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The Field of 'between' -A New Principle for Interdisciplinary Epistemology

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Abstract

Contrary to the established field of mathematical philosophy, interdisciplinary research in physics and philosophy is not well known. Of course, there are the writings of physicists for the nonscientific public introducing selected topics for mass media distribution. Yet in the presentation of highly advanced theories to an audience of physicists, reflections on philosophy do not have a place. On the other hand, reports are written by specialists in scientific theory in which the authors oppose the traditional philosophy of continental Europe. Since the 19th century renowned philosophers have put forward theories interpreting areas of natural science, trying to insert them into the framework of methods traditionally applied in natural philosophy. What is lacking is an interdisciplinary philosophical reflection for contemporary science in which a philosopher is able to grasp the principles of physical thinking, reflecting physical theory in relation to the fundamental philosophical conception of the subject: ?What is Truth?. To achieve this purpose for interdisciplinary research, philosophers should have a fundamental knowledge of physics. Vice versa, physicists should also learn the purpose of philosophical reflection and what the goals of philosophy are. The philosophy of science does not offer the same explanations for theories in physics or other natural sciences, but its goal is a fundamental reflection of ?What is truth?, as a common basis for different intellectual disciplines.

Index terms—

The Field of 'Between' -A New Principle for Interdisciplinary Epistemology Hisaki Hashi ontrary to the established field of mathematical philosophy, interdisciplinary research in physics and philosophy is not well known. Of course, there are the writings of physicists for the non-scientific public introducing selected topics for mass media distribution. Yet in the presentation of highly advanced theories to an audience of physicists, reflections on philosophy do not have a place. 1 On the other hand, reports are written by specialists in scientific theory in which the authors oppose the traditional philosophy of continental Europe. 2 Since the 19th century renowned philosophers have put forward theories interpreting areas of natural science, trying to insert them into the framework of methods traditionally applied in natural philosophy. 3 Author: Department of Philosophy, University of Vienna. Presidium of Verein fuer Komparative Philosophie und Interdisziplinaere Bildung (Association of Comparative Philosophy and Interdisciplinary Education) / KoPhil in Vienna. e-mail: hisaki.hashi@univie.ac.at What is lacking is an interdisciplinary philosophical reflection for contemporary science in which a philosopher is able to grasp the principles of physical thinking, reflecting physical theory in relation to the fundamental philosophical conception of the subject: 'What is Truth'. To achieve this purpose for interdisciplinary research, philosophers should have a fundamental knowledge of physics. Vice versa, physicists should also learn the purpose of philosophical reflection and what the goals of philosophy are. The philosophy of science does not offer the same explanations for theories in physics or other natural sciences, but its goal is a fundamental reflection of 'What is truth', as a common basis for different intellectual disciplines. The Field

