EuroQHPC-I

EuroHPC
Joint Undertaking

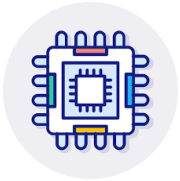
European Plans on Quantum Computing

Martin Schulz @ InPEX 2026, Rio/Niteroi, Brazil

With material from the EuroQHPC-I consortium and (in particular) Sabine Mehr

EUROPEAN QUANTUM EFFORTS

Major Thrust Areas



On Premise HPCQC Access

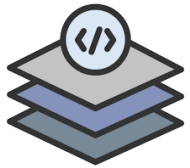
- ❑ 10 Systems funded and being stood up
- ❑ Integration with HPCQC Systems

QC as HPC Accelerator

- ❑ Supporting key application areas

Towards Common User Experience

- ❑ Access for European researchers
  - Common application procedures
  - Common access mechanisms
  - Common scheduling environments
- ❑ Similar software environments
  - Enabling easy portability



Towards a Common Software Stack

- ❑ Homogenization of software stacks
  - Separation of back-end & front-end
  - Sharing wide-reaching optimizations
- ❑ Portable interfaces
  - QDMI as one example for backends
  - Investigations of efficient IRs

Towards Quantum Utility

- ❑ End-user Engagement, incl. Industry
  - Quantum Excellence Centers
  - Development of higher-level abstractions
- ❑ Training and Support at EuroQHPC-I
  - Connected to common user journeys
  - Coordination with local projects

EuroQHPC-I

A bit of context on the EuroHPC Quantum Computing initiative…

THE EUROHPC QUANTUM COMPUTING INITIATIVE

Two pilot systems acquired for the HPCQS project

2 **100+-qubit quantum simulators** acquired in the context of ⟨HPC|QS⟩

15 **partners** in total

6 **countries** involved

GENCI/CEA **RUBY**

FZJ **JADE**

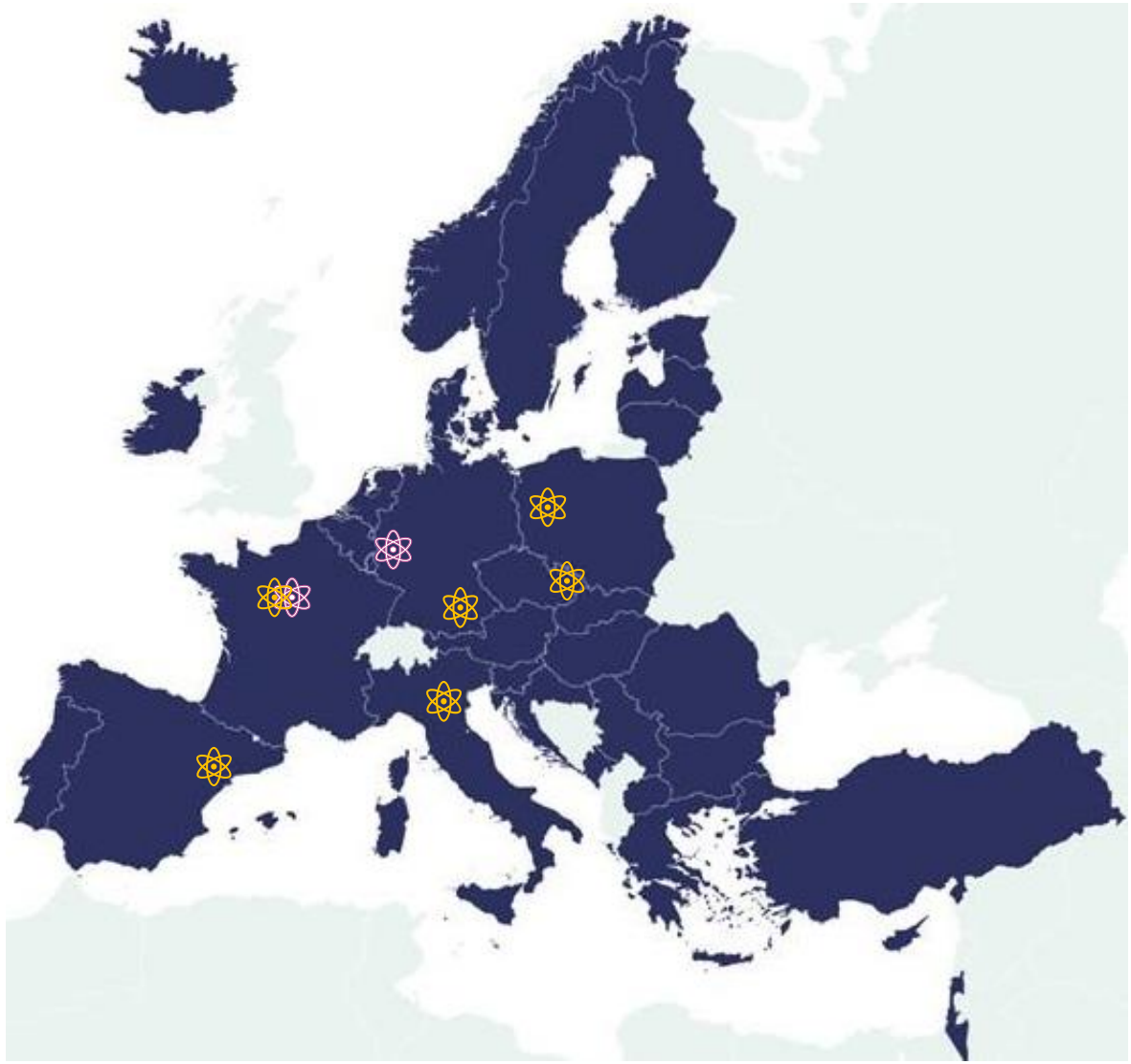
THE EUROHPC QUANTUM COMPUTING INITIATIVE

