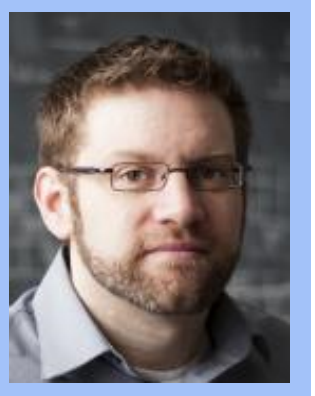
Quantum Measurement Theory

9. September 2013

Room: MA Hörsaal 2
Garching Campus, Zentrum Mathematik
TUM, Boltzmannstr. 3, 85748 Garching

13:45 Michael M. Wolf: Welcome and Opening



14:00 Robert W. Spekkens (Perimeter Institute, Canada)

Unscrambling the Omelette: Distinguishing Reality from Information in Quantum Theory

E.T. Jaynes famously remarked of the standard quantum formalism that "it is a peculiar mixture describing in part realities of Nature, in part incomplete human information about Nature - all scrambled up by Heisenberg and Bohr into an omelette that nobody has seen how to unscramble." This talk will review some recent efforts to unscramble Jaynes's omelette. The first effort is a bottom-up approach. It considers theories that are essentially classical but where there is a fundamental restriction on how much knowledge can be acquired about the physical state of any system. Such theories can reproduce a surprisingly large part of quantum theory. The second approach is top-down and argues that the formalism of quantum theory is naturally interpreted as a noncommutative generalization of the theory of Bayesian inference, with quantum states summarizing an agent's degrees of belief. After identifying all the aspects of the formalism that are about knowledge or inference, what remains can be safely identified as containing the physics. In particular, it will be argued that a unitary is a feature of reality, as is a subtle distinction between spatial relations and temporal relations in quantum theory.

15:00 Coffee break

15:30 Teiko Heinosaari (University of Turku, Finland)
QCCC speaker

Quantum Incompatibility

Two things are often called incompatible if they are not consistent with each other, for instance, a flat-head screwdriver is incompatible with a hex socket screw. In the context of a physical theory, two things, A and B, described by the theory are called incompatible if the theory does not allow for the existence of a third thing C that would have both A and B as its components. Incompatibility is a fascinating aspect of many physical theories, especially in the case of quantum theory. The concept of incompatibility gives a common ground for several famous impossibility statements within quantum theory, such as 'no-cloning' and 'no information without disturbance'; these can be all seen as statements about incompatibility of certain devices. This talk develops the incompatibility point of view in quantum theory, giving several examples on the nature of this concept. It will be argued that incompatibility should be seen as resource rather than a hindrance.

16:30 Coffee break

17:00 Paul Busch (University of York, United Kingdom)

Heisenberg Uncertainty for Joint Measurements

The Uncertainty Principle, conceived by W. Heisenberg in 1927, epitomises the fundamental philosophical implications of quantum mechanics and its radical departure from classical physics. For decades, there has been an air of vagueness and perhaps even mystique around its formulation and interpretation, which may have contributed to the media hype in 2012 when it was announced that the principle had been experimentally violated. In this lecture I survey precise formulations of Heisenberg's principle as a trade-off relation for measurement errors and disturbance due to measurement. Recent claims about experimental refutations of the principle are shown to be untenable and found to have arisen from the unwarranted extrapolation of classical physical intuitions about measurement inaccuracies and measures of disturbance.

This event is the opening day of the "Workshop on Incompatible Quantum Measurements" taking place on the dates of 10.-12. September 2013 (Room MA 03.12.011) supported by DFG and QCCC. For more information see the website.

Organizers:

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www-m5.ma.tum.de/Allgemeines/Workshop2013OpeningDay