Preface

Physical informatics is the field where the laws of physics are utilized to make new schemes for logic, computing, and communication systems or to analyze the fundamental limits of their performance. In spite of years of development (and much hype in the media), there remains a great deal of controversy surrounding many of the developments, and this has clouded the interpretation of the relevant physics in numerous discussions.

The international workshop on Hot Topics in Physical Informatics (HoTPI-2013) was held on 10-13 November 2013 at the Hunan University, Changsha, China. A small number of researchers came together to present new and ongoing work and to discuss future directions for physical secure communications, the impossibility of reversible computing, the Brillouin's negentropy principle and validity/non-validity of Landauer's erasure theorem, and the non-feasibility/feasibility of quantum computing.

Conference attendees enjoyed three debate sessions (available on youtube, too) from distinguished scholars. At these discussions, a "Pro" and a "Con" team presented their points and then publicly debated the other panel's arguments with the active participation of a Moderator and that of the Audience.

(i) *Debate session about the security of quantum key distribution.*

Questions debated:

- Can a perfectly secure key be generated in QKD and under what security measure?
- Can practical implementations of QKD ever be made as secure as predicted by the security proofs?

Moderator: Giacomo Mauro D'Ariano

Pro Team: Eleni Diamanti and Renato Renner

Con Team: Vadim Makarov and Horace Yuen

(ii) *Debate session about the possibility of reversible computing and the validity of Landauer's principle (including Maxwell demons and Szilard engines).*

Questions debated:

- Are reversible computers possible or they do violate thermodynamics?
- Are non-reversible (dissipative) Brownian computers possible and, if yes, do they dissipate more heat than regular computers?
- Does (non-secure) erasure of memories dissipate more heat, or the writing of the same amount of information?

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- Is Landauer's principle valid; or the same is true for writing the information; or it is simply invalid?

Moderator: Dave Ferry/Alexander Kirk

Pro Team: Neal Anderson and Renato Renner

Pro-only-irreversible-but-dissipative-Brownian computers: Ferdinand Peper, Rest: Con

Con Team: Robert Alicki, Laszlo B. Kish, and Wolfgang Porod

(iii) *Debate session about the future of quantum computing.*

Questions to be debated:

- Will general-purpose quantum computing be feasible?
- If special-purpose quantum computing (new computer for each task) will be used, what purpose and what limitations (accuracy, dissipation, etc)?
- Team-independent question: Is D-Wave's computer an analog computer with quantum devices and classical bits, a quantum computer with qubits, or something else?

Moderator: Wolfgang Porod

Pro Team: Derek Abbott, Phil Hemme, Dave Ferry/Alexander Kirk - partial-Pro

Con Team: Michel Dyakonov and Laszlo Kish

We hope that the first workshop of the HoTPI initiative is not the last one and it has inspired important discussions among the researchers and it was an enjoyable and memorable event for all the attendees.

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