

THE INTEGRATED CAUSAL PROCESS FIELD APPROACH

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ABSTRACT

This Paper is built around three Case Study based on Causal Process Analytics to describe how the Integrated, Black Hole and Big Bang Causal Process Fields are structured as a whole, what are the interdependencies between their Causal Dimensions and conclusions regarding the evolutionary path of the Causal Processes as part of the analyzed Causal Process Fields.

The topic is focusing on a completely new approach, with the help of new developed Causal Analytics, on how to structure all existing Causal Processes in practice and what benefits and challenges, using the presented examples when Implementing, might appear.

KEY WORDS: *Causal Processes, Causal States, Cause and Effect, Integrated Causal Process Field, Black Hole Process Field, Big Bang Process Field, Causal Dimensions, Causality Degree*

PART ONE THE PROCESS FIELD

The definition of Field concept has a multitude of interpretations, depending of the domain where it is used both as noun and verb. This paper is widely using the notion of *Process Field* for any collection of one or more Process categories in interaction that can be basically described by common mathematical analytics

There are billions of billions of *Process Fields* of the same or different category as an integral and unavoidable part of everyday life, carrying in their structure the most complex Processes that are generating Causal Fields, from the formation of the Universe to more complex Biologic Evolution Processes.

Process Fields are evolving from an abstract qualitative concept or information to a physical representation easy to be measured and assessed using its characteristic quantitative indicators and / or variables. All Processes are following an evolutionary path once initiated and the path structure is always going from non physical to physical or from an entropic to a material Process and subsequently *Process Field* representation.

Based on the Process's structure and functionality, a large collection of variables can be observed but there are also other supporting and adjacent Processes impossible to observe and assess due to their nature and characteristics.

The idea of *Causal Dimension* is given more sense to understand Processes and how they can be easier assessed using the specific dimension's class characteristics. A Causal Process Field *Dimension* is a collection of Causal Processes of the same category and it is

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completely different and identifiable by the other *Process Field Dimensions* due to its unique functions / attributes and mathematical description with reference to (1)

Sorting out and ranking Process Field's Dimensions is another issue quite difficult to perform specially when there are several contradictory criteria. One of the most universal criteria to rank Processes within a Process Field then the Process Field Classes to configure Process Field Dimension is based on Entropy or the order established by any Process's microstates. A dimension ordered using Entropy as basic criteria is called further an Entropic or a Causal Dimension.

Interactions where the correlations, between Processes are possible, take place at the level of the same Causal Dimension, then between the neighboring consecutive Causal Dimension where Causal compatibilities and correlations can occur.

A Causal Process has in its structure components, featured by their unique analytics and as remarked in (2) the components are parts of the whole, this being considered the Process and consequently its associated Process Field.

The concept of *Structure – Organization – Process* is being explained in (3) and due to its causality approach make more sense and it is more appropriate to use it in defining the Process and Process Field Structure as a whole, with their causal interdependencies further on, when fully assessing a Process, its Field Dimension and eventually several correlated Causal Dimension as part of the same Causal Process Field.

As the Entropy is the most common and a well known attribute that can describe any Process and its associated Process Field the structure of the Process must be the same as the structure of the Causal Process Field Dimension, the Causal Process is belonging to.

PART TWO THE INTEGRATED CAUSAL PROCESS FIELD

a. What is defining Process's Causality?

Integrating Causal Processes within a definable Field is a quite complex task requiring suitable measuring instruments / techniques, analytical assessment, clearly determined ranking criteria, rules of exceptions and extensions and the Field "*texture*" generated by other Processes within the same or other adjacent Causal Dimensions. The *texture* is given by the Field discontinuity and makes the Integrated Causal Process Field being a digitalized Field where every single Process is a roughly considered a "digital" Process consisting of Micro States assembled together in Macro States or Processes of the same discontinuity category or *Causal Dimension*

As it will be analyzed further, the Integrated Causal Process Field discontinuity is generated by the originated Temperature Process Field and all Processes in this Universe are carrying on the characteristics of this Field.

In this study the Causal Integrated Process Field is comprising all existing Universe's Processes sorted out as being Non Material and Material.

