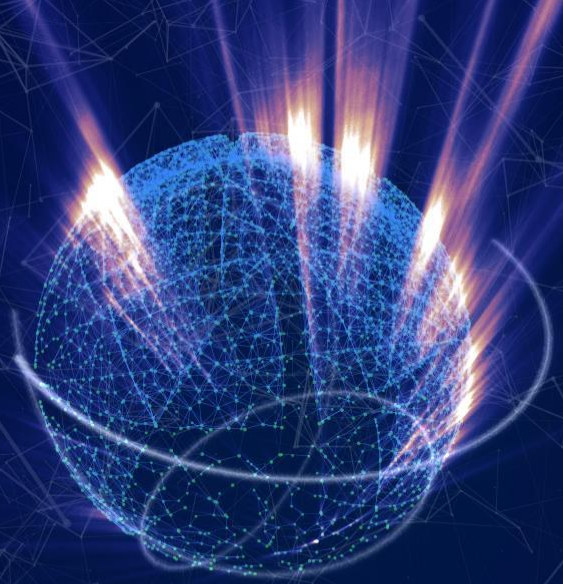


Quantum Computing @ Airbus

Update March 2022

Gerd Büttner, Airbus Operation GmbH

AIRBUS

Leading the way in the decarbonisation of aviation

Ambition to be the first to offer a zero-emission commercial aircraft by 2035

ZEROe concept aircraft powered by hydrogen

AIRBUS

Strong, innovative and customer focused – Our portfolio

Military Aircraft

- A400M
- A330 Multi-Role Tanker Transport
- Special Mission Aircraft
- Combat Aircraft
- Full In-Service Support

Space Systems

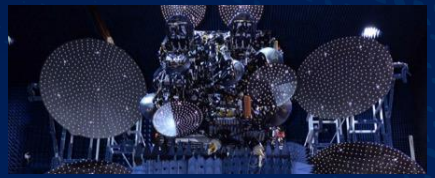
- Telecommunication Satellites
- Earth Observation Satellites
- Navigation Satellites
- Orbital and Space Exploration Infrastructure
- Science Missions
- ArianeGroup (Launchers)

Connected Intelligence

- Intelligence
- CyberSecurity
- Security Solutions
- Secure Communications
- Secure Land Communications
- Future Applications

Unmanned Aerial Systems

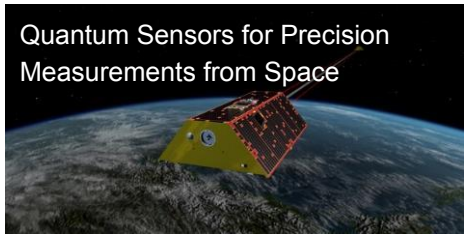
- UAS and UAV solutions for airborne intelligence, surveillance and reconnaissance, and combat missions



Quantum Technologies

AIRBUS

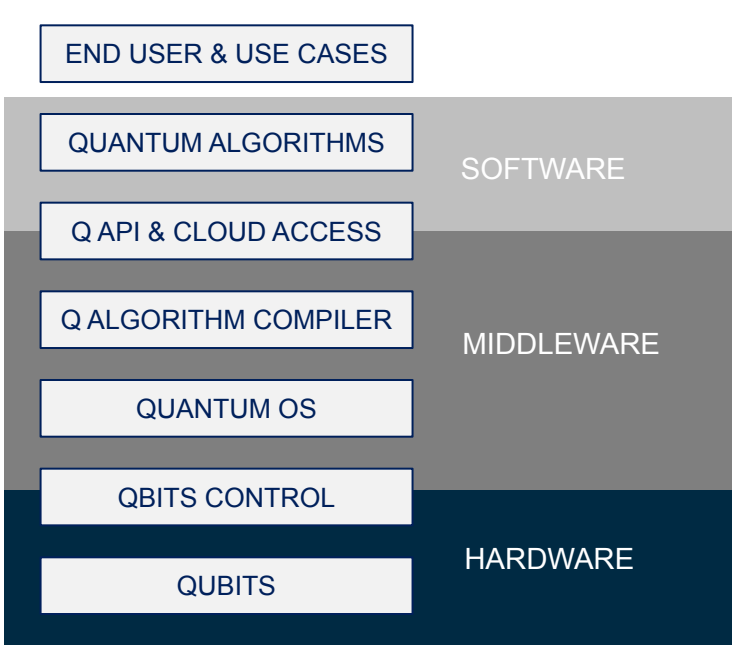
Quantum Technologies



AIRBUS

Quantum Computing | End-User Perspective

Quantum Computing Stack

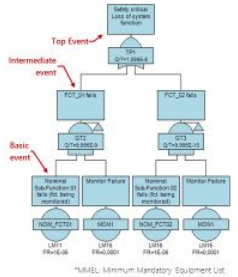


AIRBUS

- Airbus is agnostic to the type of quantum hardware implementation / vendor.
- The only determining factor is the demonstrated performances of these systems on relevant Airbus applications / business propositions.

