Arbeitskreis Philosophie der Physik (AKPhil)

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Übersicht der Hauptvorträge und Fachsitzungen

(KIP SR 3.401)

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Mitgliederversammlung des Arbeitskreises Philosophie der Physik

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Vorläufige Tagesordnung

[1] Berichte

[2] Weitere Planung 2007/08

[3] Verschiedenes

AKPhil 1: Cosmology 1

Zeit: Dienstag 14:00–15:00 Raum: KIP SR 3.401

Hauptvortrag AKPhil 1.1 Di 14:00 KIP SR 3.401

Confirming Inflation? — •Christopher Smeenk — Department of Philosophy, 321 Dodd Hall, 405 Hilgard, UCLA, Los Angeles, CA 90095-1451

To what degree do observational results support inflationary cosmology? Clearly there has been a great deal of progress in precision cosmology since the introduction of inflation, which opens up the prospect of deducing the inflaton potential from temperature anisotropies in the background radiation. Are we now in a position to make a strong empirical case in favor of inflation? My talk will focus on three obstacles to giving a clear answer to this question. First, because inflation is currently a "paradigm without a theory," it is difficult to specify robust predictions of inflation in general. This is due to disagreement about what constitutes a "natural" model of inflation. Even granting agreement on this issue, some of the predictions of inflation may be sensitive to questionable physical assumptions. Second, the evidential support inflation receives depends in part upon whether its successful predictions are unique. In terms of a Bayesian approach to confirmation theory, the support inflation receives from a given successful prediction depends on the likelihood of the prediction holding true if the theory is false. This is a general problem, but in the case of inflation it is more pressing due to ignorance of the space of alternative theories. Third, does inflation merely "accomodate" observational results by adjusting parameters of the model (the inflaton potential), or does it successfully predict them?

AKPhil 2: Cosmology 2

Zeit: Dienstag 15:15–16:15 Raum: KIP SR 3.401

AKPhil 2.1 Di 15:15 KIP SR 3.401

What is a gravitational field? — •Dennis Lehmkuhl — Faculty of Philosophy, Oxford University

It is often claimed that the theory of General Relativity (GR) shows that what we perceive as gravity is "in fact" just a consequence of the geometry of spacetime. Others claim that the very core of GR is that it actually gives an account of the gravitational field, an account which unifies the latter with the inertial field (sometimes also called the guidance field) such that the theory postulates the existence of a single gravito-inertial field. I will briefly review these apparently contradicting interpretations of GR, and discuss whether they do indeed exclude one another. This will lead me on to ask: "What is a gravitational field in GR?"; or more precisely: "What is the mathematical representative of the gravitational field in GR?" Some have argued that the curvature tensor should be seen as representing the gravitational field (most prominently Synge), others claim that the connection is the gravitational field's mathematical representative (e.g. Ehlers and Giulini). Both possibilities have in common that they presuppose the standard formulation of GR; nevertheless, there are striking conceptual differences between the proposals. After reviewing these differences, I will discuss a number of topics which could throw some new light on the issue; most importantly the similarity/dissimilarity between gravitational waves and electromagnetic waves, and the role GR plays as compared to non-metric gravitational theories on the one hand, and bimetric theories on the other hand.

AKPhil 2.2 Di 15:45 KIP SR 3.401

Old Temptation in New Outfit: The Anthropic Cosmological Principle and the Teleological Tradition — •Michael Stöltzner — IZWT, Universität Wuppertal, Gaußstr. 20, D-42119 Wuppertal

Looking at the parameters that determine the characteristics of our Universe, cosmologists keep wondering why minute variations in these values yield so markedly different scenarios. For those, who eschew multiverse cosmology, the anthropic principle (AP) seems to provide an explanation: these values are such because they are, or even must be, consistent with the existence of human observers. The concrete form of the AP ranges from a truism of confirmation theory to a metaphysical assumption comparable to design arguments. In the latter form, so I argue, the AP simply rehearses a type of teleological thinking that has been with us since the classical debates between Isaac Newton and Richard Bentley. It implicitly assumes that a physical theory is categorical, that is, leaves no further freedom in selecting physical models once its basic laws are in place. But almost all physical theories fall short of this ideal. Model selection is guided by the likelihood of empirical data given a certain assumption. It is precisely at this point where the cosmological AP has emerged in the 1970s. I argue that in this form the AP makes sense as an explanatory complement but it cannot be elevated to the general level it purportedly dwells on.

