

Universal paradigm: from bottom to conclusions

Introduction

Dear Colleagues,

During the next half an hour I will first explain the key idea of my research and its formulation as a natural law, and thereafter about its applications on few of the most interesting questions in physics.

Nature is complicated in its details, but the principle is simple. As the evidence for the simplicity I regard similarity that manifests itself everywhere. Namely, many a data when plotted on a log-log scale flows mostly a straight line. For example, big earthquakes are rare whereas small trembling is common. Likewise, major events causing large neuronal responses are rare whereas minor events are frequent. Also power laws account for species richness vs. area, degree distribution of nodes in neural and information networks, as well as for distribution of galaxies and flux of cosmic rays.

Also sigmoid growth curves and declining s-curves are found all over. Examples are production of crude oil, spread of loan words, growth of bacteria, chemical reactions, protein folding, as well as even sharper s-curves of phase transitions. When the s-curves are plotted on the log-log scale, they follow mostly straight lines. That is to say, power laws and s-curves are the one and the same.

The s-curves accumulate from skewed distributions, and hence these nearly lognormal distributions are found throughout nature. For example, the length of genes and the length of words are skewed in this manner. So is the income distributions of Norwegians. The one point that stands apart from the other probably corresponds to the assets of Kjell Inge Røkke. Also the population distributions of animals and plants are skewed alike as well as the distribution of electromagnetic radiation is skewed depending on temperature.

Spirals in nature, such as shells, cyclones, galaxies, are nearly logarithmic, that is, of the one and the same form, but presented in polar coordinates. Likewise oscillations and chaotic motions are found throughout nature.

The great sameness made me once to consider that the universal patterns display the one and the same basic law of nature. Thus, there is a general cause that makes everything to move in the same manner. **The great sameness** made me also to consider that everything is ultimately composed of the same undividable basic building blocks, just like the ancient Greeks thought, however not inviting me to philosophize it but to do physics of it.

This universal paradigm is the foundation of my thinking. Everything that I have written and published during the past ten years follows from this reasoning. That production spans the scope of science from one end to another, so it may seem like a bewildering array of works without focus – for one who is not aware of its universal basis. However, it is only us humans who dissect nature into fields of science whereas the unity of nature manifests itself in the universal patterns.

Next I will explain what follows from the change in paradigm when one reasons that everything composes of the same undividable basic building blocks of nature. First I will derive from this stance an equation of motion that yields precisely those universal patterns that I just introduced to you. Then I will apply the equation of motion to explain structures of elementary particles as well as astronomical observations, because it seems that these results have given rise to most disbelief and mistrust, perhaps even been felt as something to be refuted. I am not surprised about such feelings, since I have shared them too, but managed to put them aside as being secondary, and instead pulled myself together for rational analysis of the thesis and its consequences by the scientific method.

Energy level diagram

I presume that energy is a property of the basic building block, and hence energy is also the attribute of all entities. **Therefore** I may describe any system in terms of energy level diagram, so that each level houses identical entities. When inspecting one particular entity, such a molecule, it is apparent that its existence depends on whether there are substrates for its synthesis, such atoms for making the molecule as well as photons that couple to reaction. Every transition from one level to another couples at least one photon to absorption or emission.

The photon cannot be divided. And hence it is logically the basic building block of nature, to be precise the quantum of action, in the form of quantum of light.

To know exactly how a complicated entity comprises of its quantized of actions, is difficult to figure out, but in the case of elementary particles, it is possible. As I will show later.

Before that I will write the system diagram in the mathematical form of a state equation that, in turn, will serve us to derive the equation of motion to describe the system in evolution from one state to another driven by the forces.

The state equation is obtained from statistical mechanics by asking, what is the probability for a particular entity to exist. For example, the existence of a molecule requires that there are substrates with suitable energy and photons for the synthesis. If any one of the vital substrates is missing altogether, the product entity cannot be made. Its probability is zero. Thus the entity's probability can be given as a product of its constituent factors, where N_k is the number of substrate entities, ΔG_{jk} is the energy difference between the product and substrate, as well as ΔQ_{jk} is the energy of the photon that couples to the change in state.

