

QUANT-411

Aspects of quantum science and sustainability

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Cursus	Sem.	Type
Quantum Science and Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	2 weekly
Lecture	1 weekly
Project	1 weekly

Number of positions

It is not allowed to withdraw from this subject after the registration deadline.

Summary

We explore the intersection of quantum technologies and sustainability. Topics: 1) discussions of fundamental aspects of thermodynamics of computation; 2) analysis and benchmarks of energy consumption in current and near term real quantum devices; 3) projects on use cases through personal student work.

Content

- *Introduction.* Presentation the GESDA and open quantum institute initiative on UN Sustainable Goal Developments. Examples of use cases.
- *Fundamental concepts in thermodynamics of computing* (energy, power, entropy, information, heat dissipation, Landauer's principle, irreversible and reversible computation, memory tradeoffs).
- *Power consumption and efficiency issues* (classical to quantum stack, comparisons for NISQ devices, classical supercomputers, potential fault tolerant devices)
- *Student projects* (potential future applications of quantum science with a focus on sustainability challenges)

Learning Prerequisites**Recommended courses**

QUANT 400

Important concepts to start the course

An introduction to quantum science and technology

Learning Outcomes

By the end of the course, the student must be able to:

Transversal skills

- Write a literature review which assesses the state of the art.
- Summarize an article or a technical report.

- Make an oral presentation.
- Access and evaluate appropriate sources of information.
- Take feedback (critique) and respond in an appropriate manner.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Take responsibility for environmental impacts of her/ his actions and decisions.
- Communicate effectively, being understood, including across different languages and cultures.

Teaching methods

Mix of Ex-cathedra and Flipped classroom, Guest lectures, Class discussions

Expected student activities

Work on projects, physical presence and participation in class is key, student presentations and discussion

Assessment methods

Project based during the semester

Supervision

Office hours	No
Assistants	Yes
Forum	Yes
Others	course web site