AKPhil 3: Quantum Cosmology 1

Zeit: Dienstag 16:45–19:15 Raum: KIP SR 3.401

AKPhil 3.1 Di 16:45 KIP SR 3.401

The interpretation dilemma of a "quantum state of the universe" — •Helmut Fink — Institut f. Theoretische Physik I, Univ. Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen

The object system of quantum cosmology is the universe as a whole. Commonly, the state of a quantum system is used to make probabilistic predictions about the results of measurements at that system. Hence, the debate on whether there is a quantum ontology for individual systems without referring to relative frequencies of measurement results, is essential for the interpretation of a "quantum state of the universe". As a consequence of the structure of quantum theory, implying several no-go theorems, we regard a *classical* conceptual frame as methodologically prior to every unique *quantum* description. Our conclusion is that a state can be *either* a proper quantum state *or* a state of the universe, but not both at the same time.

As a way out of this dilemma, the approach of consistent (or decoherent) quantum histories has been recommended. But quantum histories merely serve to illustrate the problem of non-unique correspondence between formalism and facts instead of solving it. If it is a methodological apriori of physics that at least some elements of the theoretical formalism can be uniquely related to some elements of a conceivable external reality, then the consistent histories approach is unacceptable.

AKPhil 3.2 Di 17:15 KIP SR 3.401

Die Zeit vor der Zeit: Das Problem der Anfangsbedingungen in der Quantenkosmologie — •Rüdiger Vaas — Zentrum für Philosophie und Grundlagen der Wissenschaft, Universität Gießen

Wie es zum Urknall kam und ob er der Anfang von allem war oder eine Art von Übergang, soll im Rahmen der Quantenkosmologie beschrieben werden. Aber wie können Anfangsbedingungen notwendig für physikalische Erklärungen sein (als Explanans) und zugleich durch die Urknall-Kosmologie erklärt werden (als Explanandum)? Und welche Beziehung herrscht zwischen Randbedingungen, Naturkonstanten und Naturgesetzen? Sind letztlich alle nur Anfangsbedingungen? Im Vortrag werden diese wissenschaftstheoretischen Fragen kritisch diskutiert und besonders im Hinblick auf neue Modelle in der Loop-

Quantenkosmologie analysiert. Außerdem werden die Probleme von Anfangs-, Pseudoanfangs- und Ewigkeitskosmologien untersucht sowie damit verbundene konzeptuelle und ontologische Aspekte der Zeit in der Physik.

AKPhil 3.3 Di 17:45 KIP SR 3.401

Ist Stringtheorie Naturwissenschaft? — •Robert Helling — School for Engineering and Science, International University Bremen, Bremen

Die Stringtheorie gilt als erfolgsversprechenster Ansatz einer gemeinsamen Beschreibung von Gravitation und Quanthentheorie. Allerdings erlauben gegenwärtige Experimente keine direkte Überprüfung dieser Ideen. Dies wirft Fragen nach dem erkenntnistheoretischen Status der Stringtheorie auf, zu deren Beantwortung aus der Sicht eines Stringtheoretikers beigetragen werden soll.

AKPhil 3.4 Di 18:15 KIP SR 3.401

Die elfte Dimension — •Klaus Hofer — FH-Bielefeld, W. Bertelsmannstr. 10, 33602 Bielefeld

