosmic structures do not seem to have changed over time across observable space – as if in a steady-state universe (see, for instance, Schilling 1999).

The concept of the conservation of energy would also suggest a steady-state universe. Until only as recently as a decade ago it was difficult to reconcile all of the observed data to a steady-state universe. But, now, the powerful telescopes of the present day throw to us much more light than they receive. And, in this most revealing new light since the time of Bethe's theoretical insights (Bethe 1939), we see the awe-inspiring final picture emerging.

Every celestial body has a closed-loop trajectory beginning in a Cosmic Core and ending in a neighboring one only to be regenerated, or, to be born again. And a steady-state universe would go on existing under the setting (eternally fueled by the radiaton – as the perpetual-motion machine of that unknown First or One-Up Cause that transcends our space and time and thereby even such logical reasoning).

9.3. The genesis of celestial bodies, in summation

- The observable universe is an extension in three-dimensional space and one-dimensional time.
- This universe of ours is dotted with enormous nuclear centers, or Cosmic Cores, where fusion of matter prevails.
- The extremely dense Cosmic Cores are akin to atomic nuclei in a stable yet vibrant solid medium.
- Mass-energy is continually exchanged (recycled) between Cores of the cosmic latticework in an unending saga of "little big bangs" and "little big crunches" at the

Cores.

- We inhabit a relatively placid region surrounded by, but far removed from, Cosmic Cores. (We would not have evolved to the stage that we have in a region close to a Cosmic Core: The violence and the intensity of radiation would be far too great and the time scale far too small for most life forms, let alone for the current stage of their evolution.)
- Each Cosmic Core accretes matter – aging stars and galaxies – only to fuse it (in a slow crunch) and eject it out (in a hasty bang).
- The Cosmic Cores thus incessantly feed each other in a now observable steady-state universe.
- The highly fused ejectum from the Core expands out in an arc as it speeds away from the center at or above escape velocity. We see this early stage of cosmic evolution as a close group of quasars – the progenitor of the galaxy supercluster. (Even if it be outside our field of study, do we not *ever* wonder why galaxy clusters are periodic and fly in formation at mind-boggling speed – our Local Group, for instance, at six hundred kilometers per second, or more than a million miles per hour?! See, for instance, Smoot & Davidson 1993 or Peebles 1993.)
- Quasars and their ilk are collectively known today as active galactic nuclei (AGN). These are the greatest nuclear reactors of all next to Cosmic Cores. Detected today ever increasingly by modern instruments, AGN brilliantly dot enormous cloud complexes that are but the time images of incipient galaxy superclusters.
- Nuclear fission is enhanced in a low-pressure medium, just as much as fusion is promoted by high pressure.

- The high speed of expulsion from the Cosmic Core takes the ejected nuclear matter into the thinning outer regions.
- In the speeding ejectum, each large lump, which is the quasar, splits into halves in succession.
- The process of bifurcation of the quasar goes on until the fragments – individual galactic nuclei – come within the size limit determined by the regional field pressure the nuclear lumps are engulfed in.
- The single quasar thus splits successively and evolves into the galaxy cluster. And the single Core ejectum, generally consisting of a group of quasars, transmutes as the galaxy supercluster.
- The supercluster is thus a fast moving shell of matter expanding radially from its Core of origin. Distant superclusters will thus appear as perched on enormous bubble-like voids. [For a true picture of this cosmic foam, see, for instance, Peebles 1993, Figure 3.9; to which, author Peebles says on page 40: "The data were taken by Shane and Wirtanen (1967) at the Lick Observatory from a visual survey of photographic plates, as part of a larger sky survey that counted about one million galaxies."]
- Being periodic exhalation-like emissions from the vibrant mother Core, the supercluster siblings will be equally spaced. The space between them will also be the most devoid of matter in the cosmos. (The sheer uniformity of these spacings observed today is even amazing to astrophysicists and remains a challenge to their standard model.)
- Bifurcations generally taper off for the AGN as the ambient field pressure levels off. In this vast mid region between Cosmic Cores, the galaxies stabilize, but the

nuclear activities of individual galactic cores continue.