Table 1 is a representation of the *Integrated Causal Process Field*, the analytics of how it is determined, all the explanation being performed in *Part Three* as an application of *Causality Analysis*

In everyday acceptance Determinism and Causality are common concepts, Determinism being more commonly accepted and used in Control System Theory.

This study is using an extensive definition of Determinism, *the Causality*, to complete the nuances of existing definition / terminology. Taking in consideration the existing definition and mathematical relations with reference to (4), the completion of Causality definition makes the framework of Causality principles, that make running the Integrated Causal Process Field as a whole.

In the same way the Causal notion is used in the same sense, with reference to (5), for a Deterministic Machine, a Non – Deterministic Machine and a Stochastic Machine. Stochastic Analytics is considered being a consistent part of *Causal Analytics*, while it is carrying on limitations regarding the assessment's result accuracy and is based on different assessment methods.

Furthermore, there are no Non Deterministic Dimensions or Processes at the level of Integrated Causal Process Field, those possible satisfying a Non Deterministic relationship, being perfectly assessed using Stochastic analytics. Stochastic classic definition and functionality is fully used, as it is in previously referred for a Stochastic Machine.

As it will be observed further throughout this study, in the new baptized notion called *Causal Analysis*, the analytics and computational method are heavily loaded with *Causal Programming*.

Theoretical Computer Science is mentioning in (6) the computational techniques. Causal Analytics are taking these techniques with their scalability and fully readapting them accordingly the purposes of the *Causal Analysis*, the deterministic criteria of the Deterministic and Non Deterministic Turing Machine. Besides the above cited references, the basic functionality principles of a Causal Process and its Causality Analysis are using the notions of Cause and Effect and are given by:

- the Cause is always generating one Effect at a given time interval and the Effect is always generated by a Cause
- the Effect is always becoming Cause for other Process' s Micro States or Processes.
- Cause and Effect are Entropic measures and suitable special designed analytics is used for their exact assessment.

The purpose of this paper is to propose based on Causal Analytics, the set of correlation that make sense to explain in simple words and mathematical relations any Causal Process of our Universe, how it is working and the power of Information that makes the differences in our everyday life.

b. How the Causality Analytics works?

A word is a piece of organized Information being a tremendously important part of any Causal Process, its quantitative assessment being the *Process' Causality Degree* indicator. Information is the basic brick in its conversion, to causally generate Space, then Time. Starting from the Information level of its details any Causal Process can be described, in

this way, an unique identification procedure based on Space and Time being initialized for every single Causal Process in the Universe.

Using Analytics born from Heisenberg's Uncertainty Principle and being further developed and based on Shannon's Information Theory and Euler's Gamma Function, the *Entropic Field Approach* made possible to calculate *Process' Causality Degree* for any two interdependent variables as part of the same Causal Process.

The notion of Causal Process Field with its *Causal Analytics* is becoming in this way a very powerful tool that brings closer the frame and concept for a *Theory of Everything* where everything in the existing Material and Non Material Universe can be explained by the help of well known, simple to understand and use mathematical algorithms.

From the *Theory of Everything's* panoramic perspective, the *Integrated Causal Process Field Approach* is aiming to describe the primary structure of all Causal Processes by the help of a unique set of Analytics based on Causal Algorithms, put together with the basic principles of Universe's Process' Functionality and Causality. In this way, the used Analytics is structurally and consistently the same and it can be used to assess successfully a large diversity of parameters belonging to both the Material and Non Material Causal Universe.

A Causal Process has its roots in the descriptive Information of its name as a whole and is characterized by its Data's Structure determined quantitatively by frequency and *Causality Degree* and qualitatively by attributes as significance, description and so on.

From a Causal point of view, the Information structure are carrying on other quantitative attributes Causally easy to be assessed as Information Accessibility and Addressability. Information Accessibility is given by the rights a user has to access a certain Information while Information Addressability is the knowledge process where a user learn how to access Information in order for its relevance or *Causality Degree* accordingly to its purposes.

The Integrated Causal Process Field is also defined by its mixed Analytics structure where both Causal Analytics and Fractal Theory are used together to describe the whole range of existing Causal Processes. A *Theory of Everything* developed on Causal Analytics is capable to describe all Universe Processes on a state of the art technology of doing Causality Assessments and finding results otherwise difficult or impossible to measure or determine using the current scientific and technological advances of our world.

c. How a Causal Process is structured?

