THE INTERNATIONAL MEETING
CONFERENCES | WORKSHOPS | EXHIBITION

22-23-24 JUNE
DIGITAL EVENT

Forum Teratec 2021

Unlock the future !

SIMULATION |
HPC | HPDA
AI | QUANTUM

PLATINUM SPONSORS: Atos, ddn, GRAPHCORE, Hewlett Packard Enterprise, intel., VAST

GOLD SPONSORS: ATEMPO, cea, doitnow HPC Services, exaion EDF GROUP, Lenovo, UCIT

SILVER SPONSORS: arm, aws, GENCI, NVIDIA, ORACLE, rescale, XILINX

PARTENAIRE EUROPA VILLAGE: Inria

Europe is on its way towards "Hybrid Qomputing"

Workshop organised and moderated by

Prof. Kristel Michielsen, Jülich Supercomputing Centre

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

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

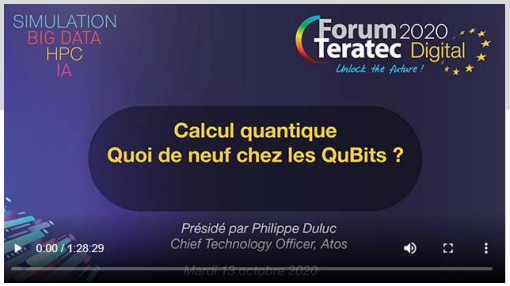
- This workshop will demonstrate that the next step in high performance computing is the introduction of quantum accelerators (quantum processing units, in short QPU) into the computing centre in a modular fashion. Supercomputers and QPUs will allow scientists to perform hybrid quantum-classical computing which we will shorten as Hybrid Qomputing.
- We will first explain what kind of algorithms are possible with this new concept, what can be hoped for and what kind of limitations we will be facing. Then we will illustrate first (industrial) results on practical use cases showing the potential impact of Hybrid Qomputing.

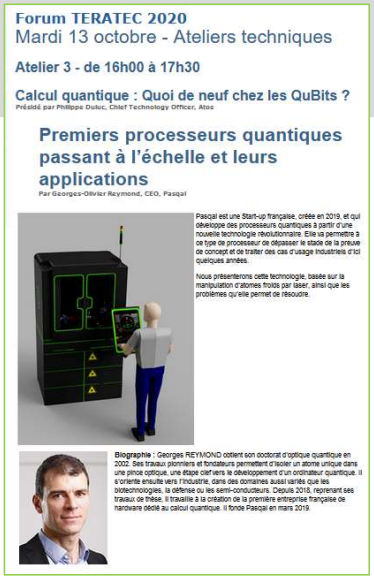
5mn	Introduction : CEA
20mn	State of the Art: the promises and limitations of Hybrid Qomputing K. Michielsen, FZJ
20mn	Algorithms for Hybrid Quantum Computing & Applications Prof. Göran Wendin –CHALMERS
15mn	The Atos Quantum Program: Paving the way to quantum-accelerated HPC Jean-Pierre Panziera, ATOS
15mn	Modular Computing & QPUs Thomas Moschny, ParTec
15mn	Use-cases to demonstrate the added value of Hybrid Qomputing: the HPCQS portfolio Venkatesh Kannan , ICHEC
15mn	Quantum computing applications in natural sciences and material design Ivano Tavernelli, IBM Research – Zurich
15mn	Hamiltonian modelling of approximate path planning problems for hybrid algorithms Romain Kukla, Léo Monbroussou, Naval Group

DE LA RECHERCHE À L'INDUSTRIE

CEA Standpoint

CEA standpoint





After several workshops on/with quantum computing at TERATEC Forums, over the last years, organised or co-organised by CEA, with focus on emerging technologies, promising use cases….

- **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

... today we shift the gear and widen the scope towards a more global and European HPC/QC vision.

We are active in the community and in close relationship with most speaking entities today!

