Arbeitsgruppe Philosophie der Physik (AGPhil)

Meinard Kuhlmann
Abteilung Philosophie
Universität Bielefeld
Universitätsstr. 25
33615 Bielefeld
mkuhlmann@uni-bielefeld.de

Dennis Lehmkuhl
Center for Philosophy of Science
University of Pittsburgh
817 Cathedral of Learning
Pittsburgh, PA 15260, USA
lehmkuhl@caltech.edu

Wolfgang Pietsch
Munich Center for Technology in Society
Technische Universität München
Arcisstr. 21
80333 München
wolfgang.pietsch@tum.de

Übersicht der Hauptvorträge und Fachsitzungen

(SR 113)

Plenarvortrag mit besonderem Interesse für die AGPhil

PV III	Di	8:30– 9:15	HS 1	**Interdisciplinarity in Early Physical Cosmology** — •Helge Kragh

Hauptvorträge

AGPhil 2.1	Mo	16:30–17:15	SR 113	**Why Einstein Never Really Cared for Geometrization** — •Dennis Lehmkuhl
AGPhil 3.1	Mo	17:45–18:30	SR 113	**Good just isn't good enough – Humean chances and the foundations of statistical physics** — •Claus Beisbart
AGPhil 5.1	Di	14:00–14:45	SR 113	**Das Messproblem der Quantenmechanik: eine philosophische Bilanz** — •Michael Esfeld
AGPhil 5.2	Di	14:45–15:30	SR 113	**Berry phase and quantum structural realism** — •Holger Lyre
AGPhil 6.1	Di	16:30–17:15	SR 113	**Models in theory building: the case of early string theory** — •Elena Castellani

Hauptvorträge des fachübergreifenden Symposiums SYBM

Das vollständige Programm dieses Symposiums ist unter SYBM aufgeführt sowie als Sitzung AGPhil 4 gespiegelt.

SYBM 1.1	Di	11:00–11:30	HS 3	**Gedankenexperimente zum Äquivalenzprinzip – Ein Zugang zur Allgemeinen Relativitätstheorie** — •Karl-Heinz Lotze
SYBM 1.2	Di	11:30–12:00	HS 3	**Was hat die Philosophie mit der Masse zu tun?** — •Manfred Stöckler
SYBM 1.3	Di	12:00–12:30	HS 3	**Masse und Gravitation: Zum Massebegriff in der Allgemeinen Relativitätstheorie** — •Domenico Giulini
SYBM 1.4	Di	12:30–13:00	HS 3	**The concept of mass in particle physics** — •Georg Weiglein

Fachsitzungen

AGPhil 1.1–1.4	Mo	14:00–16:00	SR 113	**Ontological Aspects in Physics**
AGPhil 2.1–2.2	Mo	16:30–17:45	SR 113	**Space, Time and Spacetime**
AGPhil 3.1–3.1	Mo	17:45–18:30	SR 113	**Probability and Chance**
AGPhil 4.1–4.4	Di	11:00–13:00	HS 3	**Begriff der Masse**
AGPhil 5.1–5.3	Di	14:00–16:00	SR 113	**Foundations of Quantum Mechanics 1**
AGPhil 6.1–6.3	Di	16:30–18:15	SR 113	**Models, Theories, Explanation**
AGPhil 7.1–7.1	Di	18:15–18:30	SR 113	**Poster**
AGPhil 8.1–8.3	Mi	11:15–12:45	SR 113	**Philosophy of Science Perspectives**
AGPhil 9.1–9.3	Mi	14:00–15:30	SR 113	**Foundations of Quantum Mechanics 2**
AGPhil 10.1–10.4	Mi	16:30–18:30	SR 113	**Alternative Ansätze**

Mitgliederversammlung der Arbeitsgruppe Philosophie der Physik

Dienstag 18:30–19:30 SR 113

- Bericht
- Planung 2013/14
- Verschiedenes

AGPhil 1: Ontological Aspects in Physics

Zeit: Montag 14:00–16:00 Raum: SR 113

AGPhil 1.1 Mo 14:00 SR 113

Compositionality in Particle Physics: Lessons from the Weak Interaction — •Sorin Bangu — Univ. of Bergen, Dept. of Philosophy, 12 Sydnesplass, 5007 Bergen Norway

One of the most general (and successful) ideas of modern science, especially prevalent in physics, is that chunks of matter are made of, or composed of, other (smaller) chunks of matter. As stated, this principle - call it the compositionality principle - has an ontological character: if one asks what the larger chunks of matter are, the answer is that they are, nothing more and nothing less, some sort of collection, or mereological sum, of their constituent parts (where among these components one might also want to include, as elements in their own right, the relations that hold them together.)

