No place for particles in relativistic quantum theories?

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Abstract

Several recent arguments purport to show that there can be no relativistic, quantum-mechanical theory of localizable particles and, thus, that relativity and quantum mechanics can be reconciled only in the context of quantum field theory. We point out some loopholes in the existing arguments, and we provide two no-go theorems to close these loopholes. However, even with these loopholes closed, it does not yet follow that relativity plus quantum mechanics exclusively requires a field ontology, since relativistic quantum field theory itself might permit an ontology of localizable particles supervenient on the fundamental fields. Thus, we provide another no-go theorem to rule out this possibility. Finally, we allay potential worries about this conclusion by arguing that relativistic quantum field theory can nevertheless explain the possibility of "particle detections," as well as the pragmatic utility of "particle talk."

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