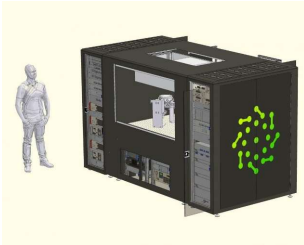
Quick reminder : CEA TGCC & CCRT

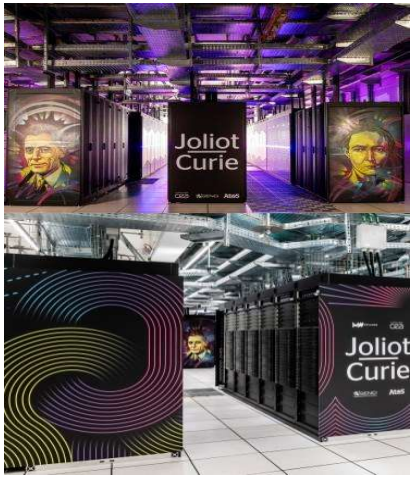
Très Grand Centre de Calcul du CEA
Two main components

TGCC

- **Research Computing Centre GENCI's Joliot-curie, 22 PF**
  - Bound to be the French reference centre in terms of Quantum Computing public infrastructure, together with GENCI

GENCI





- Starting with HPCQS EuroHPC project ⟨HPC|QS⟩

- **Industry computing centre: CCRT Topaze, 9PF – Cobalt, 3PF**
  - Hosting an ATOS QLM since 2018 (31 qubits), in particular for industrial partners use cases (⇔TERATEC TQCI)

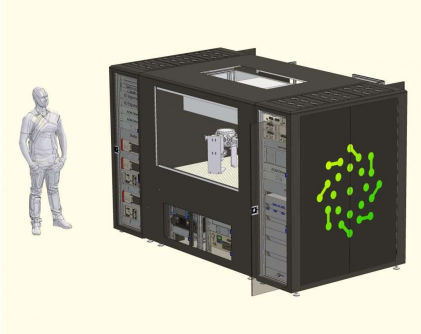
ccrt
Centre de calcul recherche et technologie

Our next move: HPCQS with Pasqal, FZJ, GENCI... & more EU partners

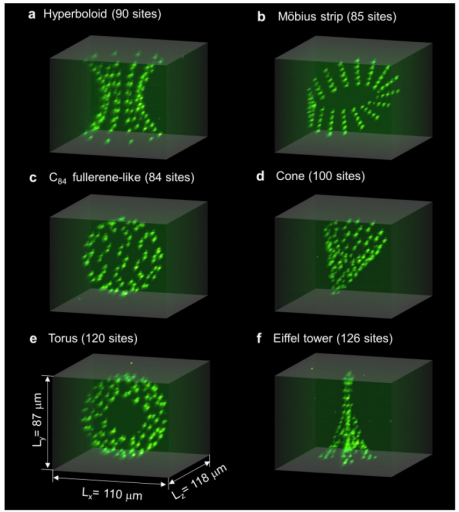
- **1 pasqal machine @TGCC, 1 @ JSC/JUNIQ**
  - Quantum Simulator (analog)
  - Neutral Rydberg atoms handled by laser (optical tweezers)

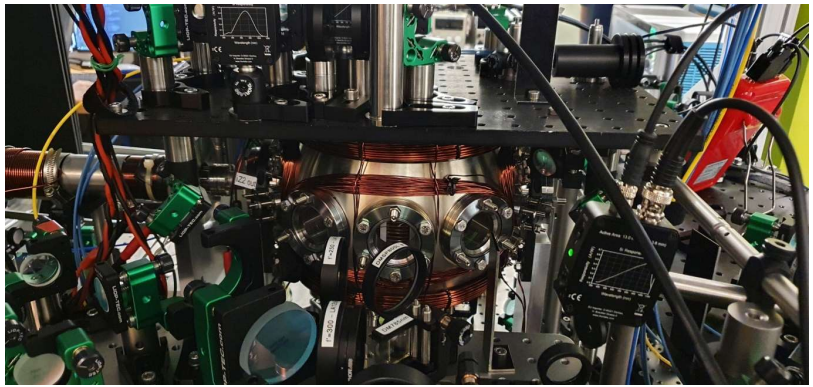
- **Latest progress https://pasqal.io**
  - 100 qubits then 196 in the lab