This paper inquires about the status of the compositionality idea in the context of the early (1930s) attempts to understand weak interaction. The proposal I articulate here is that the compositionality thesis turned out to be a rather complicated business: some instances of the claim are meant literally, and others are not. What I will do is isolate two representative cases, one in which I will argue that the model of interaction is a literal instantiation of the compositionality claim, and one in which it cannot be.

AGPhil 1.2 Mo 14:30 SR 113

Decoherence: How much does it help? — •Meinard Kuhlmann — Universität Bielefeld

Decoherence entered the scene as a solution to the measurement problem in quantum mechanics. However, it has become increasingly clear in the last decade that decoherence as such solves few if any aspects of the measurement problem. If so, the question arises in which respect decoherence does help. I will supply a differentiated answer.

AGPhil 1.3 Mo 15:00 SR 113

Natural Laws as Dispositions — •Florian Fischer — Königstr.3, 53113 Bonn

Dispositional theories of laws of nature are problematic, besides their popuarity. Reviewing the history of dispositions, I start with the simple conditional analysis. C.B. Martin pointed out that the conditions for gaining or loosing a disposition can be the same as the stimulus. Another closely related but significantly different group of counterexamples are Johnstons masks and Birds antidotes. The object keeps its disposition in these cases, but nevertheless the manifestation is somehow blocked or weakened.

There are a number of proposals how to save dispositions. I will present the accounts of Choi and Gunderson, Manley and Wasserman and finally Fara. In the end all of them are not convincing. My diagnosis is that all this accounts have something in common and that exactly this is the basic problem. They, somehow or other, narrow the scope of the disposition to exclude the counterexample cases, which is unaccapteble.

A look at the scientific practise can be of great help to examine a well-discussed case in the philosophical literature. To deal with the problems of the missing manifestation, I propose a new kind of manifestation. I conclude by comparing my view to recent accounts. I can make sense of abstraction and even answer the monotonicity charge. In the end, I would like to have removed one obstacle for a dispositional theory of laws of nature.

AGPhil 1.4 Mo 15:30 SR 113

Euler on the correspondence between light waves and the surfaces of bodies: "All surfaces of bodies are similar to tensioned strings" — •Dieter Suisky — Institut für Physik, Humboldt-Universität zu Berlin

Following Huygens and making use of the similarity between the perception of sound by hearing and of colours by seeing, Euler completed the wave theory of light by the analysis of the surfaces of bodies. In contrast to Newton's corpuscular theory, Euler had to develop additionally a model of the *surfaces of bodies*. Euler claimed that surfaces are similar to *tensioned strings* whose vibrational motion is excited by the light waves. An early version, included in the manuscript *Theses Philosophicae* (1749-52), was only recently published, the later version was already published in the *Letters to a German Princess*.
Euler's theory of perception and vision will be compared with Berkeley's *New Theory*. Analyzing seeing and touching, Berkeley claimed: "It is therefore a direct consequence that there is no idea common to both senses." Euler constructed the missing link by means of the wave theory of light.
The conclusion is that Euler's theory of light is of considerable epistemological importance because it includes a critical approach to Newton's and Berkeley's theories. Furthermore, Euler's basic hypotheses had been later confirmed by Planck's assumption of elementary oscillators in the theory of heat radiation and Einstein's treatment of emission and absorption of light.

AGPhil 2: Space, Time and Spacetime

Zeit: Montag 16:30–17:45 Raum: SR 113

Hauptvortrag AGPhil 2.1 Mo 16:30 SR 113

Why Einstein Never Really Cared for Geometrization — •Dennis Lehmkuhl — University of Pittsburgh, Center for Philosophy of Science, USA

I argue that, contrary to folklore, Einstein never really cared for geometrizing the gravitational or (subsequently) the electromagnetic field. Indeed, he thought that the very idea of geometrization was "meaningless". I will show that instead, Einstein saw the unification of inertia and gravity as one of the major achievements of GR. Interestingly, he did not locate this unification primarily in the field equations but in the geodesic equation, the law of motion of test particles. I will investigate in what sense Einstein thought a "geometrization of gravity" to be meaningless, and how exactly he distinguished it from a "physicalization of geometry" on the one hand, and a "unification of inertia and gravity" on the other.

