On the Ethics and Governance of Quantum Computing

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World Commission on the Ethics of Scientific Knowledge and Technology

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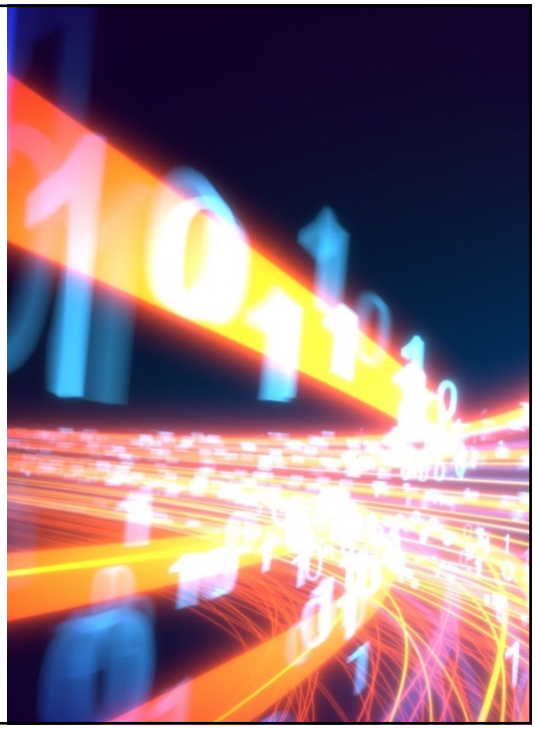
Towards the Quantum Study

- COMEST chose ethics of quantum computing (2024–25) building on earlier reports (Robotics 2017, IoT 2021, AI 2019)
- A Working Group was created at the 13th Session (Sept 2023) to draft reflections
- Expert consultations were held: online meetings (2024), session with specialists, external written feedback (Feb 2025)
- Draft content further refined in Working Group meetings (Mar & Jun 2025)
- Current draft is provisional: not final COMEST opinion, nor representing Member States' views



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Chapter I – Context and Purpose

2025 marks 100 years of quantum mechanics; UN declared it the *International Year of Quantum Science and Technology*.

Quantum computing: potential to transform security, economy, sustainability.

Ethical reflection is necessary *before* disruptive adoption, unlike past technologies (e.g., social media).

UNESCO: uniquely placed to promote a global ethics-based framework.

Aim: align quantum development with SDGs and human rights.

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Chapter I – Ethical Rationale

- Technology is shaped by context, design, and use – not neutral.
- Quantum computing affects human rights, development, and security.
- National strategies already emerging → risk of fragmentation.
- Ethics can guide regulation, standards, and governance.
- Quantum must be treated as a **global public good**, based on solidarity and equity.

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Chapter IV – Opportunities

- Ultra-secure communication via Quantum Key Distribution.
- Scientific breakthroughs: drug discovery, material science, physics.
- Healthcare: personalized medicine, protein folding analysis.
- Optimization: logistics, finance, energy grids, risk analysis.
- Economic growth, new industries, and workforce development

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Chapter IV – Risks and Harms

- Quantum divide: concentration of tech widens inequalities.
- Cryptography risk: “harvest now, decrypt later” threats.
- Democratic risk: knowledge asymmetry → governance gap.
- Dual-use: surveillance, autonomous weapons, cyberwarfare.
- Environmental costs: cryogenic cooling, rare materials.

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Chapter VI – Governance

- Debate: treat quantum as a “global common” (like space or seas).
- UN, WEF, G20 already engaging with governance frameworks.
- National strategies focus on sovereignty, security, competition.
- Standards under development (ISO, EU standardization).
- Export controls: balancing security with scientific openness.

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Chapter VI – Governance

- Ethics embedded throughout lifecycle (design → use).
- Anticipatory governance: foresight, impact assessments, precaution.
- Inclusive, multistakeholder participation essential
- Global cooperation to avoid monopolization and arms races.
- Anchored in *sustainability* and *inclusivity*, linked to SDGs.

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Chapter VII – Recommendations

Research, Design, Deployment, Implementation & Use Level

- Embed ethics at all stages: human rights, justice, solidarity, sustainability.
- Apply precautionary approach: anticipate risks, prevent harms early.
- Develop *post-quantum cryptography* to secure digital infrastructure.
- Ensure transparency, replicability, interoperability and safety standards.
- Promote open science, diversity, and global STEM education initiatives.

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Chapter VII – Recommendations

Individual, Societal & State Level

- Protect privacy and data sovereignty against decryption threats.
- Promote digital & quantum literacy for citizens and institutions.
- Launch public awareness campaigns to counter misconceptions
- Anticipate labour disruption: invest in reskilling and upskilling
- Ensure equitable distribution of quantum benefits across regions & groups.

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Chapter VII – Recommendations

International Community and Governance Level

- Recognize quantum as a *global challenge* requiring multilateral action.
- Foster multistakeholder cooperation: states, civil society, academia, industry
- Adapt international law for quantum-specific risks (e.g., encryption, dual use).
- Coordinate international standards and shared norms for safe use
- Avoid arms races, monopolization, and exclusion through cooperative governance.

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Chapter VII – Recommendations

SDG Level

- Align quantum innovation with the 2030 Agenda and SDGs.
- Prioritize sustainability: address environmental costs of quantum infrastructure.
- Ensure equitable access: close the *quantum divide* between regions.
- Use quantum computing to advance health, energy, climate, and food security.
- Promote intergenerational equity: ensure long-term benefits for future societies.

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