Working Group on Philosophy of Physics
Arbeitsgruppe Philosophie der Physik (AGPhil)

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Overview of Invited Talks and Sessions
(Lecture room H2033)

Invited Talks

AGPhil 4.1	Thu	15:00–15:45	H 2033	**Reduction, emergence and mechanisms in magnets and markets —** •Meinard Kuhlmann
AGPhil 4.2	Thu	15:45–16:30	H 2033	**Ising models of financial markets? Are we serious?** — •Stefan Bornholdt
AGPhil 4.3	Thu	16:30–17:15	H 2033	**Emergent phenomena in physics and econophysics** — •Radin Dardashti
AGPhil 4.4	Thu	17:15–18:00	H 2033	**Stock market crashes as critical phenomena? Explanation, idealization, and universality in econophysics** — •Patricia Palacios
AGPhil 5.1	Fri	9:30–10:15	H 2033	**Spacetime is as spacetime does** — •Christian Wüthrich, Vincent Lam

Sessions

AGPhil 1.1–1.3	Wed	16:30–18:00	H 2033	**Philosophie der Physik I**
AGPhil 2.1–2.3	Thu	10:00–11:30	H 2033	**Philosophie der Physik II**
AGPhil 3.1–3.4	Thu	12:45–14:45	H 2033	**Philosophie der Physik III**
AGPhil 4.1–4.4	Thu	15:00–18:00	H 2033	**Reduction and Emergence in Econophysics (joint session AGPhil/SOE)**
AGPhil 5.1–5.5	Fri	9:30–12:30	H 2033	**Philosophie der Physik IV**
AGPhil 6	Fri	12:45–13:30	H 2033	**Mitgliederversammlung der Arbeitsgruppe Philosophie der Physik**

Mitgliederversammlung der Arbeitsgruppe Philosophie der Physik

Freitag 12:45–13:30 Raum H2033

- Bericht
- Wahl
- Planung 2018/19
- Verschiedenes

AGPhil 1: Philosophie der Physik I

Time: Wednesday 16:30–18:00   Location: H 2033

AGPhil 1.1   Wed 16:30   H 2033
Physics and metaphysics in Newton and Leibniz — •Dieter Suisky — Humboldt-Universität zu Berlin

Leibniz published his treatise on a new physical theory entitled *Theoria motus abstracti* in 1671. It was based on the corpuscular theory which was mainly represented by Democritus, Descartes and Huygens. Simultaneously Leibniz developed a programme for geometry (Analysis situs), which included not only the production of lines by motion (L1), but also forces and effects (L2). Between 1675 and 1676, Leibniz introduced the notions of dead and living forces by non-metaphysical considerations and analyzed relative motion. After 1678 Leibniz performed a substantial turn towards a metaphysical foundation of physics. Newton, after having abandoned alchemistic and theological studies, was challenged by the investigation and description of planetary motion. Geometrically, the solution was constructed in terms of "curvilinear figures which are considered as generated by growing" (similar to L1). In physics, Newton replaced at first the Aristotelian theory with the idea of conatus and introduced additionally the postulate: "Force is the causal principle of rest and motion." (1685) After that step and having further distinguished between rest, uniform and non-uniform motion, Newton succeeded in constructing dynamics by means of inertia and impressed moving forces (1687). Alternatively, Leibniz maintained his previous non-metaphysical keystone of living forces (L2)(1686) which had been later called kinetic energy by his followers.

AGPhil 1.2   Wed 17:00   H 2033
The reception of the Cartesian legacy by Euler and Du Châtelet — •Dieter Suisky — Humboldt-Universität zu Berlin

The cornerstone of Descartes' theory is the strict distinction between thinking and extension which is represented by the difference between spirits and bodies. Locke and his disciple Voltaire claimed that an idea of a thinking matter is possible. Although being in other questions in disagreement, Émilie Du Châtelet (1706-1749) and Leonhard Euler (1707-1783) were in perfect accord in defending Descartes' basic notions and argued against Locke, Voltaire and La Mettrie.

In her treatise *Foundations of physics* Du Châtelet argued: Some philosophers say, that "God may have given to matter the attribute of thought, though it does not have it by its essence, and thus, as we do not know what it pleased God to do, we can not know either that what thinks in us is matter or not. ... I say that it is impossible, even by the will of God that is used here, because one have seen that the possibility of things does not depend on that will."

Two decades later in his *Letters to a German princess*, Euler confirmed this argumentation: "But spirits are of a very different nature, and their actions depend on principles directly opposite. ... This property is as essential to spirits as extension or impenetrability is to body; and as it would be impossible for the divine Omnipotence itself to divest body of these qualities, it would be equally impossible for it to divest spirits of liberty."

