ZiF INTERDISCIPLINARY RESEARCH WORKSHOP

Endophysics, Time, Quantum and the Subjective

Abstracts of the Talks

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(Compiled by Andrea Sanigová)

January 17–22, 2005 / Bielefeld / Germany

The Nature of Time as a Consequence of How We Construct the World

Diederik Aerts, Bart D'Hooghe

In classical physics there was a clear understanding of what physical space and time are. Indeed in this classical view, physical space is the theatre of the collection of all events that are actual at a certain moment of time, and physical time is the parametrization of the flow of time, moment after moment. Three dimensional space and one dimensional time have been substituted by four dimensional space-time in relativity theory, and it is often claimed that the classical concept of space and time cannot be retained as a consequence of the relativistic effects. Some put forward that reality is now the four dimensional space-time manifold of relativity theory. If this is true, what is then the meaning of 'change in time'? This problematic confronts a geometric view (as the Einsteinian interpretation of relativity theory) with a process view (where reality changes constantly in time). We investigate this problem, taking into account our insight in the nature of reality as it came by analyzing the problems of quantum mechanics. Hence we adopt the operational axiomatic method elaborated for quantum mechanics and apply it to relativity theory. We show that the contradiction between the geometric view and the process view is due to a misconception in the interpretation of relativity theory. Our new proposal is that instead of making time a new space-like dimension as in the geometric view one should do the inverse, namely make space time-like. More concretely, in our approach, instead of time being frozen into a so called block universe, it is the present, hence space, who becomes dynamic, and time-like. In the conventional approach the manifest and experimentally verified symmetry of relativistic space-time lead to the step of considering time to be space-like, while in our approach we respect this symmetry by considering space to be time-like.

Entropy as Change

Aleksandar Aksentijevic, Keith Gibson

Although universally acknowledged as important, the concept of entropy and its relationship with information has created a great deal of controversy and debate. Here, we propose an explanation of entropy based on the intuitive concept of change. Contrary to some authors, we argue that entropy is intimately connected with, and the inverse of, the notions of order and symmetry. Viewed in this way, entropy (and complexity) can be said to reflect the distance from the center of the subjective information field. To illustrate our argument, we describe a computational measure of structural complexity for binary strings and arrays, which models simple entropy-like phenomena. We provide a number of examples, which indicate that the concept of entropy has its origin in certain primal, unanalisable subjective psychological categories.

Hypothetical Subjects of Perception in Extended Time Scales

Alexey Alyushin

Perception of any modality (visual, auditory etc.) is performed as a sequence of discrete neurophysiological frames. The time scale of perception of a living being is determined by standard durations of its perceptive frames (aprox. 0.1 sec for human visual perception), as well as by its whole life span. Perception of reality in a specific time scale educes, or cuts out, a distinct contour of reality, and forms a temporal *Umwelt* of a living being. My first step following these presuppositions is to introduce a hypothetical subject of perception with duration of a frame much longer than that of any known living being (one year, or twenty years, or million years), and to model the pictures of reality drawn by viewing it in these time scales. My second step is to discuss whether there really may exist subjects of perception on the time scales of such an extension. The main candidate is a biological species, with the life span of an individual as a single perceptive

frame of a species. My third step is to discuss how subjects of perception of different time scales may (or may not) interact. Of special interest is the case when any single perceptive frame of a subject of one time scale is longer than the duration of several life spans of subjects of another time scale, so the lower exist below the limit of temporal distinguishability of the higher.

Out-of-Body, Out-of-Time: Aspects of "Self" in Space and Time – Physiology, Pathology and Therapy

Shahar Arzy, Olaf Blanke, Theodor Landis

The presentation will emphasize the importance of spatial and temporal characteristics of the "self." Deviations of these characteristics will be presented and discussed including phenomenology, psychology, and neurology. At the end we will describe a psychotherapeutic method based on changes in a character of the self, "point-of-view", on the above coordinates.

The Significance of Stable and Causal Neuronal Assemblies for the Psychological Time Arrow

Harald Atmanspacher

Stable neuronal assemblies are generally regarded as neural correlates of mental representation whose flow corresponds to the experience of a direction of time, sometimes called the psychological time arrow. We show that the stability of particular, biophysically motivated models of neuronal assemblies, called coupled map lattices, is supported by causal interactions among neurons and obstructed by non-causal or anti-causal interactions among neurons. This surprising relation between causality and stability suggests that only those neuronal assemblies that are stable due to causal neuronal interactions, and thus correlated with mental representations, are capable of generating a psychological time arrow. Yet the mental efficacy of causal interactions among neurons does not rule out the possibility of mentally less efficacious non-causal or anti-causal interactions among neurons.

Nelson's Mechanics, Time Symmetry and Mach's Principle

Guido Bacciagaluppi

Following Beltrametti and Bugajski's work on violations of the Bell inequalities in classical state-observable structures, I show that also Kochen-Specker contradictions can arise non-trivially in classical settings (as well as in two dimensions for unsharp quantum observables). The Kochen-Specker theorem is thus characteristic of contextual behaviour in general and not quantum behaviour in particular.

