A VIEW ON THE MODERN PHYSICS' SEARCH FOR ITS HOLY GRAIL

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ABSTRACT: Modern physics is in a period of continuous paradigms turmoil and review. The cavalcade of discoveries in modern physics lead to a diversity of theories and favored one tendency to search for an enveloping approach to explain such a diversity, called Theory of Everything (TOE).The search for TOE has the goal to find a universal unitary explanation of physical phenomena, it is a real "Holy Grail of Knowledge" in physics. So far TOE search was focused on using an existing theory, merging existing theories or searching for a new one able to explain diverse phenomena and results. Physics and its created knowledge system is considering phenomena in continuous interaction and transformation, which are fractal and topological self- reproducing complex energy systems of systems under general cybernetic of higher levels regulation (hyper cybernetic), called Complex Autopoietic Topological Systems (CATS).

KEYWORDS: "Holy Grail of Knowledge" in physics, Theory of Everything (TOE), Complex Autopoietic Topological Systems (CATS), fractal and topological self-reproducing complex energy systems, syzygy, hyper cybernetics.

Contents

Some issues on the background for *TOE* search

Physics studies matter and interactions between its components and hence it looks at the organizational structure of the universe itself. Physics is based on theories and on experiments / tools to prove them. In its "classic" understanding, physics is a natural science that studies matter and its fundamental constituents, motion and behavior through space and time and phenomena related to matter entities of energy and force. Physics' spectacular evolution led to continuous paradigms turmoil. There are two types of solutions considered to bring "order" in this situation, i.e. for an integrated explanation of all the phenomena, as it is reflected by the diversity of theories:

- to accommodate and give sense to and accept the existing unity in diversity

or

- to find/develop an enveloping approach for all of them.

The latter lead to a tendency known as the search for the *Theory of Everything (TOE)* (see from the initial proposed terminology[2] to the next series of step by step merging of theories to get a *TOE* as in famous books[3], or present debate about its fate[4] , to the connection

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[2] John Ellis (2002). "Physics gets physical correspondence", *Nature*, 415 (6875): 957.

[3] Stephen W. Hawking (28 February 2006). *The Theory of Everything: The Origin and Fate of the Universe.* Phoenix Books; Special Anniv.

to cosmology and to mythology[5] and even to the search for *Final Theory* instead of *TOE*[6]). The search for *TOE* has the goal to find a universal unitary explanation of physical phenomena, it is a real *"Holy Grail of Knowledge" in physics*. So far *TOE* search was focused on using an existing theory, merging existing theories or searching for a new one able to explain diverse phenomena and results, in an attempt to find a unique unifying theory, considering it a search for a final state, rather than a process.

Actually physics is in a stage that requires to decide if the four century old principle "*Discours de la methode"* (1637) has to be preserved as the main goal and driving force of knowledge, considering that the observer/physicist is independent of the object of study.

It appears that the new discoveries in physics, driven by *Quantum Mechanics* and the theories around it are better described by another type of search for models and explanations of the universe, that could be called *"Discours sur la création de la realité",* which assumes that the observer and the object under study cannot be separated. This is a holistic, *integrative* approach, which seems to be a possible answer to the existing paradigms problems. Such an approach is closest to the hidden desire in physics to give an explanation for everything in the universe, a "*Holy Grail of Knowledge in Physics*", called *TOE*. However, *TOE* has various meanings and as per present in physics' "classic" understanding it is considered to be:

$$\textit{Theory of Everything (TOE)} \stackrel{def}{=} \textit{final theory} \stackrel{def}{=} \textit{ultimate theory} \stackrel{def}{=} \textit{unified field theory} \stackrel{def}{=} \textit{master theory}$$

TOE framework in general is seen as being hypothetical, singular, all-encompassing and coherent theoretical approach. Its search is aimed at fully explaining and linking together all physical aspects of the universe. Goals of *TOE* as set up currently are to define a theory able to explain:

- The values of all fundamental physical constants; an example of one possible choice for such a theory could be the string theory.
- Why theory of relativity and quantum mechanics cannot be unified and/or described by a higher level theory
- Why the gauge groups of the standard model are as they are and the existence of 3 spatial dimensions and 1 temporal dimension for observed space-time.
- The existence of the established so far laws of physics in present format and why not in a different one.
- How constant in time are the "*fundamental physical constants*".
- How to establish if any of the fundamental particles in the standard model is actually a composite particle, for which it is impossible at the stage of present experimental basis to decide if they are too bound together.
- How we can decide on the completeness of the list of particles as they are now and/or the search for new ones considering a set of properties to be looked for.
- If there are new unobserved fundamental forces.