Performed Prototypes

First Investigation: Fault Tree Analyses



What?

Fault Trees represent the connection points between sub-systems and nodes in large, complex engineering structures.

Fault Tree Analyses investigate the combination of local failures that result in global system failures.

Applications

Fault trees are an integral part of qualification and certification processes for aircrafts, spacecrafts, and system fleets.

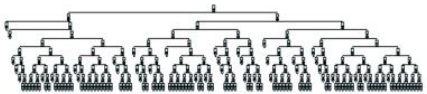
Why?

Fault Tree Analyses are NP-hard problems. Quantum Computing is known to have potential benefits for NP-hard-type problems.

Work done in collaboration with QC Ware & Airbus Engineering

AIRBUS

- 8 levels
- 2 events per gate
- Roughly equal numbers of OR and AND gates
- 128 events, 126 gates
  - 254 PUBO variables, 380 QUBO variables, 1168 hardware qubits



AIRBUS

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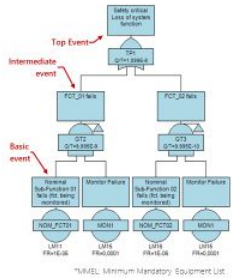
Performed Prototypes

First Investigation: Fault Tree Analyses



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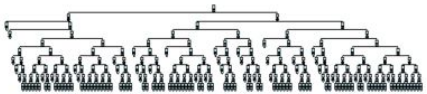

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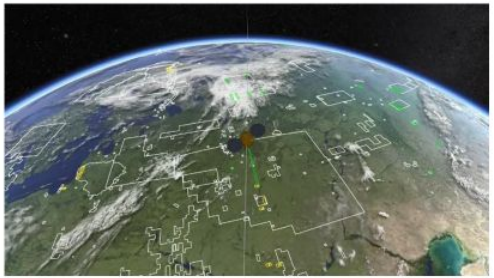
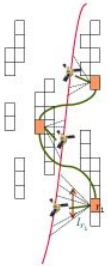
Satellite Mission Optimisation





Work done in collaboration with Airbus DS & DLR

AIRBUS

today done with a 'greedy' solver. Although fast, the **greedy algorithm often fails** to find the most optimal **solution for regions of high request density**, even at small scales.

Work done in collaboration with Airbus DS & DLR

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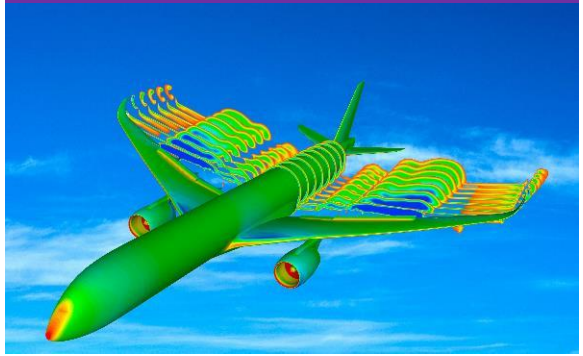
Airbus Quantum Computing Challenge

Five Problem Statements

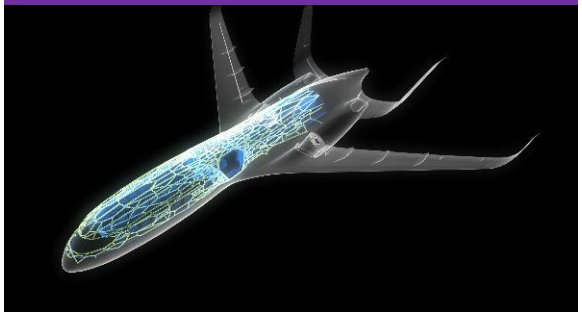
5 distinct flight physics problems with varying degrees of complexity

Aircraft Climb Optimisation

Computational Fluid Dynamics



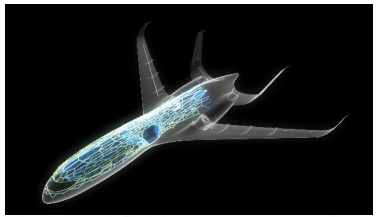
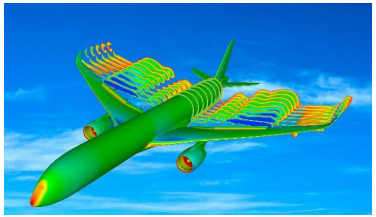
Quantum Neural Networks for Solving Partial Differential Equations