AGPhil 2.2 Mo 17:15 SR 113

Could spatiotemporal objects possibly leave their spatiotemporal locations behind? A further problem about multi-location — •Thorben Petersen — University of Bremen, Department of Philosophy

According to combinations of spacetime substantivalism and endurantism, persisting spatiotemporal objects are multi-located in spacetime, i.e. located in their entirety at different regions of substantivalist spacetime. However, the jury is still out on whether the framework of multi-location is indeed an applicable or even intelligible framework. I here shall develop a simple argument to the effect that the framework of multi-location is indeed inapplicable (to four-dimensionalist spacetimes). The argument, very roughly, is that insofar substantivalism about spacetime implies that spatiotemporal regions are static and insofar substantivalism furthermore implies that facts concerning spatiotemporal location supervene upon (or else are grounded in) facts about spacetime, it is not unreasonable to suggest that the occupiers inherit the static character from the spatiotemporal regions they occupy. Accordingly, occupiers of spacetime regions cannot be meaningfully said to leave their spatiotemporal regions behind, whence it is hard to see how enduring objects could be properly multi-located in spacetime.

AGPhil 3: Probability and Chance

Zeit: Montag 17:45–18:30 Raum: SR 113

Hauptvortrag AGPhil 3.1 Mo 17:45 SR 113
Good just isn't good enough – Humean chances and the foundations of statistical physics — •Claus Beisbart — Institut für Philosophie, Universität Bern, Länggassstr. 49a, CH-3012 Bern

Statistical physicists assume a probability distribution over microstates to explain thermodynamic behavior. The question of this paper is whether these probabilities are part of a best system and can thus be interpreted as Humean chances. I consider two strategies, viz. a globalist as suggested by Loewer, and a localist as advocated by Frigg and Hoefer. Both strategies fail because the system they are part of have rivals that are roughly equally good, while ontic probabilities should be part of a clearly winning system. I conclude with the diagnosis that well-defined micro-probabilities under-estimate the robust character of explanations in statistical physics.

AGPhil 4: Begriff der Masse

Zeit: Dienstag 11:00–13:00 Raum: HS 3

Hauptvortrag AGPhil 4.1 Di 11:00 HS 3
Gedankenexperimente zum Äquivalenzprinzip – Ein Zugang zur Allgemeinen Relativitätstheorie — •Karl-Heinz Lotze — Universität Jena, Physikalisch-Astronomische Fakultät, Max-Wien-Platz 1, 07743 Jena

Um die Allgemeine Relativitätstheorie lehrbar zu machen, nähern wir uns ihr durch Gedankenexperimente an. Dabei steht das Äquivalenzprinzip, in dem die konzeptionell verschiedenen Begriffe der trägen und schweren Masse aufgehoben sind, im Mittelpunkt.

Wir behandeln die Schwerelosigkeit in einem frei fallenden Aufzug und in einem Erdsatelliten sowie, zusammen mit dieser, die Gezeitenwirkung der Gravitation.

Weiterhin erzeugen wir "künstliche Schwerkraft", indem wir eine Raumstation in Rotation versetzen. Dabei zeigen wir, daß diese künstliche Schwerkraft alle Eigenschaften der natürlichen hat. So erlebt ein Astronaut, der einen Apfel losläßt, dessen Bewegung als freien Fall. Hält er den Apfel fest, kann er nicht unterscheiden, ob die von ihm aufzuwendende Kraft erforderlich ist, um den Apfel abweichend von seiner Trägheitsbahn auf einer Kreisbahn zu halten oder um dessen Gewicht infolge der Schwerkraft äußerer Massen auszubalancieren (Äquivalenzprinzip).

Die Frage, welche Bedeutung die aus der Speziellen Relativitätstheorie bekannten Effekte in diesem Kontext haben, führt uns unter anderem auf die Vorhersage, daß der Gang von Uhren von deren Position in einem Schwerefeld abhängt.

Hauptvortrag AGPhil 4.2 Di 11:30 HS 3
Was hat die Philosophie mit der Masse zu tun? — •Manfred Stöckler — Institut für Philosophie, Universität Bremen

Im ersten Teil meines Beitrags werde ich die Vorstellung zurückweisen, dass mit den Mitteln der Philosophie ein Wesensbegriff von Masse entwickelt werden kann, aus dem dann die Bedeutung von *Masse* und entsprechende Messvorschriften abgeleitet werden können. Umgekehrt kann die Bedeutung des Begriffs *Masse* auch nicht einfach experimentell durch Messoperationen festgelegt werden. Die Geschichte des Massebegriffs zeigt, dass er stark von den jeweiligen physikalischen Theorien und einem naturphilosophischen Hintergrundwissen abhängig ist. Andererseits gibt es doch eine bemerkenswerte Kontinuität in den Bedeutungsvarianten von *Masse*, die immer weniger von anschaulichen Vorstellungen und zunehmend mehr von formalen Eigenschaften der zugehörigen mathematischen Darstellung abhängen. Das wird bei der Suche nach dem Higgs-Boson besonders deutlich. Die Philosophie kann auf der Grundlage des jeweils gegenwärtigen physikalischen Wissens zur Bestimmung des Massebegriffs beitragen, weil sie umfangreiche Erfahrungen mit Begriffstheorien, mit der Dynamik physikalischer Theorien und mit dem Zusammenhang von Theorie, Experiment und Natur hat.

