Contribution ID: **52** Type: **not specified**

The Principle of Complete Positivity and the Open Systems View

Monday 27 March 2023 16:05 (35 minutes)

The principle that the dynamics of any open system should be derivable from the fundamental automorphic dynamics of a larger closed system represents what we will be calling, in this talk, the *closed systems view*. The closed systems view is deeply entrenched in physics. Standard quantum theory (ST) is no exception, and within it the closed systems view finds expression in the principle of *complete positivity*, a principle governing the dynamics of density operators that has accordingly taken on the status of a fundamental physical principle for many. Although ST is a highly successful theoretical framework that has been used fruitfully for the study of all sorts of systems, there are nevertheless reasons to motivate looking beyond it. In particular we will argue in this talk that the proper subject of foundational and philosophical study in quantum theory is what we will be calling the *general quantum theory of open systems* (GT), an alternative theoretical framework for quantum physics, formulated in accordance with what we call *the open systems view*, in which systems are fundamentally represented as being in interaction with their environments. In GT, physical systems are represented by density operators evolving non-unitarily in general. As we will argue, complete positivity need not be imposed as a fundamental physical principle in GT, and it is in this sense a more general dynamical framework than ST, even though it adds nothing to the Hilbert space formalism of quantum theory. That is, GT, unlike ST, straightforwardly allows us to model the non-unitary dynamics of systems in fundamental terms, and in particular allows us to model the dynamics of the universe as a whole *as if* it were initially a subsystem of an entangled system. We will argue that there are reasons, that stem from considering gravitational physics and cosmology, as well as from applications of ST itself, to motivate taking such dynamical possibilities seriously and for adopting GT as the preferred theoretical framework for quantum physics.

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Session Classification: Session