Integrated Causal Process Field is structured in three fundamental fields as it is the Entropic Field, Force Field and Energy Field all of them being consequently structured as Causal and Non Causal Process Field running within the Material and Non Material Universe.

The Entropic Field is a Field of Microstates. Microstates are defined as being the states where the Entropy is generated when the Cause is becoming Effect and then the Effect is becoming Cause, every cycle starting over and over again with Entropy dissipation as represented in *Diagram 1*. Any Entropic Field is a collection of Microstates (assembled

into a Causal Macrostate or Phase as part of a Causal Process cycle) causally generated one from another as an Effect of the Causal Couple Temperature / Information variation.

The Generic **Table 1** of the Integrated Causal Process Field as a whole, during the life of the Universe is derived from the structure and studied as two main Process Fields: Black Hole and Big Bang Causal Process Field.

A Causal derivation is represented by measures that are generating specific Entropic Fields, as the Information, Space and Time Field then the Force and Energy Field. For any of the potential Non Causal Dimension of the Universe, these variables does make sense as well as in any other Causal Dimension, but the possibility to measure and assess them is submitted to the Stochastic and Random mathematical techniques.

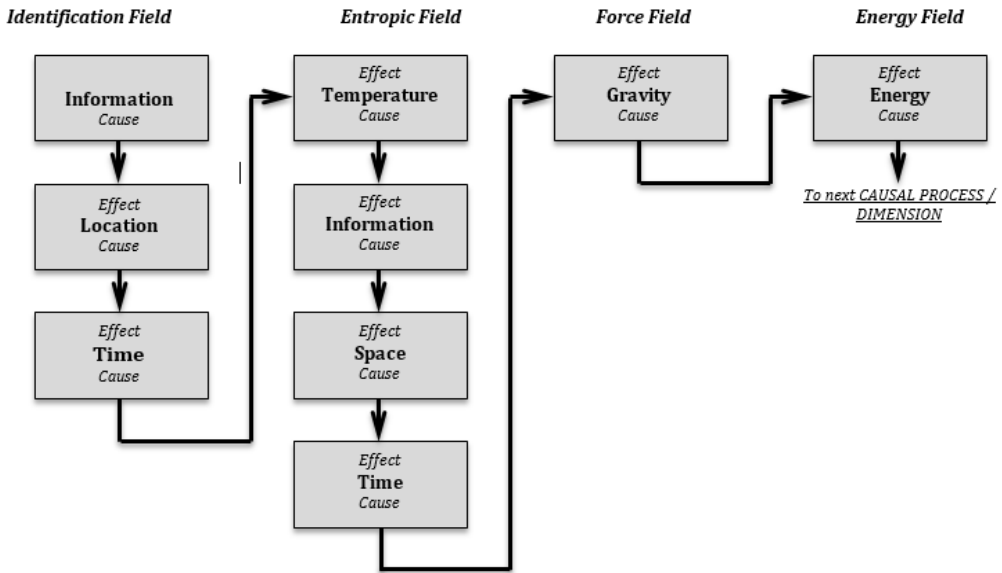


Diagram 1. Generic Vertical Causal Microstates representation for one Causal Dimension

A Causal Process is characterized by its collection of Causally correlated States (*Causal States*) while the move of Entropy from Cause to Effect to Cause, within a Microstate is generating the Entropic Field and is represented in **Diagram 2**.

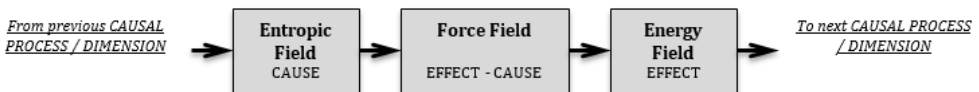


Diagram 2. Generic Vertical Causal State representation for one Causal Dimension

Example:

A moving electron has a velocity that is determining causally its next position. The Causal triplet (Cause – Effect – Cause) of velocity – position at a given time is a Causal Microstate.

As the electron has a trajectory and several Microstates are part of its trajectory, the Moving Process from the beginning to the ending of its trajectory is determining the formation of a Causal Process Field.

d. How the Integrated Causal Process Field is structured?

