

Title: Quantum Ethics Project Workshop

Speakers: Anna Knäuper

Collection: Quantum and AI Career Trajectories Mini-Course: Computational Methods and their Applications

Date: May 08, 2023 - 2:00 PM

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Today's tour

Some practical teaching exercises.

Overview of ethical considerations in quantum education.

Some big picture thoughts on ethics in QIS.

And... have fun!

Teaching quantum in an atmosphere of hype.

3 main findings:

Hype & student motivation: “student interest in their QIS courses is **motivated** in large part by popular media”

Hype, prior knowledge and myth-busting: “We heard consistently from instructors that though media attention gets students in the door, instructors observe that hype can also cause **distorted preconceptions** about quantum technology”

Hype affects content coverage: “Are beautiful algorithms with no practical purpose worth spending class time on, or is it better to skip these topics completely, to focus on the fundamental quantum mechanics? Or even, are algorithms with little practical use actually pedagogically necessary to cover so that students can read quantum computing literature with an appropriate level of skepticism? These questions are worth pondering because they highlight the fundamental **trade-offs** that come with teaching hyped topics: what comes first, the technology or the physics?”

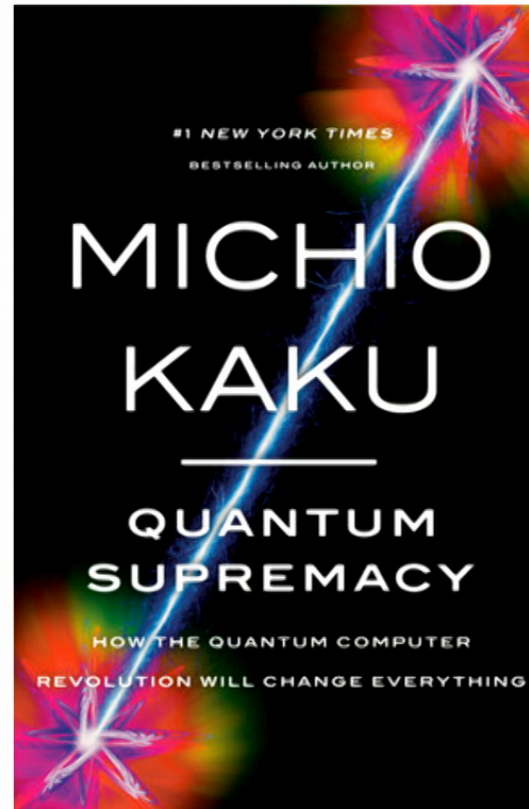
Meyer et al (2023): “How media hype affects our physics teaching: A case study on quantum computing”

Teaching quantum in an atmosphere of hype.

“The least we can do is familiarize ourselves with the recent mainstream and popular science media coverage and critically question whether the coverage is truly grounded”

Meyer et al (2023): “How media hype affects our physics teaching: A case study on quantum computing”

Hot off the press...



A few more reactions

Source: Peter Woit's blog, "Quantum Supremacy" post

Not Even Wrong

[Peter Woit](#) says:

May 4, 2023 at 11:38 am

LMML,

The danger to the field of quantum computing is from people like Michio Kaku, getting huge audiences for absurd claims at Joe Rogan. There's already a lot of discussion of a possible coming "quantum winter", with the hype hitting the wall of the reality of slow progress.

Things like the article in New Scientist about Maldacena's proposal for creating black holes don't get a lot of wider public attention. The danger of this is not to quantum computing but to fundamental theoretical physics. There's a lot of money and attention out there for anyone who claims to have an idea for how to do quantum gravity using machine learning, quantum computers, quantum information theory, etc. If prominent theorists change their research programs to chase that money and attention, it could move a field already in trouble because of string theory/susy into a complete intellectual collapse dominated by pursuit of nonsense.

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No Math, Random Reader says:

May 5, 2023 at 10:24 am

Honest question about the things Michio Kaku said (maybe dumb question... but still, honest): how much like Joe Rogan's podcast? I wouldn't be of people having casual conversation level talks. My point is: isn't this, by the way, the way theories will eventually get to the level of "aliens"? The kind of thing that just works as entertainment. There is a lot of people who knows nothing about math or physics already have lots of things to read just in edutainment like SciShow, PBS Space Time, etc. People know there is something about string theory, even if they can't understand it. I mean... people are watching Sabine

Random Non-Physicist says:

May 6, 2023 at 5:22 pm

"And, maybe it will have a positive effect, getting young people and the public interested in this kind of science, going on to read better books."