This paper is not intended to show the solutions of the successful search for *TOE*, but rather it is an invitation for reflection and discussion; it is conceived as a start for a search using some new approaches, which could lead to a series of in depth researches.

Because physics is in a conceptual turmoil, with many questions and challenging experimental results, with diverse approaches to explain them in a real model cavalcade, difficult to integrate one in another, it is understandable why the search for *TOE* becomes of high interest in order to obtain answer to one fundamental question of this situation. However,

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[4] Dennis Overbye (24 January 2023). "Where is Physics Headed (and How Soon Do We Get There)?. Two leading scientists discuss the future of their field – Comment", The New York Times.

[5] Chris Impey (26 March 2012). *How It Began: A Time Traveler's Guide to the Universe*. W. W. Norton.

[6] Steven Weinberg (2011-04-20). *Dreams of a Final Theory: The Scientist's Search for the Ultimate Laws of Nature*. Knopf Doubleday Publishing Group.

one question is not frequently asked:

*„*How a *Theory of Everything (TOE)* would look like, if it exists at all, or at least which would be the guiding principles of searching for it?"

The approaches adopted so far have one of the following tendencies:

- They either look for a theory, able to be at least non contradictory to other theories, so that to present solutions for existing paradoxes and contradictions
- Or, more ambitious, to generate a real innovative theory able to be a general envelope of existing theories, which would become particular cases of it.

Problems and possible solutions in TOE search

Recent developments in modern physics lead to a set of fundamental problems in following both of the approaches mentioned before. For instance if one looks for fitting general relativity, which is the physics of gravity, and the quantum physics in order to generate a TOE, then there are fundamental problems in merging the two theories. From physics perspective this is due to the fact they have different central cores of assumptions and results which make them incompatible in an attempt to build a logical unitary enveloping description, as accepting one of them will create paradoxes in the other. However, the possible approach to prevent the appearance of these paradoxes for those two theories (as for other generating similar situations) is to use a higher level of description of their core fundamental features.

As it was shown in a previous work[7] these fundamental features of theories (called syzygies) may have a tight connection with the physics characteristics of the systems themselves and a new notion is used in a series of iterations of fundamental search in order to describe them so that to assure the theories emergence from one level with paradoxes between them to a higher level with less identified paradoxes, in an iterative, but asymptotical process. The process is not indicating the final state, but it is asymptotically stable. Some aspects of using syzygy approach are also presented in the Annex.

Summarizing the possible solution for a successful solution in case theories are not convergent might be to focus on:

- Search for the *TOE* not as a final state, but rather as an iterative, convergent to stable but unknown process.
- The fundamental features of a TOE in any logically driven theory are defined by the features of the studied object, but not isolated rather tightly connected with the subject studying them
- The iterative process has to move from the unidisciplinary unitheory type to a multidisciplinary open theory, as paradoxes will need solutions inexistent at their level and requiring emergence to other levels.
- The search is assumed to be performed all the time in a consistent logical system, which features are consistent with those of the physical system itself. However, the syzygy type approach is not dependent of the type of logical system and of the created realities by them, as they are part of it.

A few common features of both approaches diminish the confidence in finding a solution for this search, if the process does not change.

The most important of those **features / themes biasing systematically the *TOE* search**, would be in our view the following:

Theme 1 (T1) – Lack of multidisciplinarity

[7] Serbanescu July 2017

The search for *TOE* is organized and managed in a predominant unidisciplinary and unitheory manner, so that the approaches are of one (or more) combinations of the following types (to mention the most representative):

- Specific to physics phenomenological methods and approaches, some of which have already got a dogma character unfortunately.
- Specific to mathematics tools and models
- Use of artistic, intuitive tools, even including aesthetics
- Return, as it happened many times so far in physics, his TOE to philosophical approaches, to the *philosophy of physics.*

There is also a large amount of mythological models (in broad sense, thus including a non-mythological per se cultural heritage) related mainly to cosmic genesis, as screened in a previous work[8].

Theme 2 (T2) – Dominance of organized institutions in promoting new approaches

Independently on how the approaches of T1 type are taking place, either in academic or in nonacademic environments, in art / cultural productions, in public debates, in mass media etc. they have an aggressive tent, excluding usually any debate and/or other conflicting opinions and are presented by:

- Scientific institutions and the media governed by them, adopting a ultraconservative attitude to novel approaches and in many cases having the features of real scientific inquisitions
- Opinions expressed by individual scientists formulating in a jerky manner theories for which no debate / challenge is expected to take place, many times in a lack of scientific approach attitude and, unfortunately many times even in a lack of minimal civilized dialog
- Persons with large audience to the public using intransigent and aggressive approach in support of one approach or another, invading mass media with those opinions and making the search superficial.