Six additional quantum computers acquired

6 **10+-qubit quantum computers** acquired through a call for expression of interest (CEI)

30 **partners** in total

17 **countries** involved



EuroQCS-France
GENCI/CEA

Euro-Q-Exa
LRZ

EuroQCS-Italy
CINECA

Lumi-Q
IT4I @ VSB

EuroQCS-Poland
PSNC

EuroQCS-Spain
BSC-CNS

THE EUROHPC QUANTUM COMPUTING INITIATIVE

Six additional quantum computers acquired

EuroQCS-France GENCI/CEA	LUCY	Photonic quantum computer	QUANDELA
Euro-Q-Exa LRZ		Superconducting qubits	IQM
EuroQCS-Italy CINECA		Neutral atoms	PASQAL
Lumi-Q IT4I @ VSB	VLQ	Superconducting qubits with a star-shaped topology	IQM
EuroQCS-Poland PSNC	PIAST-Q	Trapped ions	AQT
EuroQCS-Spain BSC-CNS	MN-ONA	Quantum annealer	QILIMANJARO QUANTUM TECH

THE EUROHPC QUANTUM COMPUTING INITIATIVE

Seven different flavors of HPC-QC infrastructures

PASQAL

⟨HPC|QS⟩

PASQAL

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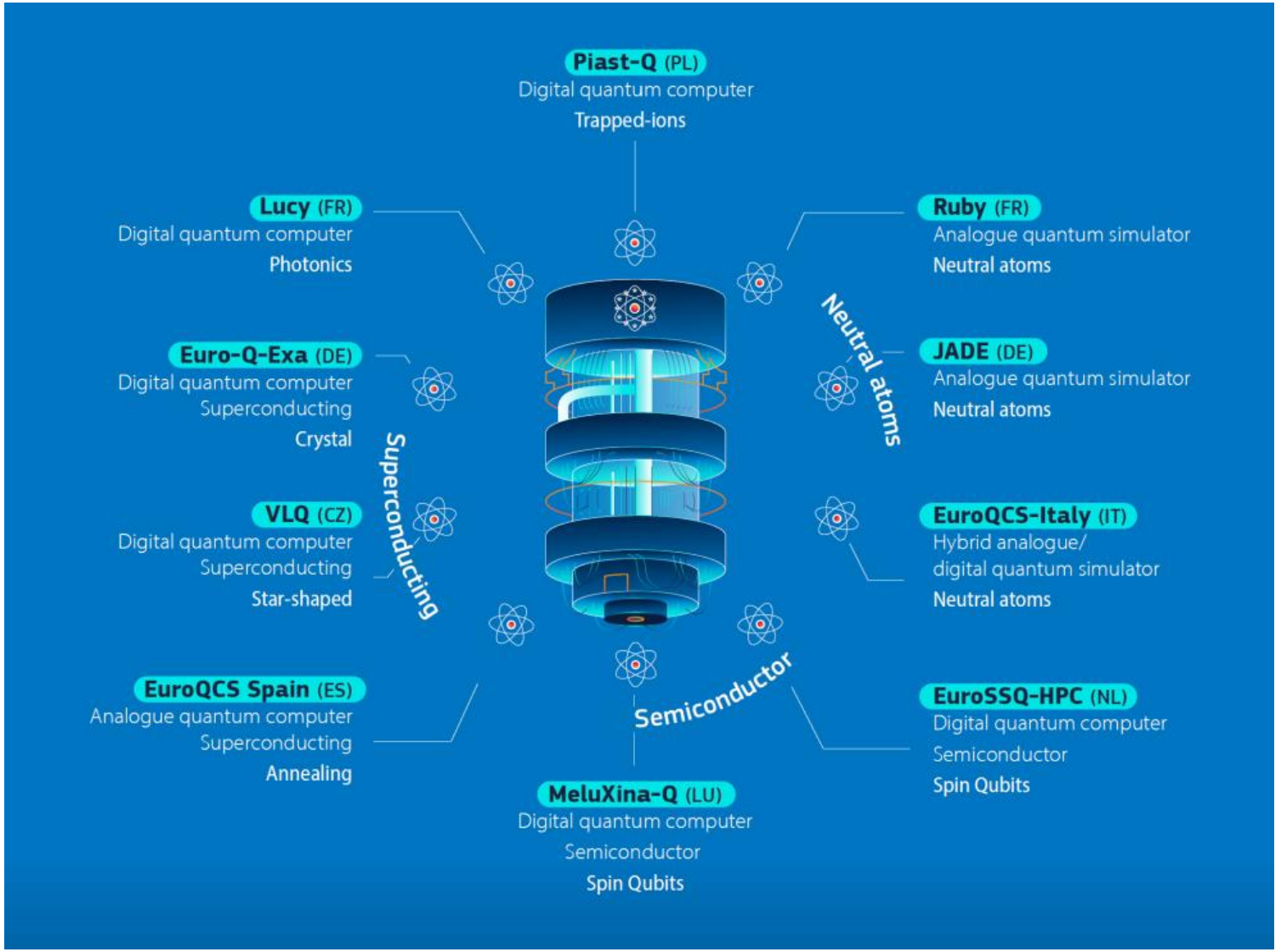
THE EUROHPC QUANTUM COMPUTING INITIATIVE

Two more systems in the procurement phase

Additional procurements

- Two additional sites
  - EuroSSQ-HPC (NL)
  - MeluXina-Q (LU)
- Focus on spin-qubits
  - Additional technology covered
  - Again as HPCQC systems
