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Referee's report on the Master's thesis

by

Filip Němec

Supervisor: Ing. Václav Potoček, Ph.D.

"Adiabatic transitions in discrete-time systems"

submitted to the Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague

The topic of the thesis by Filip Němec is the analysis of the dynamics of one-dimensional discrete-time quantum walks with localized point-defects. The problem of quantum walks has attracted considerable attention in recent years, both as a model for transport phenomena and as a tool in quantum information. The present dissertation elaborates on a question which has been formulated in the scientific literature, but only in a much simpler form. Therefore, the topic is timely and interesting for the research community.

The thesis contains a concise introduction to the topics of quantum walk and adiabacity and their relation. Although this introduction is only 10 pages long, it contains many interesting aspects of these topics with proper references to the relevant papers and books, I enjoyed reading this summary. The main part of the thesis presents both analytical and numerical results. The presented method for the solution of the single-defect problem is based on separating the problem to three parts, which yields analytic results as well as provides insight for further generalizations. Then the case of a finite lattice is analysed in some detail. In the last part of the thesis numerical results are presented for adiabatically switched pont-defects. The presented results are interesting and new and could be further developed to treat multiple coin-defects. I found especially valuable that the applicant could provide a straightforward solution to the problem of phase-altered coins, stated by Wójcik et al and presented a general solution to the example of a pont-defect by Endo and Konno.

The thesis is clearly written in a good scientific style. There are some typing errors, which I do not list here, however I note that these do not affect the readability of the text.

I have two remarks/questions about possible generalizations (out of curiosity, these do not concern my positive opinion about the thesis):

1., The adiabatic change could be continued to go back again to the original system, possibly on a different path, thereby forming a "loop". I would assume that the methods developed in the thesis could also be applied to such a case. Is it possible that after a loop the system returns to some different state (it may collect a geometric phase)?

2., The methods applied here rely on treating the point-defect as a kind of boundary point dividing the line to different regions. What about a 2 dimensional integer lattice? Is there some way to use similar methods to the 2D problem?

In summary, I find the thesis a valuable contribution to the topic of quantum walks. I suggest the grade **A(excellent)**, independent of the answers to the above questions.

Tamás Kiss