A MULTIVERSE OF DISCIPLINES IN CONTEMPORARY SCIENTIFIC RESEARCH

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Abstract. *The present paper tries to describe not only the contemporary relations between economics and physics, but also between many, many other sciences, or more correctly scientific universes, in a so-called "multiverse" of disciplines in the field of contemporary scientific research. The idea of a multidisciplinarity field, resulting from the reunited universes of Econophysics, Sociophysics, Quantum Physics, Demographysics, sciences of complexity, etc. is a normal consequence of the development of multidisciplinary sciences during this century and especially in the next one. The definitional issues of this new disciplinary multiverse are detailed against a short historical background of teaching and researching physics about the Universe. Two special examples about multiverse as a synthesis, or a reunion of universes of multidisciplinarities, are detailed through the work of two scientific researchers in the field of mathematics and informatics field, Serbia's Petrovitch M. and Romania's Odobleja Ş., and some important ideas from their papers are described in the lines of this paper. The special development of Econophysics, Sociophysics, Quantum Physics in Romania, and the impact of EDEN I, II and III are the final themes of this analysis.*

Keywords: *Universe, Multiverse, Econophysics, Sociophysics, Quantum Physics, Quantum Economics, scientific research.*

1. INTRODUCTION

Many of the contemporary disciplines have developed excessively and quite rapidly, especially in the boundary areas located at the interference with other scientific domains, thus generating the trans-, inter-, and multidisciplinarity of today's scientific research. Thus, ever more interesting sub-universes have appeared, where the contribution of one or another of the scientific disciplines incorporated is increasingly hard to delimit; the result is virtually a new concentrated, densified and coherent manifestation of scientific multidisciplinarity, already become classical.

The name of many of these new intersections is efficiently extracted from the simple adjoining and fusing of easily recognizable components of the original name of the formative sciences: thus, economics and physics have generated econophysics, sociology and physics have given birth to sociophysics, demography and physics have constituted demographysics, economics and quantum physics have eventually led to econoquantics or quantum economics, etc. [1, 2, 3, 4, 5, 6]

Pioneer stage of those new domains is hard to delimit, both thematically and (especially) methodologically. For instance, it is more than difficult to select the first three authors in sociophysics, although some references point especially to Serge Galam (*Sociophysics: a Personal Testimony*), Dietrich Stauffer (*Sociophysics Simulations I: Language Competition*), Paris Arnopoulos (*Sociophysics: Chaos and Cosmos in Nature and Culture*), with a vast list including maybe thousands of contemporary authors, in a multidisciplinary domain that has existed for over two decades. [7, 8, 9]

Gradually, those multidisciplinary subuniverses reunite themselves into increasingly well shaped universes, such as the universe of complexity, or the universe of the sciences of complexity, or else the universe of fundamental scientific research into the theory of neuron networks and of cords, etc.

Beyond these realities, ever more present in the modern academic and research milieux, the appearance becomes visible of a disciplinary universe of contemporary scientific reasearch. The present article is devoted to its birth and development. Three questions, whose answers are like the Fates' ones, dominate this completely new process. Are there any similarities between the cosmos physics, astronomy, modern physics and the universe of knowledge in general? What happens when two theories fail to match in a practical manner within a multidisciplinary domain, or within a newly emerged subuniverse? Can we talk about an identity, be it even a relative one, between the multiverse of scientific research and the real cosmic one, revealed by means of modern physics?

2. ECONOQUANTICS OR QUANTUM ECONOMICS – A RELEVANT EXAMPLE OF A CONTEMPORARY SCIENTIFIC SUBUNIVERSE

The very latest scientific experiments of elementary particle acceleration describe losses of about one percent to the benefit of antimatter. The quantum world, that of the particle-wave indetermination in the mechanics of a quantum type, in a similar manner to the coexistence, in the theory of relativity, of matter and energy, seems much more imbalanced and likely to accelerate thosea imbalances with respect to the classical macro-materialism. Now to make a parenthesis with a major economic impact, we are inclined to believe that at the back of the economic crisis should stand an energy compensation of the future evolution, which we would like to be as spiritualized – in the sense of quantum physics – as possible (so, as close as possible to the particle, the individual, the economic or public entity, etc.). The surprise

provided by quantum physics bordering on the economic phenomenon and the vast domain of the latter's applications imposes a fitting of the quantum support of the particle-wave to the economic processes...

