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REPORT ON THE HABILITATION THESIS OF DR. PAVEL STRANSKY

Summary

Dr. Pavel Stransky has presented his Habilitation Thesis with the title "Critical phenomena and chaos in collective many-body systems", summarizing almost twenty years of his research in this topic. The first part of the thesis includes research on an extension of the concept of Quantum Phase Transition (QPT) to excited states, the Excited State Quantum Phase Transitons (ESQPTs) in which the author is one of the leading experts at international level. Quantum chaos and the extension of quantum mechanics to non-Hermitian models are other topics dscussed in the thesis in which the author has made important contributions. The second part of the thesis consist on 13 appendices with the most relevant publications by the author as he has considered most convinient.

Evaluation

First of all, I would like to evaluate the formal aspects of the presented work. The thesis is very well written. A good effort has been made to present a summary of the most important developments in the field of ESQPTs and other different aspects of quantum chaos in many-body systems and non-Hermitian quantum mechanics. The text should be useful for any physicists trying to get into the field or trying to understand the most important aspects to apply the findings to their own work. The division in chapters is very appropiate as is the selection of works in the appendix which have made easier my assesment of the importance of the summarized works.

Second, I would like to evaluate the contect of the habilitation thesis. After a brief introduction, the second chapter goes into details of the main topic of the thesis, the ESQPTs. After an explanation of the general physics behind this phenomena, the thesis goes into detail on some particular models exhibiting ESQPTs of different order. The models have been chosen very appropiately from the works of the author so the most interesting behaviors associated with ESQPTs are exemplified. The dynamic and thermodynamic consequences of the presence of ESQPTs in a particular system are very well summarized in the last sections of the chapter. The

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third chapter is about chaos. The author has worked mainly on quantum chaos. However, it is not possible to study quantum chaos without first understanding classical chaos. The most important concepts from classical chaos that are then needed for applying to quantum chaos are explained beautifully in the first section of this chapter. One of the main topics of the work of Dr. Stransky in quantum chaos has been precisely to analyze the consequences of signatures of classical chaos in the quantum realm. Many collective models that are at the core of his research have classical analogs even if they describe many-body systems. The last section analyzes briefly the connection between quantum chaos and ESQPTs. This is a rare example of science in action, where apparently well based conjectures have been disproved by counterexamples. I believe there are still many open questions in this field that will be explored in Dr. Stransky's work in the next few years. The fourth chapter explores non-Hermitian extensions of quantum mechanics and their usefulness for some particular applications based on his work. This is a extremely interesting field, that I am sure will become more and more relevant in the following years. Last, in the fifth chapter he gives a summary but more importantly an outlook of his research with open questions and the directions to pursue. I believe this outlook, although brief, expresses a profound knowledge of the field and of the interesting questions that need answer in the following years.

Third, I would like to comment the author publishing activity. The publishing record of Dr. Stransky is excellent with 55 publications between 2004 and 2023. Most of his works has been published in very prestigious international journal as shown by their high impact factors. I would like to highlight the publication of four articles in Physical Review Letters, each of those has become a seminal paper in the field. Also, Dr. Pavel Stransky has published three review papers on ESQPTs, one very recent in Journal of Physics A and two in Annals of Physics, which have become the standard reviews in the field. It is also important to emphasize that his most cited papers are very recent. For example, the most cited one with 170 citations in Google Scholar is the Physical Review Letter from 2019. This is a clear indication that Dr. Stransky is in the peak of his career.

As part of the evaluation I have checked the originaly of the work using the Turnitin system. I was given a Turnitin assesment by the administration of the Charles University. But also, I have used myself the Turnitip software iThentificate, to which my organization (the CSIC) is subscribed and to which I have personal access. The similarity found is perfectly normal for a review work like a habilitation thesis and I found no evidence of plagiarism or any other academic malpractice.

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Recommendation

After reading the habilitation thesis, I am very impressed by the work of Dr. Pavel Stransky. He has made a very good job in explaining the importance and interest of his research. He has become one of the leading theoretitians in the field of ESQPTs and quantum chaos in many-body systems, a field that is increasing its importance as more experimental results are becoming available.

With this considerations in mind, I have no doubt that the thesis meets the standard requierements for a habilitation thesis. I, thus, recommend to continue the work for further progress in the habilitation procedure.

Madrid, April 2nd 2024.

Signature: Dr. Rafael A. Molina

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