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Pandemic Musings

Dr. B G Sidharth

From Below the Planck Scale to above the Hubble Scale via Dark Energy, Accelerated Glaciation & what not....

Newton discovered the Laws of Gravitation during isolation caused by the Great Plague. Sometimes isolation keeps the mind going and significant ideas can come out. This issue is dedicated to that.

Many Universes !

In the 1970s Dr. B G Sidharth proposed that there was a universe and an anti universe defined by each point. Time would go one way for one universe and the opposite way for the other. Some of the difficulties of such an idea were that how could a metric in spacetime define both a time going backwards and a time going forwards. This could be done as shown by the author several decades later in the form of a two Weiner process. Much has been written on this aspect. All this would take place within the Compton time [Sidharth, B.G., The Thermodynamic Universe, World Scientific, Singapore, 2008].

Using the two Weiner process and a formalism due to Feshbach and Villars he has argued in the past that the positive energy and negative energy that is particles and antiparticle solutions form two separate classes. This would be the answer to the conceptual problems of the 1970s theory. Next he generalized this to consider n which could even be (continuum number) universes which are described within the Compton time rather like the many worlds interpretation.

This brings us quite close to the many worlds interpretation of Everett and Dewitt [Misner, C.W., Thorne, K.S. and Wheeler, J.A., Gravitation, W.H. Freeman, San Francisco, USA, 1973] all be it from a completely different direction.

Tracking Down Dark Energy

Dr. B G Sidharth had reintroduced Dark Energy, in 1997, after it was dumped much earlier. His model for the universe was one of acceleration rather than retardation as was previously believed. This bold prediction was confirmed the

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very next year thanks to the observational work of Perlmutter, Schmidt and Riess, all three of whom observed a certain type of supernovae to come to this conclusion. Surely this is the fastest confirmation for a theory. Nevertheless there has been no clear fix on the nature of Dark Energy itself. Dr. Sidharth himself had proposed that it is the ubiquitous Zero Point Field. Though this energy is infinite in Quantum Theory it is taken to be zero with some reasons given. Dark Energy is really a vacuum energy. To understand this we must appreciate that the vacuum is a sizzling broth of particles, anti particles, disappearing particles and what not, unlike the classical concept of a vacuum. This Quantum vacuum had been studied by Miloni.

If however we consider these short-lived charged particles winking in and winking out of existence, as in the case of zitterbewegung, a trace is left behind namely transient wave functions and the energy they carry, though in a very random and disorderly fashion. This energy can be characterized as Dark Energy as described by Dr. Sidharth in his thought experiment of a pendulum suspended in a "perfect" vacuum. Contrary to what one might suspect that such a pendulum would remain stationary, it actually executes totally chaotic motion due to the Quantum vacuum energy or Dark Energy.

Report on Particle Condensation

The author had shown more than twenty years back in a paper in the well known American Journal, Journal of Statistical Physics,that in two dimensions particles behave in a very odd manner (Cf.refs.[1, 2]). What happens is that there is a two dimensionality which in fact was discovered several years later by Andre Geim and Konstantin Novoselov. This analysis leads to the situation as discussed in detail in the references given, where there is a threshold momentum for example

$$p_0 \approx \frac{4\pi^{5/2}}{1.4e-1} \tag{1}$$

Or,

$$p_0 \approx \frac{4\pi^{5/2}}{e} \tag{2}$$

where, the behaviour in two dimensions of bosons (and also Fermions) where there is a condensation or a infinite dilution that takes place. This condensation resembles the Bose-Einstein condensation. We can look upon it in another way. In these two dimensional situations (for example Graphene, Stanene) and so on we have the equation like

$$\frac{d^2u}{dr^2} + \left\{\frac{2m}{\hbar^2}[E - V(r)] - \frac{l(l+1)}{r^2}\right\}u = 0 \tag{3}$$

(Cf.above references). This is the radial two dimensioinal Schrodinger equation. *V (r)* in equation (3) is the usual potential. With a suitable magnetic field it is known that *V (r)* is proportional to $\vec{B} \times \vec{r}$. With a suitable choice of a magnetic field

$$V(r) \propto Br \tag{4}$$

Equation (4) resembles a confining potential like the one we encounter in QCD and this confinement is directly related to the condensation. In fact it has been argued by the author that quarks themselves are these low dimensional particles and that fits in very well in the quark confinement.

References

[1] Sidharth, B.G. (2001). Chaotic Universe: From the Planck to the Hubble Scale (Nova Science, New York).

[2] Sidharth, B.G. (2008). The Thermodynamic Universe (World Scientific, Singapore, 2008) pg.264-265.

Very recently it has been commented that jet streams in the cosmos or even for that matter solar wind show a departure from the laws of physics in that there are streams perpendicular to the main stream. As shown by BG Siddhartha quite some time back such an effect could be caused by a perpendicular magnetic field. This is perhaps the explanation for these cosmic jet puzzles.

The latest issue of futurism quotes University of California physicists as saying that there does not appear to be dark matter (rather attributing this to the decay of a sterile neutrino). For several years now the author, Dr. B G Sidharth, has been pointing out that dark matter is merely an artifice of a slowly varying G, the gravitational constant. He has argued that this explains all the dark matter relations without actually invoking dark matter.

Latest studies indicate (as reported for example in the latest issue of Scientific American) that we may have to revisit the accepted model of matter antimatter asymmetry. In this context it may be pointed out that Dr. Sidharth's work of a few years back harmoniously expresses all this because as he explained the four component Dirac spinor is really made up of the negative energy two spinors coupled with the positive energy two spinor. At very high energies he argued that it is the negative energy components which predominate. That is we see antimatter whereas as the energy falls it is the positive energy spinors which begin to predominate, that is we see ordinary matter. This simple explanation may hold the key to the reopened questions.

The Secret Mystery of The Quantum World 2

Quantum Mechanics has been a very counter intuitive, one might say even counter common sense topic. Even Albert Einstein could not get to accept it wholeheartedly and wrote papers exploring why it is wrong or incomplete as he put it. The work of Dr. B G Sidharth, Director, B M Birla Science Centre, Hyderabad, brings out this secret and mysterious nature of Quantum Mechanics. In several peer reviewed standard journals of physics he has argued that Quantum Mechanics has a new feature unknown to previous physics. This is that the universe is jittery that is not very definite and clear at ultra small levels. This feature has been called Zitterbewegung for donkey's years and there has been much speculation about it. What Sidharth argues is that ordinary physics with the addition of this jittering or Zitterbewegung physics goes over into the mysterious Quantum Mechanics. This is like adding a cloud of uncertainty and probability to ordinary physics and this leads to all the mysteries. The work started with a paper in Foundations of Physics 18 years ago and is still ongoing. With co-worker Abhishek Das new insights are still being obtained. These change the very nature of spacetime at the microscopic level.

