

# POLO DE TECNOLOXÍAS CUÁNTICAS DE GALICIA

## Installation and integration of a Quantum Computer in a Supercomputer Center

Benasque, 29th September 2023

# Agenda

---



Current Infrastructures



Quantum Technologies Pole



Quantum system installation



Conclusions



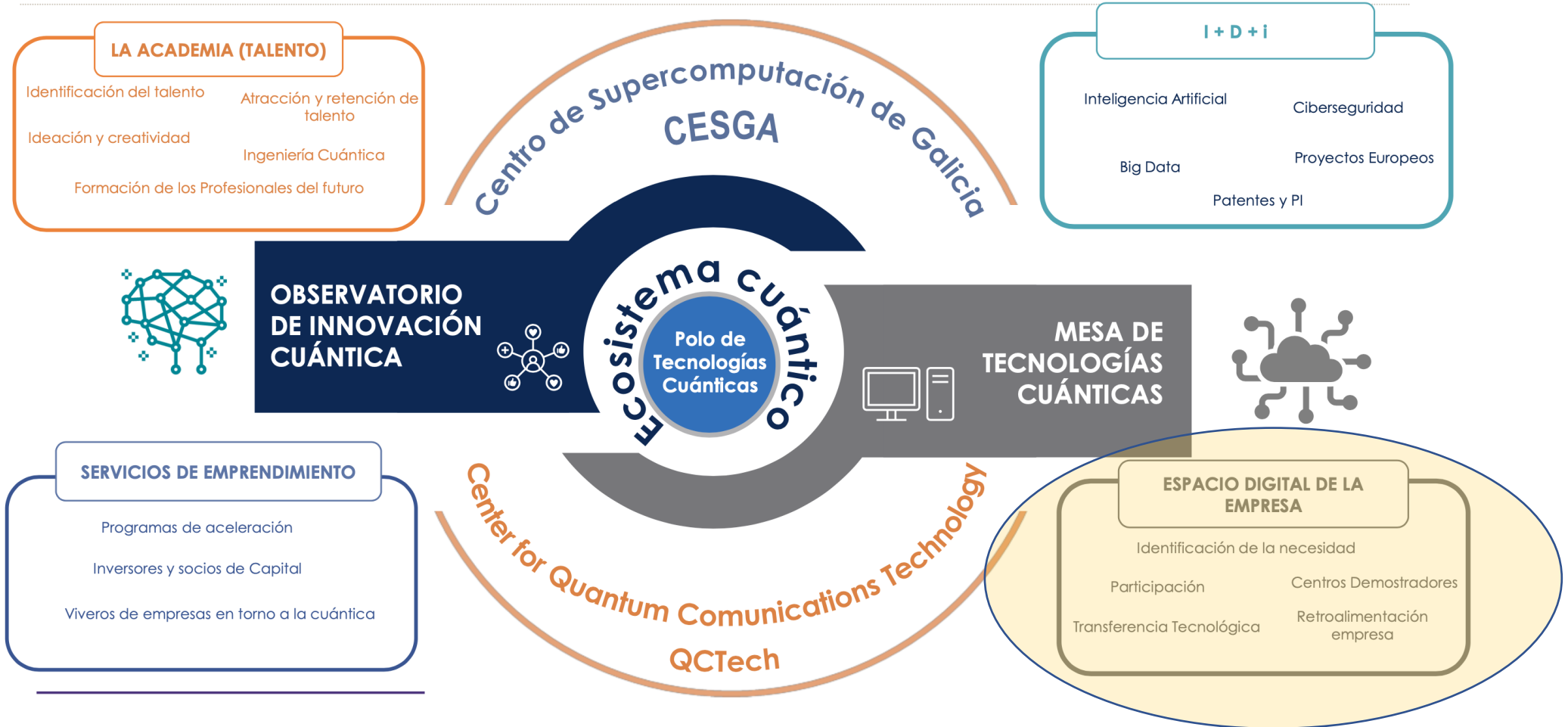
# Advanced Computing Infrastructures

- Finisterrae III
- Massive data storage
- Bigdata
- Cloud
- Quantum systems:
  - Quantum simulator (ATOS QLM)
  - Quantum Random Number Generator Quside QRNG



## Propuesta de la Estrategia General

### Esquema general de la Estrategia Cuántica



# Galicia Quantum Technologies Pole

---

- Mission 2021-2030: Achieve a disruptive boost to Quantum Technologies in computing and communications, in Galicia and Spain, for the advancement of Science, Technology and the Economy, for the benefit of society
- Led by CESGA and the Vigo Quantum Communications Center (VQCC) of the University of Vigo, with the participation of the Universities of Coruña and Santiago de Compostela.
- Infrastructures investment plan

