CINECA

QUANTUM COMPUTING UPDATE

HPC AND QUANTUM COMPUTING 2021

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Quantum As A Service

Upgrading our HPC computational power with quantum computing resources

HIGH PERFORMANCE COMPUTING PROGRAMME

ISCRA
CINECA

- ISCRA (Italian SuperComputing Resource Allocation) is a CINECA project with the aim of make available our HPC resources to Italian universities and research centers
- Access to HPC resources is regulated by **periodic calls**. In order to request calculation time, **the applicant must prepare a proposal** and submit it by the deadline of the call of his interest
- The proposal are **scientifically evaluated by international reviewers** and **technically evaluated by Cineca experts**
- Applications and codes are **evaluated on the basis of their computational readiness**
- **All this takes place under the patronage of the Ministry of University and Research: this implies that the calculation hours are assigned free of charge.**

HIGH PERFORMANCE COMPUTING PROGRAMME

ISCRA
CINECA

- Two types of call (B and C) available for accessing **Marconi100 and other HPC resources**:
  - **Class B: Standard Projects**; two calls / year
  - **Class C: Small Projects**; monthly calls, 10 selections per year (only technical evaluation)
- **Since March 2021, it is possible to request also <u>quantum computing resources</u>**
- In this **initial phase**, the quantum resources option is a part of the **Class C ISCRA Projects**
- **Projects lasting no more than 9 months but frequent calls**
- https://www.hpc.cineca.it/services/iscra

QUANTUM ANNEALERS SERVICE

D-Wave
The Quantum Computing Company™

- D-Wave Quantum Annealing Resources
  - Access to the **latest quantum annealer** model: ***Advantage*** (5000+ qubits, average degree of each node equal to 15)
  - Access to **D-Wave hybrid systems**, which allow you to solve optimization problems **up to a maximum of 1 million binary variables**
  - Access to the new **DQM (Discrete Quadratic Models) solver**, that can solve **non-binary quadratic problems**
  - **Total hours** available to users: **5 per month** for 11 months (March 2021 - March 2022, August excluded)

QUANTUM SIMULATORS SERVICE

- Pasqal Quantum Computing Resources:
  - Access to the **latest neutral atoms quantum simulator model: *Fresnel*** (quantum simulator with **100 qubits**)
  - High scalability: **over 1000 qubits expected** within a couple of years
  - Hybrid predisposition: Pasqal vision is to have one of **the first quantum computer to support high speed connectivity with HPC supercomputers (hybrid algorithms)**
  - **Experimental system not yet open to the public**: initial **scientific collaboration** and **creation of environments to prepare** the scientific community for the use of the quantum machine

HPC QUANTUM EMULATORS: PASQAL/UNIVERSITY OF PADUA

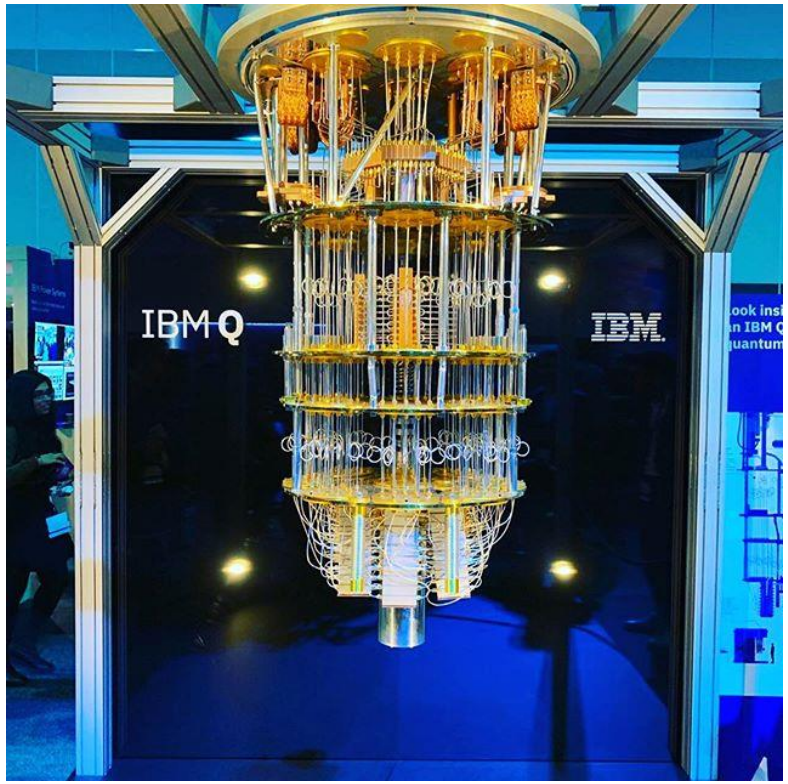
UNIVERSITÀ DEGLI STUDI DI PADOVA

PASQAL

- Project in collaboration with **Professor Simone Montangero (University of Padua)** and **Pasqal**
- Development of an **emulator for general purpose quantum computing** systems running on **CINECA supercomputer MARCONI-100**
- At the same time, the code will be integrated to **emulate also Pasqal's neutral atoms analog systems**
- MARCONI-100
  - **Nodes:** 980
  - **Processors:** 2x16 cores IBM POWER9 AC922 at 3.1 GHz
  - **Accelerators:** 4 x NVIDIA Volta V100 GPUs, Nvlink 2.0, 16GB
  - **Cores:** 32 cores/node
    RAM: 256 GB/node
  - **Peak Performance:** ~32 PFlop/s

