

The Overlapping Worlds of General Relativity and Quantum Theory: The Challenge of the Principle of Equivalence

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Abstract:

The paper deals with the history of quantum gravity from the perspective of conceptual clashes between general relativity and quantum physics. Considering how the two major theoretical frameworks of modern physics have transformed basic notions such as space, time, and matter, we ask which domains overlap, where borderline problems are created, and how incompatibilities arise between these frameworks. As an example we shall focus on the principle of equivalence and examine different attempts to apply this fundamental principle of general relativity within a quantum context. In line with our overall approach to compare the history of quantum gravity with the histories of general relativity and quantum theory, these attempts will be related to Einstein's own early use of the equivalence principle to create a new theory of gravitation. It has turned out that such a comparison may create a new perspective on how to formulate the Schrödinger equation in a generally relativistic context. Possible theoretical implications and observational consequences of this new approach, such as spectral line shifts in strong gravitational fields, will be briefly discussed as well.