Construction of Endo-Time and its Manipulation in Autopoietic Systems

Igor Balaz

Two main factors determine construction of internal temporal architecture in autopoietic systems: external pressure and network of internal interdependences. External influences are given for systems and they are only able to incorporate them into its own functional and temporal blueprint, with very small space for further manipulations. But, internal processes, or more precisely, irreversible reductions toward determined states are enclosed into mobile and alterative network of re-productive cycles. On that basis autopoietic systems are able to construct and manipulate with different temporal strategies as reversibility, delaying, circularity, spiral flows, different distribution of times and so on. Special case is construction of transient time fields, called here intersubjective times, that arise as fusions of two or more specific temporal architectures during their interactions. This paper describes construction of internal proliferation of time patterns and analyzes their functional usefulness.

Encountering Complexity: In Need of a Self-Reflecting Epistemology

Vasileios Basios

Recently, we start to understand that fundamental aspects of complex systems such as emergence, the measurement's problem, an inherent uncertainty, complex causality and unpredictable determinism, time-irreversibility and non-locality, are highlighting the participating process of observation. In addition, the principle of "limited universality" in complex systems, which prompts for "the search of the appropriate level of description in which unification and universality can be expected", can be considered as a version of Bohr's 'complementarity principle'.
These different possible levels of description, or partial objectifications, of a complex whole effectuate distinct projections upon, even redefinitions of, its own constituent parts. We shall see that these fundamental issues of complexity bear not only a formal resemblance but also certain deep connections with quantum mechanics. Despite their distinct references within the two fields, they point to a common origin at a deeper level.
But, the real challenge for investigators would be to fit their vision into the dynamics of reality and not vice a versa. This calls for a new kind of approach where we don't only need to be cognizant of our limitations. We need to be cognizant of our own objectifications. The importance of complexity's scientific contribution lies in that it has made such a radical change not only possible, but also imperative.

"I Did Not Want To Return." An Exploratory Survey Study of Altered Time Perception and its Psychological Correlates

Alexander Batthyany

The aim of this study was to draw a phenomenological map of (strongly) distorted subjective time experiences as well as to analyse their psychological properties and long-term effects on subjects. A total of 135 subjects who at one point in their life had an experience of severely altered time perception filled in the (web-based) Altered Time Perception Questionnaire (ATPQ, Saniga & Batthyany 2003). Results tended to follow a clear pattern: several triggers and distinct types of Altered Time Experiences (ATEs) could be distinguished. The majority of subjects described their experience as an extraordinarily positive experience, the only consistent exception being subjects who had their ATE in the context of a psychotic episode. Findings of the phenomenological part of the study will be presented in the framework of Saniga's "pencil-concept of time" paradigm (Saniga 2003). Besides, correlations between trigger and type of experience, as well as their psychological long-term effects will be discussed. While the present study does not allow for an estimation of a prevalence rate of ATEs in the general population, the findings suggest (a) they are not as rare as one might suspect, and (b) that asking subjects about ATEs is not only of interest for the psychological and phenomenological study of time experience, but also merits more attention in the context of psychiatric diagnostics, especially for dissimulating subjects.

Saniga, M.: 2003, Geometry of Time and Dimensionality of Space, in R. Buccheri, M. Saniga and W. M. Stuckey (eds.), *The Nature of Time: Geometry, Physics & Perception* (NATO Science Series II), Kluwer Academic Publishers, Dordrecht, pp. 131-143. [Also http://arXiv.org/abs/physics/0301003].

Quantum Neural Networks – a Paradigm for Subjective Computing Model

Laxmidhar Behera

This talk presents a novel framework of a subjective computing model using quantum neural networks (QNN). This model uses the notion of quantum probability to bring in subjectivity into computation.
In the first part of this lecture, various possible architectures of quantum neural networks will be proposed. QNN architectures are designed to model average behavior of a neural lattice using a

Schroedinger wave equation. In the second part of the lecture, it will be shown that QNN models using linear and nonlinear activation function are more efficient in various applications such as stochastic filtering, speech enhancement and adaptive control. These results will be compared with classical computational methods.
Next, it will be shown that QNN based model of eye-tracking agrees with previously observed experimental results. The model predicts that eye movements will be of saccadic type while following a static trajectory. In the case of dynamic trajectory following, eye movement consists of saccades and smooth pursuits.
The last part of this talk will focus on quantum mechanical equivalent of classical systems where we have taken an approach to obtain the quantum representation of the damped harmonic oscillator by incorporating nonlinear damping into the potential field of the Schrödinger equation.

Intuition: What Science Tells Us about How and Why Intuition Works

Paul Bernstein

Intuition – the appearance in the mind of information which can be shown to have come not through the five senses nor through a rearrangement of stored memory contents – has been explored scientifically under such names as telepathy, precognition, and remote viewing. This paper summarizes those scientific findings, and presents several theories which have been hypothesized to explain them. Those theories include several based in theoretical physics, including quantum non-locality and holography. Related biological theories are also cited, which propose to explain how information might move from the subatomic level up into waking consciousness, for example through neuronal microtubules in the human brain.