From a Causal point of view, the Universe both the Material and non Material one is divided in eleven Causal Dimensions, differentiated by the others through its Causality Degree that normally have the tendency to show a significant up or down hike of its calculated value.

In the same way if a Causal Process is determined if is part of certain Causal Dimension, its Causality Degree value must be in line with the other Causal Processes belonging to the analyzed Causal Dimension.

The structure of the Integrated Causal Process Field is represented in *Diagram 3*.

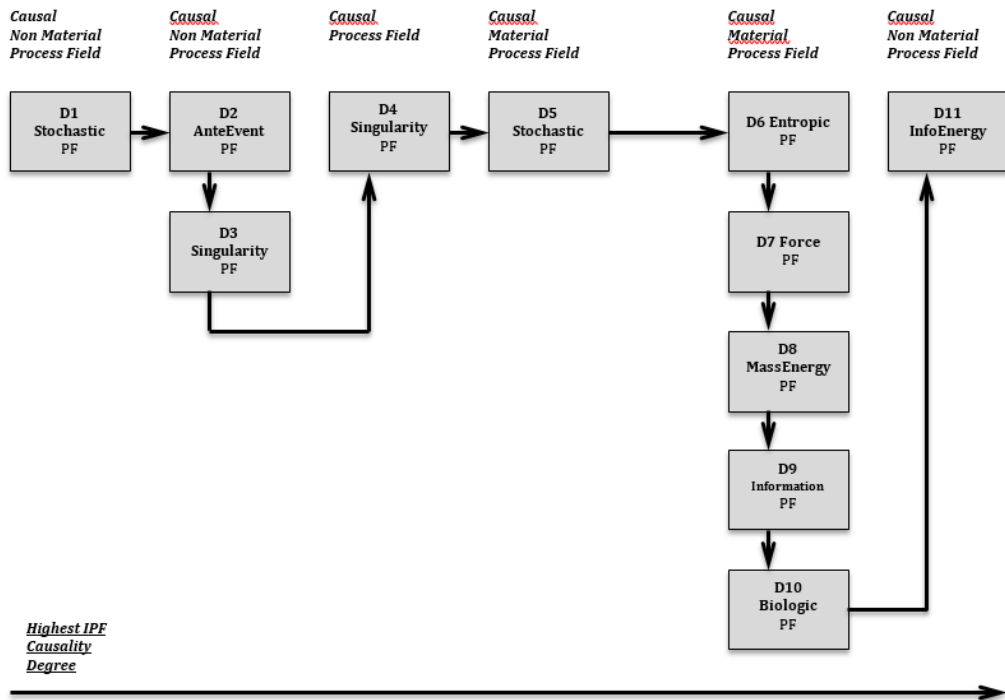


Diagram 3. Integrated Causal Process Field – Causal and Non Causal Macrostate representation

During the Process’s Objective Implementing of every day’s life, Causal Processes in their development do not have a linear decreasing value of Causality Degree from left to right as shown in *Diagram3*. A Causal Process development taking place between several Causal Dimensions for the most complex processes will always change its Causality Degree.

PART THREE APPLICATIONS BASED ON CAUSALITY ANALYTICS

All existing Causal Processes can be assessed and controlled using the Integrated Causal Process Field Analytics consisting of both Assessment and Control Indicators. The indicators are designed to analyze in depth both the Black Hole and the Big Bang Causal Process Field, being considered the most relevant Process Fields of the existing Universe. One of the main goals of this study is to define the Integrated Causal Process Field, the derived adjacent Black Hole and Big Bang Fields and using the Causality Degree to map these Process Fields with the most accuracy as possible.

3.1. Causal Process’s Assessment and Control Indicators

Causal Processes need a toolbox where special designed Assessment and Control Indicators are used to substitute the usual Qualitative and Quantitative Analytics based on Statistics with Causal Analytics based on Causal Algorithms. The difference resides in the result’s accuracy and the possibility to make Real Time adjustments while implementing the targeted Objective, the Causal Process is running for.

a. Assessment Indicators.