There is another formulation by Hestenes, student of the celebrated Richard Feynman in which Zitterbewegung is described as an electron rapidly executing a Solenoid in space. We can interpret this in the following manner:

A solenoid would exhibit a magnetic field in bits and pieces exactly as in the case of the Dirac Zitterbewegung. In any case we have this symbolic equation quantum mechanics which is equal to classical mechanics plus Zitterbewegung.

The Quaternionic Description of Quantum Mechanics

It was pointed out by Ezra Newman in the sixties that an imaginary shift of the coordinate in purely Classical equations leads to the purely Quantum Mechanical gyromagnetic ratio g = 2. Newman puzzled about it for decades and finally could not explain this enigmatic finding. The author, Dr. B G Sidharth, Director, B M Birla Science Centre, Hyderabad, has been working on this for a few decades and has concluded the following: 1. The explanation lies at very small scales where the square of the Compton scale is retained and 2. When a complex coordinate is generalized to three dimensions, as Sachs had pointed out we end up with a four dimensional space, which moreover has a Minkowski invariant thrown in.

On a further analysis the author noted that in this quarternionic description the spacetime is rather different to the simple Minkowski spacetime. To put it pictorially the former resembles the curly spiral binding while the latter is more like the smooth paper The author also concluded that this was the reason

why despite a century of efforts Einstein's gravitation could not be reconciled with Particle Physics.

Moving on we consider the second order representation of the quarternions in terms of the 2 x 2 Pauli matrices. This time the line element will be given by σ_(i) x^i. We get again an invariant but unlike in the 4 x 4 matrix consideration, this time there is no invariance under the reflection symmetry.

We consider the different situations like neutrinos, noncommutative geometry and two dimensional surfaces like Graphene where this latter case applies.

Secret of the Kerr-Newman Metric

As we say the Kerr-Newman metric can be written as

$$ds^2 = -\frac{\Delta}{\rho^2}[dt - asin^2\Theta d\phi^2] + \frac{sin^2\Theta}{\rho^2}[(r^2 + a^2)d\phi - adt]^2 + \frac{\rho^2}{\Delta}dr^2 + \rho^2 d\Theta^2,$$

where

$$\Delta = r^2 - 2Mr + a^2 + Q^2, \qquad \rho^2 = r^2 + a^2 cos^2\Theta$$

Even for distances much smaller than the Compton Wave length a, as above, this goes over to,

$$-dt^2 + a^2 sin^2\Theta d\phi^2 + cos^2\Theta dr^2 + a^2 cos^2\Theta d\phi^2,$$

where, $\Theta = \pi/2$. Now let us specialize to the case $\Theta = 0$. We get a simple metric $r^2 - \rho^2 = const$. Let us analyze what this means. Following the calculation of Moller, Sidharth [Sidharth, B.G.,Chaotic Universe: From the Planck to the Hubble Scale, Nova Science, New York, 2001], we have argued that an elementary particle can be modelled as a ball of tiny what are called particlets all in a transient relativistic motion. But there is a plane in which all the centres of gravity are distributed. The case $\Theta = 0$ corresponds to this case.

Given this model, it is possible that an ultra high energy gamma ray could pierce the particle and of course its energy would be released.

A New Twisted Relativity

Einstein's relativity has stood the test of time for many decades but it does not provide a full description of many of the much later developments. One example is that of an accelerating universe by what we today call Dark Energy. This was first pointed out by Dr. B G Sidharth in 1997. Just a year later came the confirmation for this theory. Then more recently there has been Noncommutative

Geometry playing a big role and two dimensional material like Graphene. All these require a twisted relativity. This twisted new relativity has been proposed by Dr. B G Sidharth to the International Association for Relativistic Dynamics Conference in Prague, Czech Republic.

The Universe is "Flat"

Astronomers at Portsmouth have concluded after an observation of millions of galaxies that the Universe is "Flat" and not curved as the standard big bang cosmology had assumed. This paper has been accepted for publication in Physical Review Letters.

It may be recalled that Dr. B G Sidharth, Director, B M Birla Science Centre, had in 1997 proposed that the Universe is in fact not static or contracting but rather accelerating driven by Dark Energy. This was confirmed the very next year by astronomers observing Type 1 supernovae. Three teams in fact.

Actually in Dr. Sidharth's model there is no room for concepts like curvature of space which were a left over of the earlier big bang cosmology. The acceleration or some type of inflation smoothens out the universe. This fact was even noted by Nobel prize winner Sir Tony Leggett. So it does not come as any surprise that the Universe is "flat" even though it may be anathema to most cosmologists.

Research News

Dr. B G Sidharth of the B M Birla Science Centre had several years ago described a model of the electron which is purely Classical, in his book "The Chaotic Universe". This follows from Moller's description of an elementary particle as a sphere filled with transient ultra relativistic particles. In this mathematical deduction there is a plane along which the various centres of masses of these transitory particles would lie. This description also follows from a purely Quantum Mechanical analysis of what is called Zitterbewegung, described by Dirac. Here too there would be an ensemble of transitory particles. Dr. Sidharth now further argues that if this what may be called composite particle is bombarded by ultra high energy gamma rays at very high frequency of the order of the particle's Compton frequency, then the particle would disintegrate releasing huge amounts of energy. This would be far more than in ordinary nuclear fission. The question is can this be achieved in the laboratory or is it something that happens in cosmic phenomena.

A Unitary Classical Description of Particles and Fields

The Ultra small world is divided broadly into two categories. One is particles

or elementary particles as they are called and the other are fields like the electromagnetic field etc. These are generally described within the ambit of Quantum Mechanics and its apparatus like prohibiting amplitudes, wave packets and so on. Let us now try a purely Classical description of the same phenomena without invoking Quantum Theory and its complications.