Theme 3 (T3) – Credibility for scientific stance of new approaches

Society in general, physicists in particular and all the other scientists from the connected to the topic domains, which would be able to contribute to a convergent search for an answer are actually in the dilemma of being affected by the following extremely (for a theory) dangerous situations for them as professionals:

- Ignorance of really innovative ideas, as being too out of the mainstream search
- Promotion of totally illusory, by any criteria, theories/approaches.

History of science and technology, including their applied branches, has many examples of embraced approaches by many people and for long time, which proved to be wrong and misleading.

In this context some **basic generic guiding principles for *TOE*** search are proposed. The principles are formulated to support solutions for the themes T1-T3, which are creating

[8] Serbanescu February 2017.

challenges in the search of *TOE*, as follows:

Principle 1 (P1) – Define the *TOE* object

It is necessary to redefine the object and methods of such search requiring a new view on physics and other sciences, as well as other knowledge sources, so that the P1 and P2 above are considered.

Principle 2 (P2) – Use of multidisciplinary approaches

The solution for a convergent search of TOE is to be based on multidisciplinary view, in a process that can be refined for instance by similitude with existing particular cases identified before by the author.

Principle 3 (P3) – Measure scientific validity in a multi facet knowledge understanding

The decision of scientific validity of the solution is to be based on a multifaceted approach on knowledge and it is possible in an adapted environment of the society, including scientific institutions, for the search of this nature and this may lead to significant changes by comparison to the actual situation.

***CATS*- a TOE search case study**

The amazing discoveries in modern physics, and in particular the *Theory of Relativity* and *Quantum Theory* are almost all the time presented as a result of internal normal changes within physics itself, which followed its internal rules and are the result of brilliant minds. However, there are more and more challenges on such a linear accumulation of knowledge following internal laws of physics reflecting the laws of the universe. In this sense it could be that we actually are not sure if:

- The knowledge development is purely random or
- Perhaps there are some undiscovered causes of knowledge development in the interaction with universe.

A case study on *TOE* search principles application was evaluated in an attempt to search for deeper mechanisms of knowledge accumulation, which could illustrate the idea that the search for *TOE* by looking for cases in which P1-P3 *TOE* principles could be applied. The case study is based on defining the following features:

- The *TOE* object of study is defined as a *complex system of energy systems* interacting between them and transforming in each other, at all levels of universe. These systems are fractal and topological self-reproducing complex energy systems of systems under general cybernetic of higher levels regulation (*hyper cybernetic*), called *Complex Autopoietic Topological Systems* (CATS).

Some main features of the compliance of CATS with P1-P3 are further considered.

The application of P1 is focused mainly on defining the object of TOE search, as presented before.

In accordance with the principle P1 physics is understood as a hierarchical set of realms of systems of complex systems of a special type (*Complex Autopoietic Topological Systems* (*CATS*)). These CATS systems include the observers and their knowledge realm and

are defined by an *invariant* (set of *syzygies*) as mentioned in Annex 1. CATS' features and the view on their interaction at all levels in all realms (planetary, galactic, and cosmic), the emergence from one state to another and their reaction to challenges include the role of hyper cybernetic feedback reactions. These features allow application of principle P1 in a unitary manner to any object of physics and to the knowledge structures generated by them.

Principle P2 – The need to use multidisciplinary approaches in the TOE search is also complied with by adopting the CATS approach (Annex). The objects of physics and the knowledge about them generate algebraic structures in multidisciplinary approaches, these structures themselves generated by the need to switch to various types of syzygies (invariants) as required by paradoxes in main decision moments in the building of structures of common object, subject and knowledge.

The structures are in continuous transformation and emergence, reacting to challenges but the trend is to be as close as possible to a structure described by the Poincaré sphere. The generic asymptotic type of structures expected for CATS at planetary realm might be of dodecahedron type.

Principle P3 on how to measure scientific validity of a TOE search assumes a multi facet approach.

The approach is triadic, having facets for: science, art and cultural-mythological-social aspects. The resultant knowledge is based on the degree of reaching certain levels considered adequate, based on various criteria, as for instance:

- The level of truth,
- The level of conformity and integration in the cultural environment and
- The value for society.

The degree of compliance with the above-mentioned criteria may be graded and therefore, the areas where the possible type of knowledge process results is situated may be divided in *Undesired Zones* by all criteria, *Uncertain Zones* by most of criteria and *Ideal Zones*.