Likewise the probability of a population of identical entities can be written as a product of its constituent factors and divided by the number of permutations, because the order of identical entities is immaterial. Finally the probability of the whole system can be given as the product of its factors. For example, the probability of a cell as being the product of its constituent molecular probabilities. This general expression gives the probability of any system.

The state equation in the product form can be transformed to a convenient additive measure, by taking logarithm of probability as is taught in statistical mechanics, and multiplying by Boltzmann's constant will yield entropy. When entropy is multiplied with average energy, that is, with temperature, the additive state equation is easy to understand. It consists of a term, as in the textbook, for energy that is bound in the populations as well as a term for numerous energy differences between the populations and surroundings, which imposes flux of photons to the system or from the system to its surroundings. This free energy term is missing from the textbooks, because customarily it is assumed that energy of the system does not change on average. However, unmistakably nature is changing.

The 2. Second Law

The equation of motion is obtained from the state equation as its time derivative. The equation of motion says, that every system evolves from one state to another driven by the forces towards balance in its surroundings. As expected, entropy will increase as the free energy decreases. For example, when the substrate potential is higher than the product potential, the products will form. Both factors are positive, so the product is positive. Conversely, when the substrate potential is lower than the product potential, the products will decrease. Both factors are negative, so the product is positive. Thus, the change in entropy is

always non-negative. Entropy will increase invariably when free energy is decreasing until the balance has been attained. The equation of motion is the second law of thermodynamics, without exception, without demarcation between animate and inanimate. Therefore I will call the equation also as the general law of nature.

Entropy increase, when derived in this way, does not associate with increase in disorder, but disorder just like order, is merely a consequence of free energy consumption. Water will freeze to orderly ice when cooling toward its cold surroundings. Conversely, ice will melt to more disordered water when warming toward its warm surroundings. Also a tree will organize its growth toward light, and conversely it will die and disintegrate when left without light.

The mathematical analysis reveals that the general law of nature yields precisely the scale free patterns of nature, that is power laws, s-curves, skewed distributions as well as spirals and in certain conditions also oscillations and chaotic motions. Thus, the second law of thermodynamics describes every motion, and hence it should be used at least in principle and foremost to analyze all observations.

This is what I have been doing. I have been searching for any deviation, but found none. I have expanded early investigations in chemistry and biology to more quantitative data sets of physics, but failed to find any exception to the general law of nature. My publications report from this spectrum of validation.

The mathematical analysis also reveals that the equation of motion cannot be solved in general. The motion will affect its driving forces, which in turn will inflict on the motion and so on. In other words the variables cannot be separated. Therefore, it is impossible to predict precisely trajectories of path-dependent motions that is courses with history. This is obviously in concert with our experience and observations.

I have used this form of the equation when answering many pivotal questions in biology, such as, why did life emerge and what natural selection actually is and why all natural amino acids have the same handedness, as well as to questions in economics, such as, from where does the law of supply and demand come and what underlies the tragedy of commons, as well as questions in information theory, such as, what is information and from where does the computational complexity stem. However, I will not divert to these studies, because I believe physicists are more interested in seeing how the general law of nature is applied in studies of celestial mechanics, propagation of light and elementary particles.

To this end the equation of motion can be written in terms of continuous variables by substituting chemical potential with scalar potential and denoting the photon flux as continuous dissipation as well as designating the left side as the change in momentum multiplied with velocity, in other words, as the change in kinetic energy.

This form makes clear that, the flows of energy will direct themselves so that gradients will be abolished as soon as possible. As I will explain a little later, this means that there is no need for dark energy and dark matter to account for propagation of light and celestial mechanics.

The equation of motion can also be given in the form of an integral which is known as the principle of least action, as it was originally written by Maupertuis. The principle generalizes the familiar principle of least time for light, for any other flow of energy. This geometric form of the natural law is the starting point for the inspection of elementary particles. I will begin from this subject because it is essential for the holistic worldview to discover that everything actually comprises of the quantum of actions.