A New Conceptual Framework for Physics

Emilios Bouratinos

If 20^{th} century physics have taught us one thing, it is that its findings point way beyond its conceptual framework. It doesn't mean we need a new epistemology or a new paradigm. What we need is a pre-epistemology and a non-paradigm. We must learn to think in terms of what we apprehend. We must stop apprehending in terms of what we think.
The basic task is to become aware of how we objectify the world – and why we lock into our objectifications once we do. Pre-epistemology will help us understand nature in more subtle ways. A non-paradigm will help us avoid getting stuck on any conception of it. Quality cannot be appreciated by a person obsessed with quantity; non-local connections don't reveal themselves to localising mindsets; dynamic processes are not accessible to a structure-mediated worldview.
Nothing of this means we should discard the tools of modern science. It only means their use should become more discerning. Ultimately three things matter: (1) that we keep systems and minds open; (2) that in fragmenting and abstracting nature we never lose sight of its oneness; (3) that what we count doesn't dictate for us what counts.

Evolution of Human Knowledge and the Endophysical Perspective

Rosolino Buccheri, Mauro Buccheri

Man has always tried to get a representation of the world, going from idealistic scenarios to realistic ones, passing through different kind of "mixtures" of ideas and experience. Generally, they have been based on an *exo-physical* attitude, the belief that man can achieve complete abstraction when observing nature. This has implicitly lead to the concept of *Block Universe*, the illusiveness of the flow of time, and the stubborn search for a *Theory of Everything*: all in strict contradiction with another belief, that of the free will, contradiction which was overcome by Dèscartès with the *ad hoc* assumption of the net distinction between living and inert matter.

Inert matter, however, is able to self-organize, giving rise to open systems exchanging energy, matter and information with the environment, their stability depending on their complexity. Being non-creationist, we are lead to assume that a living organism may well be the possible results of an evolution which, at a certain stage, may give rise to a net distinction between itself (the "subject") and the rest of the environment (the "objects") and, at its highest level, may even give rise to self-consciousness. We may then think that the formed subject starts to acquire knowledge via its competition/cooperation with the rest of nature within the struggle for life. This knowledge is integrated in the "*Mental Models of Reality*", including all ideas about the various aspects of the external world; ideas that change together with the changing interaction of the "subject" with its environment. Once human societies are shaped, they strongly interact with single individuals. The feedback society-individuals let *Intersubjectivity* develop and single MMoR's evolve towards Social Models of Reality. A high level example is given by scientific theories. In view of this, the notion of "objective" seems nothing but a social evolution of the notion of "subjective", concept not far from that expressed, for example, by Friedrich Nietzsche in psychological ambit.
Finally, we have never succeeded to get rid of subjectivity in science. The wave-corpuscle duality, the indivisibility observer-observed, the Heisenberg principle, the non-epistemic randomness, the "problem of measurement", show a "reality" dependent from the observer's modalities of observation, circumstance that lead to the quantum probabilism and to the holographic realism *à la Bohm*. Moreover, even thermodynamics tells us that the increase of entropy, as predicted by the second principle, depends on the human point of view, i.e. man's classification of "objects" in terms of increasing order.
These arguments put in doubt the validity *tout-court* of the exo-physical attitude which, by the way, has had strong opponents along history. Notable examples are the skepticism of Kant, Nietzsche's perspectivism, Popper's epistemology in disagreement with both Bacon's empirism and Dèscartes' rationalism, the Heidegger's criticism to the dominant subjectivism of the western tradition, and the hermeneutics of Gadamer who – following Nietzsche and Heidegger – prefers to talk of interpretation rather than truth.
We cannot escape of being inside the nature we investigate. Being aware of it and in spite of the serious technical and psychological difficulties, we should make more efforts toward the development of new methodologies of investigation within an endo-physical approach. This could perhaps help in solving some of the apparent paradoxes arisen with the advent of quantum theories. The Eakins & Jaroszkiewicz self-evolving universe seems to be an important positive step in this direction.

What Is It Like to Be Beethoven? Easy Answers to the Hard Problem

Moran Cerf

A very common notion that researchers use upon discussing the scientific search for consciousness is the discrimination between the easy problems, and the hard one. The easy problems deal with the Neural Correlates of Consciousness in our brain, while the hard problem discusses Quale - the inner, most subjective experience of the world. It is said that while we clearly advance in our scientific approaches towards the easy problems - we still remain far from understanding anything with regards to the Hard problem.
We show that some answers with regards to the Hard problem can be achieved when one tries to look at the problem in aspects that regard the problem as an Information Theory equation where Physical evidences and experiments, and mathematical notions won't suffice. We try to suggest an approach that doesn't try to 'reduce' the mental activity into a Physical/Mathematical explanation, but rather suggests a new method of discussing the problem.
Our approach suggests a connection between time, language, and evolution as key figures in the development of what we call Quale. Moreover, in this approach we try to suggest a way of measuring consciousness activity in various organisms as a way of better-understanding the exact needs we have from a scientific theory of consciousness.