This ebcomes ever more significant under the circumstances of the rapid change in the methods, measuring instruments and units or standards employed in evaluation the general economic result. There is room for quantum physics here to gain recognition, in point of methods and methodology, for several decades to come. [10, 11, 12] The materialism of the economic result of the type profit / loss is both uncertain (principially quantic), and incomplete (its side effects are not usually measured, as in the case of the declared bankruptcy of a company, which subsequently leads, through the circulation of the labour force, to developing new small and medium-sized organizations, proceeding from the energy incorporated and left unmeasured or evaluated of the personnel made redundant for limited periods of time). Another example illustrative for the high degree of incompleteness of measuring comes from the educational system, not yet recognised as a continuous energy transfer between teachers and students, having an unimaginably great economic and social impact.

The materiality of the macroeconomic result cannot obviously escape those influences, being permanently situated also within an unnoticeable area, to a significant extent (from 5 and 35, possibly even 40%), with refrence to the hidden GDP, another undecided form of quantum existence of economic matter, between matter and energy, or oscillating between two states, now a particle, now a wave… Actually, we draw a simple analogy between the famous "Schrődinger's cat, who manages, according to the quantum theory, and its specific uncertainty (or indeterminacy) to posses no less than nine lives" and the economic entity or modern company, we come to be able to easily shape the nine complex, or existenting facets, incompletely researched in the economic space.[13,14] In the paradoxical example of Schrődinger's cat, after it has been for one hour in acage with a disintegrating radioactive atom (while a counter is ticking and activates a hammer that will break a poison phial), it becomes a nearly "coherent" overlapping, i.e. ½ alive, and ½ dead. Any observation will always reveal either a living cat, or a dead cat; similarly, the future of the economic world and of the quantum company will most certainly become, in a few decades, the very image of the nine lives that are described below.

Firstly, the existence of the modern firm or company / commercial enterprise are treated statistically and obviously in an incomplete manner, as part of an ensemble (both Schrődinger's cat and the modern firm or company feel "offended" through their mere omission, as in the resulting economic system the sum total of the parts is always more than the whole, in keeping with the theory of the systems as such, and statistical measurement virtually kills the two elementary particles of the economic phenomenon). Secondly, both Schrődinger's cat and the modern firm or company are standard examples of dichotomies of the type life / death, or profit / loss, and both refuse to yield to that dichotomy, thus trying to survive. Thirdly, both Schrődinger's cat and the modern firm or company are irreversibly "fiscalized" in a world of uncertainty of results, according to the quantum priority of result measuring both in the statistics of quantum physics, and in macro- or micro-economy. Fourthly, both Schrődinger's cat and the modern firm or company are faced with hidden avriables, i.e with the hidden or "unnoticed" added value, or the hidden or "underground" GDP. Fifthly, both Schrődinger's cat and the modern firm or company are, in the neo-Copenhagen interpretation, both alive and dead, and also both profit-making and bankrupt (coherent overlapping being, as is generally known, a mere abstraction, and nothing more). Sixthly, both Schrődinger's cat and the modern firm or company meet numerous scientific universes or (economic, social, etc.) worlds, being declared now alive and profit-making in some of them, now dead and non-profitable or bankrupt in others. Seventhly and eighthly, both Schrődinger's cat and the modern firm or company either meet Niels Bohr and physical complementarity, being saved by the impossibility of giving a complete answer to the question "what does a correct and complete measurement consist of?", or with the "conscience" in a dual interpretation, yet the neutrality of the interpretation of a different consciousness (of the physicist Eugen Wigner's friend) saves it eventually. The consciousness interprets the result so that its interpreting the result turns into the interpretation of another constant (that of quantum physics or that of economics).

The last of the survival solutions of both Schrődinger's cat's and the modern firm's or company's is represented by the interpretation of idealistic monism (the consciousness through choosing one of the two opposite states, life / death, or profitability / bankruptcy, collapses the wave function, that is to say the economic energy created by the firm).

3. THE SKETCH OF A CONTEMPORARY DISCIPLINARY MULTIVERSE

We used Schrődinger's cat, comparing it to the modern company or firm, precisely to emphasize the importance of the researcher's consciousness within today's universe of knowledge, and also the necessity to amplify the processes of development of the new scientific disciplines, , of combining them into multidisciplinary universes, and, finally, of shaping an original contemporary scientific multiverse, which could cover both the economic environment, where we get close to the the dominant of individual capaitalism and of the "virtual" firms, created on the internet and multiplied by the order of 10^{20} or 10^{25}, through products and services, and also the social environment (from education to the health services, from culture to entertainment or leisure activities, etc.).