Hauptvortrag AGPhil 4.3 Di 12:00 HS 3
Masse und Gravitation: Zum Massebegriff in der Allgemeinen Relativitätstheorie — •Domenico Giulini — ZARM, Universität Bremen — ITP, Leibniz Universität Hannover

In der Newton'schen Gravitationstheorie sind träge und schwere Masse logisch unterschieden. Die Annahme ihrer universellen Gleichheit ist wesentlicher Bestandteil des Einstein'schen Äquivalenzprinzips, dessen wichtigste Implikation die geometrische Beschreibbarkeit der Gravitation ist, etwa im Rahmen der Allgemeinen Relativitätstheorie (ART). Auf der anderen Seite impliziert das Äquivalenzprinzip aber anscheinend auch die Unmöglichkeit, dem Gravitationsfeld selbst eine in Raum und Zeit lokalisierbare Energie- und Impuls-Verteilung eindeutig zuzuordenen. So hat es seit Aufstellung der ART bis in die jüngste Vergangenheit hinein immer wieder Versuche gegeben, das Konzept einer "quasi-lokalen Masse/Energie" zu definieren und fuer theoretische Untersuchungen nutzbar zu machen, jedoch nie mit durschlagendem Erfolg. In meinem Vortrag möchte ich die begrifflichen und mathematischen Hintergründe dieses Sachverhalts erläutern und einige Massenbegriffe erklären, die in der Gravitationsphysik eine Rolle spielen. Dabei beabsichtige ich auch auf einige formale Ähnlichkeiten mit dem Ladungsbegriff nicht-abelscher Eichtheorien einzugehen.

Hauptvortrag AGPhil 4.4 Di 12:30 HS 3
The concept of mass in particle physics — •Georg Weiglein — DESY, Hamburg

The recent discovery of a particle with properties that are compatible with a Higgs boson as postulated in the Standard Model of particle physics marks a breakthrough in the quest for understanding how elementary particles can acquire the property of mass. The concept of the mass of an elementary (point-like) particle is discussed, and possible mechanisms for generating masses of elementary particles within and beyond the Standard Model of particle physics are highlighted. The conceptual differences between the masses of elementary and composite particles are pointed out.

AGPhil 5: Foundations of Quantum Mechanics 1

Zeit: Dienstag 14:00–16:00 Raum: SR 113

Hauptvortrag AGPhil 5.1 Di 14:00 SR 113
Das Messproblem der Quantenmechanik: eine philosophische Bilanz — •Michael Esfeld — Université de Lausanne, Lettres-Philosophie, CH-1015 Lausanne

Das Messproblem der Quantenmechanik besteht darin, dass es keine Theorie geben kann, welche die folgenden drei Aussagen zusammen anerkennt: A Die quantenmechanische Zustandsbeschreibung eines Systems ist vollständig. B Der quantenmechanische Zustand eines Systems entwickelt sich gemäss der Schrödingergleichung. C Messungen haben definitive Ergebnisse. Wenn man C anerkennt, muss man entweder A oder B zurückweisen. Der Vortrag zeigt die Optionen auf, die sich in diesem Falle ergeben, und bewertet diese. Dabei werden ich auch auf die Quantenfeldtheorie und die Ansätze zu einer Theorie der Quantengravitation eingehen.

Hauptvortrag AGPhil 5.2 Di 14:45 SR 113
Berry phase and quantum structural realism — •Holger Lyre — Philosophy Department, University of Magdeburg

Two main claims are made in this lecture: First, the Berry phase is a geometric quantum holonomy that is directly rooted in the very structure of quantum theory itself. Common wisdom tells us that the state space of quantum theory is a projective Hilbert space. This structure is however insufficient to account for the Berry phase, the full quantum structure must rather be considered as a U(1) principal bundle over the projective Hilbert space. Second, this quantum bundle structure should ontologically be seen as a real and causally effcacious trace of nature, the quantum phase therefore directly supports ontic structural realism.

