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Discrete-time quantum walk with history dependence ZLATKO DIMCOVIC, YEVGENIY KOVCHEGOV, Oregon State University — We study a discrete time quantum walk (DTQW) with explicit correlation (or, memory/history dependence) over previous steps, implemented by a unique evolution operator. Monitoring the paths affects their interferences and we expect appearance of anomalies and classical features, while the process stays unitary. For 2-step-memory we obtain a closed-form generating function, with amplitude asymptotic. The trademark ballistic peaks of DTQW remain but a sharp central peak over a few sites appears. For deeper correlations we have so far obtained a full numerical solution for up to 20 memory-steps, evolved over $10,000$'s of time-steps. As memory increases, the amplitude first develops noisy peaks in the middle, and by around 10 step-deep memory the dominant central peak settles, while the runaway peaks typical of DTQW are all but gone. This central distribution is unlike the Gaussian curve of classical walks, the spreading is still ballistic (albeit slow), the shape stabilizes, and we observe universality. These (and some other) properties appear stable. This behavior starkly differs from previous known results. We use a multidimensional coin, but the precise operator form, explicitly encoding memory dependence in the evolution, comes from our (coinless) interchange framework.

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