Fundamentale Erkenntnisse sind meistens sehr ernüchternd und unangenehm, denn Natur und Schöpfung offenbaren sich bei genauerem Hinsehen völlig anders, als es sich die Menschheit gemeinhin vorstellt oder wünscht. Und so musste man im Laufe der Jahrhunderte schmerzlich erkennen, dass die Erde keine Scheibe sondern eine Kugel ist, dass die Menschheit nicht im Zentrum des Universums steht, dass der genetische Unterschied zwischen Mensch und Tier nur ein Prozent beträgt, dass Gehirne als biologische Rechenwerke funktionieren, dass selbst Atomkerne noch teilbar sind und dass das Weltgeschehen von Chaos und Zufall bestimmt wird. Den jüngsten und gewaltigsten Meilenstein menschlicher Erkenntnisfähigkeit makiert seit ungefähr vierzig Jahren die physikalische Beschreibung des Universums als eine gigantische Vernetzung tanzender Fäden und Schleifen, gemäß der Superstringtheorie. Diese komplexe Theorie wird gerne als Weltformel bezeichnet, da sie als einzige in der Lage ist, sowohl die Mikrowelt der Atome als auch die Makrowelt der Planeten umfassend zu beschreiben. Und da gemäß dieser Theorie unser Universum vor dem Urknall auf einen winzigen Energiepunkt verdichtet war, muss das Geheimnis von Evolution und Leben zwangsläufig auch in dieser Welt der Strings liegen. Der vorliegende Querbeitrag möchte zeigen, dass es einen fließenden Übergang zwischen Energie, Materie und Leben in jedem Winkel des Kosmos gibt und dass die gesamte Vielfalt der Schöpfung aus der Kraft und Information dieser schwingenden Strings kommt.

AKPhil 3.5 Di 18:45 KIP SR 3.401

Darlegung und Diskussion eines "Neuen physikal. Weltmodells" — •Norbert Sadler — Wasserburger Str. 25 A ; 85540 Haar

Die "Genesis des Universums" zu den heutigen physikal. und physiologischen Wirklichkeiten kann als Quantenfluktuation aus dem Quantenkosmos, unter Ausbildung eines "Protouniversums", verstanden werden. Die physikalischen Entitäten, wie z.B. die Entstehung der Masse im Universum, der Gravitation, der Naturkonstanten und der Elementarteilchen können mathem. formal und syntak-tisch berechnet und topologisch, semantisch beschrieben und dargestellt werden. Die wesentliche Erkenntnis aus diesem "Neuen physikalischen Weltmodell" ist der fraktale, selbstähnliche Aufbau der physikalischen und der physiologischen Welt !!! "Wir" sind, unter Berücksichtigung der vorgegebenen und erdgebundenen Umwelt und Randbedingungen, in unsererem pysiologischen und physikalischen "Dasein" ein fraktales Abbild des "Großen Quanten-Universums". " Wir und unsere Umwelt sind fraktal vorbestimmt " !!!

AKPhil 4: Quantum Cosmology 2

Zeit: Mittwoch 16:45–17:45 Raum: KIP SR 3.401

Hauptvortrag AKPhil 4.1 Mi 16:45 KIP SR 3.401

"Wie alles sich zum Ganzen webt": on a new orientation for the concept of matter, based on relations between quantum physics and cosmology. — •Thomas Görnitz — Institut für Didaktik der Physik, J.W.Goethe-Universität, D-60438 Frankfurt/Main, Max-von-Laue-Str. 1

It is common sense between physicists that in the beginning the cosmos is in a narrow relationship to quantum phenomena. Because of the universal validity of quantum theory this relation remains significant in the whole cosmic evolution. Whereas a classical approach is sufficient for the description of many phenomena it is no more useful at last for the case of the ground state of a system. This holds also for the cosmos. The black holes are that part of physics where quantum theory and gravitational theory come into close contact. There a Gedankenexperiment becomes possible that clarifies the fundamental role of abstract quantum information. We give it a new name (Protyposis) because it must be imagined without emitter, receiver and moreover without any concrete meaning. This meaning-free abstract quantum information is defined by means of black holes and cosmology. Protyposis enables a new conception for "matter" and makes possible to overcome the problems of the "Lego-world-view", which result from the attempt to find the "simple and therefore basic concepts" in the range of spatial smallness. Matter can be understood now as "formed and condensed quantum information". But on a first view it is nothing to see from its character of being information, as like matter does not appear as "pure motion", what it is also because of $E=mc^2$.

AKPhil 5: Structuralism and Realism

Zeit: Donnerstag 14:00–15:00 Raum: KIP SR 3.401

AKPhil 5.1 Do 14:00 KIP SR 3.401

Two Kinds of Simulations – A Structuralist Approach — •Claus Beisbart — Institut für Philosophie, Universität Dortmund, D–44221 Dortmund

Computer simulations are all the rage in present-day physics. They help to understand the large structure of the Universe, complex fluids or traffic flows. But what are simulations? And what is their role between theories, models and observations?