Becoming and Simultaneity from the Perspective of Physical and Psychological Time

Mauro Dorato

The literature on the compatibility between the time of our experience – characterized by passage or becoming – and time as is represented within spacetime theories has been affected by a persistent failure to get a clear sense of the notion of *becoming*, in its relation both to an ontology of events "spread" in a four-dimensional manifold, and to temporally asymmetric physical processes. My paper tries to remedy this situation (1) by explicating the unclear notion of becoming and (2) by discussing its possible relevance to physical theories.
I begin by arguing that the metaphysical debate between the so-called "presentists" (A-theorists) and "eternalists" (B theorists) is completely irrelevant to the question of becoming, as such a debate is generated by a failure to distinguish between a *tensed* and a *tenseless* sense of "existence". I then show that while (what I call) *absolute becoming* must be regarded as an *a priori* ingredient of any physical theory presupposing an ontology of events (virtually all of the physics we know), *relational relativistic becoming à la Stein* could come into conflict with well-known physical theories (in particular quantum mechanics). This shows that physics can at best be invoked to show that relational becoming *is not contradicted* by presently-known physical theories, but cannot be invoked to provide *positive*, *direct* evidence for its mind-independence.
In the final part of the paper, I discuss possible ways of representing the psychological present in Minkowski spacetime, by arguing that the relativity of simultaneity forces us to regard becoming as a strictly *local* phenomenon, in a sense of "local" that needs to be clarified and distinguished by quantum mechanical locality.

Remembered Duration and Working Memory Load

Stephan Dutke

Based on attention allocation models of time estimation, the role of working memory in prospective duration reproduction is explored. In four experiments, adult participants performed a counting task (duration 400 s) that allowed coordinative and sequential demands on working memory to be varied. After completing the counting task, participants reproduced the time they had worked on this task. It emerged that (a) increased coordinative demands on working memory (but not increased sequential demands) reduced the accuracy of prospective duration reproduction (Experiments 1 and 2), (b) presenting context information during the reproduction phase enhanced the accuracy of the reproduced duration (Experiment 3), and (c) individual differences in coordinative working memory capacity affected duration reproduction in the same direction as the experimental manipulation of coordinative task demands (Experiment 4). The results suggest that attention allocation models of time estimation may benefit from a more differentiated view of the type of attentional demands affecting temporal cognition.

Incessant Big Bang

Avshalom Elitzur

Two ubiquitous phenomena notoriously remain alien to the physical formalism. Time's incessant "passage" has no place in any physical law, and the "collapse" of quantum superposition into a definite state is similarly absent in quantum theory. I propose that both phenomena are real and, moreover, intimately related. I present two new quantum-mechanical experiments, the results of which seem to be even more paradoxical than the familiar Double-Slit, EPR and Delayed-Choice paradoxes. I then outline a new theory of spacetime which takes becoming as one of its basic postulates, and therefore may be better capable of explaining these novel results.

Consciousness Violates the Closure of the Physical World

Avshalom Elitzur

Nearly all modern theories of consciousness, e.g., identity theory, double-aspect theory, epiphenomenalism and parallelism, strictly adhere to the doctrine that the physical world is causally closed, and nothing non-physical interferes with its events. Much as this doctrine is dear to scientific thought, it cannot be maintained. I show that there are ordinary cases in which the *non reducible* aspect of consciousness *causally* interferes with human behavior. A survey of the modern literature shows that the problem has never been properly dealt with. The anathema of dualism must be considered as a legitimate scientific option.

Emotional Time, Creativity and Consciousness

Hinderk M. Emrich, Detlef Dietrich

Emotionality of subjective time-experience in depressed patients is related to the concept of Michael Theunissen as to the dominance of the past in relation to the spontaneity of the subject within a present moment of time. Electrophysiological measurements, using event-related potentials point to the view that negative emotions can induce a value-related cognitive/emotional blockade of valuation processes. The role of creativity to overcome such memory-related impairments is discussed within the context of possible functions of consciousness.

Conditions for Nonlocal Coupling

Dieter Gernert

Nonlocal coupling is understood as a concrete, measurable interaction between two spatially separated objects or processes. It is related, but not identical with quantum entanglement (hence a distinct term is needed). Material suggestive for nonlocal coupling is given by historic episodes and by modern quantitative data. It is the purpose of this paper to analyse conditions for such a coupling to occur. A first step towards a mathematical treatment starts from the concept of perspective notions. Mathematical tools include a measure of the similarity between complex structures and a specific, formalizable version of "context". In particular, the influence of a "subjective component", or of those who arrange the conditions for nonlocal coupling, can be expressed within an operator formalism by specific noncommutative operators, called "preselectors".

Open Limit: Endo-Space and Endo-Time

Yukio-Pegio Gunji, Taichi Haruna

We propose formal model for endo-time and endo-space, by defining measurement process opened to the world. Two categories, “before-“ and “after-measurement” are defined as a directed system and a system in which local structure is consistent with global one through “open limit”, respectively, and a pair of transformations between them, measurement and de-measurement, are expressed as weak functors. Given two categories such as *Ord* (object; preordered set) and *Lat* (object; lattice), adjunction between latticification functor (Con-structure operation) and forgetful functor (De-constructure operation) holds, and the world is closed within a pair of categories. We weaken the notion of functors, and formalize the opened world consisting of constructed parts (category after measurement) and deconstructed part (before measurement). The key notion is a device to weaken functor, and that is called “open limit”. Measurement process based on open-limit can show that present state (“now”) carries the duration of time arrow, and that locally spatial computation referring to endo-space can lead to particular spatial patterns.

Why Quantum Theory?