of 'Between', an epistemological conception developed by the author as a working principle, was introduced into the interdisciplinary field of physics and philosophy in 2006. In the 1 For example: Einstein, Grundzüge der Relativitätstheorie, Braunschweig 1990. Heisenberg, Physikalische Prinzipien der Quantentheorie, Stuttgart 1991. Heisenberg, Bohr (Ed.), Die Kopenhagener Deutung der Quantentheoire, Stuttgart 1963. **??**chrödinger, Über den Indeterminismus in der Physik, Leipzig 1932. **??**reiman, The Odd of Quantum, Princeton 1999. See the quoted works in this report. Some works of Heisenberg In a well known physical experiment, a light quantum is emitted towards a light sensor -the target. If the quantum hits the target, a visible point emerges on the flat material as the result of the physical interaction between the flying light quantum and the light sensor. 5 The location of the light quantum is as completely unknown before measurement as it is after. An exact prognosis of the route of the flying quantum and its location is not possible. The protocol of the quantum flight changes from case to case, depending on what kind of physical facility is used for the experiment and on the method by which the quantum is measured. 6 Even if some renowned physicists have contended recently that the condition of the moving quantum can be predicted to a limited extent in probability theory, 7 the nature of the quantum is shown in the principle: the quantum being is dependent on accidental moments, its protocols are case by case changeable. The nature of quanta is 'created' by the experiments and its consistency with Heisenberg's Uncertainty Principle is evident in particle physics. 8 What caused most argument in quantum physics was whether a quantum can be understood as a 'physical real being' and if so to what extent (the socalled 'physical reality' ('Das Physikalisch Reale') presented by Einstein in his arguments in the EPR-Paradox against Heisenberg). 9 4 Articles on this theme are found in my publications: see the references at the end of this paper. In the way of thinking based on substantial metaphysics (Aristotelism, Leibniz's Monadology) it may be argued that the score of a flying quantum is in reality just an 'accident' (accidentia), a pure physical effect in which an emitted Introduction quantum vanishes immediately. 10 One scientific theory is that the 'quantum protocol is none other than an artificial phenomenon produced by experimental physical facilities.' 11 Here I should like to present another proposition: a quantum is the minimal physical substance of which the material of the micro-world, the meso-world and of macro-cosmic space can be constructed. But its essential unity can be never be explained by substantial metaphysics according to Aristotle or Leibniz. 12 Specialists in Aristotelism might say: 'a quantum is only a particles -a broken part of an atom. A physical protocol of a quantum results in an 'accident' in reality, but a quantum per se is not a substantial being. The main position of substantial metaphysics since Aristotle does not in any way lose its meaning.' **??**3 I will say: 'This position is right. The uncertain nature of quanta does not interfere with Aristotelian metaphysics. The theories of Aristotle, Leibniz etc. about substance have no relation to the aspects of the physical reality of particles in the micro-world system. The nature of a quantum has been independent from the principles of substance theories since the beginning of metaphysics. In other words, the nature of a quantum is not recognizable from the position of substantial metaphysics.' There are similar cognitions in the philosophy of continental Europe. Starting from this point my own position is as follows: 'If it is so, the contemporary theory of being has the possibility of changing its essential part dynamically. I say that the nature of a quantum is 'emptiness of substance, free from substantiality'.' It emerges and vanishes immediately. The visible point of the scored quantum is the track of the vanishing being. I say: 'This track emerges in the Field of 'Between', the field between the flying quantum and a receiving material'. 14 2. The Physical Real Being -Einstein's Argumentation in the EPR-Paradox

The issue in quantum physics from its beginning has been if and how far a quantum is understandable as a physical real being. This definition (das physikalisch Reale) was coined by Einstein who repeatedly brought arguments concerning the 10 Hans-Dieter Klein, "Inwiefern ist das teleologische Konzept der modernen Physik immanent?", in: Die Natur in den Begriff übersetzen, ed. by Thomas Posch and Gilles Marmasse, Frankfurt a.M. 2003. Cf. Aristotle, Metaphysics, Book Î?" 1025a, Book Z 1032 a-b. 11 Friedrich Wallner, Structure and Relativity, Frankfurt a.M. 2005, p. 67. 12 In agreement with this analytical philosophers say that classic metaphysics and ontology, like that of Leibniz, is not valid in contemporary philosophy: Chris Swoyer, "The Autonomy of Relations", in: Facta Philosophica, vol. 6 No. 1, Bern 2004. **??**3 For the idea of substantia / ousia see Aristotle, Metaphysics, Books Z, ?, ?. 14 Uncertainty Principle against Heisenberg. In short, Einstein postulated that the base of 'physical reality' (das physikalisch Reale) is lacking in quantum physics, thus fundamental research in it is incomplete. In the opinion of Einstein the 'physical reality / physical real being' should have three main conditions: 15 a. Definitive location in space-time: Physical reality is a definite unity in (traditional) physics; a physical material can be measured in repeated experiments. It must be observed and protocoled by a repeatable measuring method which is bound to yield consistent results.

b. Stability of the measured object by execution of an experiment: In measurement the condition of the physical object should not be disturbed by the experimental physical facility. This is totally lacking in quantum physics.

c. Systematic relations of the measured object to physical circumstances: The measured object is a physical system bound to its physical reality.