Du Châtelet and Euler argue in conformity to Descartes and Leibniz and are in pronounced opposition to Locke and Voltaire.

AGPhil 1.3   Wed 17:30   H 2033
Divergente Kehrseite einer konvergenten Folge — •Friedrich Siems — Jahnweg 1A, 78476 Allensbach

Vor etwa 2500 Jahren erfand Xenon von Elea das Prinzip der konvergenten Folge, indem er das Paradoxon aufstellte, daß eine Schildkröte von Achilles nicht eingeholt werden kann, wenn diese den Wettlauf mit einem Vorsprung beginnt. Denn während Achilles den Vorsprung einholt, erzeugt die Schildkröte einen neuen Vorsprung, den Achilles wieder aufholen muß, und so fort.

Diese Vorsprünge bilden eine konvergente Folge mit dem Grenzwert Null, wobei die Anzahl der Glieder dieser Folge divergent ist. Wegen dieser Divergenz kann eine solche Folge im Experiment nicht vollständig aufgelöst werden.

In meinem Vortrag wird dies näher untersucht und in Beziehung zu den infinitesimalen Methoden der Physik gesetzt.

AGPhil 2: Philosophie der Physik II

Time: Thursday 10:00–11:30   Location: H 2033

AGPhil 2.1   Thu 10:00   H 2033
Psychological Environments in Modern Science — •Alexander Unzicker — Pestalozzi-Gymnasium München

Throughout the history of science, the psychological environments of researchers have been studied mostly at an individual level, e.g. in biographies of iconic figures such as Albert Einstein or Isaac Newton.

Yet it is interesting to consider motivation, opinion formation and overall psychological situation of scientists, in particular within the 'big science' paradigm that predominates physics since WW II.

AGPhil 2.2   Thu 10:30   H 2033
Emergence, Experience and Quantum Physics - A New View — •Ravi Gomatam — Institute of Semantic Information Sciences and Technology, Mumbai, India

How do simple parts (such as a plank and four sticks) bring about a whole (say, a 'table', in this case)? We deem the simples as real via a direct realism concerning objects in commonsense thinking. The same direct realism could not also serve to treat the wholes as real, if emergent systems are different from their constituent parts, as is commonly held. This may well be the nub of the issue in concerning emergence: we need an alternative version of direct realism.

This same need also arises in quantum mechanics, wherein the "cat paradox" shows that our usual direct realism about macroscopic objects is good enough only to get the irreducibly probabilistic interpretation, not to get at the quantum ontology underlying single events. I will motivate a new version of direct realism about experiences that leads to a new quantum notion of emergence of macroscopic objects at the level of experiences, which is what the wholes are. Unlike the microscopic holism exhibited by entangled EPR-pairs of microscopic particles, well-discussed in the literature, this new view of macroscopic quantum holism is more intuitive, sans new paradoxes and is congenial to naturalize emergence.

AGPhil 2.3   Thu 11:00   H 2033
Pataphilosophy: Phenomenology and Physics as handmaidens, The Promise of a New Science in Deleuze's History of Philosophy and Hegel's Science of Logic — •Jack Coopey — Durham University

The debates whether philosophy should itself assert its empty contents as defined by Deleuze, towards recent developments in physics in light of its ontologies, epistemologies and metaphysics, precisely because philosophy itself only analyses objects of other disciplines and does not possess its own object. It appears that at a prima facie level, that the relation between contemporary physics and phenomenology altogether appear so distant and more or less an impossibility beyond any potential conceptualization, but perhaps this is the very axis of reason which begs its very conception, and thus a dialogue or first encounter at the crossroads needs in fact to begin. The apparent conflict, paradox or contradiction between contemporary phenomenology and the recent developments in physics, is that whilst phenomenology on the other hand deals with the essences of things bracketing the metaphysical claims and presuppositions as defined by Husserl, and physics appears to now deal with concepts and objects beyond the essence of things, how and where are we to begin to draw a dialogue in these seemingly disparate objects of inquiries? Perhaps one avenue for a discussion across phenomenology and physics is in fact found within German Idealism, in the work of Hegel and hisScience of Logic in which he took contemporary philosophical understandings of the physics of his time and attempted to incorporate them.