Lucien Hardy

Quantum theory, in its usual formulation, consists of an abstract mathematical framework which enables us to make predictions for a whole range of physical phenomena. However, it is not clear why nature is described by this abstract mathematical framework. In recent years I have shown how quantum theory can be obtained from a set of well motivated principles. I am now trying to understand what philosophical framework these new principles belong to. It seems that they require us to take a different view of the role of physical theories. Thus, usually a physical theory is regarded as a bottom up (from the microscopic to the macroscopic) view of the world. In this way a physical theory is supposed to provide a "God's eye view" of reality. However, it seems to me that quantum theory is telling us that we should adopt a different view of the role of physics. Rather, I think, we should regard physics as providing a "from within the world" point of view. Thus, the equations of quantum physics can be best understood as telling us how our actions and observations are correlated.

A Structure of Experienced Time

Ivan M. Havel

Usual conceptualizations of time either utilize the mathematically motivated idea of a linearly ordered homogeneous continuum, or stem from the subjective experience of an apparently flowing passage of time from the future to the past. In our approach the subjective experience of time will be taken as a primary motivation for an alternative, essentially discontinuous conception of time. Two different motivational sources will be discussed, one based on personal episodic memory, the other on the theoretical fine texture of experienced time below the threshold of phenomenal awareness. The former case implies a granular structure of experienced time on a large scale, while the latter case suggests endowing psychological time with a discrete granular structure on a small scale, i.e., interpreting it as a semi-ordered flow of smeared (not point-like) subliminal time quanta. Only on a larger temporal scale would the subjectively felt continuity and fluency of time emerge. Consequently, there is no locally smooth mapping of phenomenal time onto the real number continuum. Such a model has certain advantages; for instance, it avoids counterintuitive interpretations of some neuropsychological experiments, especially those by Libet, in which the temporal order of events seems to be crucial.

Endophysical Models Based on Empirical Data

Robert G. Jahn, Brenda J. Dunne

Any proposed endophysical models need to acknowledge a number of subjective correlates that have been well established in such objectively quantifiable experimental contexts as anomalous human/machine interactions and remote perception information acquisition. Most notable of these factors are conscious and unconscious intention; gender disparities; serial position effects; intrinsic uncertainties; elusive replicability; and emotional resonance between the participants and the devices, processes, and tasks. Perhaps even more pertinent are the insensitivities of the anomalous effects to spatial and temporal separations of the participants from their physical targets. Inclusion of subjective coordinates in the models, and exclusion of physical distance and time, raise formidable issues of specification, quantification, and dynamical formulation from both the physical and psychological perspectives. A few primitive examples of possible approaches will be presented.

Confronting the Character of Psychopathological Experiences with the Current Philosophy of Mind

Martin Jankovič

William James significantly contributed to the discussions about subjective experience with the notion of "stream of consciousness" and Specious Present Theory. The idea of stream evokes constant flow of experience and specious present indicate that the scope of temporal experience is enriched by dying away past and present continuing into the future.
From this account follows that the present has wider scope then abstractly conceived now. Current thoughts addressing this notion use a metaphor of a "container" in which is our temporal experience included. One of these theories is a theory proposed by Nicholas Humphrey. He introduces a term "Thick moment" of subjective experience. According to this view, we live in sensorially rich present moment and sensory experience plays a main role for creating of our
conscious sense of time With the help of this approach I will demonstrate the possibilities of incorporating some extraordinary time experiences in this model.
Contrary to sense experience and its time dimension, perception, imagination (for example) can be characterized as experiences without necessary connection to sensory determined sense of time. In such cases, it may happen that the sense of external time flow is reduced to a certain extent while the broader scope of present experience still remains.
By various alteration of perception or in situations of decreased sensory awareness (meditation, psychosis, drug experience) subjects report various deviations of time and space perception. In extreme cases, such experiences may give rise to sense of eternity, or incredibly rich "now". I would like to show how we can deal these phenomena with the help of this model, particularly, after introducing the notion of "broadening" the scope of present moment.

The Entropy of the Future

George Jaroszkiewicz

This talk will touch upon a number of inter-related conceptual conflicts which are the source of many theoretical problems in our understanding of the physical universe. These are i) the exophysical versus endophysical descriptions of physical systems, ii) classical versus quantum counterfactuality, iii) classical versus quantum descriptions of physics and the apparent non-existence of the Heisenberg-cut and v) unitary evolution versus state reduction in quantum mechanics. Related to these issues is the incompleteness theorem of Godel, which suggests that it may be logically impossible to formulate physics in purely endophysical terms. These problems have deep implications for quantum cosmology, that is, any attempt to describe the universe as a completely autonomous quantum system. The relevance of these issues here is that in 1982, in an article on the simulation of physics with computers, Feynman pointed out that physicists are governed by the same laws of the universe as the quantum systems that they are experimenting on. Taken to an extreme, this suggests that the universe must indeed be some sort of autonomous quantum system. This idea will be the focus of our talk. We shall discuss the implications of taking this idea seriously in the context of the conflicts outlined above. In particular, we shall discuss the notion of entropy and its relationship to the concept of time.