Constructed in its own space-time in physics, it should have consequent relations to the physical beings around it. It must consistently show a definitive physical system. This is also absent in quantum physics.

Therefore Einstein concluded in his EPR-Paradox: 'All these conditions of 'physical reality' are lacking in quantum physics. The basic theories and research methods of quantum physics should be fundamentally reconsidered.' Einstein held this position in a scientific theoretical alliance with Popper. 16 The point debated

most by natural scientists and philosophers was, if and how far a quantum can be interpreted by the previous concepts of 'being' in 'physical reality' at all. A quantum stays in physical space-time for an extremely short duration and vanishes immediately. A light quantum is bound to its own quantum count. It has a spin in a direction and it can be observed and protocoled but its duration is extremely short, for example, it appears with its own space-time for 10 -23 seconds and vanishes immediately. A light quantum can split into two further quanta (double quantum / Doppelteilchen) after the emission. 17 The quantum nature is accidental and differs in protocols depending on the kind of facilities used in the experiments.

1 Unproductive Debates

This point has caused many confusing debates.

Consciously or unconsciously, scientists and philosophers consider that a being is bound to its substance; it exists consistent with its fundamental substantiality; according to traditional physics it is a material bound to a physical body. Natural scientists, influenced by Einstein, were conscious of the concept of the 'Being of Physical Reality'. 18 Philosophers (like Popper) tended to think that a quantum is bound not only to natural scientific fact, but also to its 'ontological substance'. **??**9 A particle of an atom is bound to its 'systematic unity' which is indivisible, like that of Leibniz's monad or the ousia / substantia of Aristotle. 20 According to physical materiality a quantum must build an elementary part of any being. But, if we collect atoms in a physical laboratory, we can build, for example, two hydrogen atoms and an oxygen atom, but we cannot produce the 'water' that we perceive in nature. We can break down physical reality in an analytical and objectivist way to the most elementary part, a 'particle' of micro-world. We can construct a physical world in the projection of our consciousness, as a scheme of the world in the view of natural science.

Physicists have proved that this character is lacking in particle physics in the micro-world. From this result the debates of physicists and philosophers developed in the direction that the 'previous theories of substance metaphysics of Aristotle, the monadology of Leibniz etc. might lose their relevance completely. Then the previous natural base of substance, monad or the physical reality / real being of physics would be negated totally in the new physics.'

In my opinion, there is a failing in the conclusions of interdisciplinary reflection. Unconsciously these thinkers presuppose that a quantum as a particle of an atom builds up a minimal part of the material being of the whole universe, by which these particles are valid as the construction of every being. In a purely physical view this is right. From the philosophical point of view we have to complement a critical reflection.

Shigeru, (ed.) Quantum Theory in Contemporary Physics? (????? ???), Tokyo 1990, pp. 26. 18 But, the constructed projection of the world and the real world are not the same; they are different. Neither can be identified with the other. From the combination of the physical parts there cannot emerge a live being. Our self consciousness cannot be produced in a natural science laboratory. 21 If we claim that we can explain and construct everything by natural science theories, our position turns into a theory focusing excessively on natural science, a physical absolutism, so-called 'physicalism'. 22

2 Epistemological Comparisons -What Aspects are

Lacking?

From this point a long series of debates have emerged unproductively. Especially when the debates centre on methodology, their results are not interdisciplinary dialogues but crude and incorrect conclusions drawn by both natural scientists and natural philosophers because the different systems of thinking in philosophy and physics are never reflected on in a comparative way. In short, physics dominates the subjects of [quid facti], the areas of concrete real factums, real materials and causality in every detail to construct the physical world in a deductive way. Compared with physics, philosophy dominates the areas of [quid juris]: the examination of the ways, forms and contents of thinking of every kind, the very methods of thinking themselves as the fundamentals of philosophy. 23 The subjects of physics are factums, objects of real being that can be measured. The subjects of philosophy are, in contrast to physics, the various ways of thinking produced in our consciousness. This is for philosophy the Intrasystem, for physics and natural sciences the Extrasystem. Things that can be operated by physical quid facti are for physics [Intrasystem unity],

