TUT 3: Tutorial Quantum Foundations from a QI Perspective

Time: Sunday 17:00–18:30 Location: ZHG104

Tutorial TUT 3.1 Sun 17:00 ZHG104

Quantum foundations from a QI perspective — •Markus Frembs — Leibniz University, Hannover, Germany

Even 100 years after its inception, the foundations of quantum theory remain an active area of research. A plethora of competing interpretations offer different views on long-standing issues such as the infamous measurement problem, Einstein's 'spooky action at a distance' and Bohr's complementarity. At the core of these lies the discrepancy between the unparalleled predictive success of the mathematical apparatus of quantum mechanics and our every-day experience, which by and large obeys the laws of classical physics.

The first part of the tutorial will discuss two famous no-go-theorems in quantum foundations - by Bell, Kochen and Specker - which throw into sharp relief how this discrepancy between classical and quantum physics has drastic consequences for our physical understanding of the world: first, certain quantum correlations defy a causal classical explanation and, second, contextuality expresses the incompatibility with classical realism altogether. The experimental verification of entanglement which has recently been awarded the Nobel Prize in Physics leaves little room for adhering to a classical interpretation.

Rather than challenging such counterintuitive predictions, the field of quantum information theory embraces them as features, asking if and how they can be put to use in computational or information-processing tasks. The second part of the tutorial will list a number of examples to the resourcefulness of quantum theory e.g. in cryptography and computation.