AGPhil 3: Philosophie der Physik III

Time: Thursday 12:45–14:45   Location: H 2033

AGPhil 3.1   Thu 12:45   H 2033
Explaining Universality: Infinite Limit Systems in the Renormalization Group Method — •Jingyi Wu — Munich Center for Mathematical Philosophy

I analyze the role of infinite idealizations used in the renormalization group (RG hereafter) method in explaining universality across microscopically different physical systems in critical phenomena. I argue that despite the reference to infinite limit systems such as systems with infinite correlation lengths during the RG process, the key to explaining universality in critical phenomena need not involve infinite limit systems. Following Norton (2012), we can properly demote the use of limits in RG explanations as a case of approximations. I develop my argument by emphasizing what I regard as the crux of RG explanations: linearization* around the nontrivial fixed point; I then present both heuristic evidence, provided by Wilson and Kogut (1974), and technical evidence, made possible by recent mathematical advancement in Yin (2011), regarding the topology around the nontrivial fixed point, to show that the properties purportedly only infinite limit systems possess can also be retrieved using finite systems.

AGPhil 3.2   Thu 13:15   H 2033
Connecting structuralism with the paradox of phase transitions — •Johannes Mierau — Technische Universität Dortmund

Reductions and emergence in physics are frequently discussed in case of phase transitions. The inhering paradox of phase transitions is mostly resolved by applying a topology onto the space of physical systems. The question of which topology is ought to be used is still at issue. In my text I am going to connect this problem to the structuralism of physical theories in order to find a justified topology.

Günther Ludwig introduced uniform structures to blur theoretic relations, which never match experimental data exactly. This concept was adopted by other structuralists. Erhard Scheibe, in particular, used uniform structures to express the experimental inaccuracy of measurements.

In this vein, every physical theory carries a topology induced by its empirical uniform structure. A theoretic model in the thermodynamic limit can represent an actual physical system, if all measurable magnitudes in regard to the specific theory conform to the finite system up to the accuracy of the uniform structure. In this way phase transitions can be defined theoretically as a concept for infinite systems, but be applied to certain real systems. Additionally, no new topology has to be introduced, since, from the structuralists point of view, uniform structures are core parts of physical theories.

AGPhil 3.3   Thu 13:45   H 2033
The dilemma of the observer and the second law of thermodynamics — •Matteo Polettini — Physics and Materials Science Research Unit, University of Luxembourg, Campus Limpertsberg, 162a avenue de la Faiencerie, L-1511 Luxembourg (Luxembourg)

The statistical description of irreversible phenomena and the information-theoretic interpretation of entropy introduce the dilemma of the observer in thermodynamics. If entropy is a measure of missing information, will the second law of thermodynamics depend on whether the observer has a Ph.D. in physics? While many would take a materialistic approach to this hurdle, arguing that the analogy between Shannon's informational entropy and Gibbs's statistical entropy is just incidental, we argue that a dependency on the observer can and should be included without making physical laws less "objective". Furthermore, this approach is actually more prudent and secular than the materialistic one, as we show that this latter surreptitiously introduces a preferential observer and "sweeps the dirt under the carpet". In technical terms, we show that the choice of prior probabilities in statistical physics is a gauge symmetry of the second law.

AGPhil 3.4   Thu 14:15   H 2033
More Talk About Toy Models — •Joshua Luczak — Leibniz Universität Hannover, Hannover, Germany

Scientists frequently use toy models to reason about physical theories and actual systems. This may seem strange because toy models do not perform a representational function. That is, they do not represent actual systems or collections of systems. In fact, they do not represent anything. Despite their frequent and important use in scientific reasoning, discussions of toy models are scarcely found in the philosophical literature on scientific modelling. This paper intends to elevate the status of these models by highlighting and justifying some of the ways they are used to reason about actual systems and physical theories. This will be achieved by highlighting and justifying some of the ways Paul and Tatyana Ehrenfests' urn (dog-flea) model—a model originally introduced so as to reason about the kinetic theory of gases and Ludwig Boltzmann's original attempts to account for irreversible thermal phenomena and the Second Law of Thermodynamics—is used within statistical mechanics.

AGPhil 4: Reduction and Emergence in Econophysics (joint session AGPhil/SOE)

Time: Thursday 15:00–18:00   Location: H 2033

Invited Talk   AGPhil 4.1   Thu 15:00   H 2033
Reduction, emergence and mechanisms in magnets and markets — •Meinard Kuhlmann — University of Mainz

Treatments of critical phenomena in physics but even more so in interdisciplinary applications exhibit a certain tension when we ask whether a micro reduction is possible: On the one hand, hardly anyone will doubt that these phenomena rest on (or "supervene" upon) the behaviour of the constituents parts. On the other hand, the universality of critical phenomena suggests that the dynamics is in some sense independent from its physical manifestation on the micro level. That is, critical phenomena seem to be "emergent" and thus defy reduction. I will argue that one can dissolve this tension by introducing the notion of "structural mechanisms". Explanations in terms of structural mechanisms are reductive in the sense that it is the interactive organisation of the micro constituents that matters. However, only certain structural features of the interaction are important whereas the nature of the micro constituents is otherwise irrelevant.

