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Implications of Einstein-Weyl Causality on Quantum Mechanics

DAVID BENDANIEL, Cornell University — A fundamental physical principle that has consequences for the topology of space-time is the principle of Einstein-Weyl causality. This also has quantum mechanical manifestations. Borchers and Sen have rigorously investigated the mathematical implications of Einstein-Weyl causality and shown the denumerable space-time Q^2 would be implied. They were left with important philosophical paradoxes regarding the nature of the physical real line E, e.g., whether E = R, the real line of mathematics. In order to remove these paradoxes an investigation into a constructible foundation is suggested. We have pursued such a program and find it indeed provides a dense, denumerable space-time and, moreover, an interesting connection with quantum mechanics. We first show that this constructible theory contains polynomial functions which are locally homeomorphic with a dense, denumerable metric space R^* and are inherently quantized. Eigenfunctions governing fields can then be effectively obtained by computational iteration. Postulating a Lagrangian for fields in a compactified space-time, we get a general description of which the Schrodinger equation is a special case. From these results we can then also show that this denumerable space-time is relational (in the sense that space is not infinitesimally small if and only if it contains a quantized field) and, since Q^2 is imbedded in R^{*2}, it directly fulfills the strict topological requirements for Einstein-Weyl causality. Therefore, the theory predicts that $E = R^*$.

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