Gauge Matters

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Abstract

The constrained Hamiltonian formalism is recommended as a means for getting a grip on the concepts of gauge and gauge transformation. This formalism makes it clear how the gauge concept is relevant to understanding Newtonian and classical relativistic theories as well as the theories of elementary particle physics; it provides an explication of the vague notions of "local" and "global" gauge transformations; it explains how and why a fibre bundle structure emerges for theories which do not wear their bundle structure on their sleeves; it illuminates the connections of the gauge concept to issues of determinism and what counts as a genuine "observable"; and it calls attention to problems which arise in attempting to quantize gauge theories. Some of the limitations and problematic aspects of the formalism are also discussed.

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