The path to Pasqal's first 200 qubits processors



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



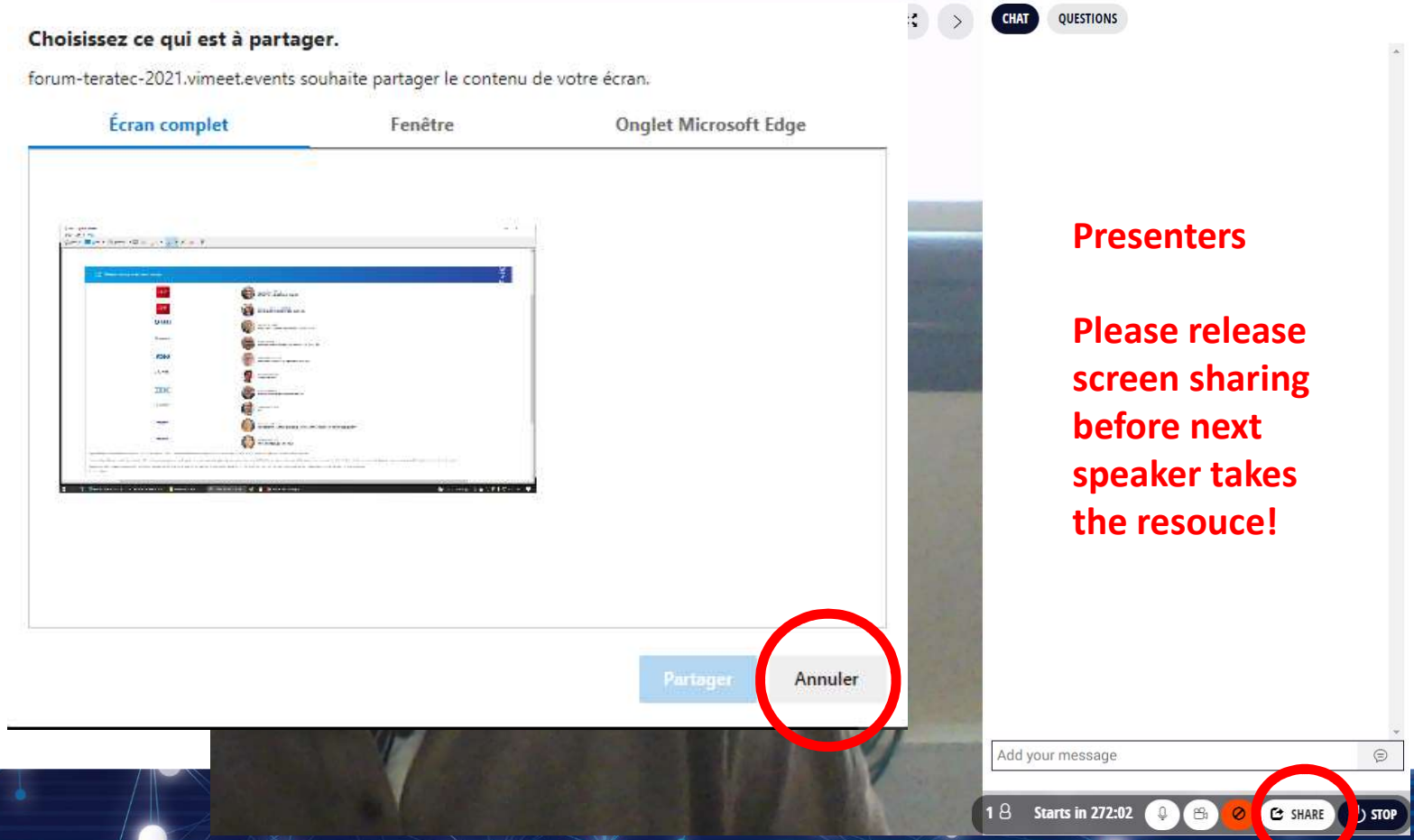


- **2021**
  - Henrique Silvério, Sebastián Grijalva, Constantin Dalyac, Lucas Leclerc, Peter J. Karalekas, Nathan Shammah, Mourad Beji, Louis-Paul Henry, Loïc Henriet
    Pulser: An open-source package for the design of pulse sequences in programmable neutral-atom arrays
    arXiv
  - Giovanni Ferioli, Antoine Glicenstein, Loic Henriet, Igor Ferrier-Barbut, and Antoine Browaeys
    Storage and Release of Subradiant Excitations in a Dense Atomic Cloud
    Phys. Rev. X 11, 021031 (2021) [arXiv]

- **2020**