In the current scientific research, there exist, or more precisely co-exist many other examples of multidisciplinarity, or of cooperating scientific disciplines, and their reunion generatesa relatively limited initial universe, which however has a very high potential. If, as we have partially demosntrated, we combine the methods and methodologies specific to statistical physics, quantum physics, etc. with those of amthematics, statistics, informatics, sociology, psychology, biology, etc. in order to decode the pluridimensional complexity of contemporary (economic, social, political, etc.) reality, we delimit a significant pluridisciplinary universe of scientific research. The ampler the development of that universe gets, the vaguer the actual possibility of defining it, or even of naming it, is; a simple attempt in the case described could be for instance "the universe statistical and quantum of econo-, socio- and

biophysics", but even so all the concurrent adjacent disciplines cannot be covered. If we continually add to that multidisciplinary universe other new universes that are being formed and expanded, such as those of "complexity or of the sciences of complexity", or the multidisciplinary universe of research based on the "theory of neuronal networks and on the theory of cords", we gradually advance into the world of the multiverse of scientific research, the vast scope of which is comparable to the enormity of the cosmic multiverse where we exist. From a graphical point of view, the situation can look like the one described below:

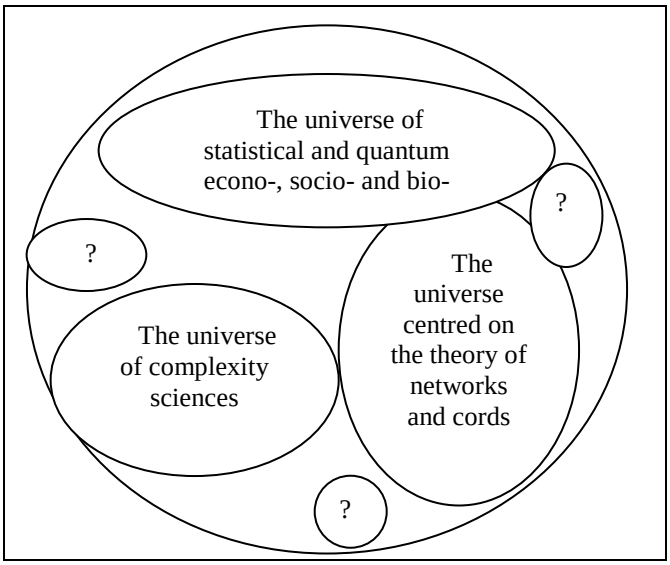

Fig. 1. The disciplinary multiverse of the expanding contemporary scientific research

Very much like the cosmic multiverse, the disciplinary multiverse of contemporary scientific research, as a space of an inimaginable vastness if measured on the scale of human space-time, a space which is also continuously expanding, permanently generates ever new multidisciplinary universes, restructuring itself like Penelope's cloth, waiting for the synthetically formalizing and multi-exprimental thought validated by Ulysses.

The multiverse of the disciplines of contemporary scientific research is a new-born child at the scale of cosmic history, and like any other new-born, is unpredictable in its responses, its metabolism, and its inner structure...

4. THE SCIENTIFIC MULTIDISCIPLINARY THEORY, AND ITS MATHEMATICAL AND SYNTHETICAL LOGICAL FORMALIZATION

A scientific theory is "a model of the universe, or a restricted part of it, and a set of rules that connect the magnitudes in the model to the observations that the researcher makes" [15, 16, 17] in the research activity proper. A classical theory in the unidisciplinary sense meets the conditions of optimization and adequacy to the specific reality, or the object of study of the discipline, if it satisfies at least two requirements:

a) the theory must describe accurately, synthetically and correctly a class of much more extended observations, starting from a "parsimonious", constructed in keeping with William of Ockham's principle, or the principle of "the minimum simplification through hypotheses", by selecting only a few arbitrary elements and significant variables;

b) the theory must make predictions, in a Popperian philosophical sense, concerning the results of the future observations of an experiment, the time evolutions of a process or phenomenon; (the completeness of a theory is validated precisely by this second requirement, and so Aristotle's theory, who stated that things are made of four elements, i.e. water, air, earth and fire, remains a mere hypothesis, while Newton's theory concerning the attraction of bodies with a force in direct proportion with their mass, and in reverse proportion to the force, through validated predictions, represents a complete theory).