- *Causality Degree* analytics with reference to (7) is calculating the Causality of a Process at any moment of its evolution from its inception till the end, when the Objective is achieved or the Process is interrupted. Applications of Causality Degree are covering roughly all assessments of the material and non material Universe. The applications where the *Causality Degree* is used in stand alone mode are significantly limited, just to determine Causal Process Field structure and Sequentiality and it cannot be used for the assessment of Real Time Processes.
- *Intensity Degree* analytics bring out a very powerful tool that in conjunction with the Causal Degree Analytics makes possible a Real Time Process assessment. Another important attribute of the *Intensity Degree* resides in its ability to find the perfect match between a question and a large collection of answers, finding the best solution for the question, as well as finding the best optimization solution for a Causal Running Process, generating specific signals used by the other Causal Control Indicators. The applicability of *Intensity Degree* Indicator is limitless having as target all research domains, where its ability to be used as a Real Time Information Search Engine is highly desirable.
- *Integrity Degree* calculates the extent of integrality of all Causal Processes within the Causal Process Field. If there are *n* Causal Processes in interaction than the aggregated Causality for all Causal Processes within an Integrated Process Field is measured by the Causal *Integrity Degree (ID)* where *Time* is representing the *Query Launching Time*:

$$ID = cd < EF_c^1; EF_c^2 \dots EF_c^n; Integrity Degree; Time >$$

The Integrity Degree Indicator is function of Causal Process Effect (Energy), the String’s Entropy of the function and Time

A 100% Integrity Degree shows that all Processes belonging to a Causal Process Field are fully integrated Causally while a value of less than 100% might suggest that adjustments are necessary to adjust all Processes fully Causally by adjusting their Causes, accordingly the planned Objective Requirements.

There are tremendous many applications where the Causal Integrity Degree of a Process can make huge differences.

Example:

For an Causal Investment Process usually the Portfolio Risk and Performance is assessed using the statistics of Standard Deviation, Value at Risk etc. Using Causality Analytics is easier to calculate the Causality Degree of each asset of a portfolio in terms of its Real Time Performance. If the Integrity Degree of the aggregated portfolio is as close as possible by 100% the investment is as close as possible to assure a positive performance.

Usually the best performing portfolios or investments funds realize Integrity Degree of about 90-92% while a bond based investment is near 95-96%.

b. Control Indicators

- *Configuration Degree* shows when a Process is 100% causally Configured and ready to be launched to create the Effect or ready for Implementing in order to obtain the targeted Causal Objective.
- *Adjusting Degree* calculates when to adjust Causes after a Process is 100% configured to obtain a better or modified Objective with different attributes compared to what it was initially designed for. Very useful indicator in assessing Causal Country Risk where High Risk Process as Natural Catastrophes, War / Terror or even Political or Financial Risk may occur.
- *Energy Effect* calculates in Causal Energy Terms how the Objective should be designed to reach the attended parameters and gives a measure of how to adjust up or down its upcoming released Energy.
- *Energy Expansion* calculates how the *Energy Effect* is or should be released during the Causal Process Implementing stage by use of Fibonacci Fractal function. It is very useful in Processes where the Mass Energy expansion is following up a complex evolutionary pattern as the formation of galaxies and solar systems the in the Biologic Evolutionary path of existing species.

3.2. Case Studies

Finding the right causal order of all Causal Fields and Processes as part of the Integrated Causal Process Field can be done using the Causal Analytics, where the Causal Analysis of the Field / Process denomination is also describing the Causal ranking as part of a alphanumeric Table or String. The name / description information of a Process is also part of the Process and is determining Causally its structure down to the very fine details.

Due the nature of the Causal Computation, the results may be twisted sometimes compared to what the modern Astrophysics, Quantum Physics and other related sciences measured and assessed. Causal Analytics is taking in consideration only the Process /

Field description and is evaluating its Causality Degree, when this is specified correctly and detailed as much as possible.

A better structural disposition of words (or their synonyms), expressions or sentences may be more significant to give a better and detailed picture of how the Fields are Causally structured and what are the Processes belonging to them. Besides that, these computational examples, carry on some interpretations that can make sense if sustained by repeated relevant measurements and assessments and might be a useful searching tool and guide for new research and developments for any other scientific domains. Obviously, the more Information is provided, the better is the Causal Process Analyzed and the obtained conclusion are more relevant.

Following examples are trying to show how the Causality Degree works to rank Fields and Processes of Integrated, Big Bang and Black Hole Causal Process Fields. These three Causal Process Fields have a complex structure not clearly charted or analyzed from a Causal point of view, as long as no Causal Algorithms or Analysis is developed by now.

