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CONCEPT RELATIVITY PART 2. SYSTEM COSMOLOGY

A new theory of the universe

What is our universe? Concept Relativity merges philosophy, physics, and information theory. Concept Relativity is a philosophy on reality and the human mind and it is a physical theory that unifies Quantum Mechanics and General Relativity. Mind and reality are unified by the concept of information and quantized by information of the concept. The conceptual framework of Concept Relativity is described in two parts.

HET MENSELIJK VERMOGEN

A systems ontology

The laws of information dynamics

A cosmic board model of systems

Our universe has concept symmetry between macro and micro levels

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Guide into the february 2023 Issue

This issue of “The Human Capacity” - magazine for the imagination – describes a new theory on the universe. I will pursue a new direction of theoretical research named Concept Relativity merging philosophy, physics, and information theory. Concept Relativity is a philosophy on reality and the human mind and it is a physical theory that unifies Quantum Mechanics and General Relativity. Mind and reality are unified by the concept of information and quantized by information of the concept. The conceptual framework of Concept Relativity is described in two parts.

The first part focusses on a physical theory – the unification of Quantum mechanics, General Relativity - introducing the object of an Information Universe, this second part presents a general information theory resulting in a systems cosmology.

In this second part I will investigate the informational structure of the Information Universe. Because information is defined metaphysically, all objects are ontological systems of information with a boundary, an internal structure, and an external environment. I will therefore introduce a new type of ontology: a systems ontology. This ontology is structured by five Meta-laws of Information Dynamics that are build around a new key concept: Information Potential. These meta-laws determine the ‘movement’ of information.

Applied on an Information Universe, the metaphysical ‘laws’ will create a new type of cosmology: A Systems Cosmology. It is a qualitative representation of a symmetric, scale-invariant hierarchy of systems of information. I will end part 2 of Concept Relativity with a section on the position of man in this cosmology.

Keywords: Systems theory, Ontology, Relativity, Information, Information Potential, Cosmology, Multiverse, Reality, Emergent properties

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Concept Relativity Part 2: a Systems Cosmology

1. Introduction

In Part 1 I stated that our universal reality is a conceptual representation of an Information Universe (IU). All things are (metaphysical) information. So we will consider that all objects, including our universe, to be **systems** of information. A system has a boundary, an internal structure, and an external environment. In systems theory it is widespread practice to model objects as systems of information using all kinds of mathematical techniques. Informational systems are easily digitalized and stored in computers, after which calculations are performed. Usually, we do not think of metaphysics during this process. But when CoR speaks of a system of information, it uses the term 'information' metaphysically. The deepest nature of all things is information, that must 'appear' and be measured by a conceptualization of the object. The object will present itself as an elementary entity or a system entity. It is this conceptualization that is modelled and digitalized, and not the metaphysical information itself. Only when the informational object is given physical properties, we, thinking observers, can interact with it. So, the systems approach is not only a useful tool, according to CoR it should be re-interpreted as a systems *ontology*.

2. Systems Ontology

2.1. The Composition of a system

The systems ontology analyses systems from a purely informational viewpoint. It uses the systems terminology to create a general theory of information, that in turn will give us a general theory of systems[i]. I studied the concepts used in systems theory in a concept mechanic (see part 1) manner. What is a system? A system is an object constituted of elements that are related with each other. There are three basic concepts in this definition: an *element*(-object), a *relation* and a *system*(-object). This concept group is a trinity and called the System Trinity, which is easily deduced from the Relation Trinity, which was defined in part 1 as the concept group containing the concepts of subject, object, and relation. If we take subject and object to be equal entities in a relation, they constitute a simple system: a system with two element-entities in a relation. The perspectives of this trinity although changes. In the System Trinity we focus on the duality between the part(s) (the elements) and the whole (the system) and not between subject and object. The concepts 'element' and 'relation' become duals and the system is the complement of this duality.

Each element of the System Trinity reflects the System Trinity by its own set of concepts which are again trinities. The concept of 'system' has three conceptual characteristics: entity, structure and set, defining a unity of a connected multiplicity. The characteristics of an element are entity, identity and a concept called 'information potential' defining the *complete* interaction potential of an elementary object (see next section). And thirdly, the relation is a long-term bound of exchanging information. It has the characteristics: binding, exchange, and information content (of the relation).I will discuss the relationship between information potential and information content shortly.

These 'decompositions' expands our vocabulary and give us new perspectives on a system. The **binding** perspective of the relation trinity binds things. It is a connection. The bound concept unites. And the binding scales things up. It creates a system, which is something 'bigger' than the connecting parts. The single element itself becomes a 'bigger thing' *by* the binding. In the **exchange** perspective of interaction, we point out another characteristic of an interaction. An interaction changes the objects (and/or subjects) that interact. That change is always an exchange. Something is carried from one to the other and vice versa. All communication between objects is an exchange of information. Interaction has a metaphysical dimension by stating that the exchanged information is equal to the information content of relation that will sum up to the information content of the system. all exchanges change the connecting parties.

The change of the connected element-entities is conceptualized into a transformation of **identity**. I will discuss the concept of identify later. The information potential of an entity 'determines' all the possible interactions within a system. Partly this information is 'hidden'. It is not realized potential. Partly this information is 'visible' within the actual interactions of a system. This stored Information is the information content of the system. Information is never destroyed and has only two forms: actual in relations and potential in elements of the system. Both forms of information express the metaphysical dimension of the system. All

information is discrete. It is a natural number. It is countable and it is counted in bits of information.

From the perspective of the system, we count the number of elements (the cardinality of the system). The elements are an enumeration and belong to a **set**, which has no other characteristic then the name 'elements belonging to the system'. So, this set is not the extension of a predicate. There is no predicate. The elements of the set are 'beings' gathered together. All systems have a **structure**, i.e., an enumeration of all active interactions between all elements of the system. The structure organizes the set of elements. Set and structure are complementary and form a system-entity.

This systems ontology fits the QM picture of interactions. According to the standard model (vector) bosons are the carriers of interactions connected with the four forces of nature. Each interaction has its own carrier. Bosons are even spin particles; they are discrete, countable quanta. They quantize the mechanics. Because bosons have even spin, they can share the same quantum state, which is essential to be an intermediate. We can pile up information in an intermediate, i.e., the strength of an interaction increases. Bosons themselves do not 'interfere' in the interaction: they just 'execute' it. They are in a sense, neutral. They just carry information from A to B. But quanta are always conceptual, they are not information themselves. The information is always conceptualized into quanta of a physical dimension. A and B do not feel bare information. They only 'feel' quanta. The quanta or conceptual represented information.

CoR dismisses self-interactions of bosons, carriers of interaction. Self interaction is problematic issue in physics. It causes all kinds of infinities which has te be 'deleted' by renormalization. CoR's viewpoint is different. Infinities are no problem; they are natural part of metaphysics[ii]. Infinities become problematic if you try to make them part of reality, measuring things and performing calculations. If you accept metaphysics, if you accept the existence of an IU there is no inconsistency anymore.

Another divergent viewpoint of CoR is, it considers properties of systems to be irreducible. It is a consistent conceptual presence build on the idea of a system. A system has its own existential presence. Many physicists tend to believe that TD concepts like temperature are no fundamental concepts but are 'derived' from statistics. Due to microscopic interpretation of classic macroscopic TD concepts, they tend to reduce the phenomenon of TD as being illusionary. The implicit scientific motivation of analyzing things judges the 'element' to be more important than the 'system'. CoR will not take such a reductionistic view. System concepts like temperature, pressure and volume are taken to be rational constants of the mind, they are fundamental concepts that define reality. The entity perspective of 'element' and 'system' are duals and have conceptual correspondence. It will enable us to investigate symmetries of concepts between the physics of element-objects and the physics of system-objects.

2.2. The System Concept Transformation

The concept of 'entity' or 'object' has two faces. When we consider it to be an elementary object we study its movement in its surrounding environment, neglecting the inner structure of the object. If an entity is considered to be a composite system object, we study the internal 'movement' neglecting the influence of the outer environment. From our relational perspective, these two views are complementary, just like the wave and particle are complementarity descriptions, connecting micro and macro world. By switching perspectives, an element-object of a system can become a system-object with an internal structure. We will define a concept transformation that that performs this switch of perspective. Performing this CoTrans repeatedly, downwards, and upwards, creates a hierarchy of systems.

The Horizon CoTrans turns a black hole inside-out and backwards-forward. Recall the Horizon CoTrans has two main parts, MM symmetry and LG-symmetry. The MM-symmetry exchanges big and small. If we consider the universe to be an information system, the appliance of the Horizon CoTrans turns the biggest system into the smallest element, and the smallest element becomes the biggest system. The IU-hypothesis implies therefore there must also be a concept symmetry between Element and System (ES-symmetry) . This kind of symmetry must be found in the concept-fields of Element-Physics and System-Physics. We expect patterns of concepts of element- and system physics which are congruential. In my concept mechanic study on concept fields of physics (part 1) I have postulated a correspondence between 4 basic concepts of Classical Mechanics (Hamiltonian external energy, time, impulse, location) and Thermodynamics (internal energy, (inverse) temperature, pressure (per degree temperature), and Volume).

Main Area	Element Physics			System Physics
Concept field	CM/SR/Bohr	QM	GR	TD
Basic concepts	*Classic element properties*	*Micro objects*	*Macro objects*	*System properties*
1a	x_i (position in space)	u (up quark)	g_{ii} (space part of covariant metric tensor)	V (volume)
1b	t (moment of time)	d (down quark)	g_{00} (time part of covariant metric tensor)	θ (Inverse absolute temperature)
1c	p_i (momentum)	e^- (electron)	T_{ii} (energy-impulse stress tensor)	pθ (pressure/ Temperature)
1d	H (external, Hamiltonian energy)	ν_e (neutrino)	T_{00}	U (internal energy of system)

Figure 1. Pattern sheet of four concept fields of physics: basic concepts

This CoTrans is called System Concept Transformation:

$$CT_{ES}\ (\underline{H}, \underline{t}, \underline{\mathbf{p}}, \underline{\mathbf{x}}) \Leftrightarrow (\underline{U}, \underline{\theta}, \underline{p\theta}, \underline{V}) \tag{2.1}$$

It is derived by symmetrisizing 'internal' and 'external' perspectives associated with System and Element Physics. The first law of Newton and the second law TD onto each other. The The CM first law of Newton of action (S) is

$$dS = Ldt \tag{2.2}$$

Using the Hamilton / Lagrange relation the law becomes:

$$dS = (\mathbf{pv} - H)dt \tag{2.3}$$

Rewritten as

$$dS = -Hdt + \mathbf{p}d\mathbf{x} \tag{2.4}$$

In TD de second law of TD relates heath to entropy (S) by

$$dQ = TdS \tag{2.5}$$

using $d(U\theta) = \theta dU + Ud\theta$ we get

$$dQ = dU + pdV \tag{2.6}$$

Rewritten as:

$$d(S - \theta U) = -Ud\theta + p\theta dV \tag{2.7}$$

2.3 and 2.7 are mapped onto each other by de System CoTrans (2.1). The variable S - θU is an unknown TD concept I have named to be the action of a TD system.

