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

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Overview of Invited Talks and Sessions

Monday: Workshop "Condensed Metaphysics": Metaphysics of Condensed Matter and Complex Systems (E 020)
Tuesday - Thursday: AG Phil Kolloquium (H 2033)

Invited Talks

AGPhil 1.1	Mon	9:30–10:15	E 020	**On the Success and Limitations of Reductionism in Physics** — •Hildegard Meyer-Ortmanns
AGPhil 1.2	Mon	10:15–11:00	E 020	**Why is More Different?** — •Margaret Morrison
AGPhil 1.3	Mon	11:30–12:15	E 020	**Parts, Wholes and Emergence** — •Andreas Hüttemann
AGPhil 1.4	Mon	12:15–13:00	E 020	**Functional Reduction and Emergence** — •Sorin Bangu
AGPhil 2.1	Mon	14:30–15:15	E 020	**Ising Models: Interpretational and Computational Issues** — •Paul Humphreys
AGPhil 2.2	Mon	15:15–16:00	E 020	**How Do Quasi-Particles Exist?** — •Brigitte Falkenburg
AGPhil 2.3	Mon	16:30–17:15	E 020	**Is the Quantum Theory of Laser Radiation a Mechanistic Theory?** — •Meinard Kuhlmann
AGPhil 2.4	Mon	17:15–18:00	E 020	**Decoherence and the Emergence of a Joint Distribution** — •Stephan Hartmann
AGPhil 3.1	Tue	9:30–10:15	H 2033	**Open Quantum Systems: Where is the system and where is the reservoir ?** — •Joachim Ankerhold
AGPhil 3.2	Tue	10:15–11:00	H 2033	**On the relation between the second law of thermodynamics, classical mechanics, and quantum mechanics** — •Barbara Drossel
AGPhil 6.1	Wed	14:30–15:15	H 2033	**Majorana's oscillator and the philosophy of neutrino physics** — •Silvia De Bianchi

Sessions

AGPhil 1.1–1.4	Mon	9:30–13:00	E 020	**"Condensed Metaphysics" I: Reduction and Emergence**
AGPhil 2.1–2.4	Mon	14:30–18:00	E 020	**"Condensed Metaphysics" II: Specific Models**
AGPhil 3.1–3.5	Tue	9:30–13:00	H 2033	**Complex and Open Systems**
AGPhil 4.1–4.3	Wed	9:30–11:00	H 2033	**Spacetime Thoeries**
AGPhil 5.1–5.3	Wed	11:30–13:00	H 2033	**Foundations of Quantum Theory**
AGPhil 6.1–6.4	Wed	14:30–16:45	H 2033	**History and Philosophy of Physics**
AGPhil 7.1–7.4	Wed	17:15–19:15	H 2033	**Philosophy of Science**
AGPhil 8.1–8.4	Thu	9:30–11:30	H 2033	**Mathematik, Physik und Wirklichkeit**

Mitgliederversammlung
(Annual General Meeting of the Working Group on Philosophy of Physics)

Montag, 26. März 19:00–20:00 Raum E 020

- Berichte
- Wahl
- Planung
- Verschiedenes

AGPhil 1: "Condensed Metaphysics" I: Reduction and Emergence

The Metaphysics of Condensed Matter and Complex Systems. Brigitte Falkenburg & Margaret Morrison

Time: Monday 9:30–13:00 Location: E 020

Invited Talk AGPhil 1.1 Mon 9:30 E 020
On the Success and Limitations of Reductionism in Physics — •Hildegard Meyer-Ortmanns — School of Engineering and Science, Jacobs University Bremen

Methodological reductionism has proved to be an extremely successful approach in physics. It led to the very construction of the standard model as the theory of three of the four fundamental interactions. It allows bridging the scales from the microscopic to mesoscopic and sometimes even to macroscopic scales in the spirit of the renormalization group. It enables to predict emergent phenomena like phase transitions or self-organized pattern formation in space and time. We shall study the question of how far one can push the reductionistic approach and, along with that, we point on its limitations when it is pushed to extremes. The price then may be not only a lack of understanding in simple terms, but also a miss of emergent traits and new interactions between composed objects which arise when these composed objects are formed out of more elementary ones, and when they afterwards are considered as the new elementary units on the coarse-grained scale, on which their compositeness may be safely ignored. The very choice of what is declared as new elementary units is a matter of convention, and if phenomena on different scales should be related to each other, it is often the art in the game to find a really convenient choice. We shall illustrate the success and limitations of the reductionistic approach, in particular in view of emergent features, with a number of examples, ranging from particle physics to complex systems in biological applications.

Invited Talk AGPhil 1.2 Mon 10:15 E 020
Why is More Different? — •Margaret Morrison — University of Toronto

Emergent phenomena are typically described as those that cannot be reduced, explained nor predicted from their microphysical base. However, this characterization can be fully satisfied on purely epistemological grounds, leaving open the possibility that emergence may simply point to a gap in our knowledge of these phenomena. By contrast, Anderson's (1972) claim that the whole is not only greater than but very "different from" its parts implies a strong ontological dimension to emergence, one that requires us to explain how, for example, superconductivity can be ontologically distinct from its micro-ontology of Cooper pairing. This is partly explained by using RG methods to show how the 'universal' characteristics of emergent phenomena are insensitive to the Hamiltonian(s) governing the microphysics. But this is not wholly sufficient since it is possible to claim that the independence simply reflects the fact that different 'levels' are appropriate when explaining physical behavior, e.g. we needn't appeal to micro properties in explaining fluid behavior. The paper attempts a resolution to the problem of ontological independence by highlighting the role of spontaneous symmetry breaking in the emergence of universal properties like infinite conductivity. If we focus on the dynamical aspects of symmetry breaking rather than interpreting it as an organizing principle (Laughlin and Pines, 2000) we are able to see how it, together with the RG arguments, illustrates both how and why emergent phenomena can be considered different from their micro-constituents.