A multidisciplinary theory develops and at the same time relativizes the predictive requirement, supplying not only one alternative, but well-delimited sets of predictions based on alternative methods and scenarios, benefiting by the same "output" parametres (outputs, or impact variables identical in point of level and intensity).

At the same time, the theory of a multidisciplinary universe of scientific research adds a new feature to the classical theory, a feature resulting from its complete validation or invalidation:

c) the theory possesses a temporary validity, in the sense that it is only a hypothesis about the reality of the universe which is itself in expansion.

The disciplinary multiverse of today's scientific research seems to amplify the requirements of acknowledging and validation of a theory, cyclically considered as superannuated, and permanently perfectible (a theory can survive only to the extent to which its predictions are ascertained):

d) the theory of any scientific universe becomes, in the multiverse, a particular case of a theory much vaster in point of applicability, not yet discovered or formulated, while the new theories of the multiverse are inferences, maximized in point of coverage degree and minimized in point of mathematical and logical formulation, of the old theories, extended and selected; this fact is actually acknowledged in the very *principle of complementariness* in physical thought, meaning that the old theories are particular limit cases of the new theories (where the limit, for instance in the theory of general relativity, is the speed of light, and in the theory of quantum physics – Planck's constant).

The final goal of scientific research, or even of science in general, is to provide one only theory (Stephen Hawking), to supply research with a stable support in knowing and anticipating the cosmic multiverse.

The formalization of a theory, as found currently, is done and primarily communicates in two aspects, i.e. the mathematical and/or the logical one. We have chosen two pioneering examples, which can provide light into the matter, in order to be able to understand the history, and the tendency that today's theory of disciplinary multiverse is getting to: that of M. Petrovich's mathematical formulations, and of Ş. Odobleja's logical formulations.

At the turn of the 20th century, M. Petrovitch, professor at the University in Belgrade, proposes the delimitation of a new discipline, synthetical through its method, but also multidisciplinary through its study object and applicability, a new branch of natural philosophy, the object / subject matter of which was to be the study of the mathematical relationships between causes and effects, disburdened of all

the residue of their specific data, methods and instruments, of the peculiarities which could specifically link those interconnection with one of another category of phenomena or processes. The mathematical theory of the equations described in fact various types of phenomena, but each domain of the real studies its specific processes. Such a mathematically formulated law can be defined as:

$$\frac{dy}{dx} + kx = 0$$

and it can represent a synthesis of several disciplines or multidiscdiplinary universes:

- the absorption of an ionizing radiation of intensity y, when passing through a homogeneous medium of thickness x (the law of radiation absorption);
- the variation of barometric pressure y according to the altitude x (Laplace's law);
- the cooling of bodies in media at rest (y is the temperature, and x the time, in keeping with Newton's law);
- radioactive disintegration (y is the quantity of substance, and x the effective time of the process);
- the loss of load through evaporation in electricity-loaded liquids (y is the superficial load density, x the time – Pellat's law);
- the variation of the quantity of a definite compound that gradually transforms under the action of another physical or biological agent (y is the quantity of transformable substance, x is the time, in keeping with the law of monomoleculary variations);
- the variation of a population that develops with no restrictions (y is the number of individuals, x is the time, according to the laws of demography), etc.

The essence of M. Petrovitch's exceptional synthetic thought can be reduced to the finding that, in a multiverse of scientific research anticipated in its intersection, or of generalized applicability component, as described by us in the present contribution, the multidisciplinary universes can be simultaneously rendered throigh common major laws. M. Petrovich anticipated by nearly a century the fact that, if in the known universes there exist phenomena different in their nature, they can be rendered through identical mathematical models, and the abstract general study of those mathematical models (to which we could also specifically add the extraction universes: the physical, mathematical, statistical, neuronal biological ones, or those centred on cords and networks, psychological and sociological, economic, demographic, etc.) can be conducted (a model specific to the multiverse, extracted from the universes of scientific research).