To answer these questions, I take the structuralist approach (advocated by Balzer, Moulines and Sneed, for instance). The basic idea is to model algorithms as theory elements. Links to other theory elements provide a way to understand how the outputs of simulations get their meaning and relate to theories and models.

I use two kinds of simulations to illustrate my approach. The first example is very straight-forward, whereas, in the second example, which is drawn from cosmology, the simulations come along with their own ontology. Drawing on my second example, I show how simulations change the way physics works.

AKPhil 5.2 Do 14:30 KIP SR 3.401

Intermediate Structural Realism — •Holger Lyre — Department of Philosophy, University of Bonn /University of Bielefeld

Structural realism (SR) is the view that our ontological commitment should be focused on the structural rather than object-like content of our best and mature physical theories. As such, SR is considered to come in two flavours: Epistemic SR is based on the idea that objects may exist, but that it is only the object's structural relations to which we have epistemic access. Ontic SR, on the other hand, is the radical claim that, literally, structures is all there is.

In the first part of my talk I will argue for some more refined intermediate positions between ESR and OSR, and evaluate them on the basis of the group structural content of modern gauge theories. In the second part I will set out what I consider to be one of the major problems of SR: the apparent ambivalence of the notion of structure and the possibility of structural underdetermination. I will end with a discussion of the question whether in the case of gravitational theories we are provided with an example of structural underdetermination.

AKPhil 6: Interpretations of Quantum Theory 1

Zeit: Donnerstag 15:15–16:15 Raum: KIP SR 3.401

Hauptvortrag AKPhil 6.1 Do 15:15 KIP SR 3.401

Downward Causation and its Quantum Model — •Michel Bitbol — CREA, CNRS/Ecole Polytechnique, 1 rue Descartes, F-75005 Paris

Downward causation is impossible as a concept, but well established as a fact. A top down flux of causation going from an emergent level of processes to the fundamental level of processes which is supposed to underpin it, sounds like a paradox. But a paradox which is forced upon us when we want to make sense of many phenomena ranging from psychosomatics to hydrodynamic instability. In order to alleviate this sense of paradox, I'll try to work out the concept of causation until applying it to trans-level causation becomes philosophically acceptable. A simple illustration will be given by way of an examination of global and local observables in quantum mechanics.

AKPhil 7: Interpretations of Quantum Theory 2

Zeit: Donnerstag 16:45–18:15 Raum: KIP SR 3.401

AKPhil 7.1 Do 16:45 KIP SR 3.401

Classical physics and classical logic in Quantum Mechanics — •Manuel Bächtold — Institut für Philosophie, Fakultät 14, Dortmund Universität, D-44221 Dortmund

Are the measurement outcomes in microphysics “classical”? If yes, in which sense? In this talk, I will come back to Niels Bohr's interpretation of quantum mechanics and his claim that every measurement outcomes have to be described by means of classical physics. Carl Friedrich von Weizsäcker's transcendental version of this claim and its recent justification provided by Brigitte Falkenburg will also be discussed. I will then support the idea that a measurement outcome in microphysics cannot be considered as “classical” because its occurrence would be governed by the deterministic laws of classical physics (indeed, in the general case, it can only be predicted in a probabilistic manner by quantum mechanics). It can be considered as “classical”, I will argue, only by reference to classical logic. It is true, when no measurement is performed, the structure of propositions expressing all the possible events conforms to a kind of quantum logic (e.g. partial Boolean algebra or orthomodular lattice). However, if considering a performed measurement, the propositions expressing its possible outcomes (i.e. “possible” according to the predictions of quantum mechanics) are characterized as follows: at the end of the measurement (i) each of these propositions is either true or false (principle of bivalence), and (ii) only one of these propositions is true (principle of mutual exclusiveness).

AKPhil 7.2 Do 17:15 KIP SR 3.401

Unschärferelationen und Extra-Dimensionen — •Christian Ythier — Faculte des Sciences, Universite de Nice, France

Könnten die Unschärferelationen der Quantentheorie [1] mit Extra-Dimensionen etwas zu tun haben ? Könnten diese Relationen eine tiefere Begründung haben, wenn die Zeit nicht eindimensional sondern dreidimensional [2] wäre ? 1. W. Heisenberg, Zeitschr.f. Phys. 43 (1927) 172; 2. G. Mouze und C. Ythier, DPG- Verhandl. 2006, vol.3 ,HK 56-5 .