Instead of conclusion

First and foremost, the search of TOE (*Theory of Everything)* might need to focus on defining strategies and principles to follow for their implementation. The principles focused on defining and refining the object of study, as well as the adopting a multidisciplinary approaches and a multifaceted verification process could lead to a better way to search for TOE.

The case study of *Complex Autopoietic Topological Systems (CATS).*considered as a system of energy systems in a hyper cybernetic connection, illustrate the fact that this might be a candidate path for the TOE search.

Annex

The characteristics of *Complex Autopoietic Topological Systems (CATS)* show how they comply with principle TOE search principle P1 (Define the *TOE* object)**. *CATS* are considered to be good candidates for TOE object and the subjects studying it.** *CATS* and their models have some special features and react to both the challenges to them and **their changes and their models** which make them potentially suitable for TOE search.

The main features of the *Complex Autopoietic Topological Systems (CATS)* are defined by the following **assumptions** adopted in the form of Generic Conjectures (GCOi):

GCO1: Energy is defined for all the levels from sub-quantum to cosmic (Table 1).

Subquantic	SQ=SYS7
Quantic	Q =SYS8
Molecular	M =SYS9
Molecular life	ML=SYS1
Planetary	P =SYS2
Planetary life	PL =SYS3
Planetary life intelligent	**PLI =SYS0**
Galaxy	G =SYS4
Cosmic	C =SYS5
Cosmic life	CL =SYS6
Cosmic intelligent	**CLI =SYS10**

Table 1. Complex Autopoietic Topological Systems

The systems in Table 1 define actually the cosmos and the knowledge on it.

CATS exist all levels from sub-quantum to cosmic, with living beings or not, intelligent living beings or not. For instance sub-quantum level is noted SQ and SYS7, molecular life system are noted M and SYS9. All the systems are noted in Table 1 as SYS_x where the index varies from "0" to "10".

The *CATS* systems are interconnected and represented in Figure 2, where the figures are the systems SYS indexes from Table 1.

They are interconnected in a system in system set ***("Matrioshka type"***), as in Figure 1, in which, by the use of indexes, it is illustrated the fact that *CATS* are composed of systems of systems embedded one in another and interacting between them. CATS are described in more detail in previous works.

In other words we may consider that everything is energy in the *CATS* definition sense. CATS were defined in a previous work of the author[9].

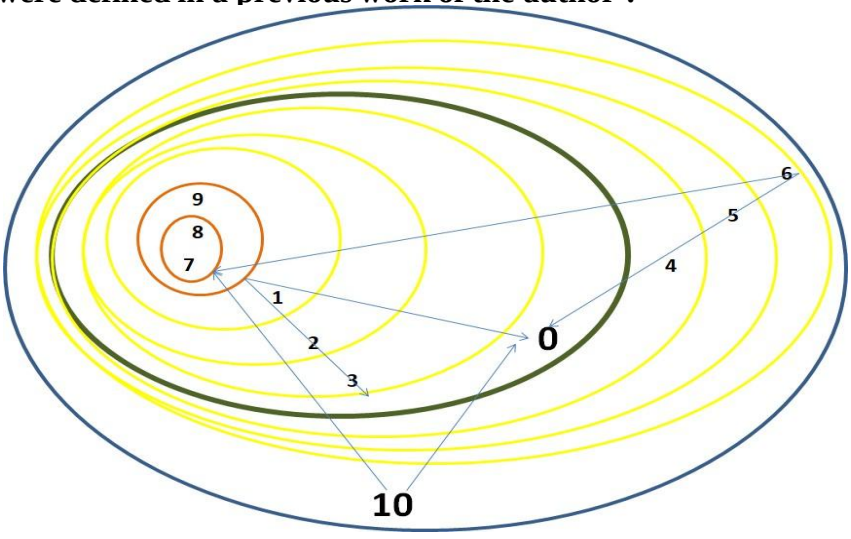

Figure 1. CATS from Table 1 representation in a "matrioshka" style

GCO2: CATS are Complex Autopoietic Systems. An Autopoietic System is a

[9] Serbanescu November 2020.

complex system having the features of Autopoiesis[10]**. Autopoiesis means "self-production" (self-creation or production) and expresses a fundamental complementarity between structure and function.**

[10] Humberto R. Maturana.; Francisco J. Varela, (1972). *Autopoiesis and cognition: the realization of the living*. Boston studies in the philosophy and history of science.. Dordrecht: Reidel, p. 141.