This Concept Transformation proposal adds new conceptual symmetries, we did not yet encounter in the Horizon or Human CoTrans. The inverse temperature in the system perspective resembles the time in het element perspective. The cooling down of the universe is a time parameter. The temperature of a black hole is near zero. It has reached the end of time. Flipping the CoRep to the Big Bang cosmology time starts again (almost 0) and temperature will be very high.

But the concept of temperature is not only a universal parameter. It is a parameter for all kinds of systems. In fact temperature can be considered a system-time. The magnitude of temperature also determines the dominant type of interaction between elements of a system.

2.3. Information Potential

In physics the concept of information is linked to entropy by the Boltzmann statistical interpretation of entropy of a TD system. In Shannon's definition of information entropy

equals *hidden* information enclosed in microstates of a system. We calculate degrees of freedom. We 'measure' disorder. But information is also be used to measure the degree of order or *organization.* Sometimes the term 'negentropy' is (wrongly) used. Concept Relativity (CoR) considers information to be a metaphysical substance. To CoR all reality is an appearance of information, in which hidden information becomes 'visible'. The present definition is originated in the theory of communication and not metaphysics. We therefore need a refinement of information that contains hidden and visible information.

Clearly order and disorder both have an informational dimension. I shall demonstrate the relation between both types of information in an example. Let us look at the outcome of a throw of 1000 coins[iii]. This statistical system has 2^{1000} possible states. The entropy of the system $S = k \log W = 1000\ S_0$. If we set the constant S_0 to 1, the degrees of freedom are 1000, and the hidden information is 1000. But what is the amount of *ordered* information presently stored and visible in this statistical system? Obviously that amount is zero. There is no organization present in the chaotic process of throwing 1000 coins. Let us now 'connect' 2 coins by an unknown interaction[iv] which forces the 2 coins to become both either 'heads' or 'tails'. We lose a degree of freedom, but we gain a binding where information is 'stored' into. This storage can be visualized as a permanent 'exchange' of information between the 2 coins that 'tell' each other what the state of the other is, so that they can match the others state. By this binding the system gains organization, it gains information content. Hidden information is *transformed* into ordered, 'visible' information stored in an interaction. I write the word 'visible' with quotes because we never actually see information. We only see a conceptualized form of it. When *all* coins are connected this way the entropy of the system would become 0 and the stored information will become 1000.

Information enclosed in order or disorder of a system are communicating vessels. The *information content* which is stored in interactions is a measure of order and complexity. It measures the number of bindings. On the other side, informational entropy measures the amount of hidden information, chaos, and disorder. It measures the degrees of freedom of a system. *All real system* have an amount of organization (Information content or ordered information or visible information) *and* an amount of 'freedom' or disorganization (entropy or hidden information). I will call the sum of both **Information potential ϕs** of a system S.

$$\underline{S} + I = \phi_S \qquad (2.8)$$

In this definition $\underline{S} = S/S_0$ is informational entropy, or **entropic information** which is a deconceptualization of entropy by dividing it by its corresponding universal constant. The quantity I denotes the **information content**, a quantitative measure of order of the system.

Information Potential characterizes a system and tells something about the *potential* amount of order and/or disorder the system can gain. Order and chaos, - or organization and disorganization, - each have their *own* quantity of information. If a system has no visible structure, like a throw of coins, or a gas or a black hole, the variable of information content will be zero and the information potential will be equal to the entropy of the system. But if there are no degrees of freedom in a system, then too the system contains information, but this information is stored in *bindings* between the elements of the system that creates a structure or organization. The information potential is equal to the information content of the structure of the system. The information potential, the sum of information content and informational entropy, is a *fixed* characteristic of any system.

The information potential of a system is metaphysical 'property'. Information potential is a metaphysical substance, assigned to a system (of information) and is denoted by a number. It also has a physical concept representation: it is the sum of all information hidden in 'chaos' and all information stored in relations of order. Assume *all* hidden information eventually will be 'realized' within (new) relations between elements of the system, then information potential is the metaphysical sum of all physical interaction potentials. I will use the symbol ϕ_S, because we can visualize Information Potential as a metaphysical field, although this field cannot be felt or measured directly. But – just like other fields – this field causes movement of information, that, again, cannot be felt directly. This movement is expressed in different physical concepts of movement. Information potential is therefore a keyword in Information Dynamics, we will discuss below.

Let me now reexamine the paradox I mentioned in part 1 of CoR. A Big Bang universe starts off with minimal entropy. A black hole ends with maximal entropy. An IU is universe and black hole. How can both be true? CoR seems to violate the conservation of information? We will solve this paradox using the concept of information potential. We state that the information potential both CoRep's is the same; the *total* amount of information, the

information potential, is fixed. But the ratio of entropic information and information content is different in both CoRep's. The Horizon Concept Transformation (CoTrans) *exchanges* information content and entropic information. The entropy of a black hole is maximal and it is *all* hidden information. It is fully disordered information. Whereas de starting entropy of a Big Bang universe is minimal. The initial state of a universe is highly ordered. So, information content is maximal. The Horizon CoTrans maps disorder onto order.

3. Information Dynamics

Having introduced a systems ontology and the crucial concept 'information potential', let us now investigate how systems of information are 'build' from an informational, metaphysical point of view. First of all, we have to ascertain that information within systems ontology moves. It is not static but dynamic. The dynamics is reflected in the dynamics of our universe representation. I will present in the next sections five meta-laws of Information Dynamics (ID). I will not use the term 'law' but instead use meta-law. The meta-law of ID are no *real* laws because they cannot be tested directly by physical experiments. They are metaphysical/mathematical in nature or if you like, they are 'laws' of thought. They express themselves in real systems through physical interactions and relations. The laws of physics and the structure of our universe are a conceptualization of the dynamics of information processes. The first two meta-laws of ID resemble laws of TD. The third and fourth meta-law are complementary laws and create a hierarchy of systems. The last meta-law is a corollary caused by the symmetry of an IU. The meta-laws are named, the meta-law of

- conservation of information (ID1),
- movement of information (ID2) ,
- the information boundary (ID3) ,
- emergence (ID4),
- hierarchy symmetry (ID5).

I will discuss them consecutively. These meta-laws are the basis of a new type of cosmology, a systems cosmology, that I will present in the last section.

Of fundamental importance is the prediction of CoR that our universe is an *open* entity[v]**.** The big bang of our universe *co-exists* with a creation of a black hole within our parent universe. And all black holes within our universe are (proto) universes which are fundamentally *open* entities. There exists a *permanent flow of mass/energy/information from outside to inside*, from the parent-universe to the child-universes.

3.1. Conservation of information (ID1)

The first law of TD is the law of conservation of energy. It has a metaphysical counterpart in the meta-law of conservation of information. According to Noether theorem a law of conservation is related to a symmetry. The conservation of energy is connected to the symmetry of time displacement. Likewise, the meta-law of conservation of information is connected to the symmetry of conceptual connectivity, which is named 'causality.' We interpret reality by chains of concepts. All 'movement' in our universe is a chain of cause and effect (mostly plotted in a time flow). The effect-concept becomes a cause-concept to another effect-concept. Causes and effects are a series of concepts that are 'connected.' The chain of causality has translation symmetry due to its repetitive character. It precisely this symmetry that establishes the conservation of information. Within the chain the information, as it jumps van link to link, does not change in amount. During a causal process, the quantity of information does not change. It is conserved. In a formula:

$$\Delta I = 0 \qquad (2.2)$$

We cannot prove conservation of information. It is a believe. But scientists strongly believe in rationality. Physicists may reject the idea of God; they will never reject the idea of causality. It is unquestionably. Conservation of information is an essential precondition to CoR because information is the metaphysical basis of all concept transformations. It must be conserved.

Because there is no experimental verification of conservation of information possible, we could look at the next best physical thing: the conversation of energy. It has been studied deeply and is well established. Energy can change its form, from potential energy to kinetic energy, to heath but the total sum will always be the same. There is no known process that violates the conservation of energy. In part 1 I argued that although the Horizon and Human Concept transformation can change the form of energy, the physical dimension is unchanged, suggesting that the sum of al energy forms will be constant in either CoRep. In the Horizon

CoTrans time/mass is transformed into reciprocal, localized space/charge. Energy is conserved. It is a strong indication that information will also be conserved.

The conservation of information was a central topic in a debate between Stephen Hawking and Leonard Susskind/Gerard 't Hooft on 'conservation of information' in a black hole [1]. Hawking claimed information is destroyed in a black hole. Susskind and 't Hooft refuted this idea because it would undermine causality and reversibility. We need conservation of information to maintain causal bounds. The battle was won by Suskind/'t Hooft in which 't Hooft introduced his holographic principle, I will discuss it later (ID3).

3.2. Movement of information (ID2)

Movement is determined by the laws of Physics. The laws of QM, GR and CM (the Physics of Element-Entities) are time symmetric. If we reverse the direction of time the laws stay the same. In the Physics of System-Entities) like TD 'movement' is a-symmetric in time. The famous second law of TD states that entropy will always increase in closed systems. If we reverse time the TD process will not be the same. If we watch the film of a broken teapot backwards, we see a different film. Another a-symmetric process is evolution. The universal picture is a growing chain of complexities, from quarks, tot atom, to living cells and intelligent beings. This process is not time reversible. One of the great puzzles in physics was, how are these two a-symmetric processes related to the symmetry of physical laws?