Coffee break

Invited Talk AGPhil 1.3 Mon 11:30 E 020
Parts, Wholes and Emergence — •Andreas Hüttemann — Philoosphisches Seminar, Universität zu Köln, Albertus Magnus Platz, 50923 Köln

Emergence has been defined or explicated in a number of different ways. Typically the definiens contains terms such as "novelty", "irreducibility", "unpredictability", "holism", etc. For at least two reasons these attempts appear not to be particularly fruitful. First, there is no consensus on how to understand the terms that are invoked in the definitions or explications in question. Second, intuitions about whether certain phenomena should count as examples of emergent phenomena tend to diverge. There seem to be hardly any clear-cut cases against which a definition or explication of emergence could be tested.

In this paper I want to take a different approach towards an explication of concepts of emergence. I will look at certain influential reductionist projects. It is in the contexts of these projects that concepts of emergence have been formed. If we understand the aims of the reductionist projects we get a better hold on certain concepts of emergence, because they are usually conceived of as failures or limitations of reductionist projects.

More particularly I will look at a philosophical tradition of ontological reductionism and at a methodological reductionist project that has been discussed by physicists. Keeping these two sense of reductionism separate will help to disambiguate two different concepts of emergence. Critical phenomena provide a useful case study in this context because the case illustrates how a phenomenon can be a emergent in one sense but fail to be emergent in another sense.

Invited Talk AGPhil 1.4 Mon 12:15 E 020
Functional Reduction and Emergence — •Sorin Bangu — Univ. of Illinois, 801 S Wright St., Urbana, IL 61801, USA

The clarification of the concept of emergence has long been on the agenda of the metaphysics of science; notions such as 'novelty', 'unpredictability' and, most specifically, 'irreducibility' have been invoked in an attempt to elucidate this notoriously elusive idea. This paper aims to join this effort, by discussing a class of familiar phenomena, such as boiling and freezing - generically called 'phase transitions'. Recent work on this topic takes these processes as uncontroversial examples of emergent, or irreducible phenomena. I am broadly sympathetic to this view, but I argue that a better understanding of the emergence claim can be gained by clarifying how one of the best models of reduction on offer - Kim's 'functional' model - deals with these phenomena.

AGPhil 2: "Condensed Metaphysics" II: Specific Models

The Metaphysics of Condensed Matter and Complex Systems. Brigitte Falkenburg & Margaret Morrison

Time: Monday 14:30–18:00 Location: E 020

Invited Talk AGPhil 2.1 Mon 14:30 E 020
Ising Models: Interpretational and Computational Issues — •Paul Humphreys — Department of Philosophy, University of Virginia, Charlottesville, USA

The class of models that includes Ising models, Potts models, spin glass models and related mathematical objects have been used to model many different condensed matter phenomena. Taking the canonical example of ferromagnetic phase transitions, I shall explore the sense in which Ising models represent real ferromagnets and how and why such a simple model can be successful. Central to this exploration will be the finite dimensional/infinite dimensional comparison and the extent to which relaxing the idealizations of the model ('de-idealizing* it) makes the model more or less accurate. I shall also suggest ways in which Istrail's 2000 proof that computing the partition functions (and hence the exact energy levels) for finite sublattices of non-planar 3D and 2D Ising models are NP-complete problems and Mu et al.'s 2008 result that there are macroscopic properties the values of which cannot be effectively predicted solely on the basis of knowledge of microstates of the system affect what can be known about these models.

Invited Talk AGPhil 2.2 Mon 15:15 E 020
How Do Quasi-Particles Exist? — •Brigitte Falkenburg — Institut für Philosophie und Politikwissenschaft, Fakultät 14, TU Dortmund, D-44221 Dortmund

Quasi-particles emerge in solids. In the context of the debate on scientific realism, their concept is puzzling. Quasi-particles are fake entities rather than physical particles. But they can be used as markers etc. in crystals. Hence, it is possible to use them as technologcal tools,even though in a certain sense they do not exist. It has been argued that for this reason they counter Ian Hacking's reality criterion, "If you can spray them, they exist." However, this line of reasoning misses the crucial point that quasi-particles are real collective effects of the constituents of a solid. In order to spell out the way in which they indeed exist, their particle properties are discussed in detail. It is instructive to compare their particle properties with those of ubatomic matter constituents, on the one hand, and the field quanta of a quantum field, on the other hand. All these particle properties are weaker than the classical particle properties. Their discussion sheds light on the way in which quantum phenomena in general exist, and on the specific way in which quasi-particles exist.

