University of Glasgow | School of Physics & Astronomy

Athena SWAN Silver Award

Prof. Ing. Igor Jex
c/o Mrs Monika Zabranska
CVUT-FJFI
Brehova 7
115 19 Prague 1
Czech Republic

Dear Prof. Jex,

Ing. Jiří Maryška

Thank you for sending me the thesis prepared by Ing. Jiří Maryška. Let me say at the outset that it contains work of quality and depth, although I cannot say that it was an easy read. It represents a detailed and very careful study of the long-time behaviour of quantum Markov processes that are ubiquitous in the study of open quantum systems. As such, it represents the most complete and up to date study that I am aware of, and Maryška is to be complemented on completing such a challenging and useful task.

The approach, throughout the thesis, is to rely on what can be proven rigourously by the application of diverse mathematical methods, some of which were new to me. The principal contributions are the forms allowed for the final states, given the presence of conserved quantities and diverse other information. The result is, I think, rather general and appealing. Maryška goes on to make connections with Jaynes' principle and the idea that steady states should, in some way, resemble those derived in thermodynamics (the Gibbs states). Finally, these ideas are applied to a practical model system associated with energy transfer, something of a hot topic at present. Overall, the whole represents a nice account of an interesting, challenging and advanced programme of research.

You will have realized form the above that I was impressed by the scope and quality of Maryška's thesis and the results contained within it. There is much to admire here and, I think, also for you and the relevant research community to build upon. I thoroughly recommend that it be presented for the formal defence.

For the defence, there are a few points and questions that the examining team might wish to explore with the candidate, and I list these here in case you find them useful.

1. The central theme of the thesis is quantum Markov processes, but these arise, especially for open systems, as an approximation, often in conjunction with a weak-coupling assumption. I wonder if these approximations have any specific effect on the steady state. There is, after all, a long time (in principle infinitely long) for minor effects, such as those due to non-Markovian behaviour, to accumulate.
2. The Markov approximation is made regularly in a number of settings; it is commonly applied to model environmental effects in quantum optics and also in solid-state physics. I wonder if Maryška is familiar with any of these and could, for example, derive a master equation of Lindblad form from a model Hamiltonian describing the damped system and the environment.
3. I would be interested to know if there are any current existing experiments in which the effects described by Maryška appear. If so then it might be worth exploring these. If not, then I would be inclined to ask where the first application of his results might occur.

Finally, there are two minor points that might be considered for the thesis itself.

1. Maryška makes frequent use of a considerable number of acronyms, QMP, QMDS, EET etc. This is not a problem as such, but as a reader who could not take in the whole thesis in one sitting, I found it slightly irritating to have to search back through the thesis for the meanings of these. May I suggest that a list of these acronyms is inserted into the thesis at a suitable point for ready reference?
2. There are minor but regular slips in the English, which is entirely understandable for a non-native speaker, but a careful proof reading of the final thesis may remove these. I should state clearly, however, that nowhere did these impact the writer's meaning, and the text could also be left in its current form.

I hope that this brief report has provided the information you require, but please do let me know if there is anything additional that you require. I am sending this report as an email attachment, but please do let me know if you need, also, a hard copy and if so I will send one in the post.

Yours sincerely

Prof. S. M. Barnett

Professor Stephen M. Barnett FRS FRSE
Royal Society Research Professor and
Cargill Chair of Natural Philosophy
School of Physics & Astronomy

Kelvin Building, University of Glasgow, University Avenue, Glasgow, G12 8QQ. Direct Line +44 (0)141 330 1879
Email: stephen.barnett@glasgow.ac.uk
The University of Glasgow, charity number SC004401