les enjeux industriels de l'informatique quantique

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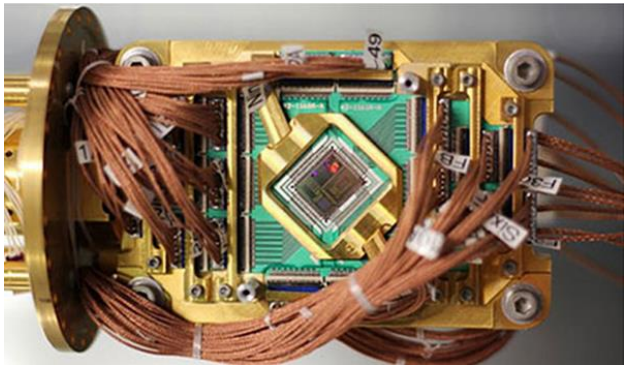
BIG, Accor Hôtel Arena, 11 octobre 2018

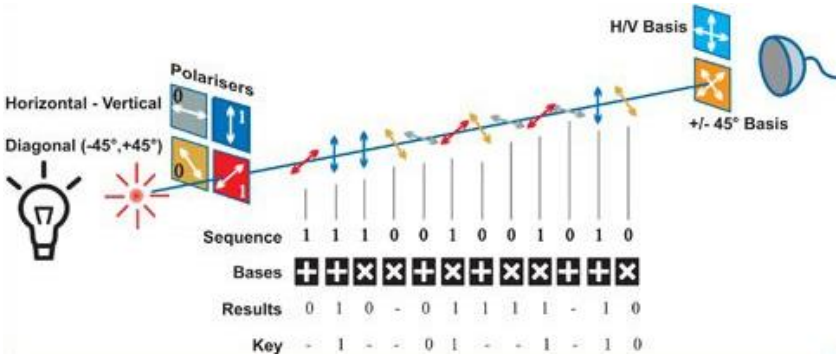
informatique quantique

1



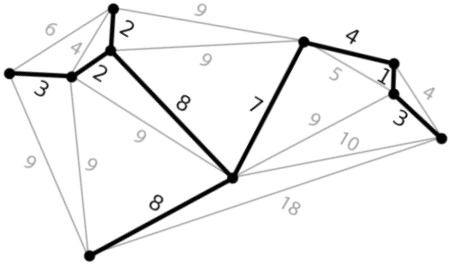
calcul quantique

2

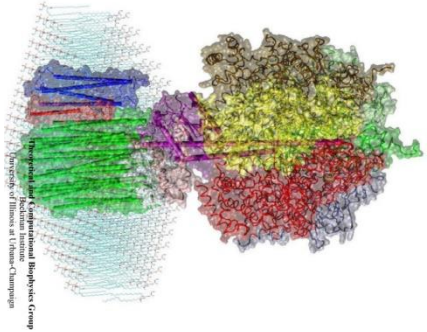


cryptographie quantique et post-quantique

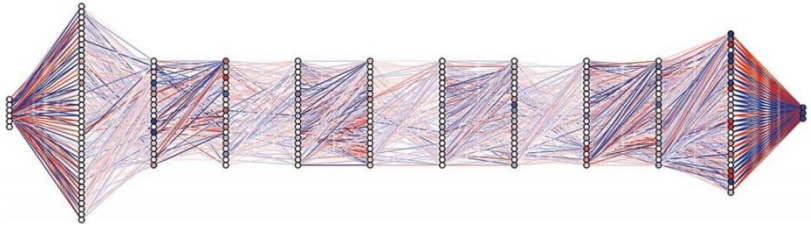
problèmes complexes exponentiels



optimisations combinatoires
trajets, placements, cartes, finance



simulations chimiques
inorganiques et biologiques



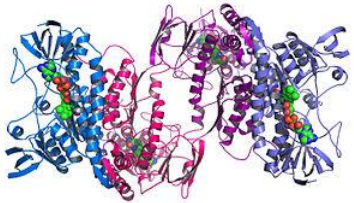
intelligence artificielle
machine learning et deep learning