Coffee break

Invited Talk AGPhil 2.3 Mon 16:30 E 020
Is the Quantum Theory of Laser Radiation a Mechanistic Theory? — •Meinard Kuhlmann — Institut für Philosophie, Universität Bremen

The quantum theory of laser radiation explains the behavior of laser light in a way that clearly seems at variance with the mechanistic model of explanation. First, as it is typical for complex systems, the detailed behavior of the component parts plays a surprisingly subordinate role. And second, being quantum objects these "parts" are not even individual things with determinate spatio-temporal properties. I want to show that despite of these apparent obstacles the quantum theory of laser radiation is a perfect example for a mechanistic explanation in a quantum physical setting, provided one adjusts the notion of mechanisms appropriately. One may presume that these adjustments are ad hoc and question-begging. However, I will lay out that the necessary adjustments are far more natural and less drastic than one may expect.

Invited Talk AGPhil 2.4 Mon 17:15 E 020
Decoherence and the Emergence of a Joint Distribution — •Stephan Hartmann — TiLPS, Tilburg University, Tilburg, The Nethrlands

Bell states and other entangled states exhibit correlations that cannot be accounted for by a non-contextual local hidden-variable model. Various authors have shown that the non-existence of a non-contextual local hidden variables model entails that there is no joint probability distribution over random variables that represent the observables in question. The converse is also true. If there is no joint probability distribution, then there is no non-contextual local hidden variables model. Starting from the observation that entangled quantum states, in the absence of any stabilizing fields, will decay under the influence of decoherence, we investigate the decay of a GHZ state under the influence of decoherence in a Markovian Master equation model. Using necessary and sufficient conditions for the existence of a joint probability distribution derived by de Barros and Suppes we then show that a joint probability distribution emerges after about 20% of the half time of the decay. Interestingly, at this time the system is still highly entangled, although a classical model can account for the correlations in it. Next, we study the physics before the emergence of a joint distribution. It turns out that the correlations of Bell states and GHZ states can be accounted for in terms of upper probability distributions, which are well known from the theory of uncertain reasoning. We will show that upper probabilities are also useful in quantum theory and explicitly construct upper distributions for the cases at hand. This talk is based on joint work with Patrick Suppes (Stanford).

AGPhil 3: Complex and Open Systems

Time: Tuesday 9:30–13:00 Location: H 2033

Invited Talk AGPhil 3.1 Tue 9:30 H 2033
Open Quantum Systems: Where is the system and where is the reservoir ? — •Joachim Ankerhold — Institut für Theoretische Physik, Universität Ulm

The conventional treatment of open quantum systems, as they appear e.g. in condensed phase structures, starts from a separation between a subunit, which contains a smaller number of interesting degrees of freedom and is termed the 'system', and a much larger subunit, termed the bath or 'reservoir', which in many cases carries a macroscopically large number of degrees of freedom. These so-called 'system+reservoir' models have been very successfully applied in various fields in physics to describe decoherence and relaxation processes. Accordingly, one considers the reduced density operator of the system and derives for the time evolution e.g. approximate reduced equations of motion or formally exact expressions in terms of path integrals. Beyond the regime of very weak system-reservoir interaction (typical for quantum optical systems), however, an understanding of reduced system properties becomes often a non-trivial matter. In this talk, I will discuss some examples to shed light on the limitations of our naive picture, namely, the failure of classical concepts for certain observables, the existence of coherent reduced dynamics only due to a reservoir, and the appearance of a classical reduced system in the deep quantum domain.

Invited Talk AGPhil 3.2 Tue 10:15 H 2033
On the relation between the second law of thermodynamics, classical mechanics, and quantum mechanics — •Barbara Drossel — Institut für Festkörperphysik, TU Darmstadt

In textbooks on statistical mechanics, on finds often arguments based on classical mechanics, phase space and ergodicity in order to justify the second law of thermodynamics. However, the basic equations of motion of classical mechanics are deterministic and reversible, while the second law of thermodynamics is irreversible and not deterministic, because it states that a system forgets its past when approaching equilibrium. I will argue that all "derivations" of the second law of thermodynamics from classical mechanics include additional assumptions that are not part of classical mechanics. The same holds for Boltzmanns H-theorem. Furthermore, I will argue that the coarse-graining of phase-space that is used when deriving the second law cannot be viewed as an expression of our ignorance of the details of the microscopic state of the system, but reflects the fact that the state of a system is fully specified by using only a finite number of bits, as implied by the concept of entropy, which is related to the number of different microstates that a closed system can have. While quantum mechanics, as described by the Schroedinger equation, puts this latter statement on a firm ground, it cannot explain the irreversibility and stochasticity inherent in the second law.

Coffee break

AGPhil 3.3 Tue 11:30 H 2033
What can we learn from a real-time analysis of nonequilibrium quantum many-body systems? — •Michael Moeckel — Max-Planck-Institute for Quantum Optics, Hans-Kopfermann-Str. 1, 85748 Garching

The interplay of nonequilibrium initial conditions and quantum many-body correlations currently receives new attention in condensed matter theory. Strong quantum many-body correlations can be imposed either by (many-) particle interactions or by the quantum statistics of the particles itself. Nonequilibrium conditions allow to initialize a quantum many-body system in an excited state. Then, its subsequent dynamics is determined by a unitary evolution in the Hilbert space.