Photon

The photon is the most familiar form of the quantum of action. We see light, we sense heat.

The action is a geometric notion. The photon has energy on its period and momentum on its wavelength, so that the product of these pair attributes is a constant, Planck's constant. The photon is an open quantum of action. When energy decreases, the period of time increases and vice versa. This manifest itself as red and blue shifts when the photon propagates from one energy density to another.

Vacuum

When two photons with equal energy co-propagate but out-of-phase, their electromagnetic fields, that is, forces cancel each other out. At the destructive interference we see no light, but the photons do not vanish for nothing. This conclusion deviates from the current consent but it is consistent with observations. The sky is dark. The vacuum is black, but still full of photon pairs giving rise to the energy density of space about nJ/m^3 , which is, as known, approximately in balance with the energy density bound in the total amount of matter in the Universe. Likewise the gravitational field about a body comprises of photons contained in the out-of-phase pairs in balance with the energy density bound in the body.

Neutrino

Geometry of the photon is open, but the quantum may turn back to its beginning. The closed quantum in a planar form I recognize as neutrino, to be precise the electron neutrino. Its symmetry is $U(1)$ and it is its own antiparticle, just as the photon.

Electron

When resolving other particles as quantized actions, I have focused on the fine structure constant, because it can be given as a ratio of actions. When the charge of an electron is given by Gauss law, the action of an electron is obtained relative to the action of a neutrino. From the numerical value one can figure out that the electron comprises of 138 quanta, to yield the torus that already Andre-Marie Ampere proposed. Due to the toroidal pitch, one quantum does not quite close a full loop, but one extra quantum will be needed to close the torus with 137 loops.

The conclusion about the quantized electron matches observations. The net number of loops gives the charge. The magnetic moment accrues primarily from the large circle and the anomalous part from the small loops, because they are not exactly perpendicular to the large circle due to the pitch. The mass of an electron compared with the mass of the Universe can be computed from the curve as the vector sum of signed curvature, just the way Leonhard Euler did. The electron mass is minute, because the vector sum of signed curvature of any two quanta at the opposite faces of the torus is almost zero, deviating only due to the pitch.

Presumably, this geometric notion of mass as curvature in relation to the curvature of the whole Universe may at first seem as odd, however, it complies with $E = mc^2$, and allows us to recognize the squared speed of light as the L^2 -norm of the vacuum.

The positron is just like the electron, but the handedness is the opposite. From this perspective antimatter is merely the opposite standard of handedness. This view illuminates the so called matter vs. antimatter asymmetry problem. Thereby it deviates from the current consent, but in the end all that matters whether deviates from observations.

Proton and neutron

It is easy to deduce from the torus structures that the up-quark is $2/3$ of a positron and the down-quark is $1/3$ of an electron. When the quarks are connected to each other by gluons, that is, short wavelength photons, one obtains structures of the proton and neutron. The tetrahedral symmetry is the familiar $SU(3)$ characteristic of baryons. The structures comply with measurements. It is easy to calculate approximate

magnetic moments to see that they agree with measurements. Also the masses can be calculated when knowing the electron mass, to see that they agree with measurements. The proton and the neutron are much heavier than the electron, because there is no curvature at the opposite side of the arcs of quarks to balance the vector sum.

The way Euler defined mass as the sum of signed curvatures projected to the curvature of the surroundings, means physically how much the photons have to curve, that is, to become denser, when next to the particle. **In the vicinity** of the electron not that much, because the torus, apart from its pitch, is symmetrical. However, the toroidal winding forces the photons in pairs away from the out-of-phase relation, which manifests itself as an electromagnetic field about the electron. When reasoning in this way, it is no mystery where the photons emerge all of a sudden when an atom ionizes. They have been around all the time, but in the out-of-phase configuration, and hence manifesting only as an energy density.