  - Constantin Dalyac, Loïc Henriet, Emmanuel Jeandel, Wolfgang Lechner, Simon Perdrix, Marc Porcheron, Margarita Veshchezerova
    Qualifying quantum approaches for hard industrial optimization problems. A case study in the field of smart-charging of electric vehicles
    arXiv
  - Pascal Scholl, Michael Schuler, Hannah J. Williams, Alexander A. Eberharter, Daniel Barredo, Kai-Niklas Schymik, Vincent Lienhard, Louis-Paul Henry, Thomas C. Lang, Thierry Lahaye, Andreas M. Läuchli, Antoine Browaeys
    Programmable quantum simulation of 2D antiferromagnets with hundreds of Rydberg atoms
    arXiv
  - ....

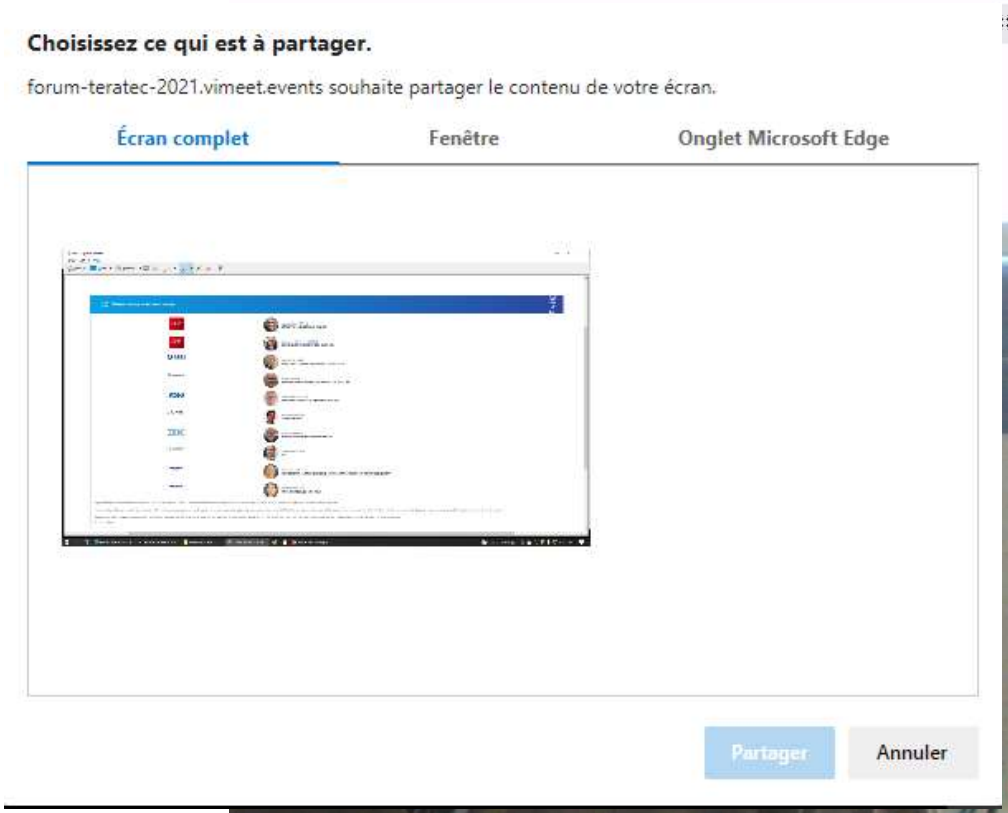
Enjoy the workshop!