- Superclusters and clusters of galaxies are thus not cosmologically recent epochs as generally believed today.
- The Cosmic Cores form the reference ("rest") frame for the Cosmic Microwave Background (CMB) radiation that we now detect. The space and time of the CMB can thus be considered, or even defined now, as the absolute space and the absolute time, respectively, of classical (Newtonian) mechanics.
- Veiled by the quasars outside, Cosmic Cores escape our direct observation. This is akin to the galactic core being masked by the stars of the central bulge.
- Again, the single quasar, moving through the thinning region away from the Cosmic Core, successively bifurcates to form a group of galactic cores. The group of galactic cores goes to form – the galaxy cluster.
- Each galactic core, in turn, spews out matter periodically, spawning the stellar cores.
- Each of the larger stellar cores bifurcates successively to form – the star cluster. The last of these separations that fell just short of escape velocity are what we now see as binaries, ternaries, and so on, in the mature star cluster.
- In short: Stars are generally found in clusters; the star cluster transmutes from the (large) stellar core; stellar cores are derived from the galactic core; galaxies are generally found in clusters; the galaxy cluster transmutes from the quasar; quasars are generally found in clusters, or groups; the galaxy supercluster transmutes from the quasar group; and quasar groups are derived from the ultimate Cosmic Core.

- What worlds the latticework of Cosmic Cores extend into are beyond observation and, therefore – beyond the scope of physics.
- Galaxies and stars, therefore, are born primarily by fragmentation – and not by agglomeration as popularly believed today.
- Planets and moons are basically stars, or star fragments, that cooled off faster due to their small size. Their molten cores are thus nuclear where net fissioning of matter would continue to varying degree. (The young and molten planet could also beget its moons in early nova-like epochs.)
- Nuclear fusion is thus the primary reaction only at the Cosmic Cores; and fission predominates the scene everywhere else down the line – in quasars, galaxies, stars, planets, and moons.
- We are today speeding away from the Cosmic Core of our birth (in a highly fused and low-entropy state) – at more than a million miles per hour through absolute space, the space of the CMB – toward the Cosmic Core of our demise (in a highly fissioned and high-entropy state).
- And the cycle repeats.

9.4. The arrow of time

Cosmologically, multiple and recurrent "small big bangs" followed by "small big crunches" would be the viable and Newtonian model for our observable universe. We see in the preceding subsections not only the logic but also the observationally verifiable logistics of these events. Galaxies and stars, therefore, are primarily formed by fragmentation and not by agglomeration as has been the popular belief to date. And we earthlings are moving in spaceship Earth from a tempestuous bang and into an equally calamitous crunch. Life, as we know it, can exist only in the relative tranquil and calm of the short interlude of space and time well between the two extremes.

Entropy at the Cosmic Cores of origin and demise is low due to the highly fused state of matter therein. Following a bang, the prime galaxy supercluster matter emerges from the Core with high acceleration. Deceleration soon sets in and entropy starts its rise as matter undergoes bifurcation and general nuclear disintegration through the vast and thinning space away from the Core. Halfway through its cosmic vault, the matter starts to accelerate gradually toward its radially dispersed centers of destination. By this time in the highly rarefied cosmic space, the stars and galaxies constituting the matter are all in middle age. General dotage eventually sets in as the matter races toward its destined Cores. When the matter finally sets with a crunch at those Cores, the entropy drops sharply back to its original value. And entropy change zeros out for the cosmic matter between its recycling centers.

We, the inquisitive observers, are now decelerating in absolute space, the space of the CMB, as also confirmed by the COBE instruments (Turner 1993). Cosmologically, our life span as biological species is a very short one and well removed from Cosmic Cores. And the nuclear disintegration of matter in our Galaxy and consequent entropy rise for the local region during this our odyssey between two recycling centers would, typically, give us the direction to – the arrow of time.

The group of galaxies we belong to is thus in a space somewhere between, but well outside, two Cosmic Cores – speeding away from one and toward the other. Due to its deceleration, our Local Group is still from reaching the halfway mark. High overall stellar activity and entropy rising toward a maximum still remain the Group's order of the day. And the average separation of galaxies, for instance, would serve as an age indicator for our Group in relation to other such evolving groups.

And what, pray, would lie beyond all these cosmic recycling centers in a Newtonian paradigm?

To the physical man, the conditions at the extremities of space and time are beyond observation. Therefore, they will remain always speculative. The original cause for mass-energy, its asymmetry of movement (a nonvanishing linear momentum coupled with a nonvanishing angular momentum), and the initial, triple-point-like condition (for atomic and cosmic systems collectively) are outside the realm of physical enquiry. Therefore, they will remain always metaphysical.