It is easy to describe for example annihilation of positron and electron using these concrete models of particles. The torus structures will open up and wind out against each other, so that the photons will discharge pairwise to the vacuum. In addition the two easily detectable photons propagating in the opposite directions account for the opposite handedness of positron and electron.

Electron capture

The particle models also make it easy to comprehend how an atomic nucleus captures an electron so that the proton transmutes to the neutron. When the electron comes close to the up-quark, it will open up to W^- boson by losing one of its loops with neutrino. The annihilation consumes the up-quark altogether, so that 1/3 of an arc is left from W^- that closes to a down-quark, and thereby neutron is complete. In this way I have described in publications also other particles and their reactions in agreement with observations.

Higgs

The quantized structure of many a particle can be deduced from its decay scheme. So I have deduced that the divine Higgs particle placed upper most is the exquisitely perfect tetrahedron with four open torus, since Higgs decays to two Z-bosons, and so. The mass of Higgs, as well as those of weak bosons is big because the torus ring is open by being short of one small neutrino loop. That tiny slot will accommodate only very high-frequency photons of the vacuum, and hence the particle energy is high compared to the vacuum.

I haven't figured out the detailed geometry of the 2nd and 3rd generation particles, for instance, how does the myon neutrino exactly look like? Its mass implies that the ring is bent away from the plane. The geodesic curvature of tau-particle neutrino is even greater. Oh, it would have been fun to play with these things too.

Interim audit

Surely the elementary particles as quantized actions, geometric entities, appear at first sight as incredible, but I believe not incomprehensible. Of course, the particle models appear naive, as new thoughts often are compared with highly refined ones, but in the end when respecting physics as an empirical science, all that matters is that these structures and others that I have published, comply with observations.

To me, and I believe, also for many others, elementary particle physics appear a bit abstract. Likewise chemistry appeared abstract some one hundred years ago, before the atoms with valences materialized as plastic models that pupils use today to build models of compounds. I hope that this insight of elementary particles as quantized actions, that is strings, will propagate and become appreciated.

Propagation of light

Next I will move to examine the propagation light using the continuum equation of motion.

The propagation of light is affected by energy density variations of a medium such as glass or water or by local variations in the vacuum density, that is, due to the gravitational fields about the bodies, or due to the diluting vacuum density of the expanding Universe.

Dark energy

Among the most interesting observations in the recent past have been the magnitudes vs. redshifts of type 1A supernovae. From this data it has been reasoned that the Universe is expanding at an increasing rate with help of dark energy.

The general law of nature tells a different story. According to it, light from the stellar explosion will be leveling off energy differences as soon as possible when spreading on an expanding spherical shell. So the light's intensity will decrease inversely to the square of the optical distance and directly proportional to the power, which will decrease as much as the universe has been expanding, that is diluting, in the meantime when the light from the distant explosion finally reaches us.

This description is familiar. The sound of a siren will decrease and lower in pitch when the ambulance drives away. When the power of light and distance is expressed by redshift, it is seen that logarithmic intensity, that is magnitude is not a function of one variable, and hence it cannot follow a straight line but curves in the distance. The curve is not a fit, but consequence when the age of the Universe is taken to be 13.8 billion years. As such it does account for observations without dark energy. The explanation, that is, the causal relation has no room for a murky parameter.

According to the general law of nature the Universe is expanding, not due to the initial bang but all along as soon as possible in quest of attaining balance, because stars, black holes and many other mechanisms, including ourselves, free the quanta from matter to embody the vacuum in the out-of-phase photon pairs. In this way the general law of least action resolves the so called horizon problem. Thus the new paradigm deviates from the current consent, however, all that matters in the end is whether it deviates from observations.

Dark matter

As indirect evidence for dark matter is taken observations that light when coming behind a distant galaxy will bend more, some four to five times more, than it should bend when calculated from the observed luminous matter by general relativity. According to the general law of nature in form of the principle of least time, light will propagate past the galaxy just as it does when choosing its path from air to water. According to this calculation, the ray of light will bend almost five times more than according to general relativity. Therefore the general law of nature is not in need of dark matter to account for observations.

