Scientific Report

7th Working Group meeting of COST Action MP1209, "Mathematical foundations of quantum thermodynamics "

Smolenice, Slovakia 6th to 9th December, 2016

Scientific mission of the meeting

The aim of this Working Group meeting was to critically discuss the current status of the mathematical background of quantum thermodynamics, identify open problems and formulate future challenges and perspectives of this important field.

Organising Committee

The local organizing committee comprised Marcus Huber, Daniel Reitzner, Tomáš Rybár, Martina Zemanová and Mário Ziman.

Assistance and advice was also given by Dr Janet Anders (University of Exeter and Chair of the COST Action MP1209) and Dr Sandra Howsley (COST MP1209 administrator).

The meeting website can be found at:
http://quantum.physics.sk/conf/mathermo2016/index.php?page=home

Location and Structure

The meeting was held at the Congress center of Slovak Academy of Sciences withing Smolenice castle. Each year numerous international meeting organised by Scientific Institutions take place there. All the participants of the meeting were accommodated at the center.

The plenary and contributed lectures took place every morning and after lunch with the afternoon reserved for free discussions. After an announcement of topics, the participants dispersed and using various flipcharts and boards started discussing the topics of the morning session and started new collaborations. Since participants had difference backgrounds (from mathematical quantum information theory to classical statistical physics), these discussions were also used to bridge gaps and develop a common understanding of some of the basic and controversial topics in thermodynamics (such as the definition of work).

We hosted 33 paticipants in total, from 8 different European countries. There were

5 invited speakers, 2 were by female presenters and 4 were ESRs (40% and 80% respectively). In addition, 13 contributed talks were also presented of which 8% were by female researchers and 92% were by ESR's. There was also a selection of posters presented. The full program is shown in Appendix 1 below and the book of abstracts can be found at:
http://quantum.physics.sk/conf/mathermo2016/docs/boa_mathermo2016.pdf

Scientific Summary

The meeting thoroughly explored the mathematical foundation of quantum thermodynamics from different angles. Many talks were focussed on approaching thermodynamics from different background: from Lidia del Rio explaining resource theories of knowledge and how they are a good framework to frame thermodynamics to Stefan Wolf presenting an interesting take on the second law of thermodynamics from an algorithmic complexity point of view. The meeting also accommodated unconventional and interdisciplinary approaches. Of course many discussions were also focussed on classical topics of quantum thermodynamics: more precise transformation laws, fluctuations, the design of quantum machines and the definition of work have been recurrent topics.

Appendix 1

WORKSHOP PROGRAM
TUESDAY 06/12/2016
14:30 - 17:00 conference bus (from Vienna Airport)
17:00 - 18:00 refreshment, registration and accommodation
18:00 - 18:45 **Christian Gogolin:** Pure state quantum statistical mechanics
18:45 - 19:10 **M. Hamed Mohammady:** Quantum refrigeration using many body systems
19:15 - 20:00 welcome dinner

WEDNESDAY 07/12/2016
08:00 - 09:00 breakfast
09:00 - 09:45 **David Reeb:** Fundamental energy cost for quantum measurement
09:45 - 10:10 **Fabio Anza:** Observable thermalisation
10:10 - 10:35 **Senaida Hernández Santana:** Decay of correlations in long-range interacting systems at non-zero temperature
10:35 - 11:00 break and refreshemnt
11:00 - 11:45 **Yelena Guryanova:** Thermodynamics of multiple conserved quantities
11:45 - 12:10 **Nicolai Friis:** Passivity and practical work extraction using Gaussian operations
12:10 - 12:35 **Rodrigo Gallego:** Thermodynamics with local control
12:45 - 13:30 lunch
14:00 - 14:45 **Lidia del Rio:** Currencies and agents in resource theories
14:45 - 15:10 **Raam Uzdin:** Generalized Clausius inequalities

15:30 - 16:00 break and refreshment
16:00 - 18:30 focused group
19:00 - 21:00 working dinner

THURSDAY 08/12/2016
08:00 - 09:00 breakfast
09:20 - 09:45 **Jonatan Bohr Brask:** Multiple environments and the quantum master equation
09:45 - 10:05 **Mark Mitchison:** Non-equilibrium steady states of autonomous thermal machines
10:10 - 10:35 **Ralph Silva:** Autonomous quantum machines and finite sized clocks
10:35 - 11:00 break and refreshemnt
11:00 - 11:45 **Stefan Wolf & Veronika Baumann:** From Quantum to Classical
11:45 - 12:10 **Paul Erker:** Autonomous quantum clocks: Does thermodynamics limit our ability to measure time?
12:10 - 12:35 **Harry Miller:** Time-reversal symmetric work distributions for closed quantum dynamics in the histories framework
12:45 - 13:30 lunch
14:00 - 16:00 focused group
16:00 - 16:30 break and refreshment
16:30 - 18:30 group reports and discussions
19:00 - 21:00 conference dinner

FRIDAY 09/12/2016
08:00 - 09:00 breakfast
09:30 - 09:55 **Philipp Kammerlander:** An operational formulation of thermodynamics makes the zeroth law obsolete
09:55 - 10:20 **Henrik Wilming:** Low-temperature cooling with finite non-equilibrium resources
10:20 - 11:00 refreshment
11:00 - 13:30 conference bus (ends at Vienna Airport)

Key

Invited speakers

Contributed Speakers