Case 1:

Our starting point will be the following considerations (Cf.[1]) where

$$m\frac{dv}{dt} = -\alpha v + F'(t)$$

Where the coefficient of the frictional force is given by Stokes's Law [2]

$$\alpha = 6\pi\eta a$$

η being the coefficient of viscosity, and where we are considering a sphere of radius a. This then leads to two cases:

Case (i):

For t, there is a cut off time τ . It is known (Cf.[3]) that there is a characteristic time constant of the system, given by

$$\frac{m}{\alpha} \sim \frac{m}{\eta\alpha},$$

so that, from Stoke's Law, as

$$\eta = \frac{mc^2}{a} \; or, m = \frac{\eta a^2}{c}$$

we get

$$\tau \sim \frac{ma^2}{mca} = \frac{a}{c},$$

that is τ is the Compton time. The expression for η which follows from the fact that

$$F_x = \eta(\Delta s)\frac{dv}{dt} = m\dot{v} = \frac{\eta a^2}{c}\dot{v},$$

shows that the intertial mass is due to a type of "viscosity" of the background Zero Point Field (ZPF). (Cf. also ref.[4]). We will revisit this circumstance later on in Chapter 4.

To sum up case (i), if there is a cut off τ the stochastic formulation leads us back to the minimum space time intervals ~ Compton scale.

To push these small scale considerations further, we have, using the Beckenstein radiation equation [5],

$$t = \tau = \frac{G^2m^3}{\hbar c^4} = \frac{m}{\eta\alpha} = \frac{a}{c},$$

which gives

$$a = \frac{\hbar}{mc}, if\ \frac{Gm}{c^2} = a$$

In other words the Compton wavelength equals the Schwarzchild radius, which automatically gives us the Planck mass. Thus as noted the inertial mass is thrown up in these considerations. We will also see that the Planck mass leads to other particle masses.

On the other hand if we work with $t \geq \tau$ we get

$$ac = \frac{2KT}{\eta\alpha}$$

whence

$$kT \sim mc^2,$$

Thus we get the Compton Scale or Planck Scale which is the particle description.

Case 2:

If there is no cut off time as is known we get the equation

$$\Delta x = v\sqrt{\Delta t}$$

from where the usual non particle descriptions follow, for example as in Nelson's Theory.

In other words we have got both a particle and a wave (or radiation) description starting from the Langevin equation.

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A few years ago Dr. B G Sidharth and Co-worker A Das had given detailed mathematical calculations on the following: If there is a vast body of water for example as in the Assam floods and a high explosive device is dropped into it, then the water would evaporate relieving the flood. Conversely if a few kilograms of cryogenic Helium is dropped into the vast body of water, the water would freeze, again relieving the flood. This work has appeared in the Italian Journal of Pure and Applied Mathematics. Later simulations have borne out the conclusion. So this may well be a solution not only for the Assam floods but in general.

Research News

Several years ago Dr. B G Sidharth, Director, had pointed out that if we are working the Fokker-Planck equation, the Langevin equation and other statistical mechanical inputs, then the evolution of the solution or system of particles would be described by two parts. The first part, let us call it A x where A is non-Markovian, and x tends to 0 with time or as the time tends to infinity, in the sense that the past and influence the present. Then there is a second part which is given by B . Markovian where B is Markovian. As the system evolves x tends to 0 that is the system becomes Markovian. In other words there is no memory of the past. It is as if time becomes demented.

Further Dr. Sidharth has shown at great length that in a sense the universe is short sighted like a Manet or a Monet painting. So these are interesting what may be called asymptotic properties of space and time.

A Note on "Pasteurization" Toy Model for Extreme Weather

submitted to Journal of Indian Geophysical Union

Abstract

We consider a model built on an earlier communication in the Italian Journal of Pure & Applied Mathematics. In this model we consider a combination of a positive delta function and a negative delta function and apply the results to a climate change problem, one in which we are seeing on a global scale alternate heavy downpours at some places and drought like conditions at other places.

Keywords: *extreme; weather; climate; change; toy; model.*

In an earlier communication we had considered a delta function variation in the heat equation leading to some very interesting conclusions [Sidharth].

Let us consider the heat equation

$$a\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t} \tag{1}$$

We next consider a modified version of (1) namely

$$a\frac{\partial^2 u}{\partial x^2} = (1 - \delta(t))\frac{\partial u}{\partial t} \tag{2}$$

We further consider the following modification of (2) namely we replace the coefficient of the time derivative in equation (2) by

$$\delta(t) = b\delta(t - \epsilon) \tag{3}$$

This would represent a Pasteur like situation where as we will see below the temperature goes down and immediately up (This is used in Pasteurization).

So we are dealing with effectively the equation

$$u'' = \epsilon\dot{u} \tag{4}$$

Let us use the usual method of separation of variables and write

$$u=U(x)\cdot V(t) \tag{5}$$

As is well known this leads to

$$\frac{U''}{U(x)} = \epsilon\frac{\dot{V}}{V(t)} = \lambda \tag{6}$$

where λ on the right side arises because the left side of equation (6) is exclusively a function of x and the right side is exclusively a function of t. λ in (6) is independent of x and t. A simple solution of (6) is immediately available namely

$$\begin{aligned} U &= e^{mx}, m = \pm\lambda \\ V &= e^{nt}, n = \pm\frac{\lambda}{\epsilon} \end{aligned} \tag{7}$$

Clearly in (7) n > > m as ∈ is small. So V can remain large but finite if t is very very small. That is in the limiting case V itself is of the form

$$V \sim \pm\delta(t) \tag{8}$$

This is what we expect in a Pasteurization process.

Remembering that the space intervals are all relative, looking at it from a

global perspective, what has been described above could equally well be a toy model for climate change, in the sense that due to the chaotic changes in climate, some places get extremely hot and other places become extremely cold. This in turn would lead to effects like deficit and excess rainfall in unexpected ways or even interfere with the elnino type phenomena.

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A Brief Note on Accelerated Glacier Melting

Submitted to Current Science

Abstract

We proposed a toy model which nevertheless illustrates the accelerated melting of glaciers as witnessed today.

Let us start with the one dimensional heat equation

$$\frac{\partial\psi(r,t)}{\partial x} = \nabla.[D(\psi,r)\nabla\psi(\mathrm{r},\mathrm{t})] \tag{1}$$

As is well known $\psi(r;\, t)$ is the density of the diffusing material at the space-time point $(r;\, t)$ and D is the collective diffusing coefficient for the density Φ at the point $(r;\, t)$.