for philosophy that of the [Extrasystem]. 24 21 The method of cloning animals is successful in theoretically but in reality there are difficulties in every detail. In cloning, the female cell which merges with the male cell cannot be split easily. Cf. Okada, Yasuhiro, Organism, Brain and Life, Tokyo 1999. It has not been successful by a variety of methods in the contemporary science to produce a totipotent cell (see the scientific websites of the subjects "stem cell", "totipotent" etc. 2010). 22 Hans-Dieter Klein, Geschichtsphilosophie, Wien 2005, chap. I.1. 23 The significance of these terms is quoted by Kant, Kritik der reinen Vernunft , "Deduktion der reinen Verstandesbegriffe", B 116, A 84. 24 These technical terms can be applied also in cognition theory and comparative philosophy: Hashi, Hisaki, "Das Feld des Zwischen -Zur system-externen Logik der Quantenphysik", in: Interdisziplinäre Philosophie der Gegenwart, Frankfurt a.M. 2009. Unproductive debates between different philosophical and scientific disciplines start from the point where philosophers and scientists mix up and standardize their own 'intrasystem and extrasystem unities', without recognition of the

different methods of their disciplinary thought. What is lacking is comparative reflection on different scientific disciplines marked with the key words of the [intrasystem and extrasystem unities].

The unique merit of philosophy is the possibility of examining and proving thinking methods of any kind. As a result of the discourse we could make clear the principles of the various ways of thinking which are valid universally.

On the other hand, the unique merit of physics is different: it is able to handle concrete material things successively, continuously and in a deductive, verifiable way. Physics presents its way of thinking through physical schemes (formula, matrix, tensor calculation, coordinate systems of Riemann geometry etc.) by which it also finds the disprovable parts of physical reality that will become further issues to explore in nature.

3 Complementary Relation of the 'Intrasystem' and 'Extrasystem'

I am of the opinion that the non-exchangeable merits of both thinking methods (physics and philosophy) should be appreciated and reflected on, to lead to a fruitful complementary interchange between both disciplines; that of philosophy and that of natural science. The background to this thinking is the position of Yukawa (YUKAWA, Hideki, 1907 -1981), professor at the University of Kyoto, who was awarded the Nobel Prize for physics for the discovery of the meson in 1949. He was of the opinion that the activity of the human spirit (Geist) can also be researched from the perspectives of the natural sciences, in such a way that 'human scientific' thinking does not lose any of its original value.

In his opinion Human Science and Natural Science cannot be separated or isolated. Both scientific disciplines serve the cognition of the human being. Each is related to the other, if we consider different kinds of knowledge from the perspective of the cognition of the human being.

4 Excursus

YUKAWA presented this position in his various writings from the viewpoint of his interdisciplinary thought. One of his typical positions is found in the essay 'chigyoraku', 25 with a quotation of the Taoist classic ??Zhuangzi: a dialogue of the Taoist Zhuangzi with his rival ??Huizi (Hui Shi ??) while they are walking by the river. **??**6 'Though I represent the position of physics and natural science, I am deeply impressed by the Taoist view. Regarding the development of sciences carefully, I Huizi (??) took a positivistic and materialistic view against the Taoist Zhuangzi (??). In comparing the Taoist and positivistic positions, Yukawa developed his own thesis that this kind of concurrence is also found among philosophers and natural scientists in the contemporary period. Yukawa said: should say that there have been very few scientists since the period of Demokritos or Huizi (??) who have upheld exclusively one of the two poles of 'either A or non-A': that is, 'I think and believe either the philosophical position concerning the universal truth of unity or the natural scientist's position recognizing only provable things in a positivist way of thinking. Contributions to the advantage of natural science have always emerged from the insight of scientists not satisfied with a merely positivistic way of thinking. To find and establish a new thesis or principle, the true scientist must hold a position between the two extreme poles: regarding the systematic construction of a hitherto unknown part of nature, they have developed their insight and imagination (like philosophers or Taoists). On the other hand, they have clarified what is provable in a positivistic way by employing a maximum of scientific deduction. I, as a particle physicist, want to find the systematic principle of a particle which is not recognizable as a 'substantial and independent particle'. The nature of a particle is recognizable only if we observe it in a relation with another particle: we cannot observe a particle in a constant and consistent state, but only in an extremely short time-span, i.e. when another particle is near the observed one and when the first particle removes the second one. The theory of particle physics is built on this field of relations, in which I, as the scientist, move always between the two poles; one of them is the insight to grasp a new cognition, and the other one is to prove a hypothesis by the scientific method.'