Invited Talk   AGPhil 4.2   Thu 15:45   H 2033
Ising models of financial markets? Are we serious? — •Stefan Bornholdt — Institut für Theoretische Physik, Universität Bremen

Within one or two decades, a subdiscipline of socio- and econophysics emerged that uses the scientific approach of physics to explore the dynamics of markets and human society in a quantitative way. This subdiscipline is also present at the current DPG meeting: the division of physics of socio-economic systems, SOE. A wide range of physics methods from statistical physics and stochastic processes to agentbased (spin) models are applied to financial and behavioral themes. But how can we expect that a complex system as, for example, a stock market, embedded in the world's economy, could possibly be described by the simplest toy models? Universality, best known from statistical physics of matter, inspires a possible route to a new kind of reductionism: Instead of modeling an economy by the famous representative agent, as done for decades, falsely assuming statistical independence of agents, today's agent based models keep agents and their interactions in order to study the emergent dynamics of their collective dynamics. I will give a brief overview of current models and their limits.

Invited Talk   AGPhil 4.3   Thu 16:30   H 2033
Emergent phenomena in physics and econophysics — •Radin Dardashti — IZWT, Wuppertal, Germany

Various kinds of phenomena and properties in physics are regarded as emergent in some sense or another. The temperature of a system, critical exponents or the Hawking effect are all discussed in this context. However, there can be significant differences in their realizations and theoretical treatment, with important consequences for their interpretation. In the econophysical literature the stylized facts of economics are also understood as emerging out of the complex system. But how

should we understand the emergence of stylized facts and what does this mean for the treatment of these models?

I will discuss examples of emergent phenomena from fundamental physics and embed it into a general framework, which allows us to shed light on these questions.

Invited Talk   AGPhil 4.4   Thu 17:15   H 2033
Stock market crashes as critical phenomena? Explanation, idealization, and universality in econophysics — •Patricia Palacios — Munich Center for Mathematical Philosophy, Munich,

Germany

We study the Johansen-Ledoit-Sornette (JLS) model of financial market crashes (Johansen, Ledoit, and Sornette 2000) that treats market crashes as critical phase transitions.

On our view, the JLS model is a curious case from the perspective of the recent philosophy of science literature, as it is naturally construed as a 'minimal model' in the sense of Batterman and Rice (Batterman and Rice 2014) that nonetheless provides a reductive explanation and causal explanation of market crashes, in the sense of Woodward's interventionist account of causation (Woodward 2003).

AGPhil 5: Philosophie der Physik IV

Time: Friday 9:30–12:30   Location: H 2033

Invited Talk   AGPhil 5.1   Fri 9:30   H 2033
Spacetime is as spacetime does — •Christian Wüthrich and Vincent Lam — University of Geneva, Switzerland

Theories of quantum gravity generically presuppose or predict that the reality underlying relativistic spacetimes that they are describing is significantly non-spatiotemporal. On pain of empirical incoherence, approaches to quantum gravity must establish how relativistic spacetime emerges from their non-spatiotemporal structures. We argue for spacetime functionalism, i.e. the idea that in order to secure this emergence, it is sufficient to establish that only those features of relativistic spacetimes functionally relevant in producing empirical evidence must be recovered. In order to complete this task, an account must be given of how the more fundamental structures instantiate these functional roles. We illustrate the general idea in the context of causal set theory and loop quantum gravity, two prominent approaches to quantum gravity.

       AGPhil 5.2   Fri 10:15   H 2033
Have We Lost Spacetime on the Way? Narrowing the Gap Between General Relativity and Quantum Gravity — Baptiste LeBihan and •Niels Linnemann — University of Geneva, Geneva, Switzerland

In the recent literature much has been written on the emergence of general relativity from quantum gravity theories. Important features of space and time are taken to be missing in quantum gravity, allegedly requiring an explanation of the emergence of spacetime from non-spatio-temporal theories. We explore which aspects of spacetime are emergent in different approaches to QG and within GR and highlight that Lorentz symmetry remains generally untouched. In any case, any approach to QG seems to start with an in-built distinction between something time-like and something space-like. We point out that spacetime in an important sense is already emerging in the context of GR when understood from a dynamical perspective. We conclude that the alleged explanatory gap between GR and non-spatio-temporal QG theories might be reduced and that the problem of spacetime emergence may fruitfully be reshaped as a problem about the interpretation of GR itself.