We now consider the solution by the usual methods but replace t by αt. The rationale will become clear. Effectively the diffusion equation now becomes

$$\frac{\partial\psi}{\partial t} = \alpha D\frac{d^2\psi}{dx^2} \tag{2}$$

with a well known replacement

$$\psi = \phi(t)\omega(x) \tag{3}$$

Thus we get

$$\frac{\dot{\phi}}{\phi} = D\alpha\frac{\omega''}{\omega} = \lambda$$

where, λ is independent of r and t, whence

$$\phi = e^{\lambda t}, D\alpha\omega'' = \lambda\omega$$

Therefore,

$$D\alpha\beta^2 = \lambda$$

where

$$\beta = \sqrt{\frac{\lambda}{\alpha D}} \tag{4}$$

It can be seen that with $\alpha = 1$ we have the normal case where for usual intervals of time we have the general ice melt. However if we use this balance is changed. In particular for a normal interval of time the ice melt contained in ω can be very large if α is small. In other words the ice melt is contained in the diffusion constant D. By introducing α ($<< 1$) we have made a short cut to come to an explanation of accelerated ice melt.

If α in the above gives an idea of the extra or accelerated melt of glaciers apart from the usual diffusion coefficient D, we can get a rough idea of the value of this factor.

In the words of an expert Fagre, things that normally happen in geological time are happening during the span of a human life time. This cuts across the whole world from the snows of Kilimanjaro and Alps to the glaciers in the Garhwal Himalayan regions of India. It is speculated that at this rate the Himalayan glaciers could all but disappear by 2035.

To put numbers glaciers in the Alps retreated 1150 metres since 1870. The Mer de Glace, the largest glacier in France has receded 500 metres between 1994 and 2008 that is thirty metres per year. Another example is that of glaciers in Switzerland which have retreated 350 metres in just two years between 2003 and 2005 and so on. If the average in the whole world is taken to be about thirty metres per year then this gives a rough estimate of. Needless to add that all this is happening due to global warming as the IPCC points out [1, 2, 3].

References

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"Breaking" News

It is now reported that even the Antarctica ice shell is melting at an alarming pace. This accelerated melt of glaciers was discussed in Dr. Sidharth's paper "A Brief Note on Accelerated Glacier Melting" communicated to Current Science on November 29, 2019. After that, the ice shells in the alps started crumbling endangering several Italian cities as was pointed out in our note on August 10, 2020.

There may be one freak remedy in this though. One could dumb cryogenic material like liquid Helium on to the places where the cracks are appearing. This may slow down or even halt, at least temporarily the melt. This was noted in Dr. Sidharth and A Das' earlier paper that appeared in Italian Journal of Pure and Applied Mathematics.

Research News

1. A recent and thorough study of the neutrinos emitted by Supernova 1987a has finally found that there are no sterile neutrinos. Sterile neutrinos are hypothetical neutrinos which interact only through the gravitational force. They have been considered to be an important constituent of dark matter. So this latest finding gives a dent to the dark matter theory. It may be pointed out that Dr. B G Sidharth, Director, had not only discussed sterile neutrinos (particularly in the context of the MINOS experiments of Fermi Lab) but also has been arguing all these years that dark matter is not a necessary hypothesis. It will be recalled that dark matter was hypothesized nearly a hundred years ago, several candidates for dark matter have been suggested: From Brown Dwarf stars to sterile neutrinos. However dark matter as noted by Dr. Sidharth for the past several years could be just an artefact of a gravitational constant that is slowly decreasing with time.
2. Dr. Sidharth has argued that a particle spin could be more a statistical or thermodynamic effect or property in the following sense: The temperature of a gas is taken to be proportional to the root mean square velocity (like the average in a group). Yet no particular molecular need have this velocity. It is a broadly representative statistical number. If we look at the concept of spin in elementary books like Bjorken and Drell, we come across a confusing dichotomy: Is spin an intrinsic property or is it more a statistical property and this latter is what Dr. Sidharth says.
3. It has been recently found that one can have electromagnetic pulses using graphene. It may be recalled that graphene was predicted on theoretical

grounds as early as 1995, but was discovered experimentally ten years later in 2005 which won the discoverers the Nobel Prize. The interesting point here is that according to Dr. Sidharth's calculations the various properties of graphene are not limited to graphene per se, but rather to the noncommutative structure of the two dimensional sheet,. For example shortly after this was pointed out it was found that Stanene (tin) also exhibited similar properties. The essential point is that these properties like magnetic pulses would be shared by any two dimensional sheet, not just graphene.

Research News

Earlier we have seen how the Zitterbewegung region can in principle be penetrated with the release of the entire particle energy. Remembering that at this level as discovered in detail earlier, there is a situation which can be modelled by a two Weiner process with time momentarily flipping forward and backwards. In this process it is possible that some of the Zitterbewegung energy from the destruction of a particle could once again form another particle. This would be a rare flip flop event because it could go on. It may be mentioned that as elaborated in earlier papers, it is this two Weiner process that leads to Special Relativity and Mass.

The Jittery Universe

We have been trying to stress that dark energy leads to a jittery universe what has been called Zitterbewegung almost universally. Let us consider time. The effect is that time would be flickering constantly backward and forward. This can be modelled by the Weiner process. It leads to as explained in detail ten years ago in several papers and the author's book "The Thermodynamic Universe" (World Scientific) at one shot, the Special Theory of Relativity and also Mass.

On the other hand in terms of space this leads to a region of transient wave functions. At a classical level this has been explained in detail by Moller in his "Special Theory of Relativity". If we have such a region then as explained a very powerful gamma ray perhaps could penetrate this region (which represents a particle) and destroys the particle with the release of energy. Of course because of the Weiner process in operation the reverse could also happen.

In the author's formulation symbolically speaking, Classical Physics plus Zitterbewegung equals Quantum Mechanics.

It should be mentioned that this Zitterbewegung has been studied from

different angles by scholars like Dirac, Hestenes and others.

Motion of Particles

In this case using the Langevin equation which is stochastic in nature there is a random term A (t) and averages are invoked so that we finally get

$$< v^2 > = (kT/M) + [v_0^2 - kT/M] \exp(-2\zeta t) \quad (1)$$

Where M is the mass of the particle. It must be mentioned that the following assumptions have gone into (1):

i) The total randomness of the term τ_c.

ii) The observation time t exceeds the collision time

iii) The collisions are statistically independent of each other only if they are well separated in time. Otherwise there exist causal relations between successive collisions.

iv) For joint probabilities we consider only Markov processes.