Until now the solution was two-folded. Firstly, Boltzmann himself gave a statistical interpretation based on symmetric mechanical laws of elementary objects. Secondly, the theory of dynamic systems, chaos theory and others showed that complex macroscopic structures evolve form microscopic elements in systems far out of equilibrium. Our Big Bang Universe is such an unstable system. In the 1970s Prigogine [2] was one of the pioneering scientists that studied systems far from equilibrium and found that complex macroscopic order arises from a steady flow of energy between the system and its environment. These systems evolve and organize themselves. Nowadays they are called self-organizing systems. Still, self-organization is considered to be a spontaneous order created by some external cause. It is therefore considered a 'secondary' process, requiring a disturbed equilibrium. Evolution is not in conflict with the second law of TD. Systems only *decrease* in entropy if the entropy of the surrounding environment *increases* equally or more. Eventually, which is the mainstream thought of physicists, on a bigger scale, all evolution, including human intelligence is just a temporally perturbation that will fade away as time goes on. The end of our universe will be a heath death, or a big Crunch, or something else, we do not know. But what we do know: humans are irrelevant in this process.

Modern cosmologies, well considered, ridicules most of human existence. CoR changes this cosmological perspective radically. According to CoR there is a firm relation between man and universe: mind and reality are conceptual expressions of information. We will have to develop a cosmology that is based on an integrated vision on mind and reality. First, we will have to ask ourselves, is our existence just a coincidence? In part 1 I discussed the 'anthropic principle', a key idea that tries to position man within the universal reality. According to the IU hypothesis our universe is an open entity, a child universe that is in permanent contact with its parent universe. So, one of the main assumptions of modern cosmologies - the universe is closed - , is refuted by CoR. Because our universe is open, an increase of complexity, i.e., evolution could be natural process due to instability caused by the flow of matter/energy between our universe and our parent universe. But CoR will go one step further: there is a fundamental symmetry between evolution and disintegration. CoR states there exists a 'complementary meta-law' that completes the second law of TD. Information Dynamics replaces the second law of TD, on an informational level, with a *dual* set of meta-laws:

$$dI >= 0 \quad \text{for open systems (ID2a)} \tag{2.9}$$

$$d\underline{S} >= 0 \quad \text{for closed systems (ID2b)} \tag{2.10}$$

where I = the information content of a system and $\underline{S}$ the normalized entropy (hidden information). ID2b is an informational version of de second law of TD which I will name 'the meta-law of closedness. ID2a is the complement and is called the meta-law of openness[vi].

The meta-law ID2a is the *fundamental engine* behind (self-)organization and evolution; It has the same level of 'lawfullness' as ID2b, the meta-law of growing disorder, disintegration, and destruction, well known by the second law of TD.

I should immediately add a metaphysical 'corollary' to this dual set of movements: there do *not* exist completely open or completely closed systems. E*very* system (object) is (partly)

open (connected to the outside world) and (partly) closed (confined by some boundary). Both meta-laws of movement of information are active in the movement of *all* systems, even the biggest system we call 'universe', as I explained in part 1. Open-ness and closed-ness are treated by CoR as dual polarities. A completely closed system can be used as a model for nearly closed systems. Every physicist is aware of the limitations of the closed system approximation. Even such a simple action like measuring the temperature of a gas of a closed container disturbs the system. By measuring the temperature, the system is not closed any longer: the act of measuring the temperature affects the system. It makes it open. But in most cases physicists calculate that this disturbance of the system is so small that we can neglect it. Such a system is almost closed, so the second law of TD (or the information movement meta-law of closedness) will dominate its progression. A *completely* closed system would exclude *any* interaction and therefore the system would *disappear* from our world.

The same reasoning, although more difficult, can we apply on a 'completely open system'. Such a system disappears because it dissolves completely into its surrounding world. Every system needs connectivity and *bounds, borders* to exist. Let us observe that same gas-system and assume we could measure the 'density of information' of this gas-system. Would the density of information within the system at all places be equal to the density of information outside the system we cannot detect a system boundary and therefore we do not see such a system. Or alternatively, locate within the container of gas a tiny part of space. This space may be called a complete open system because the particle density (which is proportional to the density of information) within this part of space is equal to the density elsewhere. We have no means to recognize a complete open system as an object. And again, physicists can use a nearly complete open system approximation, isolating the open system by introducing an artificial permeable boundary, knowing that this will distort the complete open system. By introducing a permeable boundary, we create a nearly open system we can do experiments with.

The metalaw of openness, open systems evolve to more complex systems, is a well known fact from human experience. It is called *learning*. We believe that people who keep an *open* mind are better off than people who close their mind. In Darwin's theory of biological evolution openness is inherent to the process of adaption to a changing environment. These processes are representations of the universal meta-law of openness. The information movement meta-law of openness will change our perspective on the universe dramatically: **evolution of complex systems becomes a lawful necessity** in an open universe. Until now the growth of complexity has been conceived as *spontaneous* order caused by some external agent. CoR tells us it is not a spontaneous process; it is a lawful process. Which means, just as we did with the second meta-law of TD (the heath death) we could extrapolate the development of the universe on basis of a 'meta-law of evolution' connected to the openness meta-law (ID2a), gaining additional order by interacting with de outer world of het universe. The expansion of our universe, and the acceleration of the expansion due to dark mass is the universal motor of a structural evolution of complexity (from atom, to molecule, living and intelligent being). It is no coincidence, it is lawful. All (child) universes will 'produce' intelligent beings if the information potential of the universe is large enough. The openness meta-law is also the underlying fundamental law of systems theory, chaos theory and the theory of dynamical systems.

A universe is a real system All real systems are open *and* closed. The evolution of the universe will depend on the **balance** between both movement meta-laws of ID. There is no deterministic plan because there are always things we do not know. Sometimes closedness dominates, sometime openness. We could picture an IU as pulsating entity that lives and dies. A 'young' universe is a very much open system (i.e., the flow of information between inner and outer world of the object is high compared to the information-content of the universe itself) and therefore grows fast in organization (just like a human child is learning fast, ordering the world it experiences into concepts). The abundance of complexity we see in het universe is due to this openness. Order is forced *lawfully* by the meta-law of openness. On the other hand, when a universe gets 'old' it is getting more 'closed' (i.e., the flow of information between inner and outer world of the object is low compared to the information-content of the object) and it will slowly disintegrate according to the law of closedness. This cyclic process is omnipresent. All things, even universes, gets born and dye. Even if we theorize of multidimensional entities 'bigger then universal,' these entities also will be open and closed. So, there are *always* 'bigger' systems. There is no end boundary to reality. There are many boundaries, but they always will be transcended.

I am aware this change of perspective may be quite disturbing. We normally do not think of atoms, molecules, stars, galaxies as 'evolving systems.' Evolution was 'confined' to biological, living systems and intelligent beings (cultural evolution). The rest is 'dead matter' that obeys the laws of physics. Material systems do not self-organize. But according to Information Dynamics they do. All systems are subjected to the movement meta-laws of information. The organization depends on the degree of openness and the flow of information between the system and its environment. There is no fundamental difference between matter and live from an *informational* point of view. The movement meta-laws underpin **universal evolution**. For instance, consider a system of molecules. If this is a closed system, we would be incredibly surprised if this system would change into a car. But if we accept it may be an open system, influences from outside can change this system into a car. That is what we do in our car factories. The impact of the outside world changes the internal structure of a system dramatically. Of course, a car is a product of man, it is not a self-organizing system. So how does self-organization work? If intelligence (a thinking consciousness) is a product of self-organization, how does this intelligence come into existence by evolution?[vii]

3.3. The Information boundary (ID3)

The Bekenstein-Hawking entropy is the amount of hidden information 'stored' in a Black Hole. It is a number equal to the surface of the black hole measured in Planck units. To outside spectators there is no order within a black hole so we must assume that the information content of a black hole is equal to zero. i.e., the information potential of a black hole is equal to the Bekenstein-Hawking entropic information. This number is a **maximum** boundary.

Quantum gravity gave us another astonishing idea, put forward by Gerard 't Hooft [3] and is called the **holographic principle**. It emphasizes that the information enclosed within a black hole is proportional to the surface area of the black hole and *not* proportional to its volume; the information stored in a black hole is lesser than one would intuitively think. If you double the volume, you cannot put twice as much information in it. It is proportional to its surface. The black hole surface acts like a **hologram:** all information of the inside black hole is 'written' on the surface.

According to the IU Hypothesis all black holes are universes. The information potential is conserved in the concept transformation. But contraire to a black hole, the universe starts off with a *maximum* of *order*, a maximum of information content and a minimum of entropy. So, the Schwarzschild horizon is not just a conceptual mirror; it is also a perfect book-keeping system: all information of a black hole/universe is represented on the surface of the system. Not a single bit escapes. To a black hole CoRep that information is disordered in degrees of freedom, to a universe CoRep that information is ordered in relations of the system. When the mass of a black increases, its surface area grows, information is added, the universe CoRep expands, the maximum boundary of the information potential increases.

I will *generalize* both ideas from quantum gravity into a meta-law of Information Dynamics which is valid for *all* informational systems. An IU is an informational system. In mathematical metaphysics we cannot distinct between various kinds of systems because there is no distinctive property we can use. All informational systems have just one property: information. From an informational perspective there is no difference between a black hole and a molecule or a cell. So, when a black hole has a theoretical information boundary, I will postulate that *all* informational systems will have an information boundary. Likewise, that information boundary will be *equal* to the information potential of the information system (ID3). By definition, information potential is the sum of the information visibly stored in relations within the system and the hidden information, representing some degree of freedom. There is no third category.

Likewise, I will generalize the holographic principle. All informational objects have borders that isolate them form the surrounding environment. All system-objects have a surface, which represents all information of the system. The surface of an entity, whether element or system, is an information interface that constraints the amount of information, that can be gathered from a system. Which is not as surprising as it looks. The surface of an entity is the (only!) means of communication. By its surface, a system expresses itself. I will call the surface expression of an entity its identity. Take for example a system of two human beings related to each other. The 'surface' of a human being is its sensory apparatus (skin, ear/voice, eye, nose, and tongue). All information that is exchanged between people goes through these five channels of communication. No other information can be obtained from outside these channels. Of course, we can learn more about a person by using all kinds of technological tools (CT scan, blood-analysis). But all this information is again retrieved by sensory input.

An entity (element or system) communicates by means of its surface/identity. All information is retrieved by means of this surface/identity. But that same surface also *restricts* the flow of information. The surface of entities in an expression of the information content of the entity. To outer world there is no more. We cannot know more than what the surfaces expresses. Every surface, membrane, skin of any other kind of border are information mirrors of the internal structure of self-organizing systems. Identity is the hologram of an informational object. I should point out, there are two layers of meaning, - physics and metaphysics. The idea of a hologram or identity involves conceptual content, - properties - whereas information is just number. We cannot project a volume-bit of information onto a surface-bit of information. We always need appearances, which uses information. These appearances have different forms and are sometimes difficult to compare.