As he presented this position in his international symposium for physicists in Kyoto, this analogy seemed to stimulate many participants.

Yukawa reflected on his thought in his further writings and a result on the professional level for interdisciplinary philosophy is found in the dialogue with KOBAYASHI Hideo, one of the most intellectual of critics in 20 th c. Japan, entitled 'The Progression of the Human Being' (?é??"???????). **??**7 Yukawa's thesis on how to establish interdisciplinary relations, communications and contributions from natural science to anthropological philosophy is presented in his scientific paper 'Science and Human Nature' (????é??"?). It is marked by four aspects, the Human Being as a Thinking Being, the Human Being as an Observing Being, the Human Being as an Acting Being and 'Science for the Well-Being of Mankind'. **??**8 This position of Yukawa postulates neither mixing nor a thoughtless equalization of natural philosophy and natural science. He calls for neither isolation nor equalization but a 'complementarity'. I think that this idea of [complementarity] can lead to a method of interdisciplinary thinking which is important for comparing [intrasystem] and [extrasystem] unities. **??**9 6. The "Field of 'Between' " as an Epistemological Concept I am of the opinion that we can reconstruct our **??**intrasystem] thinking from the stimulation of **??**extrasystem] thinking. Generally, one can see one's own unity in the other's reflection of himself objectively. My interdisciplinary scientific concept is the Field of 'Between', stimulated by a fundamental knowledge of Buddhist philosophy (pratitya samutp?da) which is in no way connected with esoteric concepts

or mystification of any kind. (Problems of 'reincarnation' or 'irrationality' are never in my concept!) **??**0 The essence of the Field of 'Between' is in short: 31

29 See note 24. The starting point of an analytical way of thinking was founded by Aristotle in his Organon, Metaphysics and Physics. He criticized Plato's thinking of the idea (????) of the one / hen (á¼?"?) and summed up his thesis in the following way: "To say that something that is, is not or that what is not, does exist -that is untrue. But to say that something that is, does exist and that what does not exist, is notthat is true." , Metaphysics, 1011b -1012a. Plato held only the last position omitted by Aristotle. See "Parmenides"-Dialogue 152a -166c.

Cf. Aristotle's sharp criticism of Plato, in: Metaphysics, Book M. In comparison with Aristotle, I think that Plato's insight opens a possibility of fruitful reflection for the comparative philosophies of East and West. **??**0 The projection of the "sams?ra" as a "reincarnation" in substantial transfiguration from one personality to another is believed mostly in Tibetan Buddhism: But, contrary to popular knowledge in recent decades in Europe, this way of imagination has less common ground expert in his substance metaphysics might say that 'the causality of emerging, staying and vanishing of a relation between A and non-A is in the dynamis, in the potential possibility of every thing and being. A and non-A, everyone, is an ousia, a substance. Everyone is present within his or her own being, so there is no space between A and non-A. A and non-A are a 'substantial unity'.'

If someone connects the words 'being', 'existing', 'emerging' and 'developing' etc. with a substantial, constant moment or accidence as inconsistentency, he would never grasp the essential meaning of the Field of 'Between'. The Field of 'Between', viewed purely physically, is a field of spacetime that enables a physical interaction. Viewed physically, in the double-slit experiment, a physical interaction emerges between the shooting light quantum and the receptor. Viewed philosophically and epistemologically, the Field of 'Between' is the [spacetime], where the things [A and non-A] enter into a relation.