Of course the listener must be now concerned that would not the general law of nature then yield much too big of bending for a ray of light that grazes the Sun compared to the observed value and the calculated one by general relativity. The difficult experiment at the peak of an eclipse was done first by Sir Arthur Eddington in 1919. Today the effect of Sun gravity on the propagation of photons is measured much more accurately from the time delay that a radio signal experiences on its way to Venus and back when grazing the Sun. The general law of nature yields the measured value 195 microseconds. As is well known general relativity gives the same correct value, however obtained from a different equation than the one used for calculating the bending. Why are two different equations needed to account for the same phenomenon, for the propagation of photons as light and as radio signal?

When comparing the bending of light coming behind a galaxy and when grazing the Sun, it is important to notice that the rays from a distant star are parallel in contrast when coming behind the galaxy. Also it is important to notice that when the ray passes through the Sun's gravitational lens it will not arrive in the same spot as when coming from the night sky. If one does not take into account this parallax when determining the angle, the bending will be determined about half as small as it is. Thus the general law of nature gives results in agreement with observed bending both for the galaxy and the Sun.

Galaxy

Surely as another evidence for dark matter is taken that the orbital velocity v increases from the center of a galaxy whereas the orbital velocities of planets decrease from the center of solar system. The galaxy's orbital velocity increases in the distance toward a value given by an empirical Tully-Fisher relation where the forth power of orbital velocity $v^4 = \alpha GM_o$ is proportional to the galaxy's mass M_o by small term of acceleration a , which is miraculously on the order of the speed of light divided by the age of the Universe $a = c^2/R = c/T = cH_o$.

According to the general law of nature the galaxy, just like a whirlpool, is approximately in balance with its surroundings, that is, with the rest of the Universe. Therefore the hydrogen gas clouds that orbit far away from the shining edge of a galaxy will experience in addition to the galactic acceleration also the acceleration due to the expanding Universe $a = v^2/r = c^2/R$. Thus, the galaxy orbits in the force field of the entire Universe just like a cyclone will revolve in a temperature gradient. The Tully-Fisher relation is obtained as an asymptote of the general law of nature, where the kinetic energy is in balance with potential energy, that is, from the familiar Kepler's law, but by including also the gravitational field of the whole Universe. Thus the general law of nature does not need dark matter to explain these observations either.

Clocks

It is gratifying to realize, that many a phenomena complies with common sense. For example, there is nothing peculiar about a clock running faster at attic than in cellar. At the attic the energy difference between the energy source of the clock and its surroundings due to the gravitational field is bigger than in the cellar. Therefore the faster rate is as comprehensible as the faster rate of heat leaking out, the colder there is outside. The results obtained by the general law of nature are not only compatible with observations but in many cases also with models of modern physics, in particular in the case stationary system as I have shown in publications. So, my starting point has not been to question doctrines but to comprehend causality, that is, relationships between forces and motions, in compliance with the character of physics.

I have used the general law to examine many more phenomena, especially several long-standing questions, to realize that the holistic worldview indeed makes observations comprehensible. The general law has been also helpful in addressing anomalies and observations that appear to contract laws of physics, for example, those elaborated in two recent manuscripts available at my homepage.

Closing statement

It is apparent that my work is by contemporary standards hard to quantify and it does deviate strikingly in its simplicity from highly specialized computations, models and simulations. Nonetheless, the holistic thinking and publications comply with observations and measurements.

When I began to unravel the causes of universal patterns some ten years ago, I soon understood to be on an exceptional exploration. There is very little support on the unusual territory and the journey stretches for long before companions appear.

In the course of history, it has been seen that science does not only advance by small steps, but once in a while a great leap is needed, to see clearly.

Today our university is expected to renew itself. To that end the new paradigm responds impressively by reviving the discipline by making its core tangible and comprehensible as well as broadly applicable to numerous challenges of today and future.

Thank you for your attention.