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 Schrödinger 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 $R^*$, it directly fulfills the strict topological requirements for Einstein-Weyl causality. Therefore, the theory predicts that $E = R^*$.