

# Quantum technologies and quantum computing

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**Quantum technologies** and **quantum computing** are buzzwords since few years.

# General introduction - motivation of these lectures

https:

//www.fraunhofer.de/en/research/fraunhofer-strategic-research-fields/quantum-technologies.html



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## Fraunhofer Strategic Research Field


### Quantum Technologies



Quantum technologies open up entirely new and unexplored applications in the fields of measurement technology, imaging, secure communication and highly complex calculations. They therefore have high disruptive potential. Scientists have achieved spectacular breakthroughs in quantum research in recent years. The goal of quantum research at Fraunhofer is to transfer basic research into applications as quickly as possible, for example in the form of high-precision sensor systems and secure quantum communication.

Quantum physics forms the basis of many modern technologies. Billions of electronic transistors permeate our lives at work and at home, from computers and smartphones to the control systems of modern vehicles and seemingly simple kitchen appliances. Countless photons and optical fibers link up even the most remote corners of our planet. Scientists are already talking about a "second quantum revolution" based on the targeted

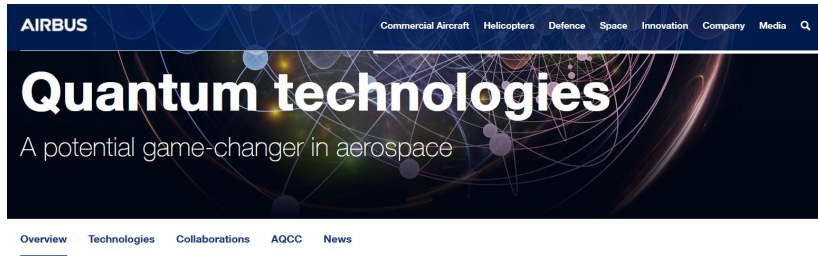
### Contact



**Prof. Dr. rer. nat. Oliver Ambacher**  
Spokesman Fraunhofer Strategic Research Field Quantum Technologies

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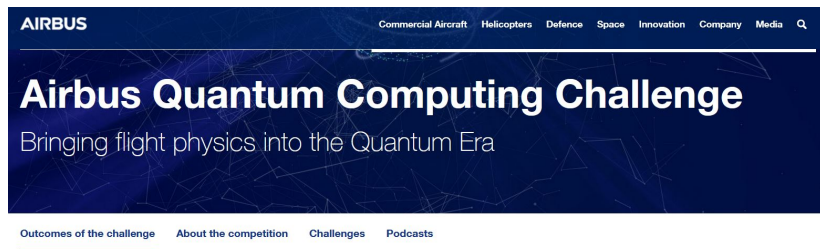
<https://www.airbus.com/innovation/industry-4-0/quantum-technologies.html>



Quantum technologies are expected to create a massive paradigm shift in the way aircraft are built and flown. At Airbus, we aim to be an early adopter of quantum technologies to enhance

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<https://www.airbus.com/innovation/industry-4-0/quantum-technologies/airbus-quantum-computing-challenge.html>



**The Airbus Quantum Computing challenge has ended and we are proud to announce the 2020 winner : the team Machine Learning Reply.**

# General introduction - motivation of these lectures

<https://www.airbus.com/innovation/industry-4-0/quantum-technologies/airbus-quantum-computing-challenge.html>

[Outcomes of the challenge](#) [About the competition](#) [Challenges](#) [Podcasts](#)

## Technical dossiers of the 5 problem statements :



Problem Statement n° 1  
0.54 MB



Problem Statement n° 2  
0.54 MB



Problem Statement n° 3  
0.74 MB

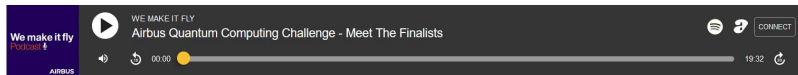
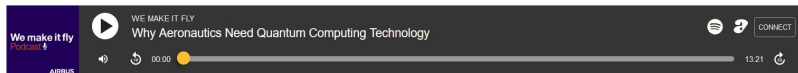


Problem Statement n° 4  
0.84 MB



Problem Statement n° 5  
0.75 MB

## Podcasts



# General introduction - motivation of these lectures

<https://www.airbus.com/innovation/industry-4-0/quantum-technologies/>

[airbus-quantum-computing-challenge.html](#)

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## Technical dossiers of the 5 problem statements :