That is,

$$Prob\ (y_2, t_2;\ y_1, t_1) = Transition\ Prob(y_2, t_2;\ y_1, t_1)\ \ Prob(y_1, t_1)$$

The interesting thing in above (5) is that as the time t tends to infinity the second term tends to 0 and we are back with the usual equation of molecular motion.

If we consider the virus to be a particle or a molecule which it is then this means that as time passes these virus molecules just move on without any correlations or in other words that will be the end of in the case of a pandemic the pandemic itself.

It is worth noting that this also means that as time passes these molecules loose the memory of what they were or how they were correlated. It is almost as if with the passage of time nature gets demented as with human beings. Further we have argued in several papers several years ago (Cf.ref.[Sidharth, The Thermodynamic Universe, World Scientific, 2008]) that nature also behaves like a short-sighted person. In other words the Universe is like a Manet or Monet painting. So as the Universe ages it becomes short-sighted and demented.

Model for a Flat Universe

Recently the most comprehensive survey of millions of galaxies in the cosmos by a team from Portsmouth found that the Universe is flat which came as a big surprise. Actually this was already mentioned by Dr. B G Sidharth in 1977.

His model was exactly the opposite with the Universe accelerating rather than contracting. The acceleration was caused by the mysterious Dark Energy which Dr. Sidharth introduced into cosmology and this was appreciated by Nobel Laureate Prof. Antony Leggett himself.

If one looks at the various images of the cosmos at different wavelengths which have been obtained by NASA and other agencies one finds that the Universe resembles a bubble with a flat equatorial type of a disc where almost all the matter rests. This is reminiscent of a model of particles as explained by Moller. Here too there would be such a volume with an equatorial disc which contains all the centres of masses. So the suggestion is that almost all of the matter in the universe lies along a flat disc like the disc of centres of masses and these mass centres would be the galaxies.

This picture reconciles the various latest cosmological inputs.

This pattern holds for various orbits for example in the Solar System and also for galaxies individually which seems to suggest that gravitation and spin of the objects plays a big role in the process.

A Mathematical Model for Neurons

It is well known that there are about 10^{20} neurons in the human brain moving incessantly. We model this situation in the following way. We consider as an approximation the brain to be a two dimensional structure like Graphene. Then the movement of the neurons would be essentially the movement on a two dimensional Graphene like structure. By passing the various details of Graphene as described in the author's several papers (for example in the Chapter of Graphene Materials published by Wiley Scrivener), we concentrate on the following aspects

$$\bar{n}_p = \frac{1}{z^{-1}e^{bE_p} + 1} \tag{1}$$

where, n_p are the number of neurons and E_p their energy. This leads to the following interesting situation given by

$$z^{-1}e^{\theta} + 1 = (4\pi)^{5/2}\frac{z'^{-1}}{p_0}; \text{ whence}$$

$$z'^{-1}A = z'^{-1}\left(\frac{(4\pi)^{\frac{5}{2}}}{p_0} - e^{\theta}\right) = 1, \tag{2}$$

At a certain value of A namely $A \approx 1$ we come to the value of the momentum

given by

$$p_0 \approx \frac{(4\pi)^{\frac{5}{2}}}{1+e} \tag{3}$$

This represents both Bose-Einstein condensation type of an effect as also for a slightly different value infinite dilution which is the opposite. Both these can reasonably be related to a state of the brain (mind){condensation is intense concentration while dilution can be reasonably linked to a state of the brain being calm.

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Dark Energy Again

In a previous communication (Jittery Universe, NAP, Volume 14, Number 1, 2020) it was argued by Dr. B G Sidharth that Classical Physics plus Zitterbewegung (ZBW) or incessant shaking leads to Quantum Physics. Now we go one step further namely that ZBW is a manifestation of Dark Energy. To understand this Dr. Sidharth had conceived of a thought experiment later used by researchers like Dr. Larisa Laperashvili and others. An ideal pendulum which is weightless and has all the other attributes of such a pendulum is left suspended in vacuum. Under normal circumstances or with normal physics one would presume that the pendulum would remain totally stationary. However what would appear is a totally random or chaotic motion of the pendulum ball. That is indeed Dark Energy which goes beyond conventional physics. So this ZBW type motion of the pendulum is a manifestation of Dark Energy.

September "Cuts"

1. The Dark Energy which we touched upon it may be recalled was first introduced in its present form by Dr. B G Sidharth in his 1997 pathbreaking paper which spoke of the energy being "ubiquitous" leading to an accelerating Universe. The consequences confirming this model are periodically coming up and most recently from the University of Portsmouth where in the most detailed study yet of the cosmos the flatness of the Universe was confirmed.
2. The UV Therapy: While the Covid 19 was mistakenly linked to higher temperatures, Dr. Sidharth pointed out that rather it is the UV radiation

which could kill the virus. The proof came immediately thereafter in experiments at the Columbia University where in the low frequency UV destroyed the virus. Of course UV with different frequencies perhaps can be used for destroying other wanted cells, may be even cancer cells in the human body. It was explained that the Russians had a slightly different methodology where the patents were given certain metastable molecules which then decomposed into UV within the body of the patient producing desirable results.

3. For almost a couple of decades Dr. Sidharth has attributed the so far unobserved Dark Matter of a slight variation of gravitation, which decreases with time. Indeed as we go back in time to the very early galaxies it is found that they seem to have some Dark Matter which could be nothing more than a great gravitation in that epoch.
4. It was pointed out by Dr. Sidharth that if an elementary particle can be destroyed by extremely intense radiation, for example ultra high energy gamma rays, the particle could disintegrate leaving behind a lot of energy. If this can be realised then it would be the ultimate fission.

Faster than Light?

Let us take a beam of particles, including elementary particles. This beam is part of High Energy Cosmic Rays Large Hadron Collider (LHC). We observe that because of the probabilistic nature of these particles there would be a core (or statistical mode) beam of particles that would be luminal (speed of light) or subluminal. However the probabilistic nature that is inherent would still leave a very few particles that could be superluminal (faster than light). These faster than light particles could be away from the main core (or statistical mode) of particles and so their appearance would be with very very low probability. Nevertheless this would lead to, for example in the LHC some Cherenkov radiation or some other superluminal effects. The same goes for High Energy Cosmic Rays.