44 988 956 872 684 695 711 909 595 661 757 551 737 391 461 381 495 437 962 032 535 214 ⋱
847 417 212 499 752 572 232 401 732 123 638 539 143 471 977 710 243 318 508 178 915 ⋱
016 041 310 810 028 749 680 395 948 695 236 435 887 854 444 086 897 885 594 538 713 ⋱
228 936 606 776 470 635 385 948 772 950 847 349 789 474 010 570 972 468 331 714 191 ⋱
425 331 349 515 850 718 358 938 779 081 862 288 937 248 229 481 122 957 649 663 638 ⋱
693 717 318 212 628 476 797 261 511 198 103 510 310 449 611 859 242 271 813 366 566 ⋱
997 130 602 961 939 610 490 851 433 975 035 584 182 642 678 405 161 190 698 336 347 ⋱
929 112 811 425 354 268 385 653 335 910 754 799 140 572 752 605 907 751 000 463 584 ⋱
653 690 396 162 388 451 026 377 547 259 579 743 647 906 554 252 830 020 138 218 006 ⋱
943 421 190 175 143 130 541 480 857 851 924 532 107 288 336 106

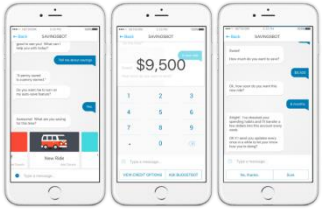
factorisation
de très grands nombres entiers