- Status
  - EuroSSQ-HPC: Under evaluation
  - MeluXina-Q: Tender expected soon



IDENTIFIED QC-USE CASES AND APPLICATIONS

Broad spectrum and growing

Domain	Sector	Platform	Method
Fluid Dynamics (FDTD/ FEM)	Industry	Hybrid HPC-QC	Quantum Approximate Optimization Algorithm (QAOA)
Drug Discovery	Chemistry	Hybrid HPC-QC	Variational Quantum Eigensolver (VQE) Fault-Tolerant Quantum computing (FTQC)
Risk Analysis	Finance	QC	Variational Partial Differential Equation (VPDE) Quantum Monte Carlo (Q-MC)
Portfolio Optimisation	Finance	QC	Quantum Approximate Optimization Algorithm (QAOA) Genetic Quantum Annealing Algorithm (GA)
Scheduling Problems	Logistics	QC	Quantum Approximate Optimization Algorithm (QAOA) Quantum Adiabatic Algorithm (QAA)
Kernel based QML	Nat. Lang. Proc.	QC-AI	Quantum Machine Learning (QML) Quantum Generative Adversarial Network (QGAN)
Satellite Image Analysis	Earth Observation	QC-AI	Quantum Neural Networks (QNN)
Condensed Matter Physics	Science	QC-AI	Quantum Machine Learning (QML)
Medical Image Classification	Medicine	QC-AI	Quantum Machine Learning (QML)

Slide by Rene Chatwell, EuroHPC

EuroQHPC-I

How are the EuroHPC centers collaborating on HPC-QCS integration?