But, then:

We see the order of things in and around us and call it the **natural order**. And this observational domain of ours is finite. That is to say, the space and time of our observation have bounds. Therefore, at the extremities of our space and time, our natural order would interface with another order (or series of orders). And all that is outside our observational limits will then be explained by this outside order, or: **extranatural order**. In the realm of this extranatural order, the fundamental physical laws, and hence the physics and the logic, will be different to our own – since the extranatural order would account for all that is beyond our finite order. In other words, the extranatural order will be superior to our natural order, or: a **supernatural order**.

The radiaton of our observable order interfaces with this unobservable outside order. In other words, the radiaton bridges the gap between the natural and the supernatural. And do we not also glimpse in the radiaton what we would call an extension of the supernatural, or an attribute of godhead: Perfect and eternal; of energy transcending space and time and even human comprehension; encoding very possibly the secrets of life and of the mind itself; bridging the abyss between the natural and the supernatural – a truly "God" particle?

10. DISCUSSION & CONCLUSION

The flat-earth and the geocentric societies all had to change their views with increasing hard data. On larger scales, the world turned out very different to what they had extrapolated it to be from their cozy little cocoons earlier. In a like manner, Einstein's general relativity, the current theory of gravity, has now seen better days of its usefulness. At the time it was conceived (1907-1915), hardly anything was known of the movement of celestial bodies outside of *just our planets and moons*. Galaxies were not even known then to exist, to say nothing of quasars and migrating galaxy superclusters. Galaxies, for instance, became an observational fact only in the 1920s. Is it any wonder at all now that galaxies and clusters thereof do not follow the same gravitational law that is seemingly applicable to the minuscule solar system?

At the frontier of quantum mechanics, too, the situation has not been getting any better, with the number of "elementary" particles diverging in count instead of whittling down toward the ideal unity. What's more, these two halves of physics, relativity and quantum mechanics, are at constant loggerheads with one another with nary a hope of ever reconciling them into a single union (Hawking 1988).

Increased observations on both these hemispheres of physics, however, have now redeemingly guided us to final unification. With a wide scope to embrace the entire order of things, the nature of things has indisputably become simple and classical mechanical in interpretation. Indeed, the entire universe of our observation is now seen as a voidless continuum in mass-energy: The stars, the atoms, and the classical void are all *literally* part of a single, seamless whole – as at triple point! (See also Sittampalam 2003, Mass-Energy.)

Phenomena can no longer be considered in isolation on either of these hemispheres of physics for our explanations to be truly consistent across the realm. In stark contrast, theories to the present day were conceived in pockets and are ad hoc, the root cause for their increasing incompatibility today. Black holes and dark matter are nonentities; so are Coulomb charges and magnetic monopoles. These are but typical of the constructs of the stopgap and patchwork theories unduly dominating our thinking today.

10.1. The motivation for the new speculation

Old notions die hard; but die they must especially in physics if it is to evolve as a science. Physics has been stuck for most of the past century with controversies and contradictions in the face of increasing and improving data. And it has indeed been an unprecedented century of startling discoveries of the world in and around us. Our inner vision to coherently interpret the new data, though, has not kept pace. Lamentably, increasing specialization in ever-narrowing fields leaves researchers with little time to update themselves in other fields for a broader worldview. This blinkered approach to basic study is the root cause for the ever-widening gap between theory and empirical reality. And coupled with complacency, preconceived notions on the nature of things tend to hold sway over many great minds of our times despite the history of science. The continuing debates on fundamentals at the highest echelons in ivory towers basically say it all for this sorry, if not embarrassing, state of affairs in physics today.

All these were clear enough signs that something very fundamental was amiss here in the world of theoretical physics. A revisit now seemed only long overdue, especially in the light of the overwhelming new data since the time of Einstein and Bohr. Beyond debate, invaluable human resources, too, could be rechanneled into more useful research when the basics are thus better known. These were the factors that motivated the rethinking here into the rudiments of nature. The investigation was to be unbridled by modern physics (which has disturbingly given up the quest for causation) and bereft of preconceived ideas that seem so ingrained in many of us. It was to be armed only with the well tried and tested tools of classical mechanics which has taken man to the Moon (that, too, on short notice!) and brought him safely back home again. Not surprisingly, the speculation that emerged from the new findings gained strength as it grew to become the final and singular theory for the whole of physics.

The motivating factors notwithstanding, however, the underlying and burning conviction all along has been: *The First Cause would not have had material or design constraints* when it came to creating what we observe as our universe. One material entity alone would have sufficed, profusely tossed out with a spin. And, voilà! We have nature.