Using 2.1 and the information boundary (ID3), the meta-law is presented in a simple inequality that will hold for all systems of information.

$$I_S <= \phi_S \tag{2.11}$$

The information content of a system, information stored in order of a system, is always smaller or equal to the information potential of the system. A *Complete System* is by definition a system that has an information content equal to its information potential. I.e., a complete system is a system that has realized its complete potential. There are no degrees of freedom anymore. The entropic or hidden information has become zero. All information is actively present within interactions, which are presented on the surface of the system.

It is essential to point out that the information boundary of an informational system depends on the *types of interaction* that builds the system. All informational systems are built by one or more of the four forces of nature. The size of the system restricts the possible mix of interactions that builds a system. Within some given size we can assume that the nature of the relations that build the system cannot change fundamentally, i.e., its surface is fixed. Due to the meta-law of openness, system of a specific size will grow in information content, expressing that information on the surface. I.e., the communications will grow and intensify. Focusing on only the openness meta-law we achieve a rudimental model of evolution of informational systems. Entities of some size start off interacting with each other relatively short termed. Increasing in number, entities become elements of a system. The short-term interaction has changed into a long-term relation. First loosely connected, but gradually gaining order and information content. Hidden information which was enclosed in degrees of freedom gets realized and becomes 'visible' in relations between elements of the system. I_S increases, entropy decreases. I_S is expressed in the surface interface of the system. Because the size is fixed, increasing information content will reach eventually a maximum, the information bound of a system. As I_S becomes equal to ϕ_S the surface expresses the maximum information. The system next, becomes a stable entity in a higher system level and starts of as an element in a system with again maximal disorder. The process now repeats.

Of course, we could also investigate the structures in our universe by looking at the universal constants and the coupling strength of the four forces of nature. From the strength of the interaction(s) that build a system a typical scale and structure could be deduced [4]. The perspective that is used here, shows us the same analyses on size, scale and structure using *only* the movement meta-laws of information and the information boundary of a system. It is a deduction from a pure informational line of thought.

Finally, let us discuss the third law of TD from the perspective of ID. The third law of TD does not state a maximum boundary but a minimum boundary: $T => 0$. The third law of TD says entropy of a system will be (near) zero if the temperature of a system approaches zero. All systems go into a ground state, the minimal state if temperature drops to zero. But the information potential of the system does to change. Therefore, the information content should increase. The ground state will be a state of complete order. All elements become united. The resistance disappears. There are no degrees of freedom. The elements 'live' in a perfect harmony. This pure state of the system is 'lost' as temperature rises. Evolution is a mirror process, decreasing temperature brings perfect order (at $T = 0$) where increasing time evolution creates perfect order when $I_S = \phi_S$. The maximum information bound is a mirror process. As a system reaches it platform is becomes stable, almost inert. It is complete. It creates levels of stability.

3.4. Emergence (ID4)

When a system completes its potential, when it reaches its maximum information boundary (ID3), the movement of information (ID2) does not stop; evolution does not end. Evolution will proceed on a higher system level. A new system level emerges based on the

complete system. The meta-law of emergence (ID4) states that the system level of complexity that emerges will have a unique irreducible property that characterizes the new system level and its evolution. This emerging property does not come out of nothing. It is 'caused' by a quantitative growth of information. The meta-law of emergence transforms quantity into quality. Because universal evolution performs this process of emergence repeatedly, a hierarchy of systems is created.

The transformation from quantity into quality corresponds with a transformation of a system into an element. A complete system is a stable system; The stability is the result of tight relations within the system. The system 'behaves' as if it is an elementary object. And it is. A complete system is *both* system and element. Complete systems are the building bricks of higher system levels. The complete system is an elementary object with an information potential which will be get realized by interacting with other emerged entities or with its surrounding world. Objects that are at these 'crossroads' of evolution are *universal object constants*. They are constants of evolutions. Object constants have a dual concept representation: an element CoRep and a system CoRep. Object constants are universal constants, comparable with the velocity of light, or the Planck angular momentum, but they are objects, no properties. The object constants are building brick of the structure of the universe. All over the universe the same building bricks are formed, driven by the movement meta-law of openness. The information upper boundary of a system creates borders, barriers which become thresholds to next system levels. Constants of evolution are 'knots of transitions.'

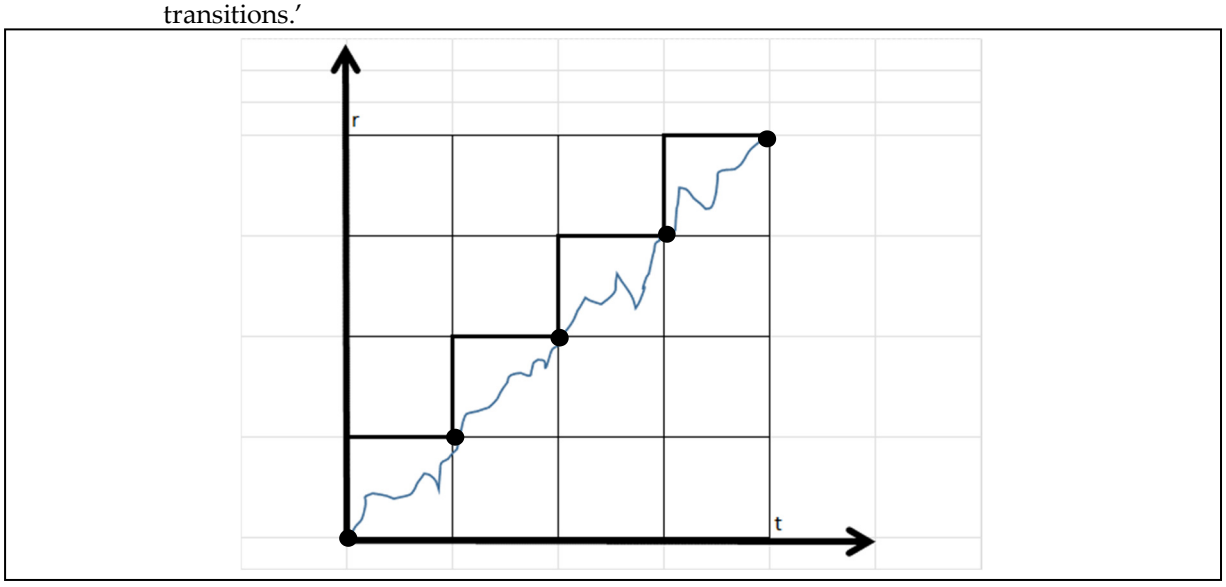


Figure 1. a hierarchy of four system-levels in space-time plane

In figure 1 I have drawn a 4-level hierarchy of information systems in which is plotted IS(t) (the irregular curve), ϕS(t) (the black staircase function) (S = 1, 2, 3, 4) and object constants of universal evolution (the black dots). Each dot symbolizes a complete system build out of millions of elements of the 'lower' dot. The irregular form of IS(t) illustrates the 'battle' between order and disorder and is caused by the movement meta-laws. The evolution took time tN – tN-1 to evolve from the evolutionary constant SN-1 to SN.

The relation between the information potential ϕS of a system-object SN and is the sum of information potentials of the element-objects of the system:

$$\phi_S = \sum E\ \phi_E \qquad (2.12)$$

If the information potential of alle elements is completely 'released' in system interactions, the information content of the system equals the sum of information potentials of the element-objects, which will transform into an information potential of the corresponding element-object on the next system-level.

The information potential is proportional to the surface of the system-object (~R2). I will therefore plot ϕS against a vertical special axis. The result is a staircase function (figure 1).

Each element-object of a system-objects is, again, a complete system of elements. The information potential of a N-level hierarchy is therefore:

$$\phi_S = \sum E_1\ \sum E_2\ \sum E_3\ \ldots\ldots\ \sum E\ \phi_B \qquad (2.13)$$

The theoretical lowest level of a systems hierarchy is a bit-system. A bit is a system-object which information potential equals 1. This is a very peculiar system, where all conceptuality breaks down. There is no difference between system, element, relation, and propagator. All are one. There is no difference between Information potential, information content or entropy. All are one. It is information itself we discover.

ϕ_S is a mathematical number indicating the information of a system-object. Let us now turn to the qualitative perspective. The stability of the object constants is related to the fact that a quantitative inner evolution of the entity is put on 'hold' (IS cannot increase) so that the focus is shifted to an outer evolution. These objects behave as elementary objects, as elementary building-bricks of a new kind of evolution connected with its corresponding system level. Looking through concept relativistic glasses we see a concept transformation happening: the 'system' becomes 'element.' Within this transformation a new cosmological 'quality' and 'interaction' emerges, that cannot be reduced to previous processes or microscopic states. When a system becomes a new unity, it becomes irreducible and it creates its own 'world of operation.' So, in a hierarchy of systems, any object is 'categorized' by its number of cosmological qualities, i.e., the system-level the object is operating on.

$$O(P) = P_1 + P_2 + P_3 + ….. + P_N \qquad (2.14)$$

where N is a finite number. Any informational system-object has as finite and distinct set of irreducible informational dimensions that correspond to the number of system-levels that was needed to build the system. The transformation from 'system' to 'element' effectively is a transformation from 'quantity' (many elements in a system) tot 'quality' (a new emerging property for a single object). From our informational/mathematical viewpoint we see a continued growth of information content, but from a conceptual viewpoint we see dramatic conceptual changes occur, which I will present shortly (the evolution cosmology). According to Wheelers famous article [5] (mentioned in part 1) a unification of QM and GR must involve the idea: more is different. These words express the fundament quantity-quality duality. A bigger number (a quantitative 'more') equals a qualitative difference. Something new emerges.

The meta-law of emergence is found in many structures and processes. In the Bohr model of an atom more shells of electrons equal new chemical qualities. Due to Pauli exclusion principle each shell has a maximum information content. If no more information can be stored a new shell emerges with new chemical qualities. The meta-law also applies on matter phase changes. When steam turns into water a new quality of matter occurs. Microscopically steam and water are simply great quantities of H2O molecules, but on a system level, completely different properties exist which cannot be reduced to each other. On an informational (metaphysical) level we see how an ever growing quantity of information (density) reaches certain system threshold after which the additional growth is realized by an emergence of new qualities. Our systems cosmology is based on this principle. The quality of live emerges from matter. The quality of thought emerges from informational maximized live systems.

