THE INTERNATIONAL MEETING

CONFERENCES | WORKSHOPS | EXHIBITION

SIMULATION |

HPC | HPDA

AI | QUANTUM

14-15 JUNE | ECOLE POLYTECHNIQUE

PLATINUM SPONSORS

ALTAIR · Atos · ddn · DELL Technologies · Hewlett Packard Enterprise · intel · VAST

GOLD SPONSORS

2crsi · aws · ATEMPO · cea · doitnow HPC Services · GRAPHCORE · ORACLE

SILVER SPONSORS

C12 · FUJITSU · GENCI · Microsoft · NVIDIA · rescale · AMD XILINX

EUROPA VILLAGE PARTNER

Inria

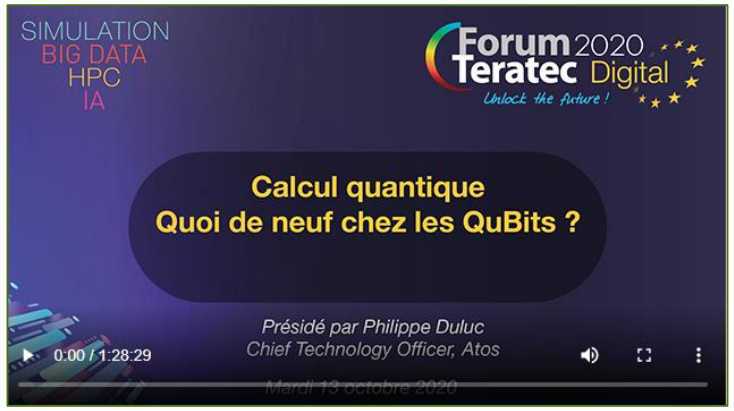
What's new with qubits? A European view

Workshop organised and moderated by

***Dr. Eng. Guillaume Colin de Verdière*, International Expert in HPC, CEA**

Dr. Eng. Jean-Philippe Nominé, Fellow, HPC Strategic Collaborations Manager, CEA

Welcome!



After several workshops on/with quantum computing at TERATEC Forums, over the last years, organised or co-organised by CEA, we come back to technology progress...

- 2021 Europe is on its way towards “Hybrid Qomputing“ https://teratec.eu/gb/forum_2021/atelier_1.html
- 2020 Quantum computing: what's new in QuBits? https://teratec.eu/gb/forum_2020/atelier_3.html
- 2019 Quantum computing : which applications will benefit ? https://teratec.eu/gb/forum_2019/atelier_2.html
- 2018 Quantum revolution is here https://teratec.eu/gb/forum_2018/atelier_3.html
- 2016 Specialised computing architectures : helpers or challengers ? https://teratec.eu/gb/forum_2016/atelier_4.html

What's new with qubits? A European view

- After last year workshop focusing on use cases, we come back this year on technological progress on the path to qubits, specifically emphasizing European developments.
- The workshop will take the perspective of the French National Quantum Strategy, which intends to leverage some of these technologies.
- After an overview of the French HQI approach (Hybrid HPC-Quantum Initiative), we will review several available or emerging European qubit technologies.

10mn	**Introduction** *Guillaume Colin de Verdière, Jean-Philippe Nominé, CEA*
20 mn	**Quantum Computing with neutral atoms** *Loïc Henriet, CTO, Pasqal*
20 mn	**Ubiquitous Quantum Accelerators Based on NV-Centers in Diamond** *Dr. Florian Preis, Head of Quantum Software and Applications, Quantum Brilliance*
20 mn	**Building scalable and ultra-coherent quantum computers with carbon nanotubes** *Matthieu Desjardins, founder, C12*
20 mn	**Quantum computing for simulation applications** *Max Hettrich, research engineer , Alpine Quantum Technologies*
20 mn	**A lean roadmap towards a fault-tolerant universal quantum computer** *Blaise Vignon, Chief Product Officer, Alice&Bob*
20 mn	**Co-designing quantum accelerators** *Bruno Taketani, IQM Quantum Computers*
20 mn	**Modular optical quantum computing** *Niccolo Somaschi, cofounder, Quandela*

DE LA RECHERCHE À L'INDUSTRIE

CEA Standpoint

National Hybrid HPC Quantum Computing Platform

- **A 5 year programme based on a national hybrid HPC/Quantum platform**

  Part of French Quantum Strategy (announced Jan. 2021)

  National funding's 72,3 M€, leveraged by European, industrial and regional funding

  Seed for a European hybrid quantum infrastructure

- **Objectives**

Integrate (HW/SW) quantum technologies in an HPC centre (CEA/TGCC)

Build the pilot of a future HPC/Quantum solution

Assess QC technologies

Develop QC hybrid software stack (libraries/middleware)

