
The inherent unity between philosophy and science reflected in modern physics

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Abstract: Modern physics has a high dependence on scientific theories and instruments for the study of the universe and microscopic fields, which establishes a certain unified relationship between scientific theories, scientific instruments, observation results, and the interpretation and evaluation of observation results. This relationship leads to the research of modern physics being both scientific and philosophical, and at the same time, whether it originates from the philosophy of science or the science of philosophy. The century long debate between Einstein and Bohr, Einstein's ideal experiment and theory of relativity, the microscopic model of quantum mechanics, the conception of superstring theory, and the exploration of microscopic ultimate in modern physics reflect the general development trend of the philosophical and scientific nature of science presented in modern science.

Keywords: Modern; Physics; Scientification of philosophy; Philosophization of Science

1.The Inner Unity of Philosophy and Science Reflected in the Debate between Einstein and Bohr

The basic focus of modern human scientific research is still on the macro level, and its research on the micro and cosmic fields has only just touched upon their thresholds. On the basis of modern science, modern science has greatly extended the field of scientific research to the micro and cosmic levels.

There is a significant difference between the methods used in the field of cosmology and micro research and those used in the field of macro research. This is that macro research can only be achieved through people's natural senses and simple experimental observation instruments and equipment, while cosmology and micro research must rely on complex experimental observation instruments and equipment, even large facilities, to be possible.

Due to the mediation of complex experimental observation tools, such a scenario occurs: on the one hand, intermediary tools must rely on some scientific theory for interpretation and design, and on the other hand, there will inevitably be some uncontrollable interaction between intermediary tools and the detected objects. Through this interaction, intermediary tools transform and reconstruct object information that cannot be directly observed by humans into a form that can be directly observed by humans. In this way, any observation result obtained through intermediary tools not only depends on the properties of the intermediary tools, but also on the corresponding scientific theories and interpretation principles for the observation results. So, a certain unified relationship was established between scientific theory, scientific instruments, observation results, and the interpretation and evaluation of observation results. If any of these links change, the scientific concepts and theories established from them will be different. In fact, when a scientist or scientific group claims to have discovered something in the cosmological or microscopic field, they must also explain how they achieved this observation through the intermediary of observation instruments, the observation path and method used, and the scientific theoretical framework used. Without explaining all of this, others cannot repeat their work, nor can they determine whether their observation results are valid.

Due to the high dependence on scientific theories and instruments, some very interesting things have emerged in modern science: on the one hand, when observing the same object through scientific instruments with different properties, very different observation results are often obtained; on the other hand, the interpretation of the same result observed by the same scientific instrument from different scientific theoretical paradigms will also be different, even completely opposite.

2.The inherent unity of philosophy and science reflected in ideal experiments and relativity

Einstein's greatness lies not only in his creation of the theory of relativity, but also in his simultaneous creation of a new physical method to prove his theory - the ideal experimental method. Unlike the image that ordinary physicists give us, Einstein's theory was not obtained from the instruments, equipment, bottles, jars, and various reagents that ordinary physicists manipulate.

The ideal experiment in science is a method of proving certain scientific hypotheses that cannot be directly tested under existing experimental conditions by following existing scientific principles and relying on logical reasoning through thinking and imagination. This is precisely a scientific activity that achieves a certain scientific conclusion through rational philosophical reasoning. Whether from the premise and process of this activity, or from the results obtained from this activity, it embodies the inherent unity between the scientification of philosophy and the philosophization of science.

Einstein's special theory of relativity aims to prove the changes in time and space properties during the process of mass to energy conversion at high speeds, while Einstein's general theory of relativity aims to prove the changes in time and space properties in a gravitational field. The "speed of light train" and "cosmic elevator" he designed separately to prove these two changes are both a philosophical speculation, a scientific imagination, and a display of artistic aesthetics.