

# From Quantum Cellular Automata to Quantum Field Theory

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This talk is based on Refs. [1,2,3]. We explore the idea that Quantum Field Theory could be grounded on a Quantum Cellular Automaton (QCA) model (i.e. a discrete unitary evolution of a lattice of quantum systems). In the  $1 + 1$ -dimensional case, we show that the translation, parity and time-reversal symmetries lead to QCA model which recovers 1D Dirac field equation in the large scale limit. The discreteness of this model implies a breakdown of Lorentz covariance, which is replaced by a doubly special relativity model with an invariant length. Finally we will discuss the phenomenology of the QCA model and extensions to the three dimensional and interacting cases.

#### *References*

- [1] A. Bisio, G. M. D'Ariano, A. Tosini *Quantum Field as a Quantum Cellular Automaton: the Dirac free evolution in one dimension* arXiv:1212.2839
- [2] A. Bisio, G. M. D'Ariano, A. Tosini *Dirac quantum cellular automaton in one dimension: Zitterbewegung and scattering from potential* Phys. Rev. A **88**, 032301 (2013)
- [3] A. Bibeau-Delisle, A. Bisio, G. M. D'Ariano, P. Perinotti, A. Tosini *Doubly-Special Relativity from Quantum Cellular Automata* arXiv:1310.6760

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