AGPhil 5.3 Di 15:30 SR 113

Time Remains: Observable Succession in Quantum Gravity — •Karim Thebault[1] and Sean Gryb[2] — [1]Ludwig Maximilian University, Munich, Germany — [2]University of Utrecht, Utrecht, Netherlands

Even classically, it is not entirely clear how one should understand the implications of general covariance for the role of time in physical theory. On one popular view, the essential lesson is that change is relational in a strong sense, such that all that it is for a physical degree of freedom to change is for it to vary with regard to a second physical degree of freedom. This implies that there is no unique parameterization of time slices, and also that there is no unique temporal ordering. At a quantum level this approach to general relativity is generally understood to lead to a universe eternally frozen in an energy eigenstate. Here we will start from a different interpretation of the classical theory, and in doing so show how one may avoid this acute 'problem of time' in quantum gravity. Under our view, duration is still regarded as relative, but temporal succession is taken to be absolute. This is consistent with general covariance because it can be maintained only by the addition of an arbitrary time parameter corresponding to the minimal temporal structure necessary for a succession of observations to be represented. This approach to the classical theory of gravity is argued to then lead to a relational quantization methodology, such that it is possible to conceive of dynamical observables within a theory of quantum gravity.

AGPhil 6: Models, Theories, Explanation

Zeit: Dienstag 16:30–18:15 Raum: SR 113

Hauptvortrag AGPhil 6.1 Di 16:30 SR 113

Models in theory building: the case of early string theory — •Elena Castellani — Department of Philosophy, Florence, Italy

The history of the origins and first steps of string theory, from Veneziano's formulation of his famous scattering amplitude in 1968 to the 'first string revolution' in 1984, provides rich material for discussing traditional issues in the philosophy of science. This paper focusses on the initial phase of this history, that is the making of early string theory out of the 'dual theory of strong interactions' motivated by the aim of finding a viable theory of hadrons in the framework of the so-called S-matrix theory of the Sixties: from the first two models proposed (the Dual Resonance Model and the Shapiro-Virasoro Model) to all the subsequent endeavours to extend and complete the theory, including its string interpretation.

As is the aim of this paper to show, by representing an exemplary illustration of the building of a scientific theory out of tentative and partial models this is a particularly fruitful case study for the current philosophical discussion on how to characterize a scientific model, a scientific theory, and the relation between models and theories.

References:

J. T. Cushing (1990), Theory Construction and Selection in Modern Physics: The S-Matrix, Cambridge: Cambridge University Press.

A. Cappelli, E. Castellani, F. Colomo, and P. Di Vecchia (eds.) (2012), The Birth of String Theory, Cambridge: Cambridge University Press.

AGPhil 6.2 Di 17:15 SR 113

Explanatory Hypotheses Formation and the Anomalous β Spectrum — •Tjerk Gauderis — Centre for Logic and Philosophy of Science, Ghent University, Belgium

Between 1928 and 1934, a persevering anomaly mystified the physics community: while alpha decay behaved perfectly according to the new quantum mechanics, the energy of electrons emitted in beta decay displayed a broad continuous spectrum. This puzzle invoked a lively debate among the most established physicists at the time. But the curious thing was that they all suggested hypotheses of very different formal types: Rutherford and Chadwick thought of varying internal energies, Bohr suggested to restrict the energy conservation principle, Heisenberg tinkered with a new quantization of space, and Pauli suggested the existence of a new elementary particle - all these hypotheses being radical and highly controversial.

In physics, an anomalous experimental result can trigger the formation of formally very different hypotheses. A scientist confronted with such a result has no strict guidelines to help her decide whether she should explain this result by withdrawing or adapting a constraint (e.g. a law) of the current theory, or by presupposing the existence of a hitherto unobserved entity (e.g. a particle) that makes the anomaly fit within that theory. In this talk I aim to gain some insights how scientists make this choice, by examining in the above case study how the choice of the various mentioned physicists depended on their previous experiences and their specific perception of the problem.

AGPhil 6.3 Di 17:45 SR 113

The Explanatory Capability of Physical Theories — •Radin Dardashti — Munich Center for Mathematical Philosophy, Munich, Germany

At any given time there are certain aspects of our well-confirmed physical theories that we cannot explain. For instance, the dimensionality of space and time or the specific group structure of the standard model of particle physics. These are taken to be brute facts and they have to be specified before the theory unfolds its explanatory powers. Attempts to explain these aspects have been limited to anthropic reasoning which has been argued against elsewhere. The aim of this paper is to consider the possibility to use results from mathematical physics to give non-anthropic explanations of certain brute facts. We will start by specifying a minimalistic approach towards accounts of scientific explanation. This will be followed by a specification of the notion of brute facts before presenting the proposed approach towards a better understanding of these brute facts. The approach will be exemplified for the specific case of the dimensionality of space and time within the theory of General Relativity.

AGPhil 7: Poster

Zeit: Dienstag 18:15–18:30 Raum: SR 113

AGPhil 7.1 Di 18:15 SR 113

Cluster-state quantum computation: the role of entanglement — •Filippo Annovi — Department of Philosophy, University of Bologna, Italy

Cluster-state quantum computation is computationally equivalent to the traditional circuit model, but the pictures of computational processes outlined by the two are radically different.

