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Measurement in quantum field theory

Monday 15 April 2024 15:15 (45 minutes)

Presentations of quantum mechanics often include a postulate that the state of a system undergoes an instantaneous change following a measurement. This is clearly incompatible with special and general relativity and raises questions concerning the description of measurement in quantum field theory (QFT). Attempts to extend measurement postulates to QFT by hand have produced pathologies, such as the "impossible measurements" described long ago by Sorkin (although, arguably, a better name would have been "impossible state updates").

I will describe a framework for measurement in QFT that is causal, covariant and consistent, based on the idea of measuring one QFT by coupling it locally to another, and in which state update rules may be derived rather than posited.

Among other things, this framework resolves the problematic aspects of "impossible measurements/updates" within QFT.

I will also explain how the violation of Bell inequalities can be seen using these ideas.

The talk is mostly based on joint works with Rainer Verch, Henning Bostelmann, Maximilian Ruep and Ian Jubb.

See arXiv:2304.13356 for a short presentation, and Commun. Math. Phys. 378 (2020) 851-889 (https://link.springer.com/article/10.1007%2F020-03800-6) for the original paper.

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