AKPhil 7.3 Do 17:45 KIP SR 3.401

Can Quantum Mechanics be Shown to be Incomplete in Principle? — •Carsten Held — Universität Erfurt, Wissenschaftsphilosophie, Postfach 900221, 99105 Erfurt, Germany

Given four plausible principles, quantum mechanics (QM) can be shown to contradict the standard expression of completeness, the eigenstate-eigenvalue link (EE). Consider:
(P0) If, for a proposition A (describing a possible event), a theory T yields another proposition $p(A) > 0$, then it is not the case that T, $A \vdash \perp$.
(P1) A QM probability, being of the form $p([A] = a_i) = Tr(W(t)P(a_i))$, is to be interpreted as $p([A] = a_i(t))$ (“the probability that S has a_i of A at t”).
(P2) There is a parameter t within QM such that the expression $[A] = a_i$ is read as $[A] = a_i(t)$(“S has a_i of A at t”).
(P3) Function $P : S(H) \to [0, 1]$ (collecting the QM probabilities for some suitable Hilbert space H) can be defined as a generalised probability function.
It is easy to show, for a non-eigenstate of some observable A and QM probabilities interpreted as prescribed by (P1), that (EE) transforms QM into a theory contradicting (P0). But (P0) is eminently plausible, so the defender of (EE) will naturally reject (P1). It can now be shown that retaining (P0) entails the rejection of all of (P1)-(P3).

AKPhil 8: History and Philosophy of Physics 1

Zeit: Freitag 9:00–10:30 Raum: KIP SR 3.401

AKPhil 8.1 Fr 9:00 KIP SR 3.401

Newtons Philosophie der Physik - zeitlos — •Helmut Hille — Fritz-Haber-Straße 34, D-74081 Heilbronn

Newtons lat. verfasstes Werk von 1686 ”Philosophiae Naturalis Principia Mathematica” wird u. a. übersetzt mit ”Mathematische Grundlagen der Naturphilosophie” (Ed Dellian) oder ”Die mathematischen Prinzipien der Physik” (V. Schüler), während ich denke, dass Newton seine Naturphilosophie zur Physik nach mathematischen, also rationalen Prinzipien entwickeln wollte. Es war der von Descartes (1596-1650) propagierte Rationalismus, dem er zu folgen suchte, weshalb Newtons Werk eigentlich mit ”Philosophie der Natur nach Prinzipien der Mathematik” übersetzt werden müsste. Leider vermengte Newton in seiner Definition III Descartes ”Erstes Naturgesetz” gleich mit Teilen seines 1. Axioms. Eine konsequente Axiomatik unter Einbeziehung der Gravitation in einer aktualisierten Sicht zeigt grundlegende Gemeinsamkeiten von klassischer und moderner Physik auf und ist m.E. geeignet, alle Teile durch ein vertieftes Verständnis einander zu nähern.

AKPhil 8.2 Fr 9:30 KIP SR 3.401

On the post-Newtonian period in the development of mechanics — •Dieter Suisky — Institut für Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin

Leonhard Euler is famous as the leading mathematician of the 18th century whereas Emilie du Châtelet is known for the translation of Newton's *Principia* into French. Châtelet's *Institutions de physique* had been published in 1740, after Eulers *Mechanica* (1736) but before d'Alembert's *Traité* (1743). A German translation, entitled *Naturlehre*, was rapidly published in 1743 while Euler's comprehensive treatise *An-*

leitung zur Naturlehre had been issued only posthumously in 1862.

In this contribution it will be demonstrated that the followers of Newton and Leibniz did merge and modify basic principles of their predecessors by introducing new principles, exemplified for Euler's procedure to invent physical notions being completely commensurable with the Leibnizian representation of the calculus.

Châtelet based the *Institutions* on Descartes's concept of extension, Newton's *Principia* and, Leibniz's principles of sufficient reason and conservation of living forces. Projected onto Euler's program, Châtelet's progress is inherently hampered by the restricted use of the language of calculus whereas the translation suffers losses from the lack of an adequate German physical terminology. Euler elaborated thoroughly both components in the *Anleitung* such that one can make use of Euler's consistently formulated conceptual frame even for the analysis of contemporary problems.