IBMQ AND CINECA FOR GENERAL PURPOSE QC

IBM Q



- The **friendship between IBM and CINECA** begins long before the advent of quantum computing.
- **IBMQ takes research very seriously**. Among their **initiatives** to promote culture in the field of **quantum computing** we mention:
  - **Unlimited and free access** to some of their quantum machines through the web-site https://quantum-computing.ibm.com
  - **Collaborations** with **research doctorates** and **high-level training**
- IBMQ also **provides access to their most advanced machines** to some promising **selected projects**. We at **CINECA can help in the selection process** by giving **technical support** and the possibility to **emulate big general purpose systems on our machines**.
- **Currently there is no official agreement of partnership**

QUANTUM COMPUTING LAB

www.quantumcomputinglab.cineca.it

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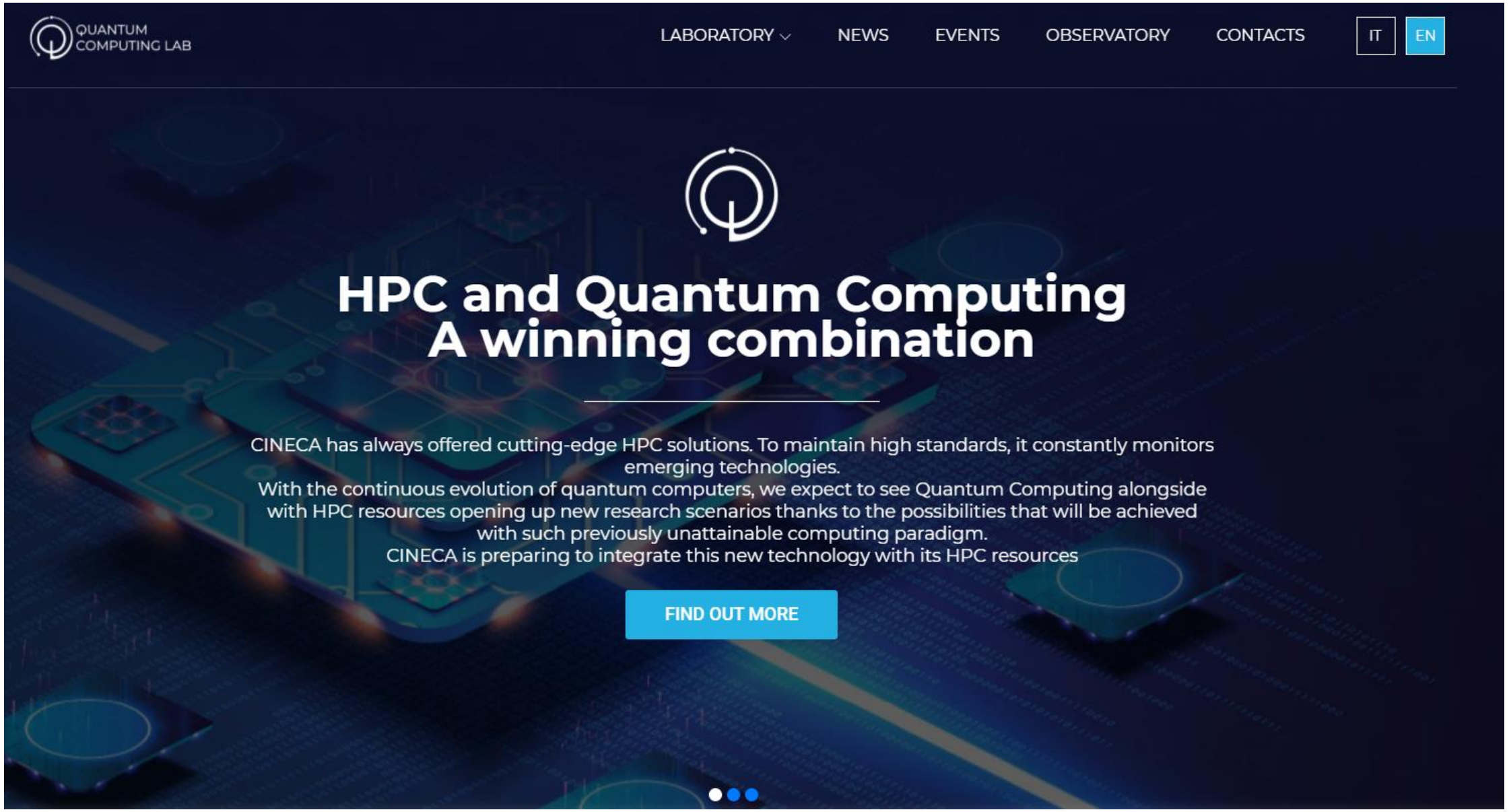
- CINECA **website dedicated to quantum computing**.
- What can I find on the website:
  - **Continuous** Quantum Computing State of the Art **monitoring**
  - Guidelines on using **Cineca QC systems (emulators and quantum resources)**
  - **Recordings and materials** of all the CINECA events regarding QC
  - **Free access** to QC material, tutorials.
  - **News and detailed informations** about our or our partners **courses or events**
  - **Events, news and updates** regarding the world of QC in general

QUANTUM COMPUTING LAB



THANKS

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