Let me say, as someone who was once on a track to become a physicist partly due to the influence of popular science, that one problem with Kaku-style hype is it gives people an unrealistic idea of what science is about and what it can do. He paints a picture of a magical, science-fictional world where the human intellect and its technology have god-like powers, avoiding the messy details and limiting realities. They're alluring stories for the uninitiated, but when you start to look under the hood, understand the science in more detail and see that it's not really like Kaku says, it's easy to become disillusioned, to realize that you've been taken in by propaganda, and to lose interest in the field. That's kinda what happened to me anyway.

Unfortunately, in America we tend to reward the hucksters, the entertainers, the PR people and the imaginers of fantasy worlds much more than those who deal in less glamorous reality. A capitalist entertainment-centric society has little incentive to reign in the Michio Kaku's of the world, and every incentive to promote them. Science should be the complete opposite of this ethos, but it has clearly been corrupted by the larger society.

Source: Peter Woit's blog, "Quantum Supremacy" post

Not Even Wrong

Pick a question

- What media coverage are my students likely to have been exposed to coming into my course? How scientifically accurate are the media portrayals of this technology?
- What preconceptions might students bring into the course as a result of media coverage? How might these ideas affect student engagement and learning?
- Where is the technology right now in the hype cycle?
- What is my goal in bringing the topic into the classroom? Is it to engage with the technology directly or to generate excitement about and appreciation for the underlying physics?
- How can I leverage discussions of hyped technologies to help students become scientifically-literate citizens? Can I use these discussions to build skills such as critical thinking, ethical reasoning, or science communication?

Meyer et al (2023): "How media hype affects our physics teaching: A case study on quantum computing"

Pick a scenario (or create your own!)

Scenario A: You will be mentoring high school students in an online 1-year quantum computing course.

Scenario B: You have 2 weeks to teach your high school class a few nuggets of modern physics (quantum + special relativity)

Scenario C: You are TA-ing an undergrad QM/QC course for one semester.

Zooming out

Four key ethical issues in QIS education & quantum technology:

Cybersecurity: “How can we prepare society for a post-quantum internet, protecting individuals and businesses from quantum-enabled surveillance and cybercrime?” (p. 4)

Rhetoric and media coverage of quantum technologies: “How can scientists communicate an accurate picture of quantum technology grounded in science rather than speculation? Might there be ways to leverage media hype to promote scientific literacy or build public support for scientific research?”

Equity and inclusion in quantum workforce development: “As with any technological revolution, there are questions of how to ensure that the benefits of quantum technology do not just accrue to the largest corporations and wealthiest nations. How can we ensure that wealth, jobs, and educational opportunities generated by the quantum industry are equitably distributed? And what will happen to these jobs should commercial applications of quantum technology prove unfeasible?”

Military applications: “Do QIS practitioners have the responsibility to advocate for quantum technology to be used for peaceful purposes, and to consider the ethical implications of military funding on their research?”

Meyer et al (2022): “Ethics education in the quantum information science classroom: Exploring attitudes, barriers, and opportunities”

Narratives against democratization of QT

"In the current QT ecosystem, we observe **three major obstacles** for opening up QT to a wider public engagement process [...]. These are the narratives of

- (i) QT as an arena for geopolitics,
- (ii) quantum mechanics as incomprehensible,
- (iii) quantum computing as a threat to the cyber-infrastructure.

Seskir et al (2022): "Democratization of Quantum Technologies"

One main narrative against democratization of QT

Quantum arms race, mainly between the US and China.

Emphasis in national strategies and flagship programs on **national security & technological sovereignty**.

"These points enable national actors to **prioritize certain militarized visions of QT** against others, even **before they are brought forth to the public arena for discussion**, and this poses a major obstacle in democratization of QT in four different respects"

- 1) Diversion of research funds to organizations with security priorities rather than scientific ones
- 2) Exclusion of students and researchers from certain backgrounds & restriction to collaboration with 'like-minded governments'
- 3) Repulsion of researchers with a focus on social justice
- 4) Reduction in awareness-raising and outreach activities

Seskir et al (2022): "Democratization of Quantum Technologies"

Imagining the quantum future

"A different argument in the literature *without explicitly invoking the terms democracy or democratization* is found via the term 'public good' [...] They argue for it to be **determined through processes of reasoning and engagement between science and society** [...] Premature lock-in to certain visions via national narratives limit wider public consultation and engagement, hence limiting the impact of **social forces** on **shaping the trajectory of QT**. [...] For a responsible development of QT, increasing public awareness is the absolute minimum that needs to happen. These points in the literature signal that there needs to be further discussion on public engagement and democratization of QT, even if in the end society just endorses the prematurely locked-in visions by national strategies. This approach is more in alignment with *participatory democracy* [...] where the whole of society [...] would be included in the process of guiding the development trajectory of QT" (p. 12)

Seskir et al (2022): "Democratization of Quantum Technologies"

Quantum for public good?