premiers marchés potentiels

transports et logistique
optimisations de parcours
gestion de flottes



santé
simulation moléculaire
drug discovery
optimisation de radios

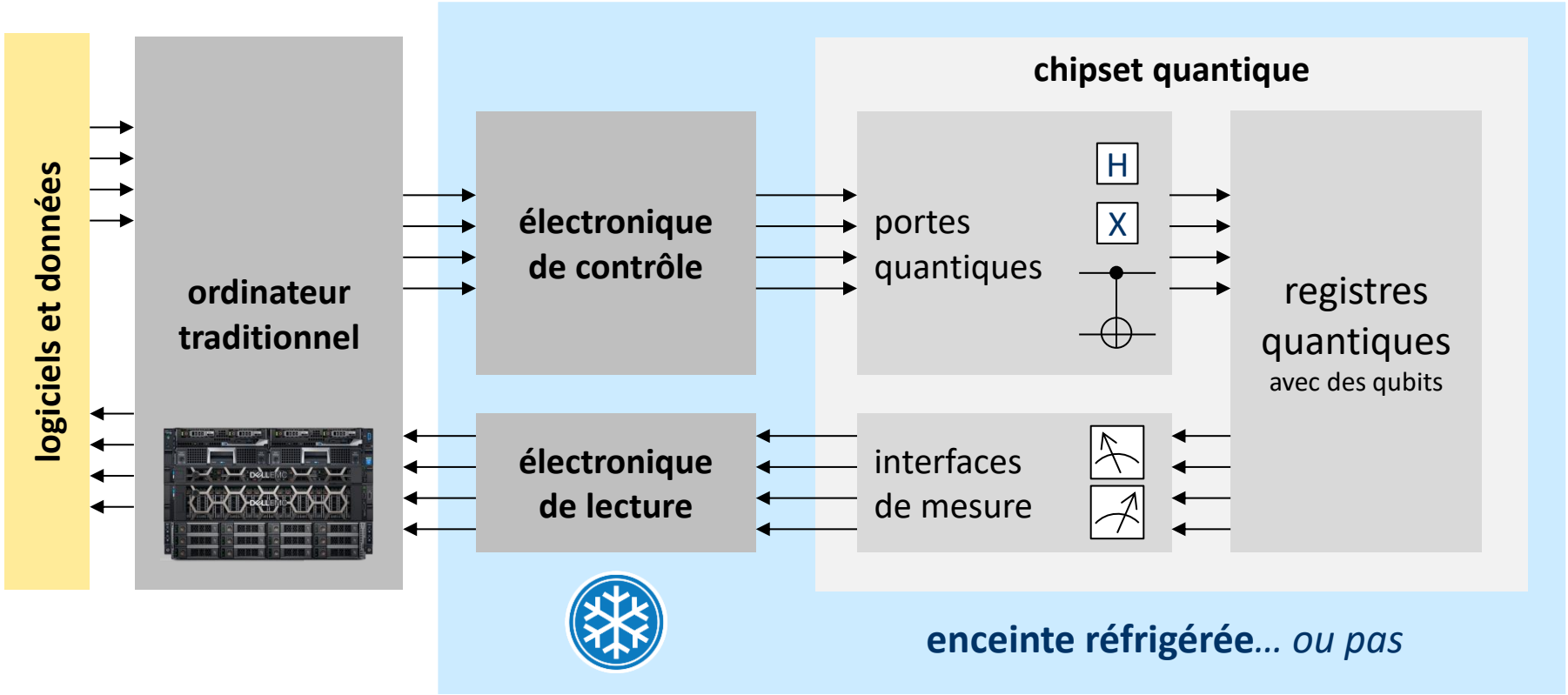


finance
optimisation de portefeuille
évaluation de risque
sécurité

énergie et chimie
optimisation de l'exploration
batteries et matériaux

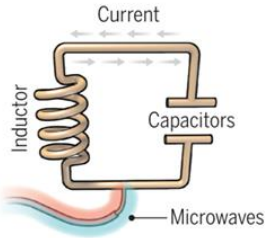
défense et renseignement
cryptographie / chiffrement
machine learning

ordinateur quantique = coprocesseur



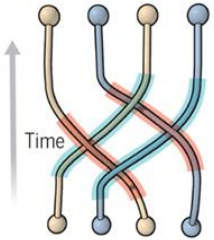
classes d’ordinateurs quantiques

simulateurs quantiques dans supercalculateur	ordinateurs **à recuit quantique**	ordinateurs quantiques **analogiques**	ordinateurs quantiques **universels**
pour tester les algorithmes quantiques	limité aux algorithmes d’optimisation	simulations de la physique quantique	exécute toutes sortes d’algorithmes quantiques



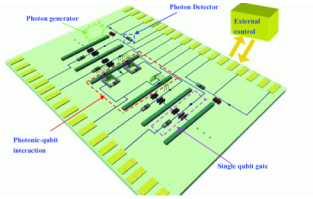
boucles supra-conductrices

IBM
intel Google
QUTech rigetti
qci UCSB
cea
OXFORD QUANTUM
Raytheon



qubits topologiques

Microsoft
NOKIA
TU Delft
QUTech

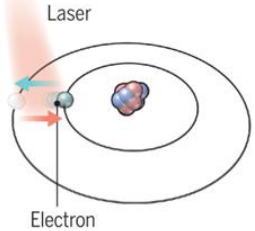


optique linéaire

XANADU hp
PSIQUANTUM
TUNDRA SYSTEMS GLOBAL LTD.
UNIVERSITY OF OXFORD
University of BRISTOL
universität wien
UNIVERSITÀ DEGLI STUDI DI MILANO
SAPIENZA UNIVERSITÀ DI ROMA

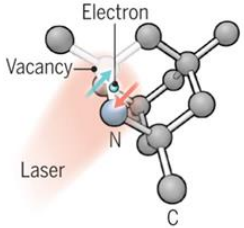
quantum dots silicium

intel
cea
Yale University
NTT
NOKIA



ions piégés

IONQ
MIT
UNIVERSITY OF MARYLAND 1856
Sandia National Laboratories
HARVARD UNIVERSITY
JG|U
universität innsbruck
IQI
IQST



impuretés diamants

QDTI
cea
MIT
UNIVERSITY OF MARYLAND 1856
TU Delft
Universität Stuttgart

startups du calcul quantique ds le monde

logiciels

QXBranch, ANYON Computing with Manufactured Quanta™, ProteinQure, BOHR, 1QBit, Q-CTRL, CQC Cambridge Quantum Computing Limited, quantumbenchmark, EVERETTIAN, HORIZON Quantum Computing, Tokyo Quantum Computing, STRANGE WORKS, QCWARE, Artiste-qb.net, ZAPATA, HEISENBERG, QILIMANJARO, NQCG, ENTROPICA LABS, HORIZON Quantum Computing, QBITLOGIC, ⟨b| e^it