In a large class of quantum dynamics experiments, e.g. in pump-probe laser spectroscopy of complex materials, the resulting trajectory in Hilbert space is assessed: From the temporal evolution of expectation values of particular observables researchers conclude on the properties of the (static) complex quantum system. The reasoning behind this approach is commonly based on an analogous understanding of energy-time uncertainty as it is motivated by Fermi's Golden Rule: Large energy transitions occur already at short times, while small energy details become observable only on large time scales of the dynamics.

In my presentation I will briefly review current experimental and theoretical work, analyze necessary prerequisites for gaining substantial information from such setups and address the question to which extent intrinsic quantum correlations can be made visible by "mapping them into the time domain".

AGPhil 3.4 Tue 12:00 H 2033

Scientific Models of Living Phenomena: An Epistemic Overview of Condensed Matter Physics of Complex Biological Systems. — •Daniele Macuglia — Morris Fishbein Center and The Committee on the Conceptual and Historical Studies of Science, The University of Chicago, 1126 E. 59th St., Chicago, IL 60637, USA.

This essay focuses on the legitimacy of studying complex biological systems by means of modeling strategies typically employed by condensed matter physicists. Some of the most important examples of complex systems do indeed belong to the biological sciences and include living phenomena such as cells, ecosystems and neural networks. These systems are ultimately composed of fundamental particles that interact by means of fundamental physical laws and it is legitimate to think of a level at which the physical and biological descriptions might meet. Yet this view is affected by a remarkable epistemic impasse that calls closer attention to the role of modeling and idealization at the physics-biology interface. Whereas condensed matter physics proceeds by modeling strategies that due to their high level of idealization are often deemed unsuitable for biological investigations, biological scientists do normally focus on a set of very narrow and context-dependent issues for which modeling is often problematic. By analyzing specific examples taken from the literature in both philosophy and the hard sciences, this paper shows what kind of conceptual and methodological difficulties might arise when studying complex biological systems by means of condensed matter physical approaches. It also describes alternative theoretical frameworks to possibly overcome them.

AGPhil 3.5 Tue 12:30 H 2033

Thermodynamics excludes a physical origin of life in open systems — •Thomas Seiler — Stuttgart

Entropy determines that all processes in nature proceed from less probable distributions to more probable ones. An objection to this premise is that the constraints of thermodynamics are not valid for open systems - in which biological structures exist.

However, the limits of open systems can be illustrated by the example of machines that reduce entropy such as refrigerators. They transfer heat from a cold volume to a warm volume. This highly improbable phenomenon can only happen because a complex cooling mechanism exists already. A further example of order increasing in open systems is the formation of crystals, e.g. snow-flakes. When heat is removed, a phase-transition leads to the appearance of macroscopic regularity which reflects a molecular regularity.

The emergence of life does not belong to such processes since these are the physical ways in which a hidden pre-existing order is made visible. No really new order or information is generated in open systems. Either the information content was already present in a complex machine or it already existed in the symmetry of the underlying molecules or in the feedback mechanism of a dissipative structure.

On the other hand, there is no physical arrangement containing the information needed to built up life from non-life or complex creatures from simpler creatures. Their physical emergence is excluded by the second law of thermodynamics because they do not belong to those pre-programmed structures which open systems can form.

AGPhil 4: Spacetime Thoeries

Time: Wednesday 9:30–11:00 Location: H 2033

AGPhil 4.1 Wed 9:30 H 2033

The difference between matter and spacetime — •Dennis Lehmkuhl — IZWT, Universität Wuppertal, Gausstrasse 20, 42119 Wuppertal

The possession of mass is widely accepted as a necessary condition for something to be a material systems in Newtonian physics. I argue that the property "possession of mass-energy-momentum" should be seen as the natural heir of the property "possession of mass" in the context of relativistic theories. Hence, possession of mass-energy-momentum (energy for short) should be counted as a necessary condition for something to be a material systems in these theories. However, we also know that gravitational waves, waves of curvature in spacetime, can possess energy, so that the question has to be posed whether gravitational waves and thus spacetimes should be counted as material systems as well. There are many definitions of gravitational energy in general relativity, all of them involving a kind of non-locality. But more importantly, all these definitions are such that gravitational/spacetime energy can only be defined for certain kinds of spacetimes. Having argued for seeing energy as a necessary condition for somethin to be a material system, I claim that spacetimes cannot be counted as material systems in GR. The theory thus leaves us with a fundamental dichotomy between spacetime and matter. I conclude with a brief discussion of whether this dichotomy might be hoped to be overcome by modifications or extensions of GR.

AGPhil 4.2 Wed 10:00 H 2033

On how to gain Insights into the Dimensionality of Space and Time — •Radin Dardashti — London School of Economics, London, UK

The dimensionality of space is seemingly such a fundamental aspect of our everyday life that doubting its tri-dimensionality may seem strange and arguing for it seems to be a trivial issue. Many arguments, mainly introduced by physicists, go even further and state that their argument offers an explanation of the dimensionality. This is, we believe, not at all a trivial issue.

But rather than dealing in detail with the proposed arguments, a more general approach has been chosen. First, we restrict ourselves to mathematics and physics from which we hope to gain insights about the dimensionality. Second, possible methodological approaches to the question are developed and analyzed by considering examples ranging from the mathematical theory of Clifford Algebras to the physical theory of Superstrings. This is followed by a philosophical discussion of the argument structures that follow from these approaches. Finally, we discuss in what sense the arguments could be considered to be explanatory arguments.