“Much like other technological innovations, the ability of quantum technologies to generate public benefit is likely to be shaped by **design choices made early on**. For this reason, the **best time to influence these societal impacts** is during the creation of quantum research agendas and design of technologies, before these unfold in ways that cannot be easily reversed” (p. 3)

Roberson et al (2021): Talking about public good for the second quantum revolution: analysing quantum technology narratives in the context of national strategies"

Take-away? Ethics by design.

Engage public early on such that values of diverse set of stakeholders shape the rhetoric & agendas guiding the development of quantum technology.



Thank you for
listening!

IF YOU DON'T TALK TO YOUR KIDS
ABOUT QUANTUM COMPUTING...

SOMEONE ELSE WILL.

Quantum computing and
consciousness are both weird
and therefore equivalent.

scottaaronson.com/blog

smbc-comics.com

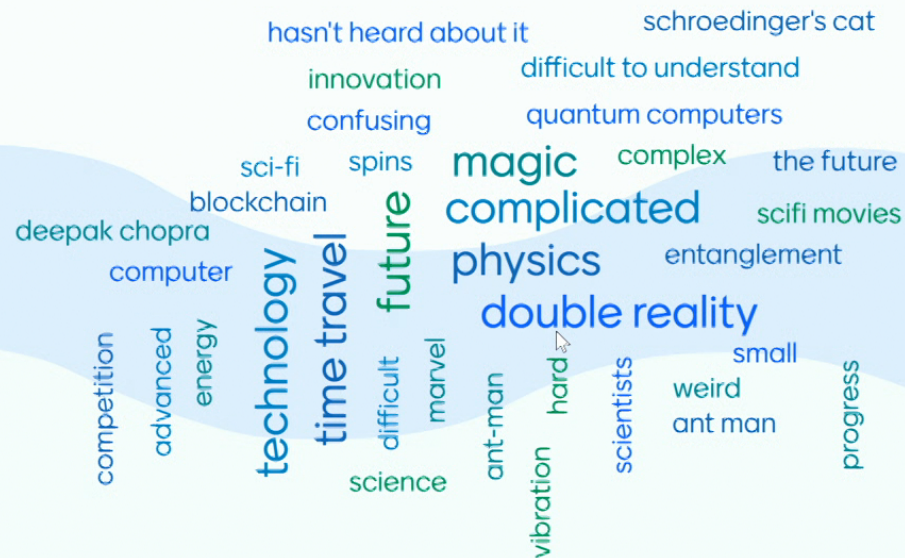
Go to www.menti.com and use the code 3461 3427

PRE-COURSE KNOWLEDGE ASSESSMENT

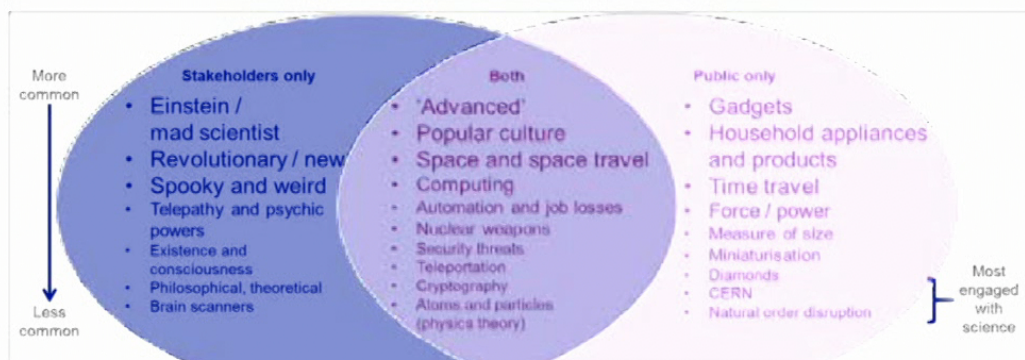


What do you think the public associates with "quantum" ?

Mentimeter



Public preconceptions of quantum?



Source: UK Quantum Technologies Public Dialogue Report (2018)



Quantum stakeholders' expectations of how the public perceives QT is not what the public actually perceives.

Teaching quantum in an atmosphere of hype.

“All six interviewees **spontaneously** mentioned media hype as a particularly salient influence on their teaching”

Meyer et al (2023): “How media hype affects our physics teaching: A case study on quantum computing”



Figure 1: Gartner Hype Cycle. Source: Gartner, 2022.²⁰

Figure 1: Hype Cycle for Compute Infrastructure, 2021





Workshop: Beyond the bubble

- Teaching & Incorporating ethics into quantum -