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Partially Ordered Sets of Quantum Measurements and the Dirac Equation KEVIN H. KNUTH, SUNY Albany — Events can be ordered according to whether one event influences another. This results in a partially ordered set (poset) of events often referred to as a causal set. In this framework, an observer can be represented by a chain of events. Quantification of events and pairs of events, referred to as intervals, can be performed by projecting them onto an observer chain, or even a pair of observer chains, which in specific situations leads to a Minkowski metric replete with Lorentz transformations (Bahreyni & Knuth, 2011. APS B21.00007). In this work, we unify this picture with the Process Calculus, which coincides with the Feynman rules of quantum mechanics (Goyal, Knuth, Skilling, 2010, arXiv:0907.0909; Goyal & Knuth, Symmetry 2011, 3(2), 171), by considering quantum measurements to be events. This is performed by quantifying pairs of events, which represent transitions, with a pair of numbers, or a quantum amplitude. In the 1+1D case this results in the Feynman checkerboard model of the Dirac equation (Feynman & Hibbs, 1965). We further demonstrate that in the case of 3+1 dimensions, we recover Bialnycki-Birula's (1994, Phys. Rev. D, 49(12), 6920) body-centered cubic cellular automata model of the Dirac equation studied more recently by Earle (2011, arXiv:1102.1200v1).

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