AGPhil 4.3 Wed 10:30 H 2033

Is Lorentz's Ether Theory Suited to Ground the Privilege of the Present — •Thorben Petersen — Institut für Philosophie, Universität Bremen

On the so-called Lorentzian interpretation of relativistic effects, it is assumed that there is ether compensation, which brings it about that electromagnetic and kinematic phenomena are both Lorentz invariant even though the underlying space-time is Newtonian. According to Einsteins special theory of relativity, by contrast, Lorentz invariance reflects a different kind of default space-time behaviour (the space-time being Minkowskian). A crucial difference is that unlike Einsteins interpretation the Lorentzian interpretation retains an absolute relation of simultaneity. Prima facie this makes it attractive to those who think that the present is ontologically privileged, for it seemingly allows to maintain that one need not relativize the present to different inertial frames of reference. The aim of this talk is to cast doubt on this assumption. I argue that one faces serious semantical, epistemological and metaphysical problems upon combining Lorentzianism with the claim that the present is ontologically privileged.

AGPhil 5: Foundations of Quantum Theory

Time: Wednesday 11:30–13:00 Location: H 2033

AGPhil 5.1 Wed 11:30 H 2033

Quantum locality with and without consistent histories — •Helmut Fink — Inst. f. Theoretische Physik I, Univ. Erlangen-Nbg.

The nature of EPR-like “quantum nonlocality” is one of the topics that every interpretation of quantum theory must deal with. There is still no consensus on what is actually implied by the violation of Bell-type inequalities. For sure, there are no local hidden variables. But is it locality or is it realism that has to be abandoned (or weakened) in the quantum domain?

In a recent article (*R. B. Griffiths: Found. Phys. 41, 705-733, 2011*), Bob Griffiths argues lucidly and instructively for Einstein locality as a valid quantum principle. According to his consistent-histories based analysis, objective properties of individual quantum systems do not change when something is done to another noninteracting system. He identifies only quantum incompatibility as the main difference between quantum and classical physics.

However, the consistent-histories approach can itself be criticized for not (uniquely) representing elements of physical reality such as measurement outcomes or pointer positions. In order to reveal artefacts of the histories interpretation, we try to reconstruct Griffiths’ conclusions from a Neo-Copenhagen perspective. Most of his conclusions survive this test of “interpretation invariance”, but there is an essential difference between the two interpretations in the nature and relevance of state-collapse.

AGPhil 5.2 Wed 12:00 H 2033

Philosophical Lessons from Recent Tests of Non-Locality — •Matthias Egg — University of Lausanne, Switzerland

Experimental tests of Bell-type inequalities, performed since the early 1980’s, turned non-classical correlations between spacelike separated events from a theoretical speculation into an experimental fact. At the same time, the precise nature of these correlations is still not well understood. While it seems unavoidable to accept the existence of superluminal influences (as argued, for example, by Tim Maudlin in ”Quantum Non-Locality & Relativity”, 1994), it is far from clear how and between which relata these influences occur. The philosophical search for a finer-grained understanding of quantum non-locality has tended to focus on the question what the different versions of quantum mechanics (Bohm, GRW etc.) tell us about this issue. In my talk I will explore a different strategy, by asking what lessons can be drawn from recent experimental tests of non-locality, for example investigations of Bell-type situations involving more than two parties.

AGPhil 5.3 Wed 12:30 H 2033

"Nur quantenmechanisch erklärbar !"? — •Michael Brieger — Berlin

Eine sorgfältige Analyse des Weges, auf dem Schrödinger zu seiner berühmten partiellen Differentialgleichung gekommen ist, zeigt, dass er die klassische Mechanik abgeschlossener Systeme nie verlassen hat. Denn sein Vorgehen besteht darin, aus allen, in solchen idealisierten Systemen möglichen dynamischen Situationen mittels eines Variationsverfahrens nur diejenigen herauszufiltern, für die die Gesamtenergie einen Extremwert hat. Daher repräsentiert eine Wellenfunktion, die seine Differentialgleichung löst und gleichzeitig im Unendlichen verschwindet, genau diesen Extremwert. Als Eigenwert in diesem Randwertproblem mit orthogonalen Eigenlösungen drückt er stationäre Situationen aus ähnlich den Knotenlinien einer eingespannten Membran. Es handelt sich also um eine reine Energiedarstellung, bei der Unschärferelationen keine Rolle spielen können. Die Eigenlösungen repräsentieren daher außergewöhnliche Situationen einer dynamischen Balance.

In Form von zeitabhängigen Zustandsvektoren repräsentieren Superpositionen der Eigenlösungen unter Einbeziehung ihrer Zeitabhängigkeit als allgemeinste Lösungen allgemeine dynamische Situationen aus energetischer Sicht. Mit ihnen gebildete Erwartungswerte beschreiben den zeitlich periodischen Austausch zwischen im Hamilton-Operator berücksichtigten Teilenergien. Ihre zeitlichen Mittelwerte folgen den Virial Theoremen für das entsprechende Potential.

AGPhil 6: History and Philosophy of Physics

Time: Wednesday 14:30–16:45 Location: H 2033

Invited Talk AGPhil 6.1 Wed 14:30 H 2033

Majorana’s oscillator and the philosophy of neutrino physics — •Silvia De Bianchi — Sapienza, University of Rome, Italy

The aim of this paper is to claim the relevance of a philosophical understanding of neutrino physics, which deserves careful analysis in its historical development. In this paper I shall investigate the origin of Majorana’s oscillator, which B. Touschek suggested to investigate for its consequences in dealing with energy spectra. The equation implied in Majorana theory of neutrino has not yet been object of extensive studies, so that its meaning and consequences are far to be understood.

