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Report on the Doctoral Thesis by Mgr. Martin Fraas

The doctoral thesis by Martin Fraas collects results of his recent work on various aspects of quantum dynamics of confined, quasi-confined and periodic systems.
The main mathematical tool he makes use of is the theory of singular interactions in Quantum Mechanics. To this subject is devoted the second chapter of the dissertation. It is a well-written, incisive and concise introduction to the field, getting together all the necessary information in a small number of pages. Few forgivable misprints are present in this part of the text.
The last four chapters are meant to give a summary of the results obtained by the candidate in his recent research work and published in a series of papers he attaches to the essay as appendices. Again the presentation is remarkably clear, written in a very effective style and has the quality to avoid all unnecessary details.
In his research activity Martin Fraas analysed models of quantum systems with one or many delta shells. In four papers he examined different quantum dynamical features such as:

- different behaviour of resonant states for different kind of spherical barriers,
- irregular character of the asymptotic evolution of initial states not in the domain of the Hamiltonian,
- spectral structure of point and absolutely continuous spectra for infinitely many, radially periodic, delta shells.

Investigation of problems like the ones mentioned above requires subtle and diversified mathematical techniques that Martin Fraas seems to control and cope with in a professional way.
The remaining two papers he presents are related respectively to an isoperimetric inequality and to helical quantum waveguides.
The latter one is a very technical account about the appearance, in a helical quantum waveguide, of bound states induced by local perturbations of the section radius or of the radius of the helix. Results are obtained through the clever use of variational techniques.
In the former one the authors are able to determine the critical value p for which the L^p-mean of the length of a curve of fixed arc-length ceases to be maximised by a circle. It is a very nice and accurate result. It may have applications in several fields of mathematical modelling of physical systems including leaky quantum graphs.

In the papers he is co-author of, Martin Fraas shows a mature attitude in the use of sophisticated mathematical reasoning. He seems to possess all the requisites for high standard scientific achievements. For these reasons I recommend that he is given the PhD degree.

Prof. Rodolfo Figari