Even in mathematics itself quality emerges from growing quantities. Ask yourselves what the difference is between 1 and 2. This is not just a matter of adding or subtracting, 1 + 1 = 2, or 2 -1 = 1, it is not solely a matter of connecting quantities, it is also a matter of changing qualities. 2 is something utterly different then 1. We use two symbols to denote that difference, 1 and 2. Would only quantities counts we would just speak of 1 + 1 and not invent the unity/symbol of 2. But at the same time 2 is based on 1, by taking two 1's together. We see that the quality of 2 emerges from growing quantity. This emerging quality 2 is irreducible and at the same time just the sum of 1 and 1. The inequality $1 < 2$ creates a fundamental difference and isolates the numbers as separate qualities. Looked at in this way the set of natural numbers is an abstract systems hierarchy. Moreover, as I said before, natural numbers are attached to metaphysical objectivity: all numbers are, considered as quality, one and the same: pure information.

The hierarchy of systems created by the second and third meta-law of Information Dynamics shows a continuous growth of information, but also each level of the hierarchy creates its own unique quality of being and a corresponding new type of interaction (ID4). The number of system levels in a universal systems hierarchy depends on the number of universal interactions a universe has. Our universe has four universal forces (gravity, EM, weak and strong force); we should therefore expect four main levels of complexity. Each system level will be characterized by some 'mix of interactions' that becomes the formative

power of system development. The 4-folded interaction is conceptually reshaped into a four folded structure of the universe based on four object constants.

This numerical equivalence is a consequence of IU symmetry, defined by the Horizon and Human CoTrans. Order and disorder, quantity and quality, system and element are entangled like the QM wave and particle are. Entanglement expresses the fact all information (entropy) is fundamentally 'connected' (expressed as a simple number). From this entanglement an unitarian potential of (distinct) properties or relations appears. Successive evolution levels of emerging structure inherit this entanglement which will have 'residual effects,' i.e., emerging properties.

What are the object constants of our universe? Or more precisely, what are the four emerging properties that characterizes these object constants? One way of answering these questions is by looking at the system formation of a hierarchy. The elements of Standard Model could be evaluated as a system level of energy. Systems of quarks/fermions become atoms. System of atoms become molecules. Systems of molecules become a cell. Systems of cells become conscious, intelligent beings. Another approach analyses the emerging properties. Inertial mass and charge, - matter - emerge out of pure energy as temperature of the universe drops below a threshold. Live is an emerging property. It is built out of 'dead' matter. Intelligence and though are caused by consciousness of a self. It transcends the processes of life. These four properties, energy, matter, live, intelligence should correspond to system levels of object constants. Additionally, four universal forces of different strength will build a four level hierarchy. We could also try to relate the mix of forces to each individual system level. In the chess board cosmological model below, I will a draw a basic structure.

All hierarchical levels are systems of information. They are fundamentally the same. Although various kinds of properties emerge, they are all based on information. The metaphysics is identical. All objects, (systems and elements) interact and relate. Information is stored in interactions and relations. Information increases by movement meta-laws. From this view point each hierarchical level represents a reality. So, the human perspective, based on intelligence is just one of many realities. Our universe consists of multiple irreducible worlds or realities. An atom has its own reality, just as a cell or a planet. Like Thomas Nagel argued [6] in his book 'Mind & Cosmos,' CoR expresses there is not just one world of (only) matter, there are many worlds of irreducible beings, all levels of a universal holistic entity. And, as we shall see, there are worlds beyond what we know of.

3.5. Hierarchy Symmetry (ID5)

All IU's are concept symmetric. The Human CoTrans I developed in part 1 states that the informational structure of the smallest microscopic objects (the standard model of QM) mirrors the informational structure of the biggest macroscopic object (het universe defined by the metric and energy-momentum tensor). This mirror transformation also affects all scales and structures in between. Consequently, a systems hierarchy must also be concept symmetric. I.e., there *must exist* a symmetry between microscopic and macroscopic system-levels of a hierarchy. This meta-law of Information Dynamics is called Hierarchy symmetry (H-symmetry, ID5). When we 'inverse' our universal system in the Human CoTrans, all layers of complexity of the hierarchy also are inverted. So CoR predict that *the number of microscopic layers of complexity must be equal to the number of macroscopic layers of complexity relative to the human thinker*.

Another way to deduce Hierarchy-symmetry is by starting with the Big Bang. In the very first moment of creation, a black hole is a very compact (almost point-like) entity, which is also the starting point of a corresponding universe. Micro- and macro-world are united and deeply intertwined. When the universe starts to expand the original unity of the microscopic and macroscopic world will be preserved. This preservation must be expressed into universal physical laws and universal physical constants. But as these constants are the basis of structural organization, this preservation must also be expressed in a symmetry on levels of structures or an entanglement of micro- and macro processes.

According to Big Bang theory the universe started off as a point like ball of energy-space-time that rapidly expanded. As the universes expands information thresholds (ID3) are passed. With the passing of each threshold new structures emerge (ID4). Systems of energetic particles transform into elementary particles. Systems of elementary particles transform into atoms. Systems of atoms transform into molecules. System of molecules transform into living cells. System of cells transform into intelligent beings. Each threshold is a specific point in space-time that divides the universe in layers of space and time and worlds of operation and being. And according to ID5 each microscopic threshold must have a macroscopic

counterpart. We find that within the universe more complex galactic structures appear; within galaxy stars appear; within star system planets appear; on planets a biosphere appears; within the biosphere social communities arise. In figure 2 I have sketched the evolution of a systems hierarchy schematically.

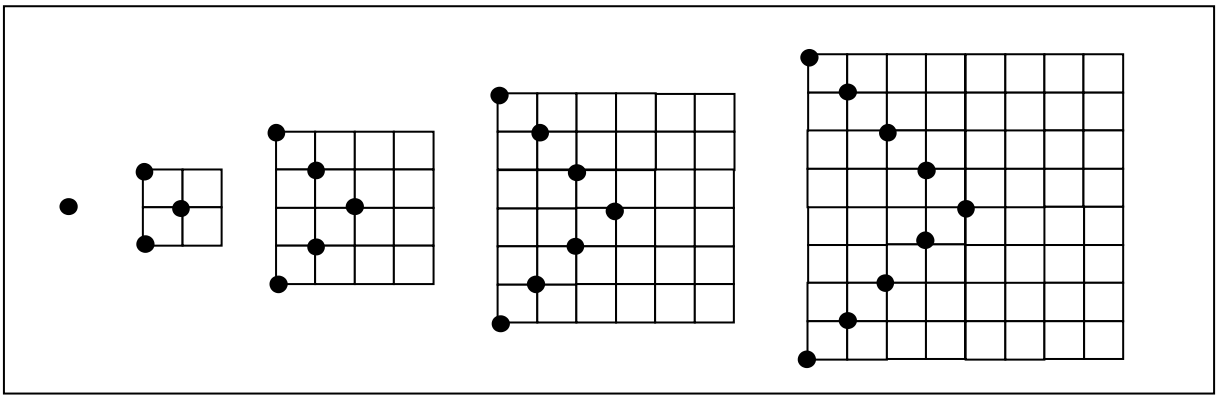


Figure 2. Hierarchical stages of expansion of the universe in a spacetime plane. Co-evolution of microscopic and macroscopic levels in a symmetric hierarchy.

The left half of each square is the past. The right half is the future, it is terra incognito. The upper half of each square is the macroscopic world. The lower half the microscopic world. The dots in figure 2 are the object constants of the IU, which are stable objects that have an information content equal to its Information potential. They are elementary objects of a system level and are characterized by an emerging quality of being. Each row is representing an emerging quality, a universal stage of becoming. Each column is a period in time (epoch) that starts with the birth of an object constant and 'ends' when a complete system is reached and the information potential of the object constant is realized in the system. A new object constant emerges. Each column represents the world of being of an object-constant.

5. Systems Cosmology

Based on the five meta-laws of Information Dynamics, a new type of cosmology, a systems cosmology, is build. A systems cosmology describes the structure of space-time, just like modern cosmologies, but it takes a qualitative approach that focusses on the emergence of universal qualities, entities, and system levels. These qualities correspond to specific interactions, which build systems realizing their information potential. When an open IU evolves, effectuating a movement of information, gradually a bigger part of the universal Information potential is realized. In this universal unfolding process, space-time is structured into hierarchical levels of objects.

5.1. The Cosmic Board model (CB)

In figure 3 I have depicted a Cosmic Board model (CB model) of a systems cosmology. It combines figure 1 and 2. As the model looks like a chess board, I used chess board conventions to denote squares of the board. The CB model shows entities and properties that appear due to information dynamics in an open IU. It divides the area of cosmic spacetime into compartments (squares) of realities that are due to the information boundary (ID 3) restricted to specific scales of time and space.

The x and y axis of this grid show R (radius of the object constant) and t (the first time moment of emergence of the object-constant) on a logarithmic scale. A systems cosmology deals with huge differences in scale. To enhance readability, I will often use variables t_h omitting the function log(). The variable t_h and R_h (h = 1,..,8) are *exponent* variables of time and radius. In this picture of the CB model the coordinates do not represent a *proportional* exponential unit of measurement. It merely defines a grid of thresholds. In reality all squares may differ in size.