In what follows, I start throwing some light on it, by exploring the background from which E. Majorana advanced his theory. I shall refer to H. Weyl’s foundations of Quantum Mechanics and to the method of second quantization applied to the Maxwell-Dirac field equation. Majorana’s theory appears to be ascribed to Weyl’s treatment of the dynamical problem of quantum physical systems in his Theory of Groups and Quantum Mechanics. Weyl’s non-linear solution derives from a specific condition that presupposed the application of a variational principle slightly different from Dirac’s. I shall explore the reasons why both Weyl and Majorana criticized Dirac’s use of positive and negative energy states in dealing with neutral particles.

Conclusively, I shall present further possible research topics concerning: 1. Weyl’s reflections on positive and negative transitions of the elettromagnetic field. 2. Majorana’s spinor as a specification of Weyl’s spinor. 3. The implications of 1. and 2. for the philosophy of space and time.

AGPhil 6.2 Wed 15:15 H 2033

Kant’s Theory of Mathematical Physics — •Katharina Kraus — Department of History and Philosophy of Science, University of Cambridge, Free School Lane, Cambridge, CB2 3RH, United Kingdom

Kant’s theory of natural science neither follows Leibniz’s rational metaphysics nor fully endorses Newton’s and Galileo’s mathematical foundation of the sciences. Rather, Kant proposes a theory according to which scientific cognition results from a combination of metaphysical concept formation and mathematical construction. The äpplicationöf mathematics to concepts that are metaphysically derived presupposes a special metaphysics of nature. For Kant, mathematical physics as a pure, synthetic a priori natural science is paradigmatic for all sciences. In this paper, I will present three different lines of interpretation of the special metaphysics of nature, the weak reading according to Buchdahl’s (1969) "looseness of fit"between transcendental principles and empirical laws, Friedman’s (1992) strong reading suggesting a strong correspondence between them, and an alternative reading according to Plaass’ (1965) idea of metaphysical construction. A comparison of these three interpretations will show which of them could still be appropriate to a philosophical foundation of modern physics. I will also examine to what extent Kant’s idea of a pre-mathematical metaphysical concept formation could be seen as a precursor of a semantic view of theories.

AGPhil 6.3 Wed 15:45 H 2033

The postponed Euler-Lambert-Kant discussion in the mirror of the Schlick-Cassirer debate — •Dieter Suisky — Institut für Physik, Humboldt-Universität zu Berlin

Striving for a discussion with the leading mathematicians of his time was a crucial peculiarity in Kant’s attempts to reconsider the basic principles of physics and metaphysics (compare Kant’s letter to Euler in 1749 and the correspondence with Lambert between 1765 and 1770). In a letter to Johann III Bernoulli (1781), Kant commented in retrospect that it would be worthwhile "seine (Lambert’s) Bemühung mit der meinigen zu vereinigen, um etwas Vollendetes zu Stande zu

bringen". Though in fact it was Kant who postponed all opportunities which were offered to him by Lambert, he was right in demanding and expecting a completion of his works.
It will be argued that the missed opportunity was revived, first of all in the debates between physicists, mathematicians and the schools of Neo-Kantianism and logical empiricism initiated and performed by Cassirer, Schlick, Reichenbach, Einstein and Weyl. The keystone, however, was delivered by Einstein whose theory of space and time replaced not only the former versions constructed by Newton, Leibniz and Euler, but provided the basis of a new philosophical interpretation. As an unpleasant result for the Kantians, Schlick questioned some of Kant's previously groundbreaking assumptions ("Nun müssen wir freilich in ihrem ... Dogma, die Philosophie biete unbedingt wahre apriorische Grundsätze dar, eine höchst unglückliche Äußerung erblicken.").

AGPhil 6.4 Wed 16:15 H 2033

Are there elements of Leibniz's theory in Newton? On the different shapes of Newton's 2nd Law — •Dieter Suisky — Institut für Physik, Humboldt-Universität zu Berlin

The representation of Newton's 2nd Law underwent several modifications between 1684 and 1687. It will be argued that some of them are probably related to Leibniz's critique of Cartesian mechanics in 1686. In comparison to the preliminary versions in the manuscripts entitled De Motu (1684a, 1684b), the final version of the 2nd Law published in the Principia (1687) is distinguished by two modifications. De Motu (a): "The change of the *state of motion and rest* is proportional to the *force impressed* and is made in the direction of the right line in which that force is impressed." De Motu (b): "The change of *motion* is proportional to the force impressed ..." In 1686, Leibniz published his famous attack upon Cartesian mechanics replacing the quantity of motion with the moving force and in 1687 appeared the name of "moving force" also in the Principia completing the previously denoted impressed force. "The change of motion is proportional to the *motive force impressed* ..."
Finally, in the French translation published in 1759, du Châtelet interpreted Newton in the spirit of Leibniz by omitting the word "impressed" and maintaining the word "moving". In the Institutions published in 1740, du Châtelet has already accentuated the Leibniz related interpretation by adding that the "change in the direction and the velocity are always due to an external force because otherwise the change would be without *sufficient reason*".

