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Ergodic behaviors in 3 state cellular automata

Classical cellular automata represent a class of explicit discrete spacetime lattice models in which complex large-scale phenomena emerge from simple deterministic rules. We discuss a classification of three-state cellular automata (with a stable 'vacuum'state and 'particles'with ± charges). The classification is aided by the automata's different transformation proper- ties under discrete symmetries: charge conjugation, spatial parity and time reversal. We distinguish models based on observed types and levels of ergodic behavior as quantified by the following observables: the mean return time, the number of conserved quantities, and the scaling of correlation functions. In each of the physically distinct classes, we present examples and discuss some of their phenomenology. This includes chaotic or ergodic dynamics, phase-space fragmentation, Ruelle-Pollicott resonances, existence of quasi-local charges, and anomalous transport with a variety of dynamical exponents.

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