Minkowski Diagrams in Slow Systems

George Kampis

Minkowski diagrams as known from relativity theory are geometric tools for representing space-time structures that arise as a consequence of the bounded speed lof light, which is the ultimate limit for the speed of causal effects spreading in the Universe. Slow causation, i.e. ordinary cause-effect relations that usually spread with the speed of a local medium much slower than light does

not pose a similar question for phyisical limits. However, in an observer-centered epistemological theory, the spreading of such effects will be coupled to the problem of knowability; as a consequence, Minkowski diagrams can help representing epistemological structures in slow systems. Here, the "light cone" of relavitistic Minkowski diagrams becomes a representation of efficient information or interaction transfer with the speed of the appropriate medium, e.g. chemical diffusion, postal service, or internet. An attractive feature of the knowledge process represented in these terms is that epistemology (i.e. "what can be known") will be naturally coupled to and conditioned by ontology (i.e. "what there exists"). The arising epistemological and ontological structures can be neatly analyzed from the point of view of determinism and simultaneity but also with repsect to the predictabilty of systems, the unicity of history, the properties of entities and the roles they play in interactions, and so on. The lecture gives simple examples for coupled local systems that can generate advanced epistemological and ontological situations as a consequence of various interaction structures identified as different classes of space-time structures.

Contextual Viewpoint to Quantum Mechanics and the Theory of Fundamental Prespace-Time

Andrei Yu. Khrennikov

In [1] we demonstrated that the Kolmogorov probability model has a very natural representation in a complex Hilbert space. This representation is based on the well known formula of total probability. The Kolmogorov model should be considered as a contextual probabilistic model: Elements of a sigma-field represent not events, but contexts (complexes of physical conditions). To map contexts into quantum states, normalized vectors in a complex Hilbert space, we use probability distributions of two incompatible Kolmogorovian random variables, so called reference variables. Thus in our model quantum representation of the Kolmogorov model is just an image of this model through two fundamental reference variables. In quantum physics we use the position and momentum reference variables. By constructing the Hilbert space representation of the conventional Kolmogorov model we demonstrated that there is no crucial difference between *classical* and *quantum* probability as it was supposed by founders of QM.
Quantum probability is can be considered as a very special representation of *classical* probability. However, we do not claim that quantum physics can be reduced to classical physics. The Kolmogorovian prequantum model is not be based on the classical physical space. The basic PRESPACE might have huge dimension (even infinite) and non-Euclidean topology. Classical and quantum physical models are special projections of prespace -- onto the phase-space and the complex Hilbert space, respectively. To create a consistent model, there should be also introduced PRETIME. The *ordinary physical time* is a projection of pretime. Thus to get classical and quantum dynamics from the realistic prespace dynamics, we should take into account not only projections (classical and quantum) of prespace, but also projections of pretime. The contextual representation of the Kolmogorov model can be used not only in quantum physics, but in many other domains. I called such probabilistic models QUANTUM-LIKE. The main distinguishing feature of all such models is the presence of *interference of probabilities*. We found this interefence in psychological experiments [2] (so psychological statistical data is quantum-like) and in some games [3]; we can expect quantum-like behaviour of financial statistical data.

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Time-Space and Space-Time: A Non-Commutative and Moduli-Theoretic Approach to the Notion of Time

Olav Arnfinn Laudal

Time has through human history been considered in a great many ways, as has its integral, history itself. Through the scientific revolution of Galilei and Leibniz /Newton, the mathematical model of time, the one-dimensional Euclidean time-space, together with a Cartesian model of 3-space, explained and could predict changes in the states of a variety of mechanical aggregates. The efficiency of Einstein's extension of this model, the modern differential-geometric notion of space-time, has been so tremendous that it may seem futile to challenge it. Never the less, time as a continuos parameter is now challenged. In Connes' non-commutative Standard model, proper time comes with an uncertainty. In other models space-time looses its smooth structure. I shall present a simple (toy) model of physics, formulated in the language of non-commutative (algebraic) geometry, in which time becomes a metric on a time-space, the moduli space of the mathematical objects representing the physical systems we choose to study. The purpose is to find a mathematical model in which we may formulate and discuss some of the philosophical questions about time still flourishing.

Phenomenal Consciousness and the Allo/Ego-Centric Interface

Pete Mandik

I propose a theory of phenomenal consciousness that draws on recent work in both philosophy and neuroscience. I give an account of what is involved in a brain state's being phenomenally conscious with special attention to the subjective properties of phenomenally conscious states. My ultimate goal is to defend the possibility of properties that are both wholly physical yet nonetheless subjective (a goal opposed by various theorists who equate physicality with objectivity). The central idea of the theory I defend is that phenomenally conscious states are representational states in intermediate levels of perceptual processing, where the distinction between lower and higher levels of processing is reconstructed as the distinction between egocentric representations and allocentric representations. Maximally egocentric representations specify the relations of environmental features to the representing subject whereas maximally allocentric representations complete abstract away from relations to the representing subject. I defend the view that conscious representations are hybrid representations that mediate between egocentric and allocentric representations. Subjective properties are the egocentric contents of these hybrid representations.

Self-Reference in Quantum Measurement

Samuel Markovitch

Quantum measurement does not necessarily entail the involvement of human consciousness. However, the fact that people implicate consciousness only in quantum measurement phenomena is not accidental. In classical physics we could remain with "objective reality" description. I suggest that it is a yet-unknown element of self-reference in quantum measurement that causes the collapse of the wave function. Proposed is a new way of addressing physics and quantum theory as a whole based on Model Theory considerations. In this way a methodological analogy is constructed between the interpretations of Peano Arithmetic's (PA) and physics. The interpretational shift PA receives when added with the negation of Gödel’s Theorem as an axiom is similar to the interpretational shift classical physics formalism receives when added with non-zero eigenvalues of the construction and destruction operators. It is claimed that non-zero eigenvalues of these operators is the essence of the formalized emergence of Quantum Theory.