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



Presenters

Please release screen sharing before next speaker takes the resouce!



Presenters

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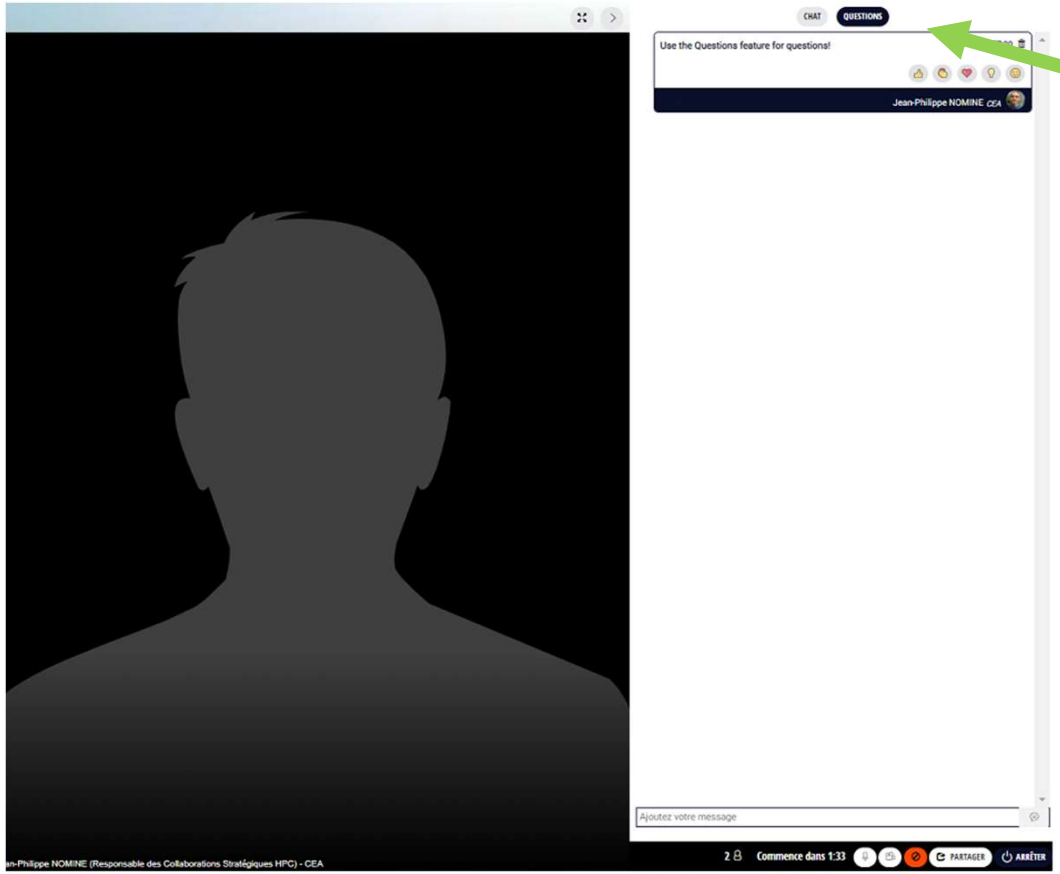

Audience

Use Questions Panel !

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Merci pour votre attention.

Thank you for your attention.

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