# Quantum Computing Infrastructure

- Deployment of Quantum Computing Infrastructure:
  - 1 Quantum Computer
  - 2 Quantum simulators
  - 1 HPC dedicated system for Quantum
  - 1 Quantum Random Number Generator
- Research in Quantum Computing
  - Algorithms
  - Benchmarking

## Actividades financiadas por:



Despliegue de una infraestructura basada en tecnologías cuánticas de la información que permita impulsar la I+D+i en Galicia. Operación financiada por la Unión Europea, a través del FONDO EUROPEO DE DESARROLLO REGIONAL (FEDER), como parte de la respuesta de la Unión a la pandemia de la COVID-19. PROGRAMA OPERATIVO FEDER 2014-2020 *Una manera de hacer Europa*



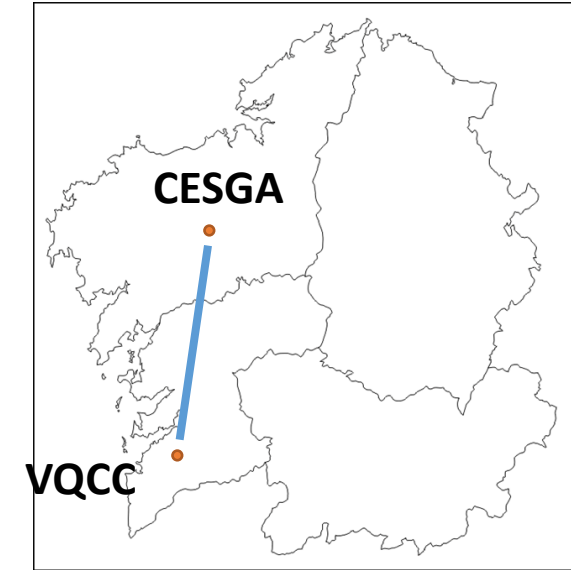
Este proyecto recibe financiación del programa de investigación e innovación Horizonte 2020 de la Unión Europea en virtud del acuerdo de subvención n.º 951821.



Apoyado económicamente por el Ministerio de Asuntos Económicos y Transformación Digital del Gobierno de España a través de la convocatoria del proyecto QUANTUM ENIA - proyecto Quantum Spain, y por la Unión Europea a través del Plan de Recuperación, Transformación y Resiliencia NextGenerationEU en el marco del Proyecto España Agenda Digital 2025.

# Quantum Communications Infrastructure

- CESGA:
  - Deployment of QKD link between Santiago and Vigo
  - Demonstration of real use cases for a QKD link
- Vigo Quantum Communications Center VQCC
  - Development of three experimentation laboratories in Quantum Comms.
  - Empowerment of Research lines

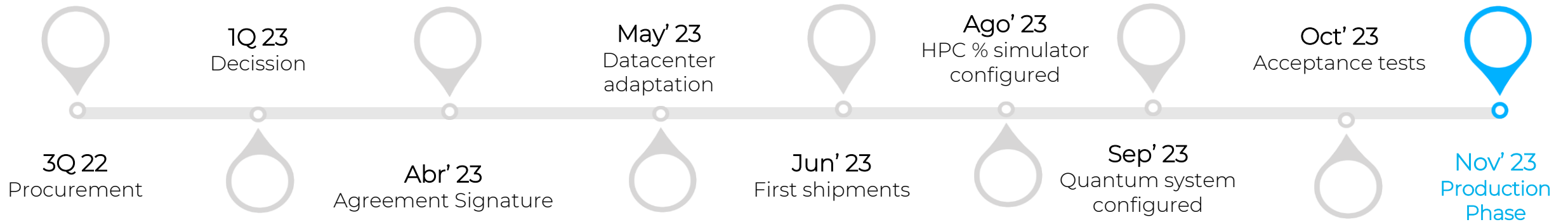


Actividades financiadas por:

## Financiación del Plan Complementario de Comunicaciones Cuánticas



# Quantum Computer Installation Timeline



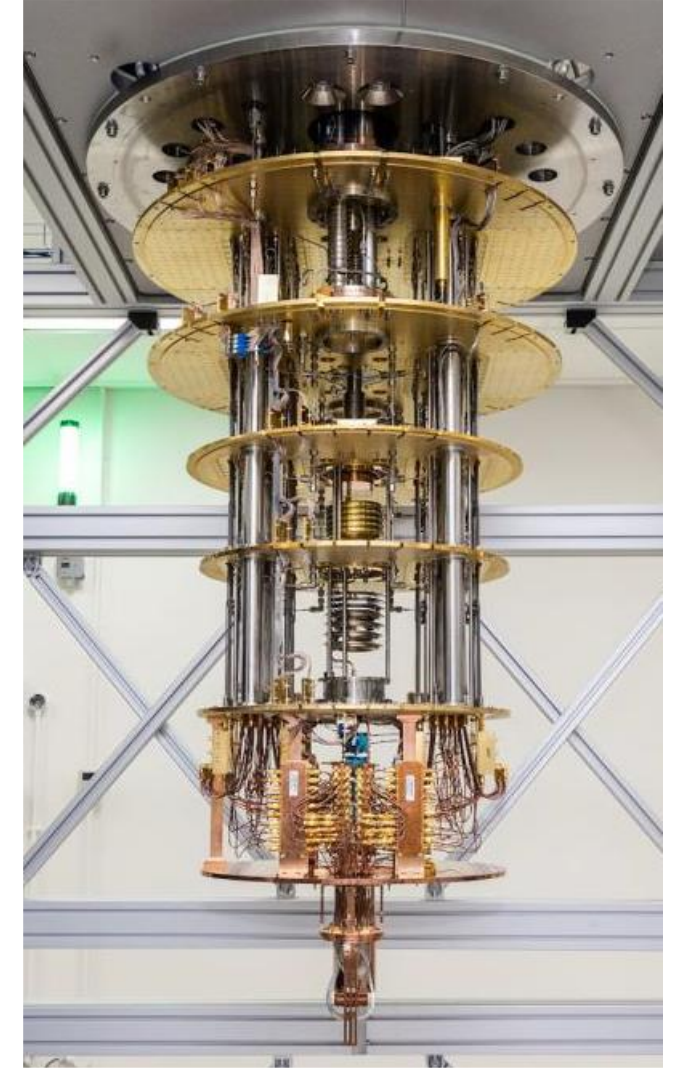
**Current status:** Equipment installed, configuring the system (qubits characterization)



# Quantum Computer

---

- Oxford Quantum Circuits
  - 32 qubits QPU superconducting
  - Universal gate-model quantum computer
  - Proprietary Coaxmon 3D architecture
  - OpenQASM Estándar Gate Set (1 & 2 qubit gates)
- HPC Fujitsu
  - 20 compute nodes: 2xIntel Xeon Gold 6338, 1TB memory, Infiniband HDR
- Quantum Simulator FX700 Fujitsu
  - 16 nodes: 1xA64FX, 32GB memory, Infiniband HDR
  - mpiQulacs

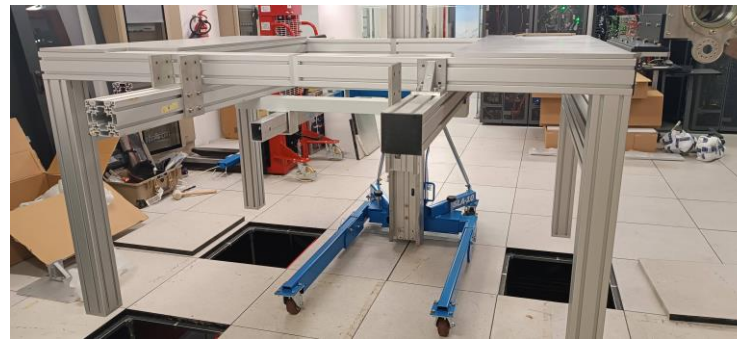


# Quantum system deployment

- Deadline (6 months)
- Height Requirements, Vibrations
- Cryostat
  - 10mk-25mk QPU Temperature
  - Helium, Nitrogen, water (compressors)
- 2 Cooling racks
  - Dilution refrigerator (vacuum and cooling)
- 2 Control racks
  - QPU operation
- 1 Networking rack
  - Input/Output to the system
  - Integration with HPC system



# Quantum System installation



# Conclusions

---

- Installation unlike any other equipment
- Little experience in the HPC environment (more used to “laboratories”)
  - Infrastructure
  - Operation mode
  - Software
- Less demanding requirements in terms of:
  - Power
  - Refrigeration
- Challenges:
  - Operation
  - Integration