An autopoietic machine is a machine organized (defined as a unity) **as a network of processes of production (transformation and destruction) of components** which:

- through their **interactions and transformations continuously regenerate and realize the network of processes (relations)** that produced them; and
- constitute it (the machine) as a **concrete unity in space in which they (the components) exist by specifying the topological domain of its realization as such a network.**

Important properties of the **space defined by an autopoietic system:**

- **it is self-contained and cannot be described by using dimensions that define another space**.
- **w**hen we refer to our interactions with a concrete autopoietic system, however, we project this system on the space of our manipulations and make a description of this projection.

*One can recognize in this problem similarity with the definitions and methods in integrated risk models **and hence with the issue of control from inside** (by a given component of the system) of that system.*

Some important **features of CATS** are:

1. The system is characterized by the fact that the interrelations between its elements/components create a synergetic effect, which actually makes the system unique. The interactions **are of short distance between elements or of long distance (in space and time).**

2. The existing relationships in CATS are defined by the existence of **feedback loops, which results in a dynamic system structure**, with constant nonlinear interfaces.

3. CATS are interacting with the environment, being **open to the exchange of energy and information.**

4. No part of CATS can contain the whole and therefore no part can assure the control of the whole CATS. This could lead to **specific tools for controlling it, like for instance distributed control, hierarchical control and/or external to the CATS unitary control**.

5. CATS elements are CATS themselves and are highly adaptive, which introduces another difficulty in the choice of the modeling tools.

6. **CATS have a historical hysteresis characteristic**, in the sense that they have a history and that leads to an effect known as "the butterfly effect", i.e. a small change in time and space will impact on the future history of the whole CATS or to a completely different component that the one that had the **initial change.**

7. **This creates the conditions for the generation of high level challenges,** called Cliff Edge Effects (CEE). However, even if the interrelations of the components are nonlinear, it is considered that they comply with the cause and effects law in this specific manner. The concept of linearity and nonlinearity apply to the models defined for CATS and it is one of the important modeling issues.

8. **CATS have boundaries difficult to define, which have a high impact on the content of their models and their own changing dynamics and flexibility**. Complex Autopoietic Systems (CAS) were introduced by (Maturana et al., 1974) and have the specific features additionally to the generic CES ones, sometimes refining the generic CES features**. CAS are systems, for which an autopoietic mechanism can be defined,**

leading to the system possibility not only to self-regulate, but also to recreate itself, as follows:

i. The system boundaries have to be clearly defined at any moment in time
ii. The system has to have components, being themselves CS
iii. The cause – effect law interactions have to be operable.
iv. The system boundaries have to be self-produced by the system, as well as the system components
v. The rest of the components should be also be able for most of them to be self-produced by the system

GCO3: For the CATS systems in table 1 and Figure 1 **the category concepts are introduced in order to model the components of each systems (energy sources of SYS x type)** and the connections between them (the laws of transformation and conservation of energy) including the applicable laws related to the entropy at each level.

The features described before for CATS and their elements are applicable to the adopted categories to describe them.

The following definitions are introduced (in accordance with the theory of categories in mathematics) (Figure 2):

- **Objects Obj1, Obj2, Obj3**
- **Morphisms f1, f2, f1* f2**
- **Three identity morphisms (not illustrated in the figure) 1X, 1Y, and 1Z**

where:

- *Obj $_I$ – energy sources of a certain level (SYS x)*
- *Functor 1- energy conservation law;*
- *Functor 2 -energy transformation laws*
- *Functor 1 combined with functor 2 consider also the entropy aspects*

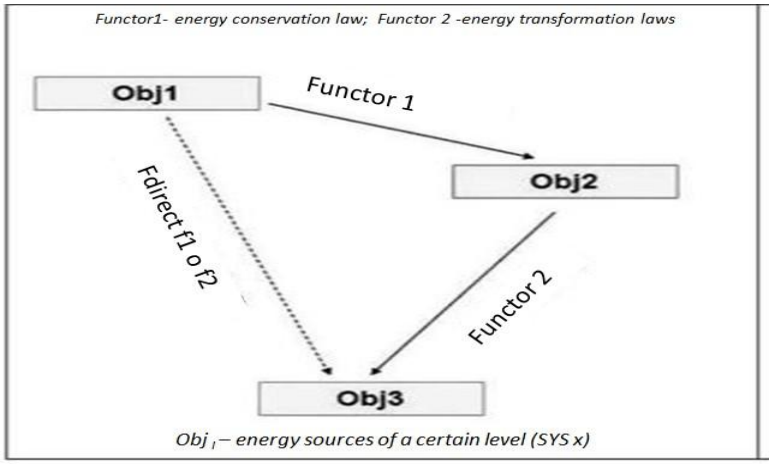

Figure 2. F Description of the category concept

The impact of using the category approach is that the resultant states of applying functors to objects, by applying energy applicable laws at a certain level for the constituent energy sources of that type, lead **to a set of states – space states of the categories** defined for SYS $_x$. The **characterization of the states is given by the minimal features of the energy type.**