AGPhil 7: Philosophy of Science

Time: Wednesday 17:15–19:15 Location: H 2033

AGPhil 7.1 Wed 17:15 H 2033

On the Value of Information — •Hans Juergen Pirner — Marsilius Kolleg und Institut fuer Theoretische Physik, Heidelberg

We investigate the role of information with respect to two different kinds of indefinite ("unbestimmte") objects. The elements of the first group appear as random or uncertain reflecting our lack of knowledge. The elements of the second group are vague, unclear or undefined showing our inability drawing boundaries. In order to reduce the uncertainties of the first group we need more information. I will discuss how Shannon's theory quantifies information and how this approach can be used to relate elements via mutual information and infer the probability of outcomes in uncertain circumstances. Building on the paradigm of a structured system and an unknown environment I will introduce a value of information which describes the increase of complexity of the system and the reduction of indefiniteness of the environment.

AGPhil 7.2 Wed 17:45 H 2033

Erhard Scheibes Reduktionsverständnis in Auseinandersetzung mit seinen Vorgängern — •Raphael Bolinger — TU Dortmund

Mitte des vergangenen Jahrhunderts hat sich ausgehend von Nagel und Woodger bzw. Kemeny/Oppenheim eine Debatte um als *Reduktionen* bezeichnete, besonders starke Zusammenhänge wissenschaftlicher Theorien entwickelt. In dieser stellte sich bald heraus, dass ein einziges Reduktionskonzept zur Erfassung aller relevanter Beispiele unzureichend war. Als Konsequenz ergab sich insbesondere im Kontext der Kritik des syntaktischen Theorienverständnisses die Herausarbeitung verschiedener Unterfälle der Reduktionsbeziehung.
In seiner in zwei Bänden erschienenen Arbeit zur Reduktion physikalischer Theorien (1997 bzw. 1999) stellt Erhard Scheibe eine umfassende Taxonomie von Theorienbeziehungen auf, die teils Überlegungen seiner Vorgänger übernimmt, teils wichtige Facetten zu deren Ansätzen hinzufügt, und bringt diese zur Anwendung. Im Rahmen des Vortrags werden einige zentrale Zusammenhänge und Unterschiede zwischen Scheibes Reduktionstheorie und den Ansätzen seiner Vorgänger aufgezeigt.

AGPhil 7.3 Wed 18:15 H 2033

An odd piece of progress: On proposals for a new SI — •Wolfgang Pietsch — Carl von Linde-Akademie, TU München, Germany

Progress in physics is usually supposed to be driven by evidence and thus objective. We will present a case study that violates this intuition but nevertheless regards the very core of physics. It concerns a recent proposal of the major metrology institutes to redefine four of the SI base units, namely kilogram, ampere, mole, and kelvin. We will attempt to make sense of this episode within a general framework of scientific evolution - drawing mainly on the work of the historian of science Thomas Kuhn. The odd features can be traced back to the fact that the episode exhibits characteristics both of normal science and of a scientific revolution.

AGPhil 7.4 Wed 18:45 H 2033

Are classical forces relations or dispositions? — •Johannes Röhl — Universität Rostock, Rostock, Germany

Realists about Newtonian Forces are confronted with the task of assigning an ontological category to these entities. I identify four main features forces must have according to a standard view of Newtonian mechanics: causal efficacy, directionality (vectorial character), superponibility and dependence on non-force entities.

The two main proposals in the debate, forces as relations and forces as dispositions or causal powers, both appeal to intuitions from Newtonian mechanics, but face considerable difficulties in detail. The dispositional conception may not be able to accomodate the directionality and the symmetrical dependence of a force on the bodies between it acts. The relational account seem to lead to revisionary accounts of causation and it is not clear how the superposition of components forces and the resulting force are to be understood.

I suggest an alternative approach that takes forces as intermediaries in a chain of dispositions and their manifestations. A force is a manifestation of a disposition, but has itself dispositional character as it causes accelerations. The relational aspect of forces can be construed as an emergent feature of the whole interaction situation. The component and resultant forces can also be accomodated by this model.

AGPhil 8: Mathematik, Physik und Wirklichkeit

Time: Thursday 9:30–11:30 Location: H 2033

AGPhil 8.1 Thu 9:30 H 2033

Probleme bei Messungen an elektronischen Bauelementen mit wenigen Elektronen (digitale Welt1) — •Rudolf Germer — TUB — HTW — ITP, www.itp-berlin.net

Die Miniaturisierung der elektronischen Bauelemente ist so weit vorgedrungen, daß die Effekte kleiner Elektronenzahlen eine Rolle spielen. Gequantelt sind die Wirkung h, die Elementarladung e und das magnetische Flußquant Fio , h = 2 e *Fio . Als Folge beobachten wir die Energiestufung beim Laden eines Kondensators E~n*n oder einer Induktivität Em~m*m; beides entspricht dem Potentialtopf mit unendlich hohen Wänden. Die Quantisierung zeigt sich bei Spannung und Strom U=-dm*Fio/dt+n*e/jC, I=dn*e/dt+jm*Fio/L. Das Messen eines Widerstandes ist ein Zählen von Elektronen und magnetischen Flußquanten. Das Digitalisierungsrauschen zeigt dann die bekannten Eigenschaften des Schrotrauschens und des Widerstandsrauschens. Beim Laden eines Kondensators muß auch das gequantelte Magnetfeld des Ladestromes berücksichtigt werden. Beim LC-Schwingkreis paßt der Wechsel von elektrischen und magnetischen Energien zwischen Kondensator und Spule nicht zu den Eigenwerten des harmonischen Oszillators. Ein Modell gekoppelter schwingender Systeme, das die Diskrepanzen beseitigt, führt zu der Annahme, daß nicht alle Energieeigenwerte realistisch sind. Experimente, um die erwarteten Effekte zu demonstrieren, werden diskutiert.