Here are investigated some of the consequences of this situation for the explanation of the quantum speed-up, whit particular regard to the role played by entanglement. At first sight, the evolution of a cluster-state computer seems to be disentangling (at each step one qubit is measured and discarded), but in a fully-unitary dynamical account it appears to be entangling (at each step a correlation is established between one qubit and its respective recorder). It is thus suggested that the different uses made of the features of quantum systems by the two frameworks, do not rule out the thesis that the speed-up is achieved by means of an entangling transformation.

However, in this last case entanglement is created step by step, and thus the main difference between the two frameworks seems to remain the absence of “quantum parallelism”. The only entangling-generating unitary transformations acting at the same time on all the qubits are the controlled-phase operation involved in the preparation of the cluster. Thus, the explanation of the quantum speed-up should be looked for just in these type of transformations.

AGPhil 8: Philosophy of Science Perspectives

Zeit: Mittwoch 11:15–12:45 Raum: SR 113

AGPhil 8.1 Mi 11:15 SR 113

What Is and Why Do We Need Philosophy of Physics? — •Wolfgang Pietsch — Munich Center for Technology in Society, TU München, Germany

Philosophy of physics is a small but thriving research field situated at the intersection between the natural sciences and the humanities. However, what exactly distinguishes philosophy of physics from physics is rarely made explicit in much depth. I provide a detailed analysis in the form of a number of theses, delineating both the nature of the questions asked in philosophy of physics and the methodology with which they are addressed. This presentation results from discussions and joint work with Meinard Kuhlmann.

AGPhil 8.2 Mi 11:45 SR 113

Quantum Physics and Relational Ontology — •João Cordovil — Center of Philosophy of Sciences of University of Lisbon

The discovery of the quantum domain of reality put a serious ontological challenge, a challenge that is still well present in the recent developments of Quantum Physics.

Physics was conceived from an atomistic conception of the world, reducing it, in all its diversity, to two types of entities: simple, individual and immutable entities (atoms, in metaphysical sense) and composite entities, resulting solely from combinations. Linear combinations, additive, indifferent to the structure or to the context.

However, the discovery of wave-particle dualism and the developments in Quantum Field Theories and in Quantum Nonlinear Physical, showed that quantum entities are not, in metaphysical sense, neither simple, nor merely the result of linear (or additive) combinations.

In other words, the ontological foundations of Physics revealed as inadequate to account for the nature of quantum entities. Then a fundamental challenge arises: How to think the ontic nature of these entities?

In my view, this challenge appeals to a relational and dynamist ontology of physical entities. This is the central hypothesis of this communication.

In this sense, this communication has two main intentions: 1) positively characterize this relational and dynamist ontology; 2) show some elements of its metaphysical suitability to contemporary Quantum Physics.

AGPhil 8.3 Mi 12:15 SR 113

Wann und wie macht *Zeit* einen Sinn ? — •Rudolf Germer — ITPeV www.itp-berlin.net — TUBerlin

Bei der Messung physikalischer Größen kann man zwischen den *fundamentalen* Größen, die sich (digital) abzählen lassen (Ladung, Flußquant, Wirkung, Photon ...) und anderen (*analogen), die sich auf zusätzliche Maßstäbe (Zeit, Volumen ...) beziehen (Strom, Dichte ...) unterscheiden. Die Zeit spielt entweder als Zeitdauer T oder als die ablaufende Zeit*t mit Vergangenheit, Gegenwart und Zukunft eine Rolle. Die Frage, wie sich *Zeit* messen läßt, soll an verschiedenen Systemen diskutiert werden. Die Antwort hängt davon ab, ob sich der Beobachter innerhalb oder außerhalb des Systems befindet. Im einfachen Fall innerhalb eines Rotators ist nur eine Periodendauer T feststellbar. Erst durch einen Austausch von Energie zeigt sich eine ablaufende Zeit*t. Beim harmonischen Oszillator zeigt sich die ablaufende Zeit*t nur innerhalb einer Periode T definiert und nur mit einer Genauigkeit, die von der Energie abhängt. Eine ablaufende Zeit*t länger als die Periodendauer T ergibt sich erst durch externe Beobachtung, Zählen oder Interferenz mit anderen Systemen. Auch hier ist die Genauigkeit energieabhängig. Eine Richtung der aktuellen Zeit t ergibt sich u.a. für gedämpfte Systeme, die bekannte thermodynamische Anschaulichkeit ist nicht zwingend. Ein harmonischer Oszillator zeigt zeitlich Symmetrie, eine Sanduhr nicht.

