

## Mathematical Physics

# The holistic structure of causal quantum theory, its implementation in the Einstein-Jordan conundrum and its violation in more recent particle theories

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Recent insights into the conceptual structure of localization in QFT ("modular localization") led to clarifications of old unsolved problems. The oldest one is the Einstein-Jordan conundrum which led Jordan in 1925 to the discovery of quantum field theory. This comparison of fluctuations in subsystems of heat bath systems (Einstein) with those resulting from the restriction of the QFT vacuum state to an open subvolume (Jordan) leads to a perfect analogy; the globally pure vacuum state becomes upon local restriction a strongly impure KMS state. This phenomenon of localization-caused thermal behavior as well as the vacuum-polarization clouds at the causal boundary of the localization region places localization in QFT into a sharp contrast with quantum mechanics and justifies the attribute "holistic". In fact it positions the E-J Gedankenexperiment into the same conceptual category as the cosmological constant problem and the Unruh Gedankenexperiment. The holistic structure of QFT resulting from "modular localization" also leads to a revision of the conceptual origin of the crucial crossing property which entered particle theory at the time of the bootstrap S-matrix approach but suffered from incorrect use in the S-matrix settings of the dual model and string theory. The new holistic point of view, which strengthens the autonomous aspect of QFT, also comes with new messages for gauge theory by exposing the clash between Hilbert space structure and localization and presenting alternative solutions including a new look at a problem of actual interest as the "Schwinger-Higgs screening".

Comments: 53 pages, expansion of conceptual content, in particular the Schwinger-Higgs charge screening and addition of references

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