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Feynman Checkers: Number theory methods in quantum theory

In the 40s R. Feynman invented a simple model of electron motion, which is now known as *Feynman's checkers*. This model is also known as the *one-dimensional quantum walk* or the *imaginary temperature Ising model*. In Feynman's checkers, a checker moves on a checkerboard by simple rules, and the result describes the quantum-mechanical behavior of an electron.

We solve mathematically a problem by R. Feynman from 1965, which was to prove that the model reproduces the usual quantum-mechanical free-particle kernel for large time, small average velocity, and small lattice step. We compute the small-lattice-step and the large-time limits, justifying heuristic derivations by J. Narlikar from 1972 and by A. Ambainis et al. from 2001. The main tools are the Fourier transform and the stationary phase method.

A more detailed description of the model can be found in Skopenkov M. & Ustinov A. Feynman checkers: towards algorithmic quantum theory. (2020)
<https://arxiv.org/abs/2007.12879>

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