The Entangled Universe

Erwin Schrodinger posited that if two particles interact once, then they for ever remain, what we call today, entangled. And so on the network goes.

Nobel Laureate Penrose introduced a somewhat similar scheme with what he called spin networks. The interesting thing about this latter scheme was that some sort of a dimension could be extracted from it. Today entanglement is a very desirable property for Quantum Computers. One might even consider

that a highly entangled system is in some mathematical sense a chaotic system. This is in the sense that a change in one of the "network" patterns could lead to a major change in the entire network.

It must be borne in mind that entanglement is more likely to prevail at low temperatures rather than higher ones where there is thermal breakdown of the networks.

At a more philosophical level if a particle is not part of any network or even weakly entangled network then it would not be part of our spacetime. This is because our spacetime is precisely a collection of such networks.

Raman Lecture

Today is Sir C V Raman's birthday. He was the first Indian to win the Nobel Prize for his work in India. In spite of that he was not an Indian citizen because this happened during the British Raj when independent India had not come into existence. He was a brilliant "Physicist", although he was working in the Accountant General's office in Kolkota. It is said that when he got his Nobel Prize he received it and came back to his seat and started crying like a child. Later he explained to the US Ambassador that he saw that a British flag was draped on his chair and was overcome with emotion that India could not have its own flag.

His work on light scattering and the Raman Effect was much too well known. Hundreds, if not thousands of papers have been written on it and there are even journals on Raman Spectroscopy. A point which Indian scientists must bear in mind is that Raman is the only Nobel Laureate who never had much equipment at his disposal. When once his student K S Krishnan told him that a new light bulb source was available but was too expensive then he said let us use the 1000 Watt brain if not the light source. For all that Raman was not very popular because he was blunt and undiplomatic. Once independent India started investing in scientific labs and institutions he called them the tombstones of Indian Science.

Roger Penrose

Coming back to the question of Nobel Prizes, this year's Nobel Prize was won by, amongst others, Sir Roger Penrose for his work on Black Holes. The Theory of Black Holes goes back to 1916 when the mathematical Karl Schwarzschild discovered a solution for the general relativistic equations. It turned out that that solution was that of a Black Hole later called the Schwarzschild Black Hole. Burt many paradoxes and problems persisted. For this Penrose came up with his ad hoc theorem called the no hair theorem. The paradoxes persisted

and even several other eminent scientists like Hawking worked on them. The paradoxes refer to what may be called the loss of information.

But Penrose had a very versatile mind and his brilliance figures in several areas of mathematics and near mathematics. For example Penrose tiles are well known at one end and his idea that even thought follows Quantum jumps was another fruitful hypothesis.

I would like to mention two other less well known formulations of his fruitful mind. One is the Twistor Theory which did not catch too much attention though he had worked it out in great detail.

I will dwell on yet another brilliant piece of work by Penrose, not so well known, namely spin networks. The spins of various particles, according to this form a network of spins. The interesting thing is that we can extract the physical three dimensions out of these considerations.

From here I would like to go to another brilliant Nobel Laureate's work which is somewhat related. Schrodinger formulated a principle which can be called the Principle of Non separability. According to him, to put it in extremely simple terms, if two particles temporarily interact, then they continue to remain in interaction however far apart they may get. This lead to much debate amongst the most brilliant minds in the world including Niels Bohr and so many others. This is because in a way it is connected with the famous Eeinstein Podolsky Rosen (EPR) paradox, and in more modern terms "entanglement" which is once again of great interest in Quantum Computing.

With this in mind I would like to state that every particle in the universe is "entangled" directly or indirectly with all the other particles in the universe. The interaction between particles could be through the four known forces like Gravitation, Electromagnetism, Weak Interaction, Strong Interaction and so forth, but not necessarily limited to these. Then in a tautologous way we could say that any particle which is not "entangled" in the above sense to any of the above particles in the universe would simply not belong to the universe itself.

In the Raman Lecture we had touched upon the Schrodinger non separability conjecture and used it in the manner of Roger Penrose's spin networks. We now generalize this further and make the statement that any particle which is not directly or indirectly in interaction, however weak of another particle does not belong to the spacetime of the universe. This mega set can of course be decomposed in the other such sets, each set sharing some interaction, however weak with another such set. In other words the universe decomposes into what have been called multiverses by Tegmark and others.

Noncommutative Electromagnetism

It was pointed out by Dr. B G Sidharth way back in 2013 (Hadronic Journal, December issue) that noncommutativity leads to some extra electromagnetic effects. This was further refined for a paper to appear in the Italian Journal of Pure and Applied Mathematics, forthcoming issue. The operative equations are

$$\partial^{\mu} F_{\mu\nu} = \frac{4\pi}{c} j_{\nu} \tag{1}$$

This particular equation is in a abridge form with μ=1,2,3,4 and ν=1,2,3,4. More fully

$$\partial_{\mu}(\partial_{\mu} A_{\nu} - \partial_{\nu} A_{\mu}) = \frac{4\pi}{c} j_{\nu} \tag{2}$$

In these equations a quantity ε appears which is the extra effect. If ε = 0 we come back to the usual equations of electromagnetism. It is interesting to note that when ε=1 we have the noncommutative case, when it is 0 the usual case and if ε=-1 we get the signs of magnetism and electricity reversed. This suggests that the triplet {ε} behaves like a spin 1 meson like the π meson. We can go one step further and equate this theoretical triplet with an actual spin 1 particle.

Origin of Life?

Hayabusa the Japanese spacecraft after travelling nearly 300 million kilometres over five years plus landed on a distant asteroid, then bounced back and made a second landing to break it up. It then collected samples of the asteroid material and brought it back safely for an earth landing in Australia. One cannot over emphasize the importance of this mission. Years ago the spacecraft deep impact crashed on to an asteroid and splintered it. Here we actually have at our disposal material from inside the asteroid. In particular we look for the carbon content (apart from other things) because carbon is crucial for formation of life. It may be recalled that Dr. B G Sidharth had proposed years back that the formation of life would take place in what may be called a dual mode, that is some organic material would strike the earth from outer space, possibly from comets and this material would mix with the existing water and other chemical on a lifeless earth to produce the first forms of life. This would be in contrast to the lithospansfermia model that life came to the earth readymade from outer space or the Urey model which said that life was entirely produced on the earth with earth material. The present Hayabusa mission could go some way in clarifying the situation.