10.2. What new experiments could be done to test this new and final theory

The final theory propounded here is not something that is entirely new. In fact, it is reminiscent of the old "ether" theory. (In a way, this work is a tribute to the proponents of that theory of over a century ago – their intuition and gut feeling from everyday experience were not wrong after all!) The work here, however, takes the old ether concept a step further, to refine and to show that the universe is in fact an ether *continuum* where:

A. The classical vacuum is the ether in its "evaporated" state; classical matter is *the very same ether material* in its "condensed" form; and the ether itself is indeed mass-energy.

B. The smallest ether quantum capable of triggering detection in *any* material instrument corresponds to the photon's per-cycle quantum of energy. We have here named this absolute and truly fundamental quantum of analysis as the RADIATON. The radiaton, therefore, is detectably the most elementary particle of nature. (In other words, anything that is fractional or more basic will not be physically detectable. It would, therefore, not concern physics.)

C. The radiaton has the classic attributes of a perfectly elastic particle; both mass and energy thus become intrinsic to the particle, that is, as mass-energy; and the particle serves also as the unique "binding agent" in the "new" physics.

A good way to test one of the many – well over a dozen – predictions of the final theory (Sittampalam 1999) will concern the electron-antineutrino flux from the Sun's coronal neutron decay. In this end stage of radioactivity, which peaks in intensity at the solar corona, the single neutron transmutes into a proton, an electron, and an electron antineutrino. As such, the flux of each of these subatomic products of decay will bear a constant relationship to one another at any given radius from the Sun. Hence, say, averaged over the rotational cycle of the Sun at the ecliptic, the solar electron-antineutrino flux would vary linearly with the solar electron or proton flux. (That is, stronger the solar wind over a cycle, proportionately more intense will be the antineutrino flux over the same cycle.) Produced further within the corona are the electron neutrinos from the proton-proton fusions that take place under the backpressure of fission, reminiscent of the H-bomb. As such, this secondary solar electron-neutrino flux, too, would vary in intensity with the rest of the exhaust particles. (A corroborative report on the latter fact may be seen in McNutt Jr. 1995.)

It invariably takes the greater scientific community, however, to critically and conclusively verify any predictions of a physical theory. Most of the predictions of the final theory here may be tested with present-day instruments and in existing facilities, that is, with minimal cost. With these in mind, some of the predictions have also been posted on the web (Sittampalam 2003: NASA Tests, KamLAND Test, UCLA Test, and Two-Slit Tests).

10.3. Conclusion

This work has essentially been a mental probe – with full empirical backup – into our physical world, from the atomic to the cosmic. In the light of the overwhelming new data since the time of Einstein, the whole of our observable universe is now seen *literally* as a vibrant and voidless single medium – AND THE WAY TO UNIFICATION IN PHYSICS.

A simple action-and-reaction mechanism is seen to underlie all the physical processes in nature. Thus, we have unified not only all of the forces in nature but also all of her particles of mass and energy – in the radiaton, the mighty yet ordinary and, outwardly, uncomplicated per-cycle quantum of the photon. Inwardly, it may well carry the secrets of life and of the mind itself. (This "software" that it carries, for its subtle environmental influence at submicroscopic range, is also likely to be a simple one – and the "chaotic"[10] seed of biology.)

[10]Chaos theory is implied here. This theory forms a relatively new branch in mathematics. Processes that seem random or irregular, such as evolution, may actually follow very simple and discoverable laws. It is system behavior that depends so sensitively on the system's precise initial conditions that it is, in effect, unpredictable and cannot be distinguished from a random process even though it is deterministic in a mathematical sense.

Thus, the last few decades, especially, have seen our insights into the nature of things turn into a panorama of unprecedented breadth, depth, and allure. Everywhere we now turn, deep connections and simplicity transpire to be the order of things at basic levels. Awestruck, one begins to note that the utter simplicity of basic mechanisms in nature is but a revelation of the greatness and the elegance of the eternal design, to which the work here bears full testimony. Even the most diehard skeptics of our times should find the revelations disturbing, if not annoyingly attractive.

Let us, therefore, take heart that the dark ages of physics, of black holes and dark matter, are to be no more. The flickering light of the space-time continuum now takes its bow from its limited kingdom and short reign – since a great and all-enlightening sphere to dispel the darkness for all time has been seen on the horizon.

IT IS THE DAWNING OF THE AGE OF THE MASS-ENERGY CONTINUUM. Let us not shut our eyes or be complacent in our ivory towers and draw down the shades.

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