AGPhil 1: Foundations of Quantum Mechanics

Time: Tuesday 14:00–15:30 Location: A 060

AGPhil 1.1 Tue 14:00 A 060

On Causal Explanations of Quantum Nonlocality — •Martin Schuele[1] and Ämin Baumeler[2] — [1]IHPST Paris, France — [2]Institute of Informatics, Università della Svizzera italiana, Switzerland

Quantum nonlocality is the phenomenon that entangled quantum systems can exhibit instantaneous correlations between space-like separated measurements that cannot be explained by local variables, i.e., need communication.

Because such "correlations cry out for explanations", as Bell put it, a prominent move to interpret nonlocality is by postulating a causal influence between the space-like separated parts of the entangled system, i.e., the correlations are due to a causal connection between the parts of the system. As this assumption seems to be at odds with the causal structure imposed by special relativity, various schemes needed to be proposed to mediate between the quantum-theoretical and experimental findings and special relativity.

We will criticize this approach to an explanation of nonlocality by first reporting on various findings in quantum information science that provide evidence against some superluminal causal influence and, secondly and more generally, by arguing that the counterfactual account of causation usually assumed in these treatments gives a wrong or at least ambiguous picture of causation in this case. Instead, we argue for an interventionist account of causation which says that there is no causal connection between the space-like separated parts of the quantum system showing nonlocality.

AGPhil 1.2 Tue 14:30 A 060

Vorstellungen zu merkwürdigen Ergebnissen der Physik — •Bernd Steffen — Bischofsgruener Weg 85, 12247 Berlin

Folgende Ergebnisse der Physik sind schwer mit unserem Vorstellungsvermögen in Einklang zu bringen: Nichtlokalität in der Quantenmechanik, Wellennatur von Teilchen, Imaginärer Anteil der Wellenfunktion, Verschränkung und 'spukhafte' Fernwirkung, Dunkle Materie, Dunkle Energie. Ausgehend von Ideen von Ghirardi, Rimini and Weber (1986)zu stochastischen Sprungprozessen im Hilbertraum und von Bell(1987, 1989) zu "flashes", beschrieben durch Punkte in der Raumzeit, werden Vorstellungen zu einer nichtlinearen Dynamik entwickelt. Dabei wird für Teilchen eine kurzlebige imaginäre Existenz mit imaginärer Masse und imaginärer Verzerrung des Raumes postuliert im Wechsel mit entprechender realer Existenz. Die Wechselwirkung der imaginären Anteile könnte sich als dunkle Energie äußern. Nichtlineare Prozesse können chaotisches und nichtchaotisches Verhalten zeigen. Herkömmliche Teilchenphysik würde sich in den nichtchaotischen Lösungsbereichen in der Nähe von Attraktoren befinden. Dunkle Materie würde in den chaotischen Lösungsbereichen angesiedelt sein. Eindeutige Teilchen der dunklen Materie wären danach nicht zu erwarten.

AGPhil 1.3 Tue 15:00 A 060

The Einstein field equation in terms of the Schrödinger equation — •Vasil Penchev — Bulgarian Academy of Sciences (Institute for the Study of Societies and Knowledge), Sofia, Bulgaria

The thesis is: The Einstein field equation (EFE) can be directly linked to the Schrödinger equation (SE) by meditation of the quantity of quantum information and its units: qubits.

Arguments:

1. The three of the EFE members are representable as Ricci tensors interpretable as the change of the volume of a ball in pseudo-Riemannian space in comparison to a ball in the three-dimensional Euclidean space (3D).

2. Any wave function in SE can be represented as a series of qubits, which are equivalent to balls in 3D, in which two points are chosen: the one within it, the other on its surface.

3. The member of EFE containing the cosmological constant corresponds to the partial time derivative of the wave function in SE. This involves the energetic equality of a bit and a qubit according to the quantum-information interpretation of SE. The zero cosmological constant corresponds to the time-independent SE.

4. The member of EFE, which is the gravitational energy-momentum tensor, corresponds to zero in SE as it expresses that energy-momentum, which is a result of the space-time deformation.

5. SE represents the case of zero space-time deformation, EFE adds corresponding members being due to the deformation itself.