Promote, disseminate and support usage (applications)

- **Programme organization & funding**

QPU acquisitions (36,3 M€ (FR) + co-funding by Europe)

Industrial & academic R&D (25,5 M€ + co-funding by industrials)

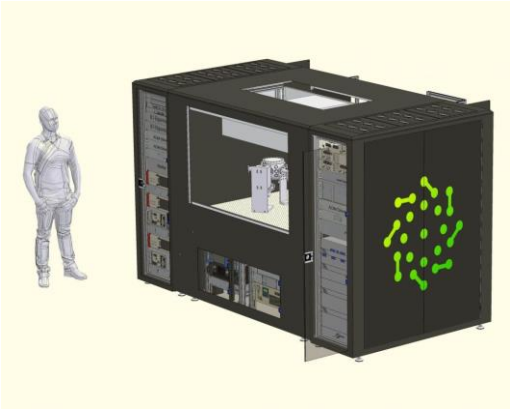
QC ecosystem and User community support (10,5 M€ (FR) co-funded by Europe, industrials and French regions)

HPCQS update: High Performance Computer – Quantum Simulator hybrid | HPCQS

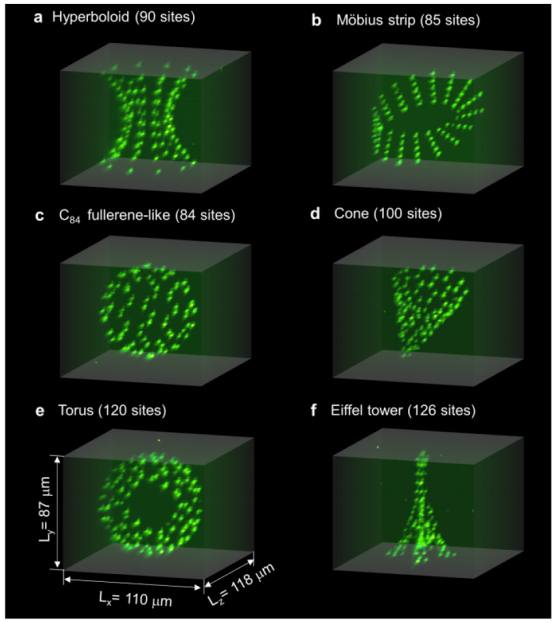
- **EuroHPC project 2022-2025**
- **1 pasqal machine @TGCC, 1 @ JSC/JUNIQ**
  - Quantum Simulator (analog)
  - Neutral Rydberg atoms handled by laser (optical tweezers)
  - 2 * 100+ qubits in production

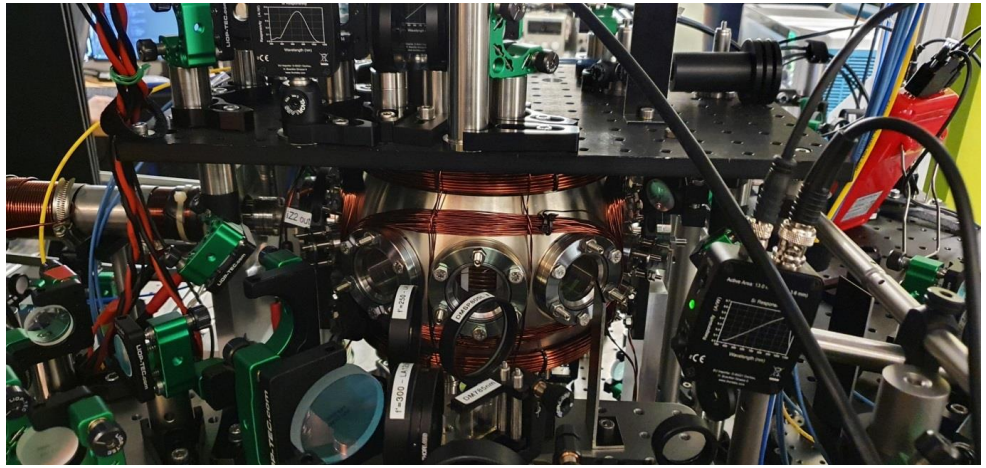
PASQAL

- **https://pasqal.io**
  - 200 qbits in the lab in 2021…
    Exploring the entanglement frontier with programmable arrays of atomic qubits – PASQAL
    *Scholl, P., Schuler, M., Williams, H.J. et al. Quantum simulation of 2D antiferromagnets with hundreds of Rydberg atoms. Nature **595,** 233–238 (2021). https://doi.org/10.1038/s41586-021-03585-1*



Single-atom fluorescence in 3D arrays, in Nature 561, 79 (2018).





Enjoy the workshop!

Credits / pictures: CEA, CEA/CADAM, P. Stroppa, Pasqal