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FOCUS

PROJECT

Information, Coherence, Entanglement

Einzelne physikalische Systeme des Ultrakleinen wie Atome, Photonen - also Quantenlichtteilchen - und Ionen gehorchen Naturgesetzen, die fundamental verschieden sind von denen, die wir von der durch die Alltagserfahrung geprägte makroskopische Welt kennen. Diese Welt wird bestimmt durch Gesetze der Quantenmechanik, einer fundamentalen physikalischen Theorie, die zu einer enormen Genauigkeit experimentell bestätigt ist. Diese Theorie macht prinzipiell nur statistische Vorhersagen, sagt aber in aller Regel nichts darüber aus, welches Messergebnis man konkret zu erwarten hat. Einzelne Quantensysteme wie einzelne Atome können auch in Zuständen sein, die kein klassisches Analogon kennen, und die zu stärkeren Korrelationen führen, als dies in der von uns anschaulich vorstellbaren klassischen Welt denkbar ist. Diese Verschiedenartigkeit dieser Theorie von all dem, was wir aus der Erfahrung kennen, hat seit ihrer rauschhaften Entwicklung in den späten 20er Jahren des letzten Jahrhunderts eine rege Debatte ausgelöst über den Status des absoluten Zufalls, der Nichtlokalität in der Theorie, und von Kausalität.

Lektüreempfehlung

Cramer, M., C. M. Dawson, J. Eisert, and T. J. Osborne. 2008. "Exact relaxation in a class of non-equilibrium quantum lattice systems." Physical Review Letters 100, 030602.
C. M. Dawson, J. Eisert, and T. J. Osborne. 2008. "Unifying simulation methods of quantum many-body systems." Phys. Rev. Lett. 100, 130501.

TUESDAY COLLOQUIUM, 29.06.2010

Quantum mechanics, Bell's theorem, and absolute randomness

Imagine you meet a friend on the street that you have not seen in a long while.

"What a random coincidence!", you might be tempted to cry out.

Yet, what appears like a random incident is, of course, rather a consequence of you not having kept contact with this person; you could have known that you would meet him or her at this very moment (e.g., had you only made a phone call some moments before). This "apparent randomness" is hence merely associated with a lack of information. Similarly - although it may be hard to predict outcomes in practice - the randomness that we encounter, say, when playing Roulette, is a kind of randomness where we are essentially only lacking information about the exact initial condition of a ball entering the Roulette wheel. In classical physics, indeed all apparent randomness is at the end of the day associated with some sort of lack of knowledge: the theory is deterministic after all.

In this talk, I will make the daring attempt to argue that the role of randomness in quantum mechanics - the fundamental physical theory of nature that we know today - is crucially different compared to what we are familiar with in our everyday experience. In particular, we will see that it cannot be reduced to mere ignorance about local hidden variables - in a sense its randomness is "absolute". One can even rule out the existence of such hidden variables while assuming them to be intrinsically unobservable - quite an interesting state of affairs.

In the last part of the talk we will see how quantum correlations of the type as being employed in the argument can be used in technological applications such as quantum cryptography, and how they are ironically eventually responsible for why in the world we physically experience quantum effects seem to play such a small role.

Eisert, Jens (Basingstroke,2012)

Probing the relaxation towards equilibrium in an isolated strongly correlated one-dimensional Bose gas

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1765646901

Eisert, Jens (College Park, Md.,2011)

Directly estimating nonclassicality

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725390841

Eisert, Jens (College Park, Md,2011)

Optimal unitary dilation for bosonic Gaussian channels

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725384655

Eisert, Jens (College Park, Md.,2011)

Experimental implementation of the optimal linear-optical controlled phase gate

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725383969

Eisert, Jens (College Park, Md.,2011)

Absence of thermalization in nonintegrable systems

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725383284

Eisert, Jens (College Park, Md.,2011)

Information propagation for interacting-particle systems

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=172538258X

Eisert, Jens (College Park, Md,2011)

Preparing the bound instance of quantum entanglement

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725381249

Eisert, Jens (Berlin, Heidelberg,2011)

Concentration of measure for quantum stateswith a fixed expectation value

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1725378884

Eisert, Jens (Melville, NY,2010)

Area laws for the entanglement entropy - a review

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=176562939X

Eisert, Jens ([Bad Honnef],2010)

Focus on quantum information and many-body theory

https://kxp.k10plus.de/DB=9.663/PPNSET?PPN=1726551393