AGPhil 9: Foundations of Quantum Mechanics 2

Zeit: Mittwoch 14:00–15:30 Raum: SR 113

AGPhil 9.1 Mi 14:00 SR 113

Experiments thought to prove non * locality may be artifacts — •Karl Otto Greulich — Beutenbergstr, 11 D 07745 Jeba

Detecting non-locality via entanglement, reflected by the instantaneous transfer of quantum properties over a large distance, requires almost ideal experimental conditions * ideal sources for entangled photon pairs and ideal detectors. Deviations from this ideal situation may critically hamper interpretations of experiments on non-locality or entanglement. Of two major known loopholes, the detector loophole is not yet unequivocally closed. Now another loophole emerges: When in such experiments downconverting crystals with lasers as primary light sources are used, exceeding threshold values in the Bell inequalities, i.e. their violation, can be caused by so far not fully recognized problems in the generation and detection of photon pairs. Taken together, nonlocality is still not yet unequivocally proven. Thus, one of the most serious experimental challenges of causality is on brittle ground.

References: K.O. Greulich , Another loophole for the Bell inequalities Proc. of SPIE Vol 7421 * 08, (2009) ; K.O. Greulich Proc. of SPIE Vol 8121-15, (2011); for downloads see, http://www.fli-leibniz.de/www_kog/ then klick *Physics*

AGPhil 9.2 Mi 14:30 SR 113

Methodological Testing: are Fast Quantum Computers Illusions — •Steven Meyer — Tachyon Design Automation, San Francisco, USA

Popularity of the idea for computers constructed from the principles of QM started with Feynman's 'Lectures On Computation', but he called the idea crazy and dependent on statistical mechanics. In 1987, Feynman published a paper in 'Quantum Implications - Essays in Honor of David Bohm' on negative probabilities which he said gave him cultural shock. The problem with imagined fast quantum computers (QC) is that speed requires both statistical behavior and truth of the mathematical formalism. The Swedish Royal Academy 2012 Nobel Prize in physics press release touted the discovery of methods to control "individual quantum systems", to "measure and control very fragile quantum states" which enables "first steps towards building a new type of super fast computer based on quantum physics." A number of examples where widely accepted mathematical descriptions have turned out to be problematic are examined: Problems with the use of Oracles in P=NP computational complexity, Paul Finsler's proof of the continuum hypothesis, and Turing's Enigma code breaking versus William tutte's Colossus. I view QC research as faith in computational oracles with wished for properties. Arther Fine's interpretation in 'The Shaky Game' of Einstein's skepticism toward QM is discussed. If Einstein's reality as space-time curvature is correct, then space-time computers will be the next type of super fast computer.

AGPhil 9.3 Mi 15:00 SR 113

The Concept of Motion in Modern Physics — •Michael Vogt — HfBK Dresden, Kunstbezogene Wissenschaften, Güntzstr. 34, 01307 Dresden

Since ancient Greece physics can be understand as the science of moving things, change of beings, or motion in general. The way, how a theory has access to its specific subject, determines the concept of reality. The physical concept of motion, therefore determines physical reality.

For the identification of the characteristic difference between classical physics and quantum physics it is necessary to establish a term of motion with extended comprehension. Analysing the Physics of Aristotle under this point of view provides us with an appropriate concept of motion. It will be shown that within the modern physics, there is initially a reduction of all types of motions to continuous locomotion. However, by introducing discontinuity in the change of state within quantum mechanics we no longer can believe, that there is continuity in all kinds of changes or motions. Therefore, the reduction to continuous locomotion is no longer possible in the quantum world.

Utilizing the Aristotelian concept of coming-to-be and perishing it is possible to develop a specific new concept of motion, which is suitable for quantum physics. Thus, the relation between classical and quantum physics can be elucidated in a novel way.

AGPhil 10: Alternative Ansätze

Zeit: Mittwoch 16:30–18:30 Raum: SR 113

AGPhil 10.1 Mi 16:30 SR 113

Über das absolute raumzeitliche Bezugssystem der authentischen galilei-newtonischen Bewegungslehre als Grundlage des Wirklichkeitsbezugs und Wahrheitsanspruchs naturwissenschaftlicher Erkenntnis. — •Ed Dellian — Bogenstr. 5, 14169 Berlin

Galileo Galileis "Discorsi" von 1638 stellen als Grundlage der geometrischen Lehre von der wirklichen (=absoluten)Bewegung der Körper ein metrisches raumzeitliches Bezugssystem vor, welches die üblichen analytisch-algebraischen Repräsentationen dieser Lehre unterschlagen. Galileos Darstellung impliziert einen bisher ignorierten Proportionalitätsfaktor der Dimension "Raum durch Zeit". Dieser Faktor entspricht in jeder mathematischen Hinsicht der Naturkonstante c, die unter dem Namen "Vakuumlichtgeschwindigkeit" die moderne theoretische Physik bestimmt. Die Aufdeckung dieses Zusammenhangs wirft ein neues Licht auf die philosophische Interpretation der galilei-newtonischen Bewegungslehre und vor diesem Hintergrund auch auf die philosophische Bedeutung der Einsteinschen speziellen Relativitätstheorie und deren Wirklichkeitsbezug.