Problem Statement n° 1

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Problem Statement n° 2

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Problem Statement n° 3

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Problem Statement n° 4

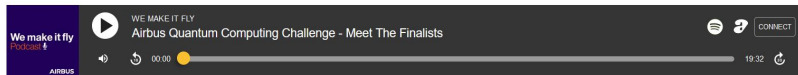
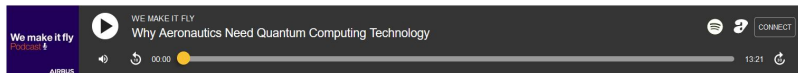
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Problem Statement n° 5

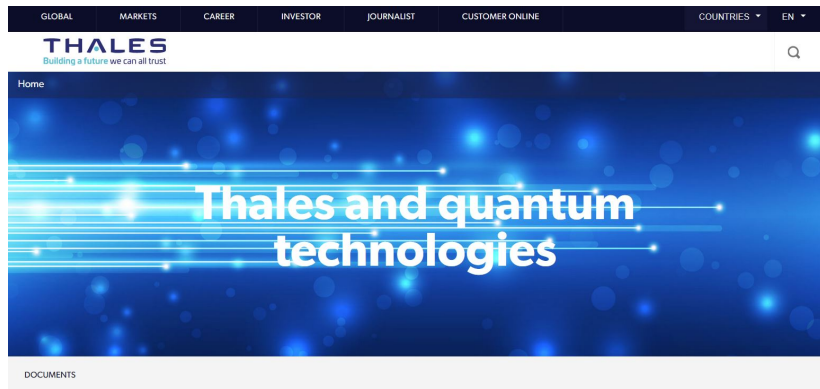
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## Podcasts



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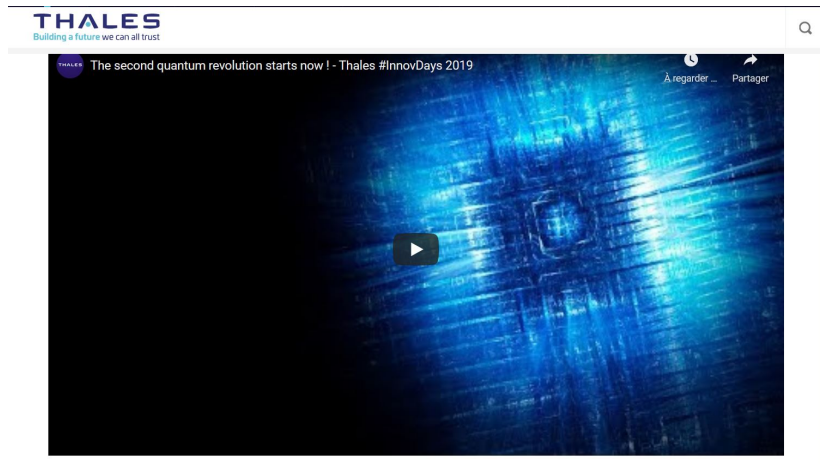
<https://www.thalesgroup.com/en/thales-and-quantum-technologies>





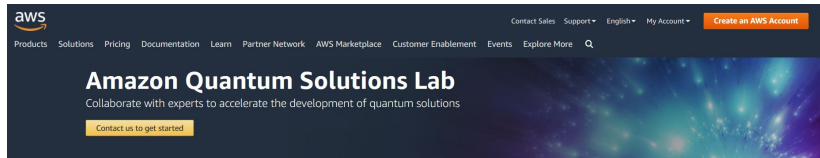
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<https://www.thalesgroup.com/en/thales-and-quantum-technologies>



# General introduction - motivation of these lectures

<https://aws.amazon.com/fr/quantum-solutions-lab/>



The Amazon Quantum Solutions Lab will help you get ready for quantum computing.

Amazon Quantum Solutions Lab engagements are collaborative research programs that allow you to work with leading experts in quantum computing, machine learning, and high-performance computing. The programs help you research and identify the most promising applications of quantum computing for your business and get quantum ready. Amazon Quantum Solution Lab experts will “work backwards” with you to dive deep and learn about the science of quantum computing, develop and benchmark new algorithms and solutions, and build the internal expertise and strategies required to prepare your organization for the future of quantum computing.

# General introduction - motivation of these lectures

[https://www.esa.int/Enabling\\_Support/Space\\_Engineering\\_Technology/Space\\_Optoelectronics/Quantum\\_Technologies](https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Space_Optoelectronics/Quantum_Technologies)

→ THE EUROPEAN SPACE AGENCY



## Quantum Technologies

1613 VIEWS 11 LIKES

ESA / Enabling & Support / Space Engineering & Technology / Space Optoelectronics

We are already surrounded by quantum technologies. From microprocessors, to digital cameras, to lasers—these technologies rely for their operation on the quantum behaviour of electrons in solids and on the stimulated emission of coherent radiation, respectively. Advances in experimental techniques and equipment over the past few decades have enabled the manipulation of single quantum objects (photons, atoms) to harness more advanced, subtle, aspects of quantum mechanics: superposition and entanglement. Thanks to these properties a new era of Quantum Technologies is now