We may apply this [A and non-A] in physical reality to ontology: there are two beings actualizing a relation between [A] and the other [non-A]; we may say in ontology and in anthropological philosophy, [A] and [B]. In this field, non-verbal communication can emerge between the contents of their consciousness (including parts of their unconsciousness), and their thinking and their feeling. Within Buddhist philosophy it is possible to think that both beings or persons, [A] and [B], do not have a fixed 'substantial unity': Of course we can say: 'viewed physiologically, each of them has his own DNA combinations, his own genetic series non-exchangeable with another; each is an organic 'closed system'.' 32 But in Buddhist philosophy, the crucial issue is not the biological 'a priori' **??**3 Tokyo 1965, 1979, 2001, Selected Works, Kyoto 1998, 2002. Nishida's system of philosophy includes the philosophy of science in which human experience in a real world is marked as a fundamental dimension for building the theories and the system of his philosophy. In this position logic is not limited to the that what is experienced by a person in a relation or in meeting is more than what is defined by the DNAcombination, or subject to physiological and biological facts. The psychological situation of a person on a certain day, his emotions e.g. his nervousness, or his character traits e.g. his arrogance, etc. are phenomena that cannot be defined as a 'substance' philosophically. These are, in Aristotle's philosophy, not the 'substance' but something which is 'accidental'. Those particles emerge spontaneously in the field of communication between [A] and [non-A]. They remain for a short time and vanish at the end of the communication. 35 Interaction, reflecting oneself against the existence of a partner, communicating and isolating can happen in this Field of 'Between'. Viewed purely from physics, this is the space-time of the full execution of physical interactions and the results can be developed in further space-time.

For interdisciplinary epistemology I would like to define this using the previous terminology, namely **??**intrasystem] In the previous sections, the Field of 'Between' was presented as an ontological and epistemological concept in the micro-world and the meso-world. I am of the opinion that this concept is also able to take part in the field of macro-cosmic space.

For example, we can consider the dynamics of the ocean, its low tide and high tide (flood): 36 The water level of an ocean rises if it is in the gravitational field of the moon, exactly, in the additional relation of the [centrifugal force of the rotation of the earth-moon system] (around their center of gravity) and the [gravitation of the moon], resulting in the high tide. That is, both the nearest regions and the furthermost regions to the moon on the earth have a high tide. On the intermediate regions between those two regions mentioned before of the earth, the gravitation of the moon and the centrifugal force of the revolution (rotation) almost cancel each other: The result is low tide, while the water of the ocean of the whole earth is pulled up in the high tide regions, during which the water of the ocean on the whole earth remains in the same quantity. Natural science calculates the proportional relations of the [gravitation of the moon] and the [centrifugal force] due to the rotation of the earth-moon system around their center of gravity, the proportion of the quantity of the high tide to that of the low tide.

Viewed from my natural philosophy, the phenomenon of this dynamic process emerges in the [Field of 'Between'], in the [time-space] between the [gravitation of the moon] and the [centrifugal force of the earth-moon system rotation] around their center of gravity.

Figure 1:

Figure 2:

Wien 1992.

Figure 3:

And where is the place of man as a thinking and acting person? I say that man has his/her [time-space] in the [Field of 'Between'], the [time-space between the moon and the earth]. [1] [2] [3]

[1]For example: see ibidem.3 For example: see ibidem.following sections the essential points of this principle are presented in a compact form.4

[2]Aristotle, Metaphysics, Books Z, H, ?. Leibniz, Monadologie, Stuttgart 1990.

[3]Yukawa, Hideki, "chigyoraku" (???, "To know the pleasure of the fish in the water -A Taoist message in a dialogue with a Positivist") in:The surprising Spirit (???), ed. by Tsurumi S., Tokyo 1990.26 Zhuangzi ??, chapter 17 (??, the water of autumn), Abs. 16. Ed. by Ogawa, T., Tokyo 1978, pp. 398 -399.

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