ordinateurs

D-Wave, IONQ, SILICON QUANTUM COMPUTING, XANADU, universität innsbruck, Quantum Motion Technologies, TUNDRASYSTEMS GLOBAL LTD., rigetti, MDR, PSIQUANTUM, BraneCell, OXFORD QUANTUM TURING, qci, EeroQ, MDR

composants

Sparrow Quantum, SEEQC, CryoConcept, μQUANS, Delft Circuits quantum computing hardware, QUANDELA, OXFORD INSTRUMENTS, BlueFors CRYOGENICS, Qnami, BRA-KET SCIENCE, CRYOMECH, JANIS, NANO-META, elementsix, Qubitekk, ColdQuanta, SPICE LABS

écosystème français du calcul quantique

recherche

entreprises

logiciels

ordinateurs

composants

Prevision·io

AtoS — langage aQasm

AtoS — simulateur HPC AQML

IBM France

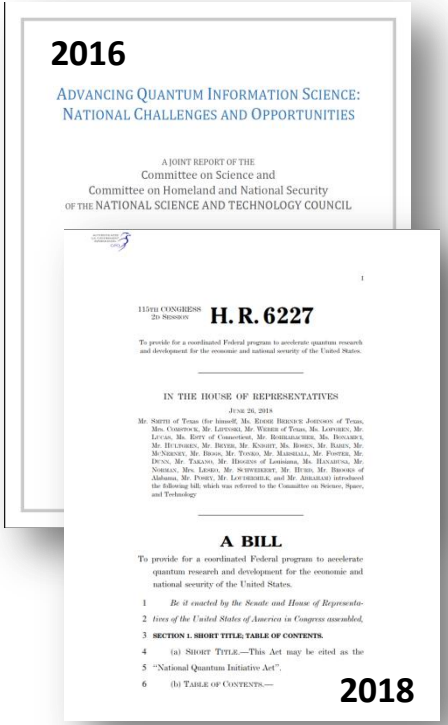
QUANDELA

CryoConcept

MYCRYO FIRM Cryodevices & Consulting

stratégies industrielles publiques

USA

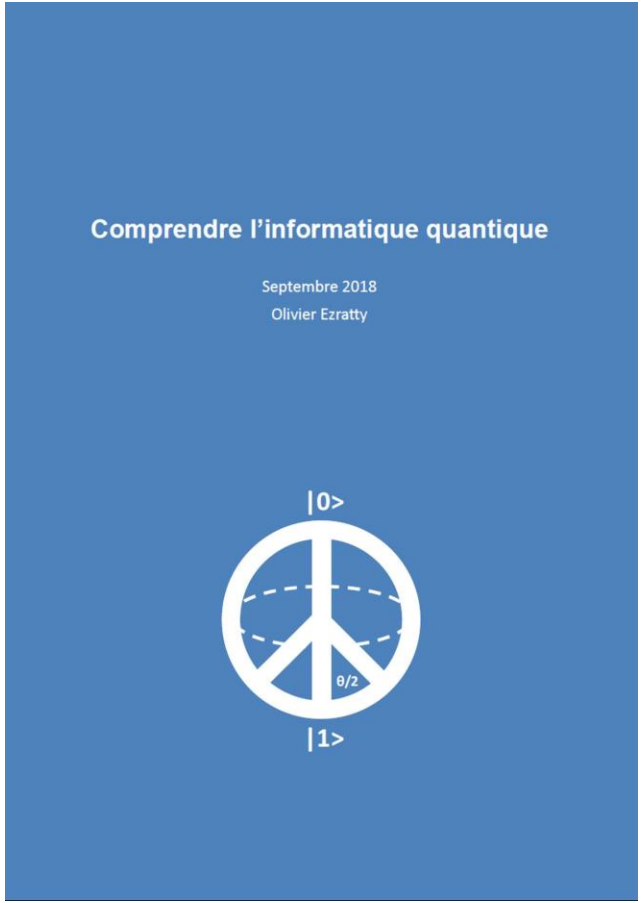


Europe

Asie

grandes questions

enjeux matériels ?

enjeux logiciels et de plateformes ?

que font la France et l'Europe ?