Prof. Dr. Tobias Hurth
Institut für Physik, THEP
hurth@uni-mainz.de

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

PRISMA+ Colloquium

Dec. 3, 2014 at 1 p.m.
Lorentz-Raum 05-127, Staudingerweg 7

Prof. Caslav Brukner
Wien

Quantum clocks and quantum causality

Quantum physics differs from classical physics in that no definite values can be attributed to observables independently of the measurement context. However, the notion of time and of causal order preserves such an objective status in the theory: all events are assumed to be ordered such that every event is either in the future, in the past or space-like separated from any other event. The possible interplay between quantum mechanics and general relativity may, however, require superseding such a paradigm. I will approach this problem in two steps. Firstly, I will consider a single "clock" – a time-evolving (internal) degree of freedom of a particle – to be in a superposition of regions of space–time with different ticking rates. While the "time as shown by the clock" is not well-defined, there is still the notion of global time. Secondly, I will consider that space-time itself is in a superposition, and show that this situation gives rise to quantum correlations for which one cannot say that one event is before or after the other. Finally, I will comment on possible implications of this result for quantum computation.

Contact:
Ellen Lugert
lugert@uni-mainz.de

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