UNIVERSITÄT
LEIPZIG

Physics Colloquium

Tuesday, December 9, 2025 at 16:30

Chris Fewster

University of York, United Kingdom

Quantum theory, relativity and measurement

Many presentations of quantum mechanics include a postulate that measurement causes an instantaneous change of state (or "collapse of the wavefunction"). On the other hand, special relativity rules out the idea of an instantaneous change at some moment of time, by the relativity of simultaneity. Anyone who has put these two thoughts together may have wondered how measurement can be described in a relativistic quantum theory such as quantum field theory (QFT). However, attempts to extend the measurement postulate to QFT have produced pathologies such as superluminal communication, which is also ruled out in relativity.

In this talk I will describe how these problems have been solved in the last few years using an operational approach, in which measurement of one quantum field (the system) is accomplished by coupling it to another (the probe). In this approach, the state update following measurement is derived from the theory rather than being imposed from the outset, and one obtains a perspective on measurement in QFT that is compatible with relativity and resolves some of the pathologies that have plagued previous descriptions.

- Measurement in Quantum Field Theory, CJ Fewster and R Verch, arXiv:2304.13356 <https://arxiv.org/abs/2304.13356> Encyclopedia of Mathematical Physics (2nd ed, 2025) vol 5, pp. 335-345 <https://www.sciencedirect.com/science/article/abs/pii/B9780323957038000768>
- CJ Fewster and R Verch, Quantum fields and local measurements, Commun. Math. Phys. 378 (2020) 851-889 <https://link.springer.com/article/10.1007%2Fs00220-020-03800-6> arXiv:1810.06512 <https://arxiv.org/abs/1810.06512>.

Venue: **small lecture hall.** Universität Leipzig, Faculty of Physics and Earth Sciences 04103, Linnéstraße 5.

Everyone is welcome to a reception with coffee, drinks and cookies in the Aula following the talk.

For an up-to-date semester program, sign-up for the physics colloquium mailing list, and subscription to the digital calendars in CalDAV format, head to the colloquiums web page https://www.physes.uni-leipzig.de/fakultaet/veranstaltungen