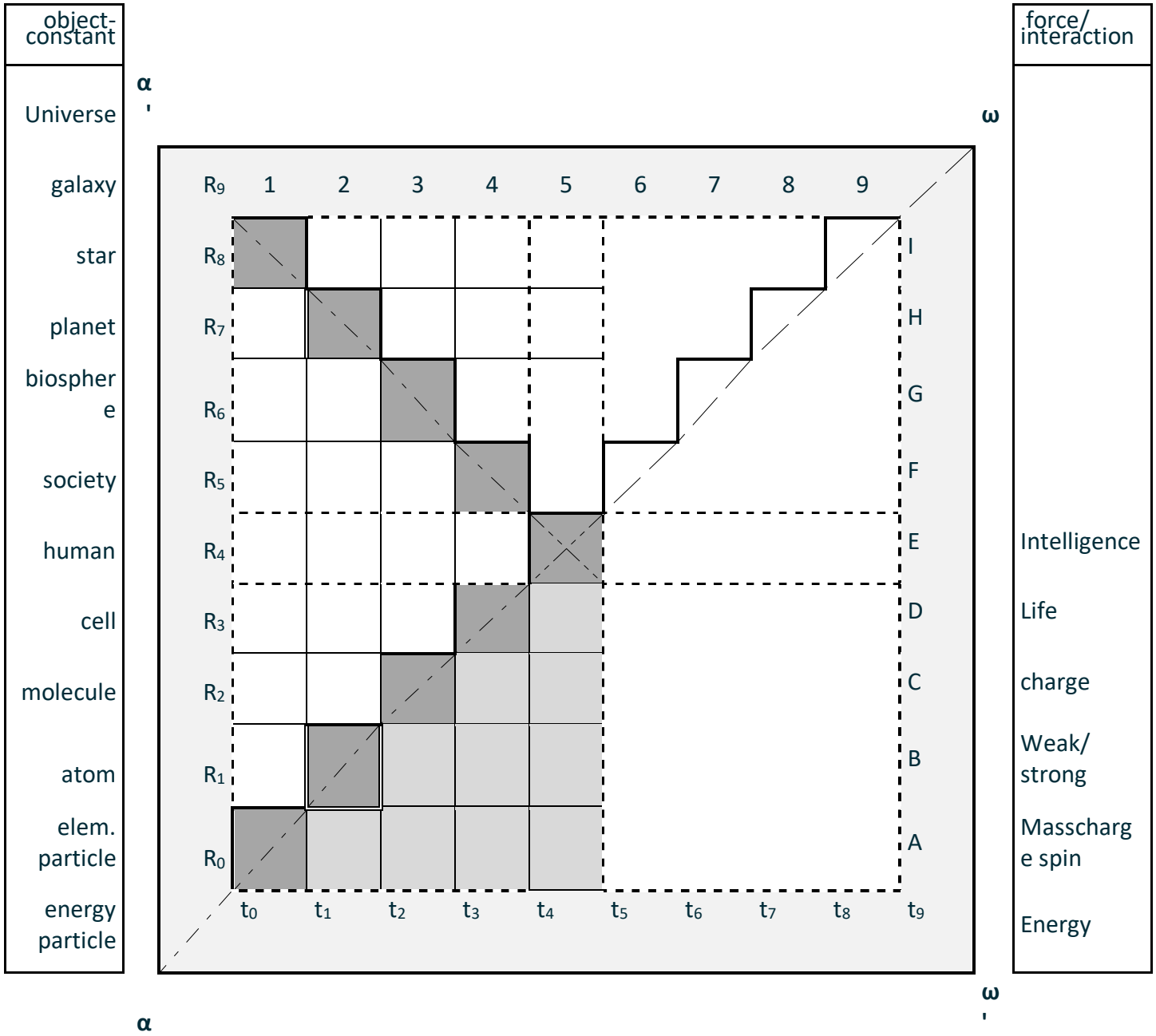
Property rows (ranks) - A to I - will be called worlds of becoming which are space scale related structures connected with an emerging property. Each world of becoming has a unique quality, irreducibly emerged from the lower level (ID 4) by transformation of a system into an element (the system CoTrans). Columns (files) - 1 to 9 - are called worlds of being. They are time epochs of a series of object-constant that function on all scales.

New object-constants emerge at spacetime coordinates (t_1, R_1), (t_2, R_2), (t_3, R_3) , (t_4, R_4) and (t_5, R_5). The lines of the cosmological grid are planes of transformation where new properties emerge and systems become elements on a higher hierarchical level. A1, B2, C3, D4 and E5

are called natural realities of these object-constants. Each reality unfolds the potential of the object-constant that is associated to the emerging property of the object-constant. Each being realizes its information potential, (be)coming into existence, within the cosmological spacetime square which is the cross section of a row of becoming and a column of being.

The CB model shows four quadrants, created by the dual concept pairs past-future and micro- macro cosmos. I added a central 'cross of squares'. Past and future are united in the 'present' column (E). Micro and Macro world are united in the 'normal spatial scale' (of humans) (5). E5 is the cross-section of row 5 and column E. It is the human universe. It is the mirror 'point' of the Human CoTrans. The mirror-point of Horizon CoTrans (see part 1) is (t_0, r_0).

All hierarchical levels have different scales. But from our informational viewpoint *identical* processes and structures occur, based on the meta-laws of Information Dynamics. Universal evolution is s*cale invariant*. Many concepts typical to some level, can be applied in analogy on other levels. We have a 'tree of evolution' (originated from the live-level) on each level. E.g., the tree of evolution in the atomic world is called the periodic system of elements and the tree of evolution of stars is the Hertzsprung-Russel diagram. All natural realities can be divided into the same distinct phases of development. The evolution 'starts' off with short-term interactions between single elements. We may recognize identical phases of evolution characterized by element-interaction, element multiplication, element differentiation, system growth, system-differentiation, complexification, and complexity differentiation which combine growth in quantity (multiplication) and growth in quality (differentiation) on elementary and system-level.



LEGENDA

Natural reality of an universal object constant, co-evolution of micro and macro object-constant

area of hiërarchy enrichtment

Energy area without time space and mass concepts

Increasing mean information content per object constant within a system of object constants

System upper border of natural world of a object constant = maximum information potential

universal horizon of micro object-constant

Increasing information content of macroscopic entities is defined by R - phi



quadrant demaraction (past/present/future - micro/normal/macro)

(t_h,R_h) Emergence of an object-constant at time t_h with radus R_h

(x_h,y_h) Emergence of an object-constant at time $t_h = 10^{Xh}$ with radus $R_h = 10^{Yh}$ using exponential variables

Figure 3. The CB model of the systems cosmology. A symmetric system hierarchical CoRep of our IU.

In the CB model hierarchy symmetry is depicted by co-evolution of elementary particles (A1) with galaxies (I1), atoms (B2) with stars (H2), molecules (C3) with planets (G3), life (D4) with the biosphere (F4). The universal evolution of microscopic object-constants creates series of systems, each build on its predecessor. The macroscopic evolution creates smaller, more complex systems within the bigger system. The micro and macroscopic universal evolution are linked structures like a double helix of a DNA molecules. Stars are the 'factories' where 'atoms' are built, which form later new types of stars. Planets become the 'factories' of molecules, the domain of chemistry, and the surface of the planet (the biosphere) becomes the factory of cellular life. This intertwining of microscopic and macroscopic processes is fundamentally caused by the hierarchy symmetry of an IU. Micro- and macro properties affect each other continuously. Both structures evolve simultaneously. In part1 the unification of QM and GR is proposed by universal concept symmetry of GR and QM which entangles the biggest (spacetime) and the smallest (the standard model) objective levels. When the universe expands corresponding microscopic and macroscopic levels occur likewise entangled.

Each object constant has its own 'natural' reality, which is typically associated with building systems of information based on the corresponding emergent property, connecting object-constants with each other. There are two boundaries of interest within this reality. The first is the system boundary: how big can systems of object constants become? What is its maximum radius (R)? Physically the potential size of a system depends on the number of elements of the system and the (range of the) interactions between these elements. According to information dynamics the information potential of a system is the sum of the information potentials of its elements (N). For complete systems, the information potential is proportional to the surface of the boundary of the system (O). So N and O are important quantifiers for our hierarchical analysis later on.

The second boundary of interest is the *universe horizon*. The universe horizon defines the 'observable universe' of the object-constant. The horizon is the spacetime size of the universe at the moment the object-constant emerged. It connects micro and macro entity. We can use a single parameter (t) to position the object constant within the model. The 'factory' mentioned above is the universe horizon of an object-constant. This object-universe is the enclosed area where the object-constant can occur, and independently of each other can express its potential. The object horizon is a boundary beyond which no information can be retrieved by that object. The nature of this object-universe is well characterized by Daniel Dennett's concept of 'design space' in his book [7] on biological evolution. The object-universe limited by the universe-horizon is space where universal evolution designs what the object can be. Galaxies and stars are the universal horizon of atoms; the design space of atoms is the area B2-7 in figure 3. The design space of molecules are planets (C3-6). The design space of the cell (life) is the biosphere. (D4-5). It is a concept we also can use for the evolution of the universe as a whole.

Processes, activities, and scientific disciplines, all may be classified within the CB model. They are positioned within a square of the board. Especially I like to point out processes of 'hierarchy - enrichment' . When a new object-constant appears in the universe, a new natural reality unfolds which will *affect* all lower levels of becoming. An intelligent being is not only an intelligent being, it is also a living being and a material being. The emergence of intelligence will enrich the living dimension and material dimension by intelligent applications. Bodily movement becomes sport, instincts become feelings, eating becomes the art of cooking, reproduction becomes sex. These activities are located in the area of 'hierarchy

- enrichment' below the natural realities. When the first humans changed a stone into a spear point, they enriched matter by some new intelligent application. Human intelligence opens new areas of applications of live, matter and energy. We normally group these activities in the term 'technology'. But technology becomes, in our informational perspective, an expression of a fundamental and universal process of information dynamics. Hierarchical enrichment is not solely a 'human thing'. *all* object constants transform lower level properties in a way we cannot deduce from these lower levels themselves. Cellular life has changed the molecular content of the planet: the oxygen in our atmosphere is created by the 'invention' of photo synthesis of cells. In general, every emerging property, uses lower levels as 'material' of 'exploration'. It enriches the lower levels with new applications. The living cell enriches chemical processing in a way no single molecule could ever 'explore'. We normally do not call it technology but is an analog process.

5.2. A short story of universal evolution

Let me now give a short story of the universal evolution of our systems cosmology using the CB model. We start off in the very left corner which is the Big Bang (denoted by alpha, the first dot in figure 2). The first epoch is dominated by energy. No matter is present, no charge is present. Even the concepts of time and space are not present because they belong to the world of matter. That is why I choose to position the first epoch of pure energy outside the game board of squares.

