World Conference on Social Sciences

19 - 21 December 2025 Berlin , Germany

Information, Relationality, And Thermodynamic Time: Reconstructing Rovelli's Quantum Information Theory

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Abstract

In classical information theory (represented by Shannon's framework), the study of information transmission typically presupposes a fixed "channel" endowed with absolute attributes. This assumption implicitly holds that the properties of the channel are determinate and observer-independent, remaining unchanged regardless of perspective or the state of the channel itself. However, contemporary physics—particularly the development of quantum mechanics—fundamentally challenges the very notion of "absoluteness." As Carlo Rovelli has emphasized in one of his core arguments, quantum mechanics compels us to abandon the conception of states and properties as "absolute" and "observer-independent." The insistence on such absoluteness is precisely what underlies many of the paradoxes and interpretative difficulties that plague quantum theory. Rovelli extends this general philosophical critique of "absoluteness" consistently into the domain of information theory, thereby provoking a profound re-examination and critique of the classical presupposition of the "absolute channel." From this relational perspective, information should not be conceived as an abstract entity existing independently of physical relations, but rather as an observable measure of relative relations between systems. Accordingly, the reconstruction of classical information theory on the basis of relational ontology—namely, the reconstruction of information theory itself—is not only a demand of theoretical coherence but also a necessary step in responding to the challenge of quantum reality and in building a more universal theory of information.

Keywords: Information Theory, Relationality, Quantum Mechanics, Carlo Rovelli, Thermodynamic Time