These three analyzed Case Studies are trying to show how the Integrated Causality Process Field is structured what are the basic Causal Processes and how Causality works and is generating the Causal Dimensions

Next two Applications where Causal Analytics is used, bring out the idea of the Causality of Big Bang before the Event as well as the Causal structure and functionality of Black Holes. Both examples are concerned mostly with the very unique and yet common Causal structure of the Singularity Field.

All these examples are doing a detailed Causal Analysis of Causal Process Fields Expansionary Evolution as a relevant data input for further studies regarding the Inflationary Evolution of both material and non material Universe's Causal Processes.

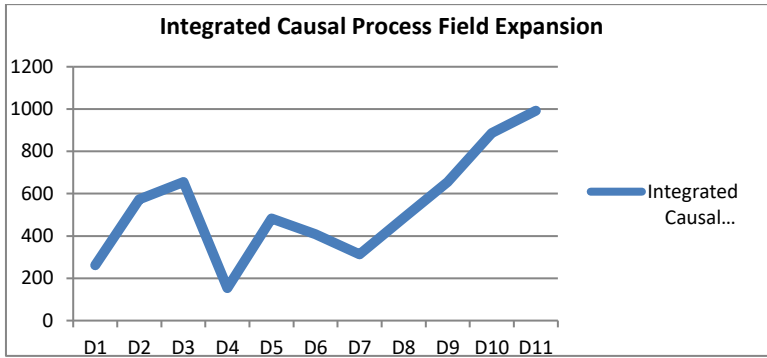
a. Integrated Causal Process Field – Causality Table Analytics

Integrated Process Field is the first Causal Process Field to be assessed on its evolution, having also the highest Causality Degree ($cd = 174,51$) among the studies presented in this paper. A high Causality Degree denotes a complex field, structured in many Causal Dimension each one of them being structured further on, in other Causal Process Fields and Processes.

Graph 1 – Analysis based on **Table 4** input data, shows five stages of the Expansion / Contraction of the Integrated Causal Process Field all of them accordingly the measures and assessments with reference (8) well known also as General Unified Theory (GUT)

Table 4. Integrated Causal Process Field – Dimension Causal Degree

Causal Dimension	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
Causal Assessment	261,09	572,89	655,72	153,53	482,15	408,99	313,47	485,69	655,66	885,89	992,2



Graph 1. Integrated Causal Process Field – Causality Expansion

- 1st. stage D1 – D3 is a rapid expansion of the Causal Process Field characterized by strong increase of the Causality represented by Information and Temperature, then the Space and Time.
- 2nd. stage D4 or the preparation of Singularity Process Field is characterized by a strong and rapid contraction of the Causal Process Field where both Information and Temperature reached a very low Causal Degree in order to get ready for the next expansion stage.
- 3rd. stage D4 – D5 is a strong expanding Process taking in consideration the duration of the Causal Process Field expansion.
- 4th. Stage during the D5 – D7 is a slow contracting period of the Causal Process Field where the Causality is slowly diving while generating a larger diversity of Causal Process Fields of reduced Causality. Usually a high Causality Process may be divided in several lower Causality Processes.
- 5th. Stage of the Expansion of the Causal Process Field is characterized by a strong expansion period contemporary with us and our Universe, with the development of Biologic structure, Information and Energy Conversion Causal Processes.

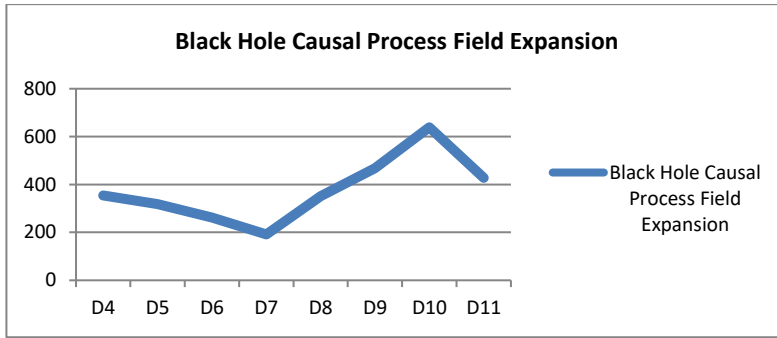
b. Black Hole Causal Process Field– Causality Table Analytics

Black Hole Causal Process Field is the next Causal Process Field to be assessed on its evolution, having a Causality Degree of 94,40.