GCO4: CATS energy system SYS$_x$ (Table 1 and Figure 1) **transformations are defined as mentioned above as space states**. C**haracterization of the SYS x states is given by a set of minimal features, which are called syzygies. D**escription of the **space states of**

the CATS is performed using specific minimal features called syzygies, which in their case are related to *Energy*, defined for this purpose a**s a in the category understanding of the SYSx as a function of mass, speed of light and entropy.**

GCO5: CATS systems described for their space states by the syzygy "Energy" are also topological structures. In this approach t**opology can be connected to issues like**:

- The ***continuity* of transformations and their perceived models**, i.e. knowledge (models) and existence (real behavior) of CATS
- The **transformations/changes of CATS** and the models describing them take place ***step by step*, until a stable state is reached**.
- During and after the changes and **challenges a "core features" of SYSx as defined by their syzygies ("Energy") transform them from one structure to another, going through various states. The results are topological structures, described by algebraic methods** – for which equivalent to them geometrical polyhedral representations might be used.

The systems composing CATS are in continuous interaction and transformation leading to the change of their states described by the minimal set of characteristics (syzygy). The concept of syzygies as a set of minimal characteristics of CATS description is used in analogy with their use in mathematics, but bears physical core system features throughout all the transformation processes.

The transformation processes for a given system and from one type of system to another are described by the type of structures that result for their description in each state. These structures are a geometrical representation demonstrated in mathematics, which are defined by surfaces, angles and vortexes. The type and number of those geometrical characteristics may be considered as a good representation of the trend of expected changes.

GCO6: Various states of **the SYS_x space state are reached during this process; a stable situation of the transformation is defined by a parameter**, called **Enantiotropy, which is described using the category approach described at GCO3.**

The resultant polyhedral geometrical representations pass through various states (energy changes from one state to another for the same type of energy, or from one type to another etc) in a process driven by **Enantiotropy.**

- **Enantiotropy is an analogue of the entropy of the states reached in a SYSx**. The Enantiotropy of the optimal situation in a SYSx is that, where the system might move to any of several surrounding cases.
- **Enanthiotropy defines the change of state of a given system without considering the** interface from other systems ("up and down" x) and it is called in this case **"Lateral Enantiotropy".**
- **Enanthiotropy may be described in time dependence or in imaginary number type of description for a better understanding of its dynamics**
- **For a** set of systems at a certain moment *in CATS* one may have both description of changes of every of component systems by **Lateral Enanthiotropy,** but also by considering interation between systems ordered in a "*matrioshka set*" **(**as represented in Figure 1) by the **Up and Down Enanthiotropy**.
- **This is a description of transformation and changes of energy from one state to another and from one form to another, by adopting a generic definition of the energy system (including source, use, dependent systems and knowledge/models describing them).**

• **The dynamics of those processes is geometrically represented for the structures generated by the syzygy values for all systems and states. These geometrical representations** of the structure generated by those changes the space state is **described by a polyhedral geometry**, in which states are defined by the facets and the optimal/stable situations, by the vertexes.

• **T**here is **a possible asymptotic state for the SYS_{10} system (**Table 1 and Figure 1**), defined by the Poincaré hyper sphere, creating a set of** topological structures, as represented in Figure 3.