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<https://home.cern/fr/news/news/computing/cern-meets-quantum-technology>



LE CERN

ACTUALITÉS

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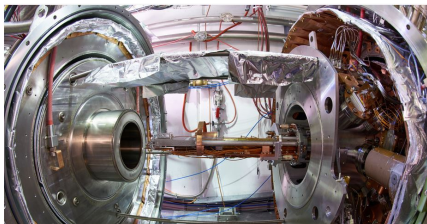
RESSOURCES

RECHERCHER | FR -

## Quand le CERN rencontre la technologie quantique

L'Initiative Technologie quantique du CERN va explorer le potentiel de certains dispositifs intégrant des phénomènes quantiques déconcertants, tels que l'intrication, enrichissant et étendant ainsi la portée de son programme de recherche scientifique

30 SEPTEMBRE, 2020 | Par [Matthew Chalmers](#)



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<https://iopscience.iop.org/article/10.1088/1367-2630/aad1ea>

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Deutsche Physikalische Gesellschaft  DPG IOP Institute of Physics

ROADMAP • OPEN ACCESS

## The quantum technologies roadmap: a European community view

Antonio Acín<sup>1,2</sup>, Immanuel Bloch<sup>3,4</sup>, Harry Buhrman<sup>5</sup>, Tommaso Calarco<sup>6</sup>, Christopher Eichler<sup>7</sup>, Jens Eisert<sup>8</sup>, Daniel Esteve<sup>9</sup> , Nicolas Gisin<sup>10</sup>, Steffen J Glaser<sup>11</sup>, Fedor Jelezko<sup>6</sup> [+ Show full author list](#)

Published 16 August 2018 • © 2018 The Author(s). Published by IOP Publishing Ltd on behalf of Deutsche Physikalische Gesellschaft

[New Journal of Physics, Volume 20, August 2018](#)

**Citation** Antonio Acín *et al* 2018 *New J. Phys.* **20** 080201

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Abstract

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JOURNAL ARTICLES

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Recent advances on integrated quantum communications

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## Two lectures:

- Introduction to Quantum computing ;
- Quantum technologies and industry.

## Slides available online:

- <https://github.com/kmaussang/ECC-Quantum-computing>
- <https://github.com/kmaussang/ECC-Quantum-Technologies>

## Goal of these lectures:

- better understanding of what are exactly quantum technologies ;
- which physics and research behind it ;
- real opportunities vs oversold perspectives ;
- basics of quantum computing algorithms ;
- example of real quantum computer accessible online (IBM-Q) ;
- expected impact for industry.

# General introduction - motivation of these lectures

<https://github.com/kmaussang/ECC-Quantum-computing>

The screenshot shows the GitHub repository page for `kmaussang / ECC-Quantum-computing`. The repository is under the `main` branch with 1 branch and 0 tags. It has 11 commits, last updated 4 days ago by `fat20w`. The repository contains several PDF files, each with an "Add files via upload" button and a timestamp of "4 days ago".

File Name	Action	Time
Chap0_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Chap1_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Chap2_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Chap3_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Chap4_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Chap5_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Chap6_QuantumComputing-2021.pdf	Add files via upload	4 days ago
Quantum-Computing_2021.pdf	Add files via upload	4 days ago

The right sidebar shows the repository's metadata: "About" (No description, website, or topics provided), "Readme", "Releases" (No releases published), and "Packages" (No packages published).



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<https://github.com/kmaussang/ECC-Quantum-Technologies>

The screenshot shows the GitHub repository page for `kmaussang / ECC-Quantum-Technologies`. The repository has 1 watch, 0 stars, and 0 forks. The main branch is `main` with 1 branch and 0 tags. The repository contains 2 commits and 7 files. The files are listed in a table with columns for file name, action, and time.

File Name	Action	Time
Chap1_QuantumTechnologies-2021.pdf	Add files via upload	4 days ago
Chap2_QuantumTechnologies-2021.pdf	Add files via upload	4 days ago
Chap3_QuantumTechnologies-2021.pdf	Add files via upload	4 days ago
Chap4_QuantumTechnologies-2021.pdf	Add files via upload	4 days ago
Chap5_QuantumTechnologies-2021.pdf	Add files via upload	4 days ago
Chap6_QuantumTechnologies-2021.pdf	Add files via upload	4 days ago
QuantumTechnologies_2021.pdf	Add files via upload	4 days ago

The repository also has a README file and a Releases section. The About section states: "No description, website, or topics provided."