AGPhil 8.2 Thu 10:00 H 2033

Die Eigenschaften der Zeit in verschiedenen Koordinatensystemen (digitale Welt 2) — •Rudolf Germer — TUB — HTW — ITP, www.itp-berlin.net

Vorgänge in elektrischen Schaltungen lassen sich in unterschiedlichen Koordinatensystemen verfolgen. Am verbreitetsten ist sicher das System (U, I, t). Kennlinien, Widerstand R, Leistung P und umgesetzte Energie E lassen sich mit dem System gut beschreiben. Die Zeitachse stellt eine Zeit t dar, die einen Ablauf kennt und einen Zeitraum umfaßt. Man kann verstehen, wie ein Kondensator über einen Widerstand aufgeladen wird. Besondere Schwierigkeiten bereitet das Demonstrieren der Energie eines LC-Schwingkreises mit zwei die Energie abwechselnd speichernden Systemen. Das System (U, Q, t) beschreibt den Kondensator C und die darin gespeicherte Energie E einfacher, das System (Fi, I, t) die Induktivität L. Die Energie hat in diesen Koordinatensystemen keine zeitliche Ausdehnung und die Zeit t ist die aktuelle, ablaufende Zeit mit beschränkter Kenntnis von Ereignissen der Vergangenheit. Schreitet man gedanklich fort und wählt das System (Fi, Q, 1/T) , so wird wieder ein Widerstand R gut beschrieben und die Quantennatur einiger Phänomene tritt in den Vordergrund, Fi= m*Fio, Q = n*e, h = 2 e*Fio. Die Zeit begegnet uns in Form von Frequenz f und Periodendauer T, nicht aber als die von einer Uhr angezeigte, über diese wird gemittelt. In diesem System ist der LC-Schwingkreis in interessanter Weise darstellbar.

AGPhil 8.3 Thu 10:30 H 2033

Zur Anwendung der Physik auf Probleme mathematischer Art — •Boris Heithecker — 28870 Ottersberg

Es gehört zum tradierten methodischen Selbstverständnis der Physik, dass sie sich der Mathematik als Hilfsmittel zur Beschreibung der Natur bedient. Die Physik bildet damit ein Anwendungsfeld für die Mathematik. Die Idee, dass sich umgekehrt die Physik zur Lösung von Anwendungsaufgaben mathematischer Art heranziehen lässt, liegt unter anderem dem neueren Forschungsgebiet Quanteninformation zu Grunde. Das Verhältnis von Mathematik und Physik lässt sich also prinzipiell auch umkehren, indem die Physik auf die Mathematik angewandt wird. Dabei handelt es sich gegenwärtig zwar größtenteils noch um reine Anwendungsversprechen; aber es gelingt zum Beispiel offenbar, Algorithmen zum Faktorisieren von ganzen Zahlen physikalisch zu implementieren.

In dem Beitrag soll die Frage nach möglichen Konsequenzen für aktuell in der Philosophie und Wissenschaftstheorie der Physik diskutierte Probleme gestellt werden. Dabei scheint zunächst die Frage nach der Simulierbarkeit physikalischer Modelle im Vordergrund zu stehen. Bei genauerer Betrachtung gewinnt die Frage nach der Anwendbarkeit der Physik auf die Mathematik jedoch vor allem Bedeutung vor dem Hintergrund der Frage nach den Voraussetzungen und Modalitäten der Genese einer technischen Anwendung durch eine "Erfindung" aus dem Anwendungsversprechen einer Theorie.

AGPhil 8.4 Thu 11:00 H 2033

Physical existence: A uniquely possible explicit dual manifestation of the mereotopological logical structure of a metaphysically existing known mathematical object — •Paul Wilfried Bücking — paul_buecking@gmx.de

A new notion of superstrings enabled to detect the existence of a duality relation between the logical structure of a known mathematical object and an identical one in the relation of fundamental particles. A metaphysical/physical duality showed up when correlating the intrinsically geometrically expressed logic of this object with a geometrically representable formalism emerging, when sorting fundamental matter and antimatter particles by charge. Then the mereotopological logical structure of the mathematical object can be correlated in a straight way with the specific asymmetries underlying physics at its fundamental scale. Geometry is an explicit manifestation of internal relation, that is, it displays a logical context. It reveals that both aspects of the duality have an identical internal logical structure. This implies that the physical world is a uniquely possible dual explicit manifestation of the metaphysically existing implicit logical structure of this mathematical object, discovered decades ago. The why of physical existence, considered to be intrinsically unknowable, has revealed. Nature turns out to be simple at its geometric root. The infiniteness of its indwelling logical context cannot however be conceived. It seems to reveal in the eons of evolution of the duality. There is no creation, but self-realization of a Logical Principle.