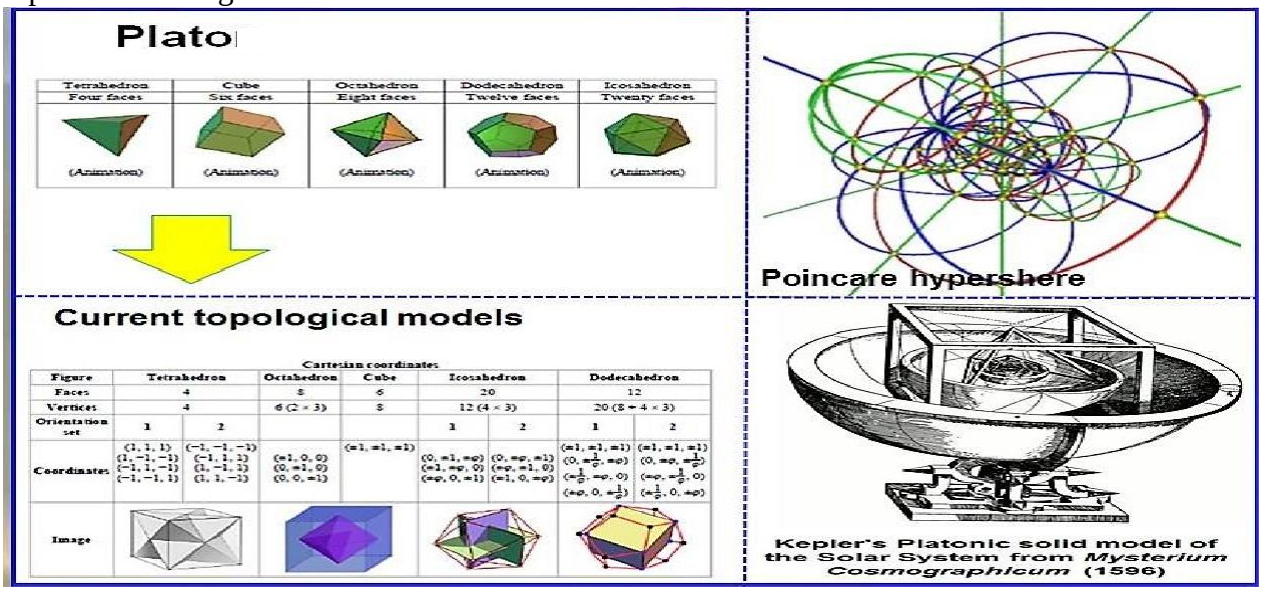

Figure 3. Transition matrix and geometrical polyhedral representation of the transition phases' process

• **The geometrical polyhedral representation of the transition phases of the energy systems** transformation process illustrates accurately the specifics of CATS states as a whole and its components.

• **The resultant structures described for CATS syzygies lead to various geometrical polyhedral cases (tetrahedron, cube, octahedron etc**. There are results indicating and being confirmed for various energy systems of CATS type as being of some of those types, for instance the planetary unsolved energy state is of icosahedron type, while the human body is described by a dodecahedron.

• For polyhedral geometries them there is a hierarchy of Enanthiotropies, which indicates the direction of expected transformation to the next state of a given system or its emergence to a new one, in a *matrioshka type* of connections. Therefore **there is a direct correlation between the number of facets, vertexes, and the geometrical volume and surfaces defining actually the Enanthiotropy**. The states described by the geometrical representations of the energy systems structures have a physical meaning:

- Numbers of facets illustrate the number of states of a system during its changes, in its topological space states.
- The volume shows the fact that the states are reached after a lot of transits and changes as defined in the GCO5
- The surfaces are in correspondence with the number of facets and indicate on the combinations and changes taking place in the SYSx during its transformations
- The enantiotropy indicates the probability of reaching optimal points (represented by vertexes) during the transformations of SYSx

Table 2 Main principles of cybernetics[11]

No	Principles	Short presentation of principle
P1	Occam's Razor	One should not increase, beyond what is necessary, the number of entities required to explain anything
P2	The Identity of the indistinguishables	Two entities that do not have any properties allowing to distinguish them should be seen as a single entity
P3	The Principle of Causality	Equal causes have equal effects
P4	Downward Causation	All processes at the lower level of a hierarchy are restrained by and act in conformity to the laws of the higher level
P5	Blind Variation and Selective Retention	"Blind Variation and Selective Retention" (BVSR) -Donald T. Campbell, as a way of describing the most fundamental principle underlying Darwinian evolution.
P6	The Principle of Autocatalytic Growth	Stable configurations that facilitate the appearance of configurations similar to themselves will become more numerous
P7	The Principle of Selective Variety	The larger the variety of configurations a system undergoes, the larger the probability that at least one of these configurations will be selectively retained
P8	The Principle of RecursiveSystems Construction	BVSR processes recursively construct stable systems by the recombination of stable building blocks
P9	Law of Requisite Variety	The larger the variety of actions available to a control system, the larger the variety of perturbations it is able to compensate
P10	Law of Requisite Constraint -	In order to be a proper coordination of actions to perception, the system must be able to select the correct choice. The ability of the system to avoid incorrect or unviable choices is a constraint on the behavior of the control system. If no such constraint existed, the system would have to try out actions blindly, and the larger the variety of perturbations, the smaller the probability that those actions would turn out to be adequate.
P11	The Law of Requisite Knowledge	In order to adequately compensate perturbations, a control system must "know" which action to select from the variety of available actions
P12	Law of Requisite Hierarchy	The weaker the average regulatory ability and the larger the average uncertainty of available regulators, the more requisite hierarchy is needed in the organization of regulation and control for the same result of regulation
P13	The Principle of Incomplete Knowledge	The model embodied in a control system is necessarily incomplete
P14	Principles of Reasoning with Uncertainty	Cybernetics and Systems Science have produced important principles of information and uncertainty. These principles were developed in the context of specific theories which represent information and uncertainty using a particular mathematical formalism of variety, usually probability and thereby stochastic information theory. The principles are: • Principle of Uncertainty Maximization • Principle of Uncertainty Minimization
P15	The Red Queen Principle	For an evolutionary system, continuing development is needed just In order to maintain its fitness relative to the systems it is co-evolving
P16	The generalized "Peter Principle"	In evolution systems tend to develop up to the limit of their adaptive