Odobleja manages to anticipate, through his logically formulating the so-called consonantist thought, another aspect of the potentiality of today's multiverse. *Consonantics, or the product of thinking a new logic ofresonance or of consonance, is a manner of reuniting logic and psychology, both with physiology, and then of those three taken together with physics, and further on, with technology* [18]. Logic, prior to consonantist psychology, Odobleja would say, seemed completely disoriented. *"Logic has lost the guiding thread, and can no longer find it. Untiredly, logicians ar seeking for it everywhere: in algebra, in superior mathematics, in grammar, in metaphysics, in cosmology, in sociology. The only place they won't look for it is psychology of thought…"* [19]. Consonantics turns into a logical answer, sought and waited-for, within the context of multidisciplinary developments, and this alternative is not only multidisciplinary through its origin and essence, but also through the method that derives from both its conceptions, and the experience of its own coming into being – the method of the multidisciplinary approach and the collaborative links between sciences.

Odobleja's consonantics is an attempt to incorporate and re-examine the main lines of scientific research, lines that had previously been examined in an isolated manner, becoming the first significant "crossroads" of the larger majority of the sciences, and drawing closer scientific disciplines that used to be virtually disjoined: mathematics, physics, technology – and, respectively, biology, physiology, psychology, linguistics, economics. To conclude, we can assess that Șt. Odobleja reinstates, in both scientific research and thought, the preponderance of the method of logic, but within a new context, of a universal and multidisciplinary type. Another additional clarification that Odobleja brings into the framework of the method of researching a multidisciplinary universe deals with the need for a good classification, accompanied and marked by the logical formulation of its specific system of laws. *"All our science is made up of classes and laws. The latter are the more important: it is the laws that maek the value of any science"*.

5. SOME FINAL OUTLINES OF THE MULTIVERSE OF CONTEMPORARY SCIENTIFIC RESEARCH

In the generalized physics of cosmos, the multiverse appeared in a time point within a black hole, called by Stephen Hawking a singularity (in fact, a point in space-time at which the curve of space-time becomes infinite). Such a birth probably occurred at the level of the first subuniverse of a multidisciplinary type within a space of thematic, methodological and methodical frontier. The expansion then characterized both evolutions.

In the physics of the quantum type, space is never empty, and each particle automatically has an associated anti-particle. Similarly, in contemporary scientific research, there are no "empty spaces" where discoveries come out of nothing, or places not previously searched, be it in a vague manner… As a mere illustration, today's analysis of efficient markets is placed into the spot represented by the E. Fama's doctoral thesis, [21], which in turn did not develop within the same empty space, but in a spce well delimited through L. Bachelierâs contribution. [22]

In the theory of general relativity, any negative particle is attracted into the "Black Hole", whereas in the theory of quantum physics the positive particle attracted into the balck hole emits Hawking radiation (v. Stephen Hawking), very much as the old theories of knowledge are virtually swallowed within the braoder context of the new laws, i.e. only part of them generate the necessary formal or consonant energy also for the furutre researches.

The explosion inside the "Black Hole" gives rise to soups of particles, in modern physics, very much as the invasion of the borderline interdisciplinary space generates new multidisciplinary domains, new methods, new methodologies of scientific research. Any multidisciplinary universe is fused

into the multiverse of research to gradually expand scientific knowledge within the multiverse of all the disciplines.

In the general theoretical physics, the theory of general relativits by no means fits the theory of quantum physics, and their comprehensive reunion becomes possible only in the multiverse, in a theory of "the whole", similar to the common message conveyed by Peter (the peasant, or the experienced pragmatician) and Paul (the intellectual, or the deep theorist), finally detectable in Christianity, or faith.

Any multidisciplinary universe, once made up, enters a process of expansion, and in a parallel movement, aa process of dramatic decrease in gravitation (in the physical universe) or of coherence (in the universe of scientific research) takes place.

Gravitation prevents the universe from collapsing "inside itself" and the multiverse from gradually disappearing, while (thematic, methodical and methodological) coherence concurs towards the survival and expansion, within the ever-changing limits of the disciplinary multiverse, of scientific research.

6. A FINAL REMARK

The periodical meeting of a multidisciplinary group of teachers, academic professors and researchers, capable, during the two workshops EDEN I and II, of making up a first significant nucleus of an academic orientation in Romania towards the new scientific universes of the 21st century (from the universe of "statistical and quantum econo-, socio- and bio-physics" to that of the "sciences of complexity", or to that centred on the theory of the "networks and cords", etc.), has resulted in several potentially significant outcomes; the expansion of the latter is directed, as part of the next workshop, EDEN III, towards the academic scientific research in Serbia, India and, especially, the Belgian school headed and inspired by Professor Marcel Ausloss. That expansion, but from contradicting, confirms the general expansion of the multidisciplinary universes in today's disciplinary multiverse.

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