The next universal stage starts off at t_1 when elementary particles and the first proto galaxies appear. The emergent property is some unknown property I named masschargespin, because all three are created together. From our perspective these properties 'breaks' down immediately into inertial mass and charge and spin. The concepts mass and SpinCharge are corresponding partners in het horizon CoTrans. It is important to note that although energy and mass are equivalent by $E = mc^2$, inertial mass should not be reduced to energy. According to Information Dynamics, inertial mass emerges from a *complete* system of energy particles. A physically interpretation of this process should be object of study[viii]. Note, Charge and inertial mass emerge *simultaneously*. They appear paired. But after their appearance they 'go their own way'. Because of differences in strength between the gravitational and EM forces micro and macro cosmos develop separately (but paired). The weak force of gravity, associated interaction of mass, does not play any role in subatomic processes, but it will be playing a dominant role in (proto-) galaxy formation (by co-evolution). New levels of complexity emerge because inertial mass is trans mutated to energy.[ix]

The next hierarchical level occurs from a *complete* system of elementary particles. It is an atom. The macroscopic counterpart of an atom is a star. The emergent property of the atom design space is the weak/strong interaction.

Next, the universal evolution of atoms ends with the appearance of the molecule. The object horizon of the molecule is a planet, that will only be created after two or three generations of star-systems. The design space of the molecule, its universe, is a planet. The 'dominant' interaction that creates systems of molecules is based on charge.

Universal evolution sets its course from anorganic to organic processes and finds its 'destination' in the cell: a new object-constant. We enter the world of biology. Its macroscopic counterpart is the biosphere, a small layer on the surface of the planet.

After four billion years of evolution on Earth, we reach the next stage of evolution in the universe: the object-constant of an intelligent living being.

I like to emphasize that object constants are abstract informational entities which are defined by the metaphysical movement of information creating a system hierarchy. The system borders of object-constants we name 'atom' or 'star' are not definitely established. The system border of the atom could be its nucleus. The system border of a system of atoms (a star) could be as big as the Oort cloud. The object-constant 'cell' is not the first existing cell on earth, the mother of all cells. The object-constant cell is an archetype. All kinds of cells existing on earth are occurrences of this object-constant. It is not possible to pinpoint a specific physical occurrence being the 'first' cell or the first molecule, because the object-constant is informational category and cannot be interacted with.

5.3. The velocity of evolution

Let me do some basic calculations on this 'first-order' model (which like any first-order model has many shortcomings). Obviously CoR puts constraints on to the structure of our universe which must create interdependencies between characteristic values of object constants. One of these interdependencies of the CB-model is derived by applying the

Horizon CoTrans on *each* level of the hierarchy assuming that the universe of an object-constant is equal to its object-horizon. An object constant O_h is located in the CB model by its creation time coordinate and its radius (t_h, R_h). It's macroscopic counterpart, has coordinates (t_h, R_{8-h}). Het Horizon CoTrans interchanges time and inverse radial space. Applied on level h we get: $t_h \Rightarrow 1/r_{h'}$. Using QM wave-particle correspondence[x] $rR = r_P^2$ we obtain a simple transformation $t_h \Rightarrow c\, R_{h'}$ for some constant c. Reversing this relation, we obtain:

$$R_h = v_{CB}\, t_h \quad (h = 1,2,3,4) \tag{2.15}$$

Or put in exponent variables:

$$v_{CB} = R_h - t_h \quad (h = 1,2,3,4, \text{exponent variables}) \tag{2.16}$$

v_{CB} is a constant of the CB model. It is the directional coefficient of the $\alpha\omega$-diagonal in the CB model and is defined to be the 'velocity of evolution'. Because of hierarchy symmetry the slope of the other $\alpha'\omega'$-diagonal in the CB model must be the same *negative* value.

$$R_{8-h} = R_8 - v_{CB}\, t_h \quad (h = 1,2,3,4) \tag{2.17}$$

Or put in exponent variables:

$$v_{CB} = R_8 - R_{8-h} - t_h \quad (h = 1,2,3,4, \text{exponent variables}) \tag{2.18}$$

CoR predicts a fixed correlation between the universal creation time of an object-constant and its radius. In table 2 I have calculated v_{CB} for specific occurrences of object-constants of all levels of the systems cosmology. It is yet too premature to put conclusions to this series.

	property (SI-units, exponent variables)	t_h (s)	R_h (m)	v_{CB} (m/s)
	normalized property (number)	t_h/t_P	R_h/r_p	v_{CB}/c
	Planck units conversion: add	**43,2683**	**34,7926**	**-8,4757**
h	**Universal object constant: occurence**			
	Universe (GR)			
10	Galaxy (t_0, R_8): Milky Way	9,0	21,0	30,0
9	Star (t_1, R_7): Sun	12,8	8,8	21,6
8	Planet (t_2, R_6): Earth	17,1	6,8	23,9
7	Biosphere (t_3, R_5): Earth's biosphere	17,4	6,0	23,4
6	Community ():world economy	17,6	6,0	23,6
5	Intelligent being (t_4, R_4): human individual	17,6	0,0	-17,6
4	Cell (t_3, R_3): bacterium	17,4	-6,0	-23,4
3	Molecule (t_2, R_2): amino acid	17,1	-8,0	-25,1
2	Atom (t_1, R_1): Carbon	12,8	-11,2	-24,0
1	Elementary particle (t_0, R_0): proton	9,0	-15,0	-24,0
0	Energy (wave)			

Table 1. The velocity of evolution in the CB-model

5.4. The cardinality of a complete system

Dirac and others (Davies 1982) have pointed out some numerological coincidences concerning characteristics of the structure of the universe. For instance, why is the number of stars in a galaxy equal to the number of galaxies in the universe? Why does het number exp(40) occur repeatedly? According to CoR these coincidences should be explained form analysis of our systems cosmology. Let us ask ourselves, more generally, what is the number of elements of a complete system? Let us assume two consecutive hierarchical levels are both complete systems, meaning they have maximal information realized. The information potential (ϕ_h) of the system-object (O_h) is fully actualized and stored in relations that build the system and must therefore be equal to the sum of information potential (ϕ_{h-1}) of the (N_h) element objects (O_{h-1}) of the system. From the generalized holographic principle, we know the that in a complete system the information potential (ϕ_h) of the system is fully 'projected' on the surface ($S_h = 4\pi R_h^2$) of the object. The amount of information projected on the surface is the number of unit-squares with radius R_{uh} (representing 1 bit of information) on the surface. The unit-square R_{uh} depend on the type of relation that builds the system and will be different for each level of the hierarchy. Assuming all element-objects have the same information potential, the relation becomes,

$$N_h \ \phi_{h-1} = 4\pi R_h^2 / R_{uh}^2 \quad (h = 1,2,3,4) \tag{2.19}$$

The value N_h - the number of element-objects of a system-object-constant – is expressed in terms of mass of the element-objects, assuming we can neglect the mass 'stored' in relations (which we can not in case of a quark-system!). Ordinary we would have expected $N_h = m_h / m_{h-1}$ but due to the generalized holographic principle we find

$$N_h = (m_h / m_{h-1})^{2/3}. \tag{2.20}$$

Converted to exponent variables:

$$N_h = 2/3 \ (m_h - m_{h-1}) \quad (h = 1,2,3,4, \text{ exponent variables}) \tag{2.21}$$

In table 2 I have calculated N_h for a set of occurrences of object constants and compared it with an estimate of the actual N value. Again, it is too premature to put conclusions to this series.

Note, the choice of the object occurrence has of course significant impact on the calculated value. It would be better to use mean values but no sufficient data are available.

I added an additional column using the Eddington Number and 'dividing' all exp(80) particles proportional to our 10 level hierarchy. Each object constant is built out of exp(8) elements of the lower level.

	property (SI-units, exponent variables)	t_h (s)	R_h (m)	m	N_h	N_h	N_h
	normalized property (number)	t_h/t_P	R_h/r_p	m/m_P	$(m_h/m_{h-1})^{2/3}$	N	N
	SI to Planck units conversion: add	**43,2683**	**34,7926**	**7,6623**	**0,0000**	**0,0000**	**0,0000**
h	**Universal object constant: occurence**				**N From mass**	**N estimate from data**	**N from Eddington number**
	Universe (GR)			53,0	7,1	10,0	8,0
10	Galaxy (t_0, R_8): Milky Way	9,0	21,0	42,4	8,1	10,0	8,0
9	Star (t_1, R_7): Sun	12,8	8,8	30,3	3,7	2,0	8,0
8	Planet (t_2, R_6): Earth	17,1	6,8	24,8	5,8	24,8	8,0
7	Biosphere (t_3, R_5): Earth's biosphere	17,4	6,0	16,0	9,3	10,0	8,0
6	Community ():Roman Empire	17,6	6,0	12,0	12,7	12,0	8,0
5	Intelligent being (t_4, R_4): human individual	17,6	0,0	2,0	6,0	12,0	8,0
4	Cell (t_3, R_3): bacterium	17,4	-6,0	-7,0	1,3	6,0	8,0
3	Molecule (t_2, R_2): amino acid	17,1	-8,0	-9,0	0,7	5,0	8,0
2	Atom (t_1, R_1): Carbon	12,8	-11,2	-10,0	11,2	2,0	8,0
1	Elementary particle (t_0, R_0): proton	9,0	-15,0	-26,8			
0	Energy (wave)						

Table 2. Calculations on the cardinality N of complete systems in the CB-model

5.5. The ideal cosmological System Number

Another line of thought, calculating the cardinality of a complete system hooks on the concept transformation CT_{ES} between System physics and Element physic (2.1). Underlying all universal structure is movement of information. An IU as an expanding container of information. The density of information differs due to imperfections of the black hole/Big Bang process. As the container expands these differences in density become isolated areas (object constants). The movement of these systems of information depends on openness and closedness. Different densities cause information pressures. The information boundary of the systems (ID3) creates complete, stable system, both on a microscopic and macroscopic scale. But the information densities of complete systems are not equal, because the dominant interaction differs in each system. As time progresses, as temperature of the universe drops due to expansion, level after level occur. Let us now assume System and Element Physics can be applied on all these hierarchical system levels of our systems cosmology because all systems depend on the same metalaws of information.

