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Quantum reference frames and relational subsystems

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One of the most basic notions in physics is the partitioning of a system into subsystems and the study of correlations among its parts. Operationally, subsystems are distinguished by physically accessible observables which are often implicitly specified relative to some external and/or background structure. In the absence of external relata as in Page-Wootters dynamics, gauge theories, and gravity, physical observables must be relationally specified relative to some internal dynamical degrees of freedom, ultimately quantum, that is a quantum reference frame (QRF). In this talk, I will discuss how different QRFs identify distinct external-frame-independent/gauge-invariant notions of subsystems. As a consequence, physical properties of subsystems such as entanglement, dynamics (open vs. closed), and thermodynamics are contingent on the choice of internal frame. In particular, such a relational definition of subsystems provides an alternative proposal for defining entanglement entropy in gauge theories.

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Keyword-2

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Keyword-3

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