Graph 2 – Analysis based on Table 5 input data, shows three Expansion / Contraction stages of the of the Black Hole Causal Process Field, all of them accordingly the measures and assessments done in (9).

Table 5. Black Hole Causal Process Field – Dimension Causal Degree

Causal Dimension	D4	D5	D6	D7	D8	D9	D10	D11
Causal Assessment	353,7	318,37	262,26	191,64	351,27	467,46	639,01	428,01



Graph 2. Black Hole Causal Process Field – Causality Expansion

- 1st. stage D4 – D7 is a slow contraction of the Causal Process Field characterized by slow decrease of the Process’s Causality after the Event.
- 2nd. stage D7 – D10 is characterized by a vigorous expansion of the Causal Process Field where several Causal Processes begin to be separated and Causally interdependent one of another.
- 3rd. stage D10 - D11 is a strong contracting Process taking in consideration the duration of the Causal Process Field contraction, inducing the idea that the Black Hole Process Field as well as all belonging Causal Process are part of larger Causal Process cycle where Black Holes are appearing and disappearing cyclically.

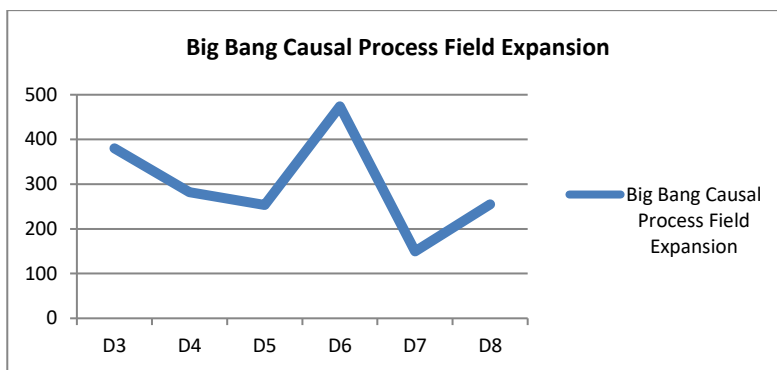
c. Big Bang Causal Process Field – Causality Table Analytics

Big Bang Causal Process Field is the last Causal Process Field to be assessed on its evolution, having a Causality Degree (72.05) being a Process Field with a very simple structure and stretching over five Causal Dimension.

Graph 3 – Analysis based on **Table 6** input data, shows five stages of the Expansion / Contraction of the Big Bang Causal Process Field all of them accordingly the measures and assessments done in (10).

Table 6. Big Bang Causal Process Field – Dimension Causal Degree

Causal Dimension	D3	D4	D5	D6	D7	D8
Causal Assessment	380,42	282,23	253,11	474,06	149,68	255,22



Graph 3. Big Bang Causal Process Field – Causality Expansion

- 1st. stage D3 – D5 is a slow contraction of the Causal Process Field characterized by a decreasing Causality generated by Information and Temperature.
- 2nd. stage D5 – D6 or the preparation of Singularity Process Field is characterized by a strong and rapid expansion of the Causal Process Field where Stochastic and Entropic Processes are increasing their Fields Causality.
- 3rd. stage D6 – D7 is a strong contracting Process, taking in consideration the duration of the Causal Process Field expansion, where the Causal Processes are sorted and derived causally one from another, in preparation for the next Process stage.
- 4th. Stage during the D7 - D8 is a rapidly expanding period of the Causal Process Field where a high increase of Field's Causality is rapidly creating a larger diversity lower causality Processes. As long as what the last stage of the Big Bang Causal Process Field concerns, the pattern of the expansion / contraction evolution is suggesting that the Big Bang Causal Process Field is a part of a cyclic Process and all necessary information sustains the facts that the Big Bang Process Field in the presented form will occur again conducting to the death of the present Universe.