Time, Memory, and Consciousness: A View from the Brain

Hans J. Markowitsch

Memory can be defined as mental time traveling. Seen in this way, memory provides the glue which combines different time episodes and leads to a coherent view of one's own person. The importance of time becomes apparent in a neuroscientific comparison of animals and human beings. All kinds of animals have biorhythms – times when they sleep, prefer or avoid sex, or move (as birds) to warmer places in other continents. Mammalian brains have a number of time sensitive structures damage to which alters a subject's behavior to his or her environment. For human beings, damage to certain brain regions may alter the sense of time and consciousness of time in quite different ways: there may disturbed '*chronognosia*' (unreflected, immanent experience of time), '*chronologia*' (comparing the inner history with the external), and '*chronometria*' (total objectivitiy and measurement of time). Furthermore, brain damage, drugs, or psychiatric disturbances may lead to an impaired perception of time, sometimes leading to a severe positive or negative acceleration in time perception. The interaction of time, brain, memory, and consciousness will be discussed on the basis of recent and classic studies in the field of neuroscience.

On the Subjective Nature of Relative Frequencies at Spacelike Separation

Thomas Marlow

We discuss the foundational use of relative frequencies in a standard EPRB experiment and show how they are to be interpreted given the passive Lorentz invariance of relative frequencies and the changes in temporal ordering due to changes in frame of reference. This leads us to a critical discussion on the foundational use of relative frequencies in no-signalling theorems, and to introduce a notion of "prior-frequency" which explicitly blocks any objective notion of probability in such situations by introducing a fundamental ambiguity. Thus we argue that probabilities are, in part, subjective, but we do so in a novel pedagogical fashion (we use the standard "easy" notion of relative frequencies rather than Bayesian probabilities).

The Structure of the Minimal Self: Lessons from Anomalous Self-Experience in Schizophrenia

Josef Parnas

The notion of minimal, basic, pre-reflective or core self is currently debated in the philosophy of mind, cognitive sciences and developmental psychology. However, it is neither clear nor explicit which experiential features such a self is allowed to possess and its metaphysical status varies widely across scholars. Studying the schizophrenic experience may help mapping the structure of the minimal self, because schizophrenia provides an investigative context comparable to a radical phenomenological epoché. In this presentation, the following aspects will be taken up and explored: the notion of *perspective* and of *first person perspective*, the *mineness* of the phenomenl field and the elusive nature its *centre*, the question of *transparency*, the *embodiment* of point of view, and the issues of *agency* and *ownership* (as different from "mineness"). It will be argued that minimal self can only articulate itself in a non-minimal context. This articulation presupposes both a substantial and a relational (processual) nature of the self.

Perceptual Rivalry, Time Subjectivity and Gravitation

John D. Pettigrew

The temporal dynamics of perceptual rivalry are very stable in the same individual under the same circumstances, yet the switch rate varies by more than an order of magnitude between individuals.

In addition, switch rates on a wide variety of different forms of rivalry are coupled, and even individual variations in apparently unrelated phenomena, such efference copy, can be predicted from the rivalry switch rate. All these observations suggest that they are based on a single underlying neural timing mechanism. If this is so, then one might expect the wide individual variations in subjective time to be predictable from rivalry rate. Testing this prediction proves to be technically difficult because of the impact of different tasks on the rivalry rate task, but there is some correspondence between variations in rivalry rate and variations in subjective time.

Abstract Algebra, Projective Geometry and Time Encoding of Quantum Infomation

Michel Planat

Algebraic geometrical concepts are playing an increasing role in quantum applications such as coding, cryptography, tomography and computing. We point out here the prominent role played by Galois fields viewed as cyclotomic extensions of the integers modulo a prime characteristic p. They can be used to generate efficient cyclic encoding, for transmitting secrete quantum keys, for quantum state recovery and for error correction in quantum computing. Finite projective planes and their generalization are the geometric counterpart to cyclotomic concepts, their coordinatization involves Galois fields, and they have been used repetitively for enciphering and coding. Finally the characters over Galois fields are fundamental for generating complete sets of mutually unbiased bases, a generic concept of quantum information processing and quantum entanglement. Gauss sums over Galois fields ensure minimum uncertainty under such protocols. Some Galois rings which are cyclotomic extensions of the integers modulo 4 are also becoming fashionable for their role in time encoding and mutual unbiasedness.

Understanding Emotions: Objects of Science and Subjects of Narrative

Bjørn Torgrim Ramberg

Regarding the mental, recent philosophy has tended to distinguish the representational from the phenomenal; *content* from *feeling*. Propositional content is the essential notion in so far as mental states are invoked to account for reasoning and to explain action, while qualitative awareness is the focus of investigations of first-person experience of consciousness. Emotions, I argue, are not easily bifurcated in this way; neither a *propositional-attitude theory* nor a "*feeling" theory* of emotion can do justice to the narrative, communicative and explanatory roles of emotion. Neither can emotions be captured in terms of a synthesis of these two mental elements; for at least some emotions, we have reliable physiological markers that bring them under the scope of biological theories involving natural kinds. Emotions, then, as an element of the subjective, hook up with the vocabularies of science in a more intimate way than either propositions or *qualia*. Emotions thus appear to be a promising entry point for a natural-scientific approach to subjectivity. I assess this promise from a pragmatist perspective.