Signal Interrupted

For decades, the giant Radio Telescope in Arecibo, Puerto Rico, has been scanning the heavens for any sign of alien signals. It was the base for the SETI programme (Search For Extra Terrestrial Intelligence). It even featured in the James Bond film Golden Eye. For some years now NASA has been apprehensive about how strong the Radio Telescope is. Finally a few days back it collapsed. We have to wait longer to resume our searches for extra-terrestrial intelligence a little longer till the telescope is fixed up.

Science News

These days the talk is all about cold temperatures for vaccines. What is missing from the conversation is the link between ultra-cold temperatures and the density of the ambient. At a most elementary level this is the link between pressure volume and temperature given by PV is equal to RT. Now these are all Thermodynamic quantities depending on billions of molecules. If there are only a few molecules then these considerations become tenuous so pressure and temperature both fall down the temperature at normal pressures will be much higher than at very low densities. This thermodynamic link can also extend to higher temperatures with very interesting consequences in various fields. For example, very recently the long dream of high-temperature superconductivity has been realized, but at very high pressures in the case of quantum computers, we need to reduce the thermodynamic temperature or what is called noise. We could try this out at very low pressure.

Also, Dr. B G Sidharth argued more than two decades ago that on the contrary very high pressures could trigger off nuclear reactions because of the very high temperatures within relatively small volume.

Brain Machine

Around 1964 I had attended a talk by an Indian American. He argued that one day a Computer would replace the human brain. I had contested this viewpoint because it didn't seem right that the brain could be reproduced by a machine. Since then it is true that to a certain extent what we call AI (Artificial Intelligence) has made considerable progress here using expert systems and neural networks. We are able to do mostly replicated conclusions but as far as a brain machine is concerned, it is still a distant dream.

According to Antonio Damacio the leading American brain researcher, the brain is trillions of trillions of neurons moving randomly in the brain. To be precise we suspect today that there 1010 neurons in random motion in the brain. In a recent post I had modelled the situation of the human brain in two

dimensions and this lead to two extreme results. In this statistical model there would be extreme convergence of the neurons in a small area rather resembling the Bose condensation and yet another extreme infinite dilution. In between there are all other scenarios. The main point is it would be next to impossible to follow them in nano detail.

On the other hand Roger Penrose had a different but interesting take in his book called The Emperor's New Mind. He suggested that human thought undergoes Quantum jumps.

Now let us consider the general jiggling neurons in the brain. These would release some faint radiation. Perhaps microwaves. These microwaves could produce shadowy images of our thought, rather like an imprecise Xray film. Perhaps we can imagine a science fiction like scenario where the images can be enhanced into better images. This would be the first step towards reading thoughts. The ultimate lie detector machine. If that happens it could have a dramatic effect on civilization much as agriculture in ancient civilizations or industry in more recent history. This would put a halt to intrigue lies, misrepresentations and so on which are so common in the present age leading to, we can imagine through the era of goodness and truth, what has been called the Satya Yuga.

Science Scapes

1. Dark Matter resurfaces: Scientists are again beginning to doubt the existence of Dark Matter which in any case has not been found in over 70 years of search. Instead scientists are veering back towards modified gravity theories or MOND. MOND was proposed in the early 80's by Milgrom, an Israeli physicist. The problem is that it looks like an ad hoc fix with no further justification. This was the criticism levelled by Dr. B G Sidharth over the years. Instead he has proposed a varying G theory. This comes from no less than Dirac himself, even though in the original Dirac theory there was an inconsistency. Dr. Sidharth's approach has been that as G varies even so slowly with time, the Dark Matter presence would be thrown up as an artefact.

In recent years this aspect has resurfaced in other ways. For example there appears to be more so called Dark Matter in very distant galaxies, that is, newer ones rather than the not so distant galaxies. So even after 70 years the question remains is there really Dark Matter?

2. Solar Neutrinos: The puzzle of Solar Neutrinos has persisted over the decades. In 1987 when the supernova was spotted by Ian Sheldon, it did

appear that some Neutrinos had reached the Earth before light from the supernova that is before the supernova itself was spotted. Such so called superluminal neutrinos have not persisted in subsequent researches even though Dr. Sidharth has been arguing in their favour in several papers.

The current piece of evidence is that these Neutrinos participate in the solar fusion which generates all the energy.

The Borexino Experiment has observed that Neutrinos aid fusion in the Sun in the Carbon, Nitrogen and Oxygen cycle. So indeed the Neutrinos have a lot going for them.

Science Scapes

1. One of the so called paradoxes of the usual theory is that the laws of motion like Newton's laws are time symmetric, that is they remain the same if time goes forwards or backwards. But the universe itself is not. There is an arrow of time. In Thermodynamics we say that entropy always increases. Entropy is really the amount of disorder in the system. This seems to go directly against Newtonian Mechanics being invariant under time reflections. The paradox is easily resolved because as is well known two is company but three is a crowd and once there is a crowd then things can go bizarre. In other words we then move over to a description of a universe in terms of Statistical Mechanics. I was engaged in a conversation with Professor Ilya Prigogine after his latest book, "The End of Certainty" which he wrote with Isabella Stringers. In this Professor Prigogine gave his well-known views on nonequilibrium thermodynamics and irreversibility of time. I had some discussions with him in Brussels on his arguments and was trying to tell him that the answers may lie not in the "bulk" physics of thermodynamics but rather in the fine structure of micro spacetime. He wrote that he found it difficult to comprehend how micro spacetime would come in and that was it because Professor Prigogine passed away before we could push the discussion further. In particular one phrase of his caught my attention, "Is the future given?" That's where much like Schubert's unfinished symphony matters rested, at least temporarily. It took me a long time to articulate what I had in mind, and this came in the form of a talk I had given in the University of Udine sometime around 2017. The title of the talk was "Back From the Future" (with apologies to Steven Speilberg). Here I was arguing that at the micro spacetime level it is possible that we go back in time and that was the point that I was trying to put my finger on with Professor Prigogine.