AGPhil 10.2 Mi 17:00 SR 113

Die Rolle von Prinzipien und Symmetrien in der Physik — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Die heutige theoretische Physik ist bestimmt von Prinzipien und Symmetrien.

Diese Vorgehensweise ist jedoch nicht wirklich neu, sondern wurde im Grundsatz vom Philosophen Plato entwickelt. Sie wurde später von Newton ersetzt durch Bezug auf tiefer liegende Gesetze. Die Verallgemeinerung von Newtons Vorgehensweise ist das reduktionistische Weltbild, welches die Grundlage des heutigen Wissenschaftsverständnisses ist.

Vor etwa einem Jahrhundert, in der Zeit der Neuorientierung durch Relativitätstheorie und Quantenmechanik, entstand daneben eine Rückbesinnung auf den platonischen Ansatz, der im Grunde bis heute die Physik beherrscht.

Es ist die Frage zu stellen, ob dieser ausschließliche Bezug auf Prinzipien und Symmetrien hilfreich ist und ob er notwendig ist. Dazu werden Beispiele aus Relativitätstheorie und Quantenmechanik vorgestellt, die an der Ausschließlichkeit zweifeln lassen.

AGPhil 10.3 Mi 17:30 SR 113

Structure of Our Universe and Its Particles by First Principles — •Claus Birkholz — Seydelstr. 7, D-10117 Berlin

The recent breakthrough resulting in a non-perturbative unification of Einstein's relativity with Planck's quantum theory has posed onward questions:

> Why is (bent) space-time (1+3)-dimensional?

> Why is it an SU(2,2) which is the covering group of fully quantized General Relativity?

Only a handful of more or less evident postulates is needed in order to deduce that fundamental physics must be based on an atomistic model and that the number of degrees of freedom should be some small power of 8 in terms of a degeneracy expansion. Irreducibility, then, is slicing our world into separate bent universes orthogonal to each other.

After deriving Einstein's "World Formula" from first principles, its evaluation provides a consistent Quantum Gravity in fully quantized space-time on its first degeneracy level - as a singlet representation with respect to the Grand Unification (GUT). Its second degeneracy level adds "internal" forces as vector representations of the GUT. A particle (viewed from outside) and our universe (viewed from inside) are subject to identical equations.

Finally, the mechanism is derived how a particle is condensing out of Dark Matter.

AGPhil 10.4 Mi 18:00 SR 113

Atomares und Galaktisches Leben — •Klaus Hofer — Uni Bielefeld

In Schwarzen Löchern wird die *Schöpfung* partiell auf einen winzigen Punkt verdichtet, aus dem beim Urknall ein neues Universum hervorgeht. Jedes neugeborene Universum bildet einen abgeschlossenen Schöpfungsraum, welcher sich selbst überlassen durch Raum und Zeit treibt. Sämtliche Schöpfungsprodukte innerhalb eines heranwachsenden Universums basieren auf einer gigantischen Verwebung aus Energie, Masse und Information zu Materie und Leben. In diesem komplexen Wechselspiel aus codierter Materie ist unsere Erde lediglich einer von AberMilliardenBillionen Sternen und Planeten, ähnlich einem Wassertropfen in den Ozeanen. Wobei die gesamte Menschheitsgeschichte in kosmischen Zeitdimensionen lediglich dem kurzen Aufblitzen dieses Wassertropfens entspricht. Dieser Beitrag will verdeutlichen, dass unser Universum alles andere als ein chaotischer und brodelnder Sternenhaufen ist, sondern auf allen Dimensionsebenen von lebendiger Materie durchsetzt wird. Denn sämtliche Formen evolutionären Lebens basieren auf hochcodierten Massehaufen, die von einer übergeordneten Schwarmintelligenz formatiert und gesteuert werden. Dieser unübersehbare Wirkungsmechanismus der Evolution legt den Schluss nahe, dass Massen sich nicht nur anziehen, sondern auch intensiv Informationen untereinander austauschen. Aus diesem erweiterten Blickwinkel ist die Existenz von *Außerirdischem Leben* selbst in und auf Atomen ebenso real, wie ganze Galaxien und Universen als organische Le-bewesen wachsen und sterben müssen.