15 min break

       AGPhil 5.3   Fri 11:00   H 2033
Limits of Bronstein's Cube: Compound Reduction and Overlapping Domains in State Space Approaches to Inter-Model Reduction — •Joshua Rosaler — Institute for Theoretical Particle Physics and Cosmology, RWTH Aachen University

The so-called "Bronstein Cube" of physical theories attempts to characterize the relationships among the theories of modern physics by placing them at the corners of a cube, where movement along any dimension of the cube represents a limit as some constant of nature is taken to zero or infinity. The picture of inter-theory relations suggested by the cube suggests that these different limits should commute - for example, the classical limit as Planck's constant vanishes should commute with the non-relativistic limit in which the speed of light approaches infinity. Elsewhere, I have argued that the relevance of this approach for the behavior of real physical systems is at best obscure, and defended an alternative, model-based approach to reduction in physics that focuses on the relationships between the state spaces of different models (Rosaler 2017), (Rosaler 2015). Here, I will explain how reductions between different models can be composed on this state-space based approach, and also the sense in which different reductions may be said to "commute" on this picture.

References
Rosaler, J. "Reduction as an A Posteriori Relation." The British Journal for the Philosophy of Science, 2017.
Rosaler, J. "Local Reduction in Physics." Studies in History and Philosophy of Modern Physics, 2015.

       AGPhil 5.4   Fri 11:30   H 2033
The Emergence of the Classical World from a Bohmian Universe — •Davide Romano — Rome, Italy

I shall present a general strategy for the classical limit problem in the context of the de Broglie-Bohm theory. In this framework, the problem reduces to the following questions: 1. Why does the wave-function disappear in the classical regime? 2. Why do the Bohmian trajectories become (approximately) Newtonian? The answer to the first question is due to the formation of well-localized effective wave-functions for the subsystems of entangled states. This process also provides a physical explanation for decoherence effects of open quantum systems. Concerning the second question, I will suggest a solution that makes use of a combination of decoherence and quantum potential (Q). It is well-known, in fact, that when Q is negligible the Bohmian particles follow a Newtonian trajectory. Problem: Q cannot be made negligible for all the states (Q=constant for a stationary wave, for example). However, the classical regime is necessarily a decoherence regime, and it can be shown (Zurek, Habib and Paz (1993), Coherent states via decoherence, Physical Review Letters) that the emerging wave functions from decoherence will be Gaussian states. This is a good result: in fact, the quantum potential of a Gaussian state is negligible under the conditions of big mass, small de Broglie wave-length and negligible quantum action. These conditions are the hallmark of the classical regime: this finally shows that a macroscopic Bohmian system in interaction with the environment will follow an (approximately) Newtonian trajectory.

       AGPhil 5.5   Fri 12:00   H 2033
Dualities from the 'external' point of view and the possibility for emergence of space-time — •Eugene Chua — Munich Center for Mathematical Philosophy (MCMP)

Physicists have claimed that there is emergence of space-time from quantum entanglement, in the context of gauge/gravity dualities. However, can dualities accommodate emergence?

I first consider the 'simple view' of emergence-as-failure-of-reduction. After introducing dualities via AdS/CFT, I argue for the simple view*s inadequacy: it cannot categorize a duality as either reduction or emergence. However, one might reply that dual theories are equivalent (what De Haro [2017] calls the *internal* view) so there should be neither emergence nor reduction. Hence, the simple view was right to withhold categorization. I problematize this reply by arguing for the internal view*s inadequacies. On one reading it is too strong: dual theories supposedly have the same semantic content, including physical interpretations. By considering examples including Fraser's [2017] discussion of analytic continuation, I show that this reading is inadequate. On another reading, though, it is too weak: it suggests dual theories have the same physical content given a duality, but this does not imply the relevant equivalence. I conclude that the external view - on which dual theories are distinct - appears more plausible; hence emergence-as-failure-of-reduction is inadequate. Finally, I defend an account of emergence-as-dependence-plus-autonomy-and-novelty, and show that this sort of emergence remains a possibility given fundamentality assumptions.

AGPhil 6: Mitgliederversammlung der Arbeitsgruppe Philosophie der Physik

Time: Friday 12:45–13:30 Location: H 2033
duration 45 min