

A Partial Elucidation of the Gauge Principle

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Abstract

The elucidation of the gauge principle "is the most pressing problem in current philosophy of physics" Michael Redhead in 2003. This paper argues for two points that contribute to this elucidation in the context of Yang-Mills theories. 1) Yang-Mills theories, including quantum electrodynamics, form a class. They should be interpreted together. To focus on electrodynamics is potentially misleading. 2) The essential role of gauge and BRST symmetries is to provide a local field theory that can be quantized and would be equivalent to the quantization of the non-local reduced theory. If this is correct, the gauge symmetry is significant, not so much because it implies ontological consequences, but because it allows us to quantize theories that we would not be able to quantize otherwise. Thus, in the context of Yang-Mills theories, it is essentially a pragmatic principle. This does not seem to be the case for the gauge symmetry in general relativity.

Keywords: gauge principle, gauge symmetry, Yang-Mills theory, BRST symmetry

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