Living in Duration

John Sanfey

Qualitative awareness appears to be unnecessary for a complete physical description of the world. Appearances are deceptive however. Here I show that the effect of qualitative awareness on reality is already part of physics but has long been mistaken for an aspect of objective reality. Specifically, it has been mistaken for those techniques allowing duration of time in physical theory. This idea sounds far-fetched at first, but consider that objective science is simply the process of agreement on invariance from multiple subjective experiences. If it were true that qualitative awareness has some physical but unique explanation, but was also necessary for the observation of physical invariance, we should expect this distinctive signature of consciousness to be mistaken for objective reality. The fact of this reflection allows us to deduce and to physically define the mechanics of qualitative awareness.

A Geometrical Chart of Altered Temporality (and Spatiality)

Metod Saniga

"Anomalous," "peculiar," or "strange" experiences of time (and as well space) are those fascinating aspects of altered states of consciousness for which our common-sense language has no vocabulary. The aim of this contribution is to introduce and describe in detail a language much more suitable for handling with such experiences, viz. the language of algebraic geometry. I shall demonstrate that this language offers a proper framework for such "uncanny" time's perceptions as the feelings of "eternity," "everlasting now," time "standing still," or of time "flowing backward," to mention a few. Moreover, this language will help us understand why, for example, our experience of time is so different from that of space, why our ordinary/waking state of consciousness is called "ordinary," or why deep mystical/religious states are of so rare occurrence. Finally, I will present to my knowledge the first mathematically underlined map charting qualitatively well a whole range of non-ordinary forms of time (and space).

Measurement Act – Speech Act

Jean Schneider

The central problem of measurement in Quantum Physics will be shortly summarized: it consists in the internal contradiction following from the tentative description of the measurement by an hamiltionian description of the system-apparatus interaction. In revisiting the full analysis of the measurement process, the accent is put on an instrument generally forgotten: natural language. I will then discuss formal analogies and differences between the measurement act in Quantum Mechanics and the "speech acts" according to the modern linguistic theory.
I will present the proposition that the measurement act is not a physical process, in the sense of an interaction between two systems, but a symbolic process, in the sense of modern semiotics. It follows that the measurement apparatus cannot be viewed as a system described by a state vector. Finally I will give perspectives on possible applications of these views to the "Mind-Body Problem."

Altered Temporality

Benny Shanon

Temporality is universally conceived as the most fundamental determinant of human cognition. There are, however, states of mind in which people feel that temporality changes radically and perhaps even becomes irrelevant. Here I attempt a typology of the patterns of such non-ordinary temporal experiences. The discussion is based on the phenomenological study of the special state of consciousness induced by Ayahuasca, a powerful Amazonian psychotropic brew.

The Relational Blockworld

Mark Stuckey, Michael Silberstein

We start with an overview of the theory of symmetry variables. This theory provides a kinematic foundation for quantum physics that explains quantum nonlocality via a relational block world, i.e., the fundamentality of relations to relata while respecting the relativity of simultaneity. As a consequence, diachronic/trans-temporal objects (relata) are not fundamental in the description of reality and the project of ontological reductionism terminates well before a realm of "entangled particles", in stark contrast to conventional interpretations of quantum physics. As a speculative addendum, we suggest that a similar formalism might provide a model whereby consciousness is

fundamental to the solution of the binding problem. Heuristically, consciousness would be represented by a group (irreducible matrix representation) without counterparts in the brain. This group structure would provide the fundamental (matrix) variables in a description of perceptual states via relationships between active brain regions (relata). In this sense, consciousness would neither reside in the brain nor supervene on brain activity.

Conjecture on Existence of Time Quantum and its Consequences

Yaroslav Volovich

We analyze consequences of a conjecture that there exists a fundamental (indivisible) quantum of time. We construct discreet time formalism and within it study the problem of particle interference and motion in central potential.
We compare the particle scattering (interference) on a single slit in discrete time formalism and in quantum mechanics. We demonstrate how discrete time formalism poses some essential properties of quantum interference such as a dark region behind the center of the slit (Fresnel's phenomenon).
As a second application of discrete time formalism we consider motion in central attracting potential. We compute energy of stationary orbits and show that the spectrum is discrete. In particular some physically important spectra like the spectrum of unperturbed 'hydrogen' atom and quantum 2D oscillator are obtained within the discrete time formalism.

Experience of Time Passage: Psychophysical Measurements and Biophysical Modelling

Jiří Wackermann

The experience of time's flowing or passing appears, from the 1st person perspective, to be a primordial fact of one's consciousness, but it seems to be inaccessible to, or inadequately treated by, the 3rd person accounts of time experience (psychophysics, cognitive psychology). In our analysis of the "dual klepsydra" metaphor/model of reproduction of temporal durations, time passage occurs as a cognitive construct constituted on a basis of "proto-cognitive" functions of the psychophysical organism. This conclusion contradicts the common concepts of "subjective" or "psychological" time as readings of an "internal clock", and may contribute to our understanding of the experience of "now-ness", and of certain forms of so-called "altered states" of consciousness. This study shows how phenomenological, experimental and modelling approaches may fruitfully combine with and complement each other.