Wingbox Design Optimisation

Aircraft Loading Optimisation

Meet the Five Finalist Teams

Capgemini (Netherlands / France)	**Machine Learning Reply** (Italy)	**Niels Backfisch** (Germany)	**Origin Quantum** (China)	**Universidad de Montevideo** (Uruguay)
				
PS4: Wingbox Design Optimisation	PS5: Aircraft Loading Optimisation	PS3: Quantum Neural Networks for Solving Partial Differential Equations	PS2: Computational Fluid Dynamics (CFD)	PS5: Aircraft Loading Optimisation
				

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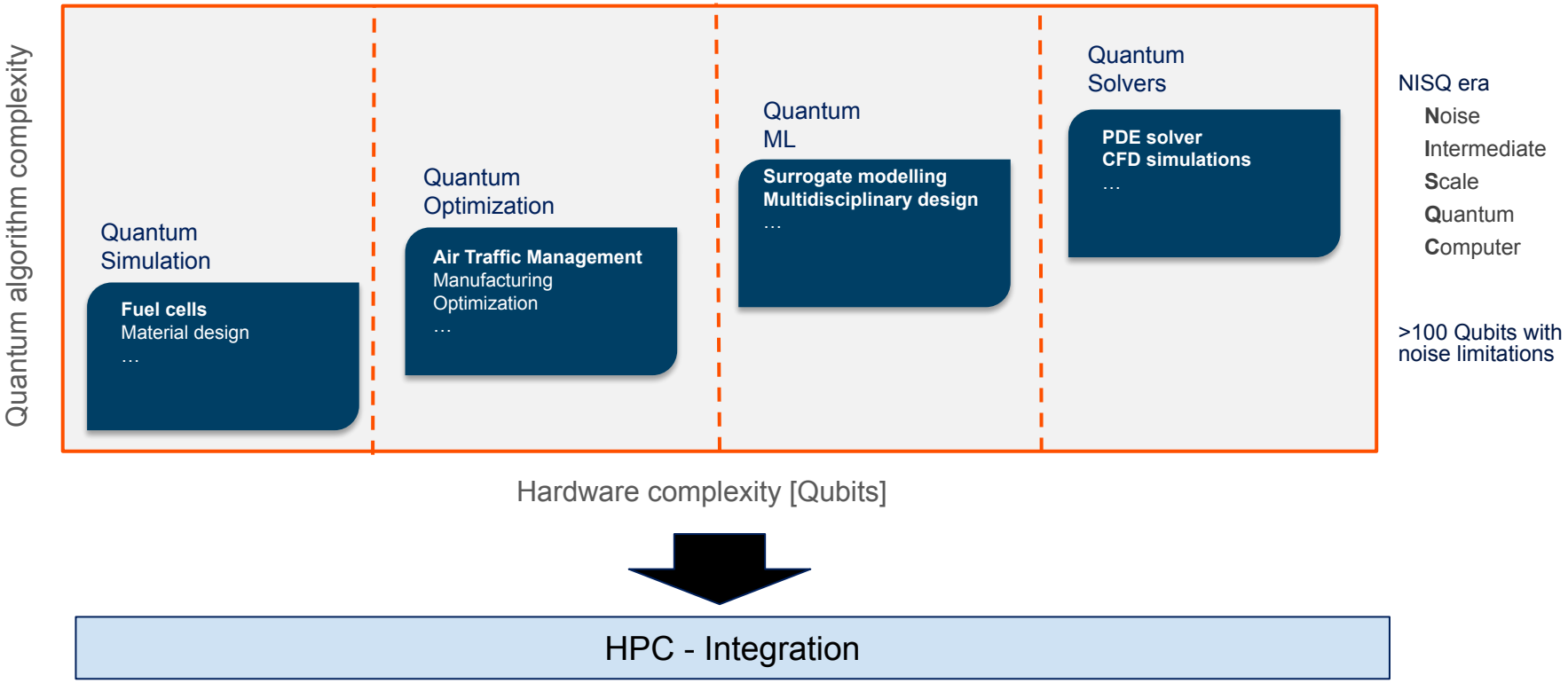
What's coming next



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Membership

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ETP 4 HPC

EUROPEAN TECHNOLOGY PLATFORM FOR HIGH PERFORMANCE COMPUTING

PRACE

QuIC European Quantum Industry Consortium

Thank you for attendance

Gerd Büttner,
Gerd.Buettner@airbus.com