There are some conclusions drawn from the Analytics of the Causal Integral Process Field:

- Information is derived reciprocally Causally from the Temperature and vice versa. Both Temperature and Information is available everywhere at anytime throughout the entire Material and Non – Material Universe. Information and Temperature is Causally before the Space and Time inception from a Causally point of view, concluding that Information and Temperature are not Time and Space dependent. If Information is not Space and Time dependent it travels instantly throughout the Universe and is instantly available everywhere. Information is non Material, cannot be destroyed, deleted or isolated. Information can be altered, deviated, modified and so on. To carry and store Information at a physical level is energy, space and time consuming.

- Parallel Universes are not resulting as existing from the same Causal point of view analyzed in the Big Bang and Black Hole Causal Process Field as long as the born of a Material Universe is marked only by one Big Bang Event.
- All Causal Processes belonging to both Big Bang and Black Hole Process Fields are cyclic processes the character of the Process Field being part of the renewal ever increasing cycle where the Causality of the Field produces major changes in the Field structure, that make the Field to reinitialize its Causal cycle again. If the Causality is starting High the Process and ending Low is a Big Bang Process Type and if the Causality is starting Low and ending High is a Black Hole Process Type. A Black Hole Causal Process Field cannot be initialized Causally without a Big Bang Causal Process Field and reciprocally a Big Bang Causal Process Field cannot be initiated outside a Black Hole Causal Process Field the Causal Interdependence between these two Causal Fields being always present.

Observations – Numeric Calculus Determinations

Taking in consideration the Integrated Causal Process Field (**Table 1**), Causality Degree is normally increasing for each Causal Process Field Dimension from left to right and for Causal Process Fields as part of each Causal Dimension decreasing from up to down. There are still some questions regarding how to determine following numbers of:

- *Integrated Causal Process Field's Dimensions* – the Causality of Dimension's Field Name is always lower than the highest Causality Degree of the first Process Fields that are belonging to it. In this way there are determined eleven Causal Process Field Dimensions.
- *Dimension's Causally ranked* – the Causality Degree of each Causal Process Field Dimension is describing different Causal states of the Integrated Process Field and is given by the median value of all Dimension's Causal Process Fields for the Integrated Causal Process Field or for Causal Processes, for Black Hole and Big Bang Causal Process Fields.
- *Black Hole and Big Bang Causal Field's Processes* – cannot be exactly determined as long as there might be some additional unaccounted Causal Process that are not part of the presented Tables. Roughly, all Process Fields / Processes are going through the whole knowledge of the existing theories and tried to cover everything known and discovered using scientific documented methods. The unknown remains unknown so far.

REFERENCES

- [1] Hawking, Stephen (2005). "Information loss in black holes". *Physical Review D*. **72** (8). arXiv:hep-th / 0507171. Bibcode:2005PhRvD..72h4013H. doi:10.1103/PhysRevD.72.084013.
- [2] Maturana, H.R. and Varela, F.J. (1987) *The Tree of Knowledge: The biological roots of human understanding*, Shambala, Boston
- [3] Glassop, L.I. (2007) *Rethinking Causality: pattern as the science of change*, Heidelberg Press, Melbourne

- [4] Oppenheim, Alan V.; Willsky, Alan S.; Nawab, Hamid; with S. Hamid (1998). *Signals and Systems*. Pearson Education. ISBN 0-13-814757-4.
- [5] Dimitri P. Bertsekas, John N. Tsitsiklis (2007) *Introduction to Probability*, (2nd ed.). Athena Scientific, Belmont, Massachusetts Institute of Technology. ISBN: 978-1-886529-23-6
- [6] John C. Martin (1997). *Introduction to Languages and the Theory of Computation* (2nd ed.). McGraw-Hill. ISBN 0-07-040845-9. Section 9.6: Nondeterministic Turing machines, pp. 277–281.
- [7] Dragos Cazacu (2015). *The Entropic Field*, PIM, ISBN 978–606–13–2692-1
- [8] Dordrecht, Kluwer, p. 93-149; Vladimir Vizgin (1994), *Unified Field Theories in the First Third of the 20th Century*, Basel, Birkhäuser; Hubert Goenner
- [9] Leonard Susskind and James Lindesay (2004) - *An Introduction to Black Holes, Information and the String Theory Revolution* World Scientific Publishing Company
- [10] Peacock, J. (1999). *Cosmological Physics*. Cambridge University Press. ISBN 0-521-42270-1.