AKPhil 8.3 Fr 10:00 KIP SR 3.401

Euler's mechanics as a unified theory of matter and motion — •Dieter Suisky — Institut für Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin

Leonhard Euler (1707 - 1783) is famous as the leading mathematician of the 18th century. Though his pioneering work on mechanics had an essential influence in 18th century, its impact on the 19th century has been obscured by the overwhelming success of his mathematical writings.

The following features make the difference to the theories of Euler's predecessors Descartes, Newton and Leibniz: (i) a unified approach to mechanics based upon a universal model of the body and the introduction of algorithms for the modelling and solution of mechanical problems, called *Auflösungskunst*, (ii) the rigorous statement on the priority of *relative motion*, based upon the introduction of *observers*, called Zuschauer (*Mechanica*, 1736). This is comprehensively elaborated in the *Anleitung zur Naturlehre* (published 1862, but not mentioned by Mach) and maintained in the *Theoria* (1765), completed with the relative motion of two observers who are comparing their observations. The results confirm (iii) the invariance of the equation of motion in inertial systems (maintained by Einstein) and, (iv) the explanation of the origin of forces. Finally, (v) the reliability of mechanics is based both upon experience and mathematical foundation of the algorithms which are turned out to be in harmony with the physical foundation of measuring procedures. Einstein added the invariance of light velocity preserving all basic essentials of Euler's theory.

AKPhil 9: Histroy and Philosophy of Physics 2

Zeit: Freitag 11:00–12:00 Raum: KIP SR 3.401

AKPhil 9.1 Fr 11:00 KIP SR 3.401

From the origin of forces to the origin of mass. Euler's algorithm for the definition of inert mass - reconsidered — •Heinz Lübbig[1] and Dieter Suisky[2] — [1]Physikalisch Technische Bundesanstalt Berlin — [2]Humboldt-Universität zu Berlin

In this contribution the concept of mass will be analyzed. Historically, (i) Newton considered the *heavy mass* being as a universal property the origin of forces which manifest themselves in the interaction of bodies. Independently of the mass of bodies, the interaction is described by the same universal parameter, the gravitation constant. (ii) Following Newton in the method, Euler introduced an algorithm to define different *inert* masses which manifest themselves also in the interaction of bodies. Independently of the mass, Euler assigned the *same impenetrability* to the bodies which is considered as the origin of forces. However, neither Newton nor Euler explained the origin of mass. Recently, an algorithm for the origin of mass had been proposed where *different masses* of elementary particles result from the interaction executed by *massless* particles. Using QCD, Wilczek determined theoretically the numerical values of the proton and neutron masses in terms of the equivalent energy carried by moving gluons, i.e. *massless* subnuclear particles. The mediatory function of the gauge invariance-principle is indicated. In addition, as a gluon-analog the role of the (massless) photon in photon-assisted macroscopic quantum dynamics (of Bosons: Josephson effect, and Fermions: rational Quantum-Hall effect) is demonstrated which is as a consequence of the contingent flux quantum/charge-duality.

AKPhil 9.2 Fr 11:30 KIP SR 3.401

Interne und externe Faktoren der Theorienentstehung und ihre historische Rekonstruierbarkeit — •Vanessa Cirkel — Institut für Philosophie, Fakultät 14, Universität Dortmund, D-44221 Dortmund

In der Wissenschaftsphilosophie, ebenso wie in der Wissenschaftsgeschichte, waren und sind die Fragen nach den Faktoren, die zur Entstehung einer bestimmten Theorie geführt haben, von besonderem Interesse. Ein großes Augenmerk ist dabei auf das Verhältnis von wissenschaftsinternen und -externen Faktoren gerichtet.

Der Vortrag will an historischen Beispielen aus der Frühphase der Erforschung der kosmischen Strahlung untersuchen ob und inwieweit diese Faktoren überhaupt plausibel nachzuvollziehen sind und welche Bedeutung die Ergebnisse aus dieser Analyse sowohl für die Wissenschaftsphilosophie als auch die Wissenschaftsgeschichte haben.