2. We are all aware of the slightly amended limerick: "There was once a lady of Niger who went for a ride on a tiger. They moved faster than light and came back the previous night." So the point here is that superluminal or faster than light motion is equivalent to going backward in time, which we do not take seriously. But again in this case too this is possible at the micro spacetime level. The point is that as described in Dr. Sidharth's book "The Thermodynamic Universe", there would be a double Weiner process, but this is possible only within the Compton Scale. By the time we come into the physical world above the Compton Scale things get evened out and we are back in the usual world of physics. In fact it is argued in the above book that it is this forward and backward motion of time that gives rise to Special Relativity.

Is the Future Given?

This refers to my unfinished conversation with Professor Ilya Prigogine, the celebrated Nobel Laureate. Now I would like to view this same problem from a completely different point of view. This refers to some experiments that were made on the human brain by Benjamin Lebit in the 1980s. The brain experiment has since been repeated hundreds of times, but one consistent conclusion comes out namely that there is no free will. Free will as discussed by Prigogine himself in "Order Out of Chaos" and so many other western philosophers is on the basis of a form of determinism. For example, Descartes proclaimed a few centuries ago "ergo cogito sum", That is I think therefore I am. Sidharth pointed out a slight logical missing link in this argument that is the consistent statement would be I think therefore I think I am. Otherwise there would be a direct jump from think to the universe. Returning to Lebit's pathbreaking experiments, he wanted volunteers to tap a computer screen at their own volition. Simultaneously the brain impulses were being recorded. What he found was that the impulses were triggered off a little before they actually touched the screen. In other words thought had started before they actually did the act, and this thought was beyond their volition, to put it simply. The experiment has been repeated hundreds of times over the past two decades, but always with the same result.

An interesting take on this is to invoke Einstein's Theory of Special Relativity. According to this space and time do not have a separate existence. There is always some space mixed in time and vice versa. So the question of before and after gets mixed up. But in any case we again come to a situation where "The Future seems to be given."

Science Scapes

Sidharth has argued that Quantum Mechanics can be looked through the prism of beats, a phenomenon which appears with tuning forks. What happens here is that when there are a few frequencies many of them destructively interfere, but some interfere constructively. So we hear the beats that, is the constructive interference of these sound waves while the rest is just a hum. Now if we take the Quantum Mechanical waves a similar pattern repeats itself, just that these are probability waves. There would be a lot of destructive interference but at times constructive interference. In other words we could see a particle. We would have a great probability of seeing a particle, than at other places. These are the well-known wave packets. Recent simulations of the Schrodinger equation solutions show precisely, such jumps.

The above picture is confirmed by latest research at a few top ranking Universities including Columbia University and Yale. What they have found is that the Schrodinger wave function remains muted corresponding to the low hum of the tuning forks but occasionally there is a jump when the particle has the greater probability of appearing.

Covid 19

The world is desperate about how to contain Covid-19. All sorts of measures are being tested. Earlier in June Dr. B G Sidharth, Director, B M Birla Science Centre, Hyderabad put up a post how rather than heat (infrared) radiation as suggested by many molecular biologists, it is the ultra violet radiation that would be detrimental to the virus. Confirmation for this has come from the fact as pointed out in Russia some patients are made to inhale metastable molecules which decay releasing ultra violet radiation which in turn destroy the virus inside the patient. Now further confirmation for this has come from no less than the Columbia University where they have found that ultra violet radiation of 220 nano metres wavelength does indeed destroy the virus molecules. It can be speculated that as the higher latitudes get more ultra violet radiation than the lower ones, it is possible that they play the role in decreasing the Covid cases in countries of Europe and also some in North America. Although on the flip side ultra violet radiation can cause sun burn and in severe cases even cause skin cancer from which the lower latitudes are shielded by the ozone layer. Ultra violet radiation it seems helps the usual measures of social distancing and face masks.

Dr. Sidharth had argued that not so much the temperature as the frequency of radiation is what destroys the Corona Virus molecules. In fact experiments have shown that this is indeed so, particularly in Columbia University, US. We need low frequency ultra violet rays which are relatively harmless to the human

skin or eye. We could now think of a helmet which can be filled much like those of doctors treating Covid patients. In this helmet which could also contain proper protection to the eye ultra violet rays are released, killing any Covid viruses.

We have argued at length that low frequency ultraviolet rays can kill the Covid virus as has been proved experimentally subsequently. Furthermore there is a Company in Boston which is manufacturing such devices which emit these ultraviolet rays which are otherwise harmless to human beings. So this type of equipment can be placed in enclosed spaces, for example theatres or aircraft. Without harm to the people inside, the Covid virus would be destroyed.

Dr. Sidharth went on to elaborate that with such low frequency ultraviolet emitters one could have a room, an auditorium or an aeroplane interior or any close space virus free. Since then a premier Indian Institute claims to build exactly such a hall.

Another application of the specified low frequency ultraviolet radiation that is harmless to human beings is the following: Drones could ply at a suitable height into Covid clusters and shoot out the ultraviolet rays to ill the viruses.

Dr. B G Sidharth pointed out that working with Statistical Mechanics in particular equations like the Fokker-Planck equation, a solution would split into a part Ax where X tends to 0 (as t tends to infinity) + B. A is the non-Markovian part where there is correlation between the various particles whereas B is Markovian. In this latter case it is impossible to predict what comes next. Now remembering that viruses are also particles, in the above scenario we could interpret it as there being a strong correlation between the hosts of the virus, that is infected patients and their histories. But with the passage of time the situation becomes Markovian, that is the memory of the past is wiped out and they become ordinary stochastic particles.

The Bat Versus Mosquito

In April Dr. Luc Montaigner who got the Nobel Prize in 2008 for his work on HIV said that the Coronavirus was man made in Wuhan and it had traces of both HIV and the mosquito bone diseases. Not much was made of this but now there is circumstantial evidence to back up the Nobel Laureate.

1. One of the very early cases of Covid 19 was treated in Rajasthan on an elderly Italian tourist who recovered after a HIV related treatment.
2. It is well known that the American President Donald Trump and a few other top leaders have been taking the mosquito preventive HCQ.

3. More recently it turns out that the mosquito bone dengue disease is also providing the antibodies required for a Covid 19 vaccine.

Perhaps all that is needed is one of these treatments, may be with a flu sort thrown in.

From the above considerations it would be reasonable to suppose that a dengue vaccine might serve the purpose for Covid 19.