[11] Francis Heylighen, 1992. *Principles of Systems and Cybernetics: an evolutionary perspective*, http://pespmc1.vub.ac.be/CYBSPRIN.html; F. Heylighen, C. Joslyn, 1994. *Principles of Systems and Cybernetics*, http://pespmc1.vub.ac.be/CYBSPRIN.html.

		competence

GCO7: For CATS **defined as topological structures** the **changes and challenges at the same level are defined by transfer matrices**, applied to their syzygies in a cybernetic description. The principles of cybernetics were defined in classic works and a general description is in Table 2.

CATS systems are, in light of cybernetics principles, "black boxes" for every change at the same level (lateral changes impacts) and changes due to their transformation in other systems (up/down systems impact).

The transformations move from one state to another in some steps driven by the dynamics of the core characteristics and may pass through groups of situations in a process that is non-mandatorily an evolution, it is a change. At a certain point of "saturation" of transitions, a point of total critical rearrangement happens both for any individual system and its knowledge and for their interactive grouping (CATS as a whole). This point is governed by laws of change due to feedback connections and a total reset of CATS system may occur. This point is conventionally called **Zarathustra point**, in some analogy with eternal recurrence theories of beginnings in cycles, as illustrated in many mythological beliefs and postulated by Poincaré, a moment of the restart from absolute new beginning, which is resetting the whole process. Everything is restarted from the beginning in the sense of combination and changes of states for individual systems and for the whole ensemble (CATS), as for instance:

- restart of Planetary set of CATS,
- restart of cosmic CATS in this reality,
- conscious life energy system reset due to singularities.

GCO8: CATS in imaginary type of coordinates, the recent results show that we are expecting a set of hyper complex representations, of up to 11 imaginary axes. This result is already reflected in polyhedral representation already and leads to a set of syzygies in more than three coordinates as usual for our reality.

The syzygy components generate for CATS in this case three categories of systems:

- ***Real type of energy,*** which is related for each system (type SYSx in Table 1 and Figure 1) to the observable energy changing in the same system ("x") , by changing from one state to another
- ***Simple Complex Energy,*** which is related for each SYS x to that type identifying itself by the results of their interaction with the Real Energy.
- Both ***Real energy*** **and** ***Simple Complex*** are specific to a given SYSx and do not interact with other levels /energy systems and they describe a type of interactions called in this approach ***Lateral Control in a given energy system***
- **Hyper complex Energy,** which is related to interactions from other systems than "x" **("up or down")** and they describe the ***Hyper Control in a given energy system.***

The types of energy systems described above generate three types of realities. Real type of energy generates realities of Planetary level, while simple complex energy and hyper complex energies generate Galactic, respectively Cosmic type of realities. All those types of energy systems and realities are governed by the syzygy mechanisms mentioned before in a cybernetic and hyper cybernetic type of interactions.

Hyper-cybernetics is considering all the given energy system states and the interaction with higher or lower order of energy systems, for a given set of CATS energy systems in a defined universe. The interfaces of hyper complex type include also those from

other universes, as feedback and feed before functions, as the CATS approach as a potential TOE approach actually is not limited due to the number of universes.

GCO9: CATS' syzygys are described by multidisciplinary approaches, as shown for specific physics models in an already mentioned article of the author. This is compliant with the Principle P2 (Use of multidisciplinary approaches). The *knowledge process* leads to topological structures, which are dependent on some important factors, as mentioned in the previous paragraphs:

- the type of civilization according to the *knowledge process*
- the peculiarity of the knowledge structure, as for instance:
  - what type of triadic „object-model-reality element" is considered,
  - the type of paradigms governing each phase and
  - the solutions to change the syzygies based on „import" from other complementary triadic sources of reality, except science: art and cultural-mythological areas.

GCO10: CATS' syzygys include models of KP, of topological type themselves, which are:

- defined in a triadic, multifaceted approach from science, art and cultural-mythological-social aspects
- based on the degree of reaching certain levels considered adequate, based on various criteria, as for instance:
  - The level of truth,
  - The level of conformity and integration in the cultural environment and
  - The value for society.

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