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Delocalized States and Topological Edge States of Quantum Walks in Random Environment HIDEAKI OBUSE, Karlsruhe Institute of Technology, Germany, NORIO KAWAKAMI, Kyoto University, Japan — The quantum walk (QWs) describe quantum mechanical time evolution of particles, which is identified as random walks when systems are brought to classical limit. QWs can be applied for efficient algorithms of quantum computation and have been realized in experiments. Remarkably, QWs realized by many experiments possess chiral symmetry. Thereby, QWs in a one dimensional (1D) space possibly have non-trivial topological phases and show edge states near boundaries of the system. In this work, we consider QWs interacting with spatial and temporal disorders and study how the edge states of QWs are influenced. Even by introducing the weak spatial disorder to the QWs, the edge states are robust. However, in the strong disorder limit, the energy gap vanishes and the edge states disappear. We found that critical states due to the Anderson transition in the 1D chiral class alternatively appear at energy $\omega = 0$ in this case. Significantly, these critical states also appear at $\omega = \pm\pi/2$ for any strength of static disorder, since the extra sublattice symmetry of the time-evolution operator U makes $\omega = \pm\pi/2$ singular. Consequently, for the QWs with relatively weak spatial disorder, the edge states, critical states, and Anderson localized sates are coexist.

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