I will assume he ideal gas law (pv = nRT) can be applied on all systems of information where R depends on the type of system, i.e. the kind of interaction that constitutes the system. Consider a gas-system in a container closed on one site with a freely movable piston (of area A). Using a system-object approach, according to the ideal gas law (pV = nRT or pV = 3/2 NkT, or $pxA\theta = 3/2\ Nk$), temperature (T) drops as density (N/V) decreases or pressure (p) increases. In the classical limit (N -> 1) we could use an element-object approach and apply the first law of Newton (F = ma or F = d**p**/dt) onto that single gas-molecule. Theoretically the ratio of the

internal force of the system (*of one element*) onto the piston and the external force of the (single) molecule on that same piston should be 1, because we only change perspective, - the physics is the same –. But in a system-element change by CT_{ES} the one-molecule ideal gas law corresponds to the QM uncertainty relations of Heisenberg. The ratio is proportional to h/k. If we assume that in a complete system the ratio should be 1, expressing that element and system perspective are complete balanced, we need a system cardinality of k/h elements. More precisely, the ideal cosmological system number (N_{ES}) expressing the universal relation between a complete system and its elements must

$$N_{ES} = \underline{k}/\underline{h} = 1.3\ 10^{11}\ \ c_{cal}$$

$$N_{ES} = 11{,}11 + \log(c_{cal})\ \text{(exponent variable)}$$

$\underline{k}$ and $\underline{h}$ are informational dimensions without a physical dimension. In order to create an informational number we need a calibration constant of physical dimension Kelvin second $[c_{cal}]$ = (Ks). It is a constant of the System CoTrans mapping the concepts of t (time) and θ (inverse temperature).

Finally, note the characteristics of the CB model written down in table 2 must all be related tot a fundamental number of our universe: the ratio between the EM and gravitational coupling constant,

$$\alpha_{CB} = \alpha - \alpha_G = 42{,}6197\ \ \text{(exponent variables)}^{xi}$$

According to the Human CoTrans gravitation and EM interaction are conceptual mirror images of each other. So, we expect in both CoReps the same ratio. The number is not changed by the CoTrans. Only physical concepts change in a CoTrans. α_{CB} characterizes the relation between micro and macro universe from the perspective of the human, meaning that the upper and lower half of the table 2 are related by α_{CB}.

Conclusions

Systems Ontology, Information Dynamics and the CB cosmological model create a *conceptual* framework which has many aspects that can be studied by all disciplines of science. It unifies all sciences by a cosmological overall vision. The main characteristics are scale invariance due to meta-laws of Information Dynamics. We could study pulsating rhythms on all levels due to the dual movement meta-laws of information. Many questions arise. Can we detect the meta-laws of ID on different system levels measuring energy density? Can the systems cosmology explain various numerological 'coincidences' in the structure of our universe? Do the main system levels have subsequent sublevels? Are these levels also scale invariant? Can the system cosmology help us understanding the relation between energy and inertial mass? The possible directions of research are innumerous. But they are united by one theme: the universe and who we are within that universe.

6. Appendix. Who we are

Concept Relativity connects mind and universe (part 1) and gives intelligent species a position within a systems cosmology of our universe (part 2). Trespassing the demarcation between metaphysics and physics, - i.e., unifying mind and reality, - has paradigmatic consequences, most physicists will feel uneasy by. If science includes metaphysics, it will unavoidably have to 'take a stand' in areas of ethics, politics, and spirituality. Cosmology becomes an old fashioned *human* cosmology. Modern cosmologies take only entropic processes into account. Systems cosmology creates a more complete picture. The systems cosmology is an *evolution cosmology* because it focusses on the open movement of information and qualitative changes due to this evolution. Evolution is a universal process of moving information that started at the very first moment of the universe and can be extrapolated to the future. The systems cosmology tells us where we – humans - came from, who we are and *where we are going to*. Let me list in this appendix some of these consequences.

The meta-law of emergence sharpens the *distinction* between cosmological levels by stating that each level is characterized by a distinct and unique property. We descend from animals but we are no longer animals. Mind transcends live. Just as Live transcends matter. Just as matter transcends energy. And information dynamics is the common cause that makes it all happen. We are all systems of information. To unleash the potential of an intelligent mind we firstly should eradicate the Darwinian struggle for live in which many humans are still trapped. There is no need for it. Intelligence transcends this struggle. If humans would recognize who they are, they would stop killing each other, end famine, and organize housing

and care for everyone. After fulfilling these basic needs of living our mind can really start flourishing and unfold its potential.

What will we do? No doubt, humans will transform the Earth, - with respect to energy, matter, and nature -. It is the unavoidable course of (cultural) evolution. But we first have to redefine our relationship to nature. Earth and nature are no longer our enemies. They are a part of us, we evolved from them. And they are a source of human inspiration. The earth is not something we can exploit, like we did for the last three centuries, resulting in climate change and diminishing biodiversity. No, in fact, with the emergence of intelligence, earth, plants, and animal also become in a sense 'human' (cosmological enrichment). By looking at matter and nature with intelligent eyes, - a manner of looking no animal or plant can ever see their own world, - they become part of the human reality. They become human. Real intelligence will bring about respect and care for all our living companions and the earthly matter.

So, what is intelligence? What will change on the cosmic system level of intelligence? What characterizes intelligent species? Thought. Thought is the new DNA. It relates men in communities. Thought that expresses itself in a community or society becomes part of a universal evolution. All socialized though is technology. We *are* technology. From the first throwing stone, the first sentence, the control of fire, to the Hubble Telescope, from tax systems, laws, and culture, it is all human technology: a product of the mind realized in a social context. The social community is a system of intelligent beings which are related by stories. Human intelligence is all about inventing concepts and telling stories[xii]. These stories create the natural reality of humans.

Some people fear technology of today. They fear AI, gen- and nanotechnology will destroy humanity. But if we *are* technology, how could it destroy humanity? What we should fear is the misuse of technology for personal profit that increases inequality and that deprives people of potential. We should fear the misuse of technology by states to control peoples mental expression. We should fear the degradation of humanity when we reduce human intelligence to a computer. We should fear economic powers that monopolizes technology. We should fear technology in the hands of (nearly) 'animals'. which is like giving a box of matches to class of small children. Technological development is human development. It expresses wat we are. It should be a topic of political debate and democratic decision-making.

Earth is our home planet. Even more, we are born out of the Earth. It fills our genes and memes. And we are not alone. There exist many other planets that produce intelligent beings. Our Systems cosmology *predicts* we are not alone in the universe. Intelligence is a stage of universal evolution. It is the result of a *lawful*, informational process and not some coincidental miracle. If our universe is capable of 'producing' intelligence around our sun, it will produce intelligence everywhere in the universe where open systems evolve.

Wat lays ahead, spoken cosmologically? This is unknown territory to scientists. It involves a paradigmatic change of mind. The mind of the scientist is analytic and tends to see the whole as composite and *reduce* it into is constituents. The scientist looks always 'down' and 'back'. Whereas the philosophic and religious mind look 'up' and 'forward'. Spirituality tends to see the whole as a part and magnifies it into greater wholes. Ultimately, both mindsets exist in one mind. Inevitably, we must also inspect the prominent story of the future of humankind our systems cosmology is telling us. What happens when we climb up along the universal systems hierarchy (the right half of figure 3)? Human individual development co-evolutes with society and culture. Gradually human relations will intensify and become more complex. A society could eventually achieve *system completeness* realizing its full potential. These societies incorporate the complete biosphere of a planet. A complete world-state system will be created unifying all things that live[xiii]. Evolution will step up to the next level in our systems hierarchy. The social-biological system becomes an elementary entity (t_5,R_5) with a new quality, - which I will denote 'planetary-intelligence' -, which we, human beings, will never understand, simply because this quality is beyond understanding. Evolution will start over on a higher level: eventually stellar entities organize themselves into galactic societies and reach maximal information capacity at some point (t_9,R_9). Galactic intelligence emerges and a new reality of galactic entities is created. The last foreseeable level will be a universal conscious entity which will operates on a supra-universal system level we are not aware of (ω).

Of course, there is no guarantee what soever of such an evolutionary destination. Nearly closed systems will decay. The future of man, and even the future of the universe could well become that of a dinosaur: extinct, non-existent. We do not know what the information potential of humankind nor that of our universe is. What we *do* know is when a universe loses

its openness the information movement meta-law of closedness will take over and the universe will start to implode, complexity will fall apart and finally it will die. But then again, in a multiverse, there are many universes. If our universe will not become conscious, other universes may be capable to reach this unthinkable state of complexity. After that, my imagination stops. But I am convinced reality will not stop.

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Notes

1. In this article I focus on the concepts of the systems ontology that are needed to build a systems cosmology. A systematic (concept mechanic) study of the impact of combining ontology and information theory was undertaken by me in de early nineties of the last century. Partly available online: https://www.johanneswhjanssen.nl/onewebmedia/asf.PDF (only in Dutch)
2. Infinity is part of the mathematical trinity (0,1,∞) and is basis of all mathematical disciplines.
3. Greene, Brian, The Hidden Reality, Parallel Universes and the Deep Laws of the Cosmos Random House Inc. 2011 chapter 9.
4. For instance, think of a steel rot that has on each end a coin fixed
5. When cosmologists speak of the universe as being "open" or "closed", they most commonly are referring to whether the curvature is negative or positive. Which is not the case here. Openness means there is an unknown outside, which is in contact with our universe.
6. I have dismissed the use of words like order, disorder, self-organization, or disorganization in de definition, because these words have loaded meanings. Furthermore, I do not use the word 'self-organization' because it could suggest that this law only holds for living things, which is not true. It is a universal law. The law affects all object-systems of all universes because all objects are systems of information.
7. In a systems ontology philosophical concepts, like consciousness, being and becoming, will be interpreted in a information theorical manner. See note 1.
8. Physicist that aren't happy with the QM interpretation of the electron mass, have theorized that mass is the result of a oscillation of charge or a Zitterbeweging. A potential candidate is the Energy Wave Theory https://vixra.org/pdf/1606.0112vA.pdf It could be a potential candidate theory for building non-energetic concepts like mass of charge solely using energy-waves.
9. Because mass is 'evolved' from energy, it can be changed back into this form.
10. An alternative way to understand the particle-wave correspondence points out that in the CB model all objects are multilayered 'bodies' of which the most elementary 'body' must be, its energy body. This energy body is a wave, it is omnipresent, non-local. The higher matter-bodies are located. Both representations are connected. I expect there will exist a relation between live-time and size of the object with the vibration time and amplitude of the corresponding wave of energy.
11. "The answer to the ultimate question of life, the universe and everything is (JJ:roughly!) 42" The transgalatic Hitchhiker's Guide
12. Even our present scientific world view is a story. Our minded created it.
13. There are a number of ideas of different thinkers that speculate in this direction. This hypothetical end point could be associated with, for instance, the Omega point of Pierre Teilhard de Chardin's universal evolution theory. The Gaia theory also focusses on the unity of the earth biosphere. But explicit consciousness, - i.e. Gaia having a planetary intelligence, - is no part of the theory.