THE EUROHPC QUANTUM COMPUTING INITIATIVE

The EuroQHPC-Integration project

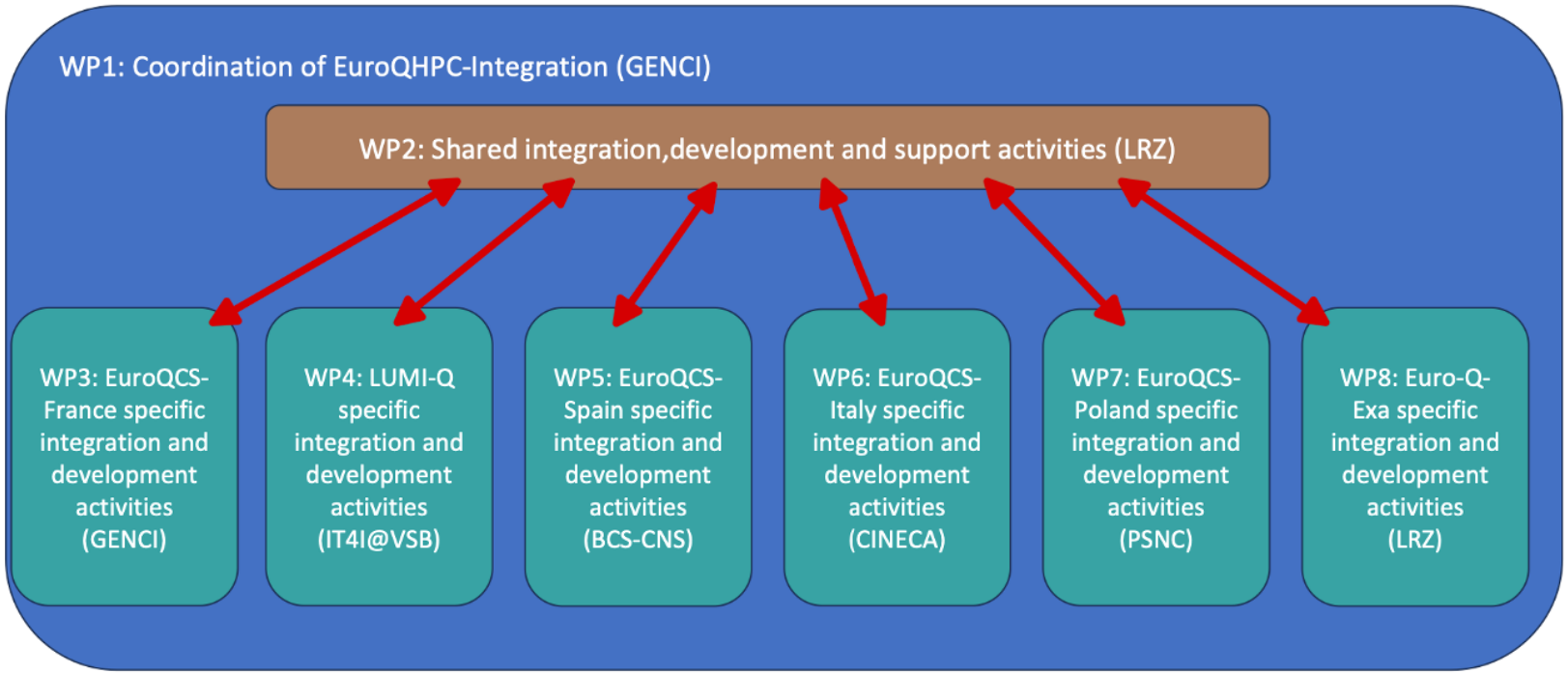
Coordinated by GENCI
HPC at the service of knowledge
Coordinator: Sabine Mehr
Integration WP: Martin Schulz

Partners & affiliated entities involved:

- All partners from the initial six hosting sites
- Will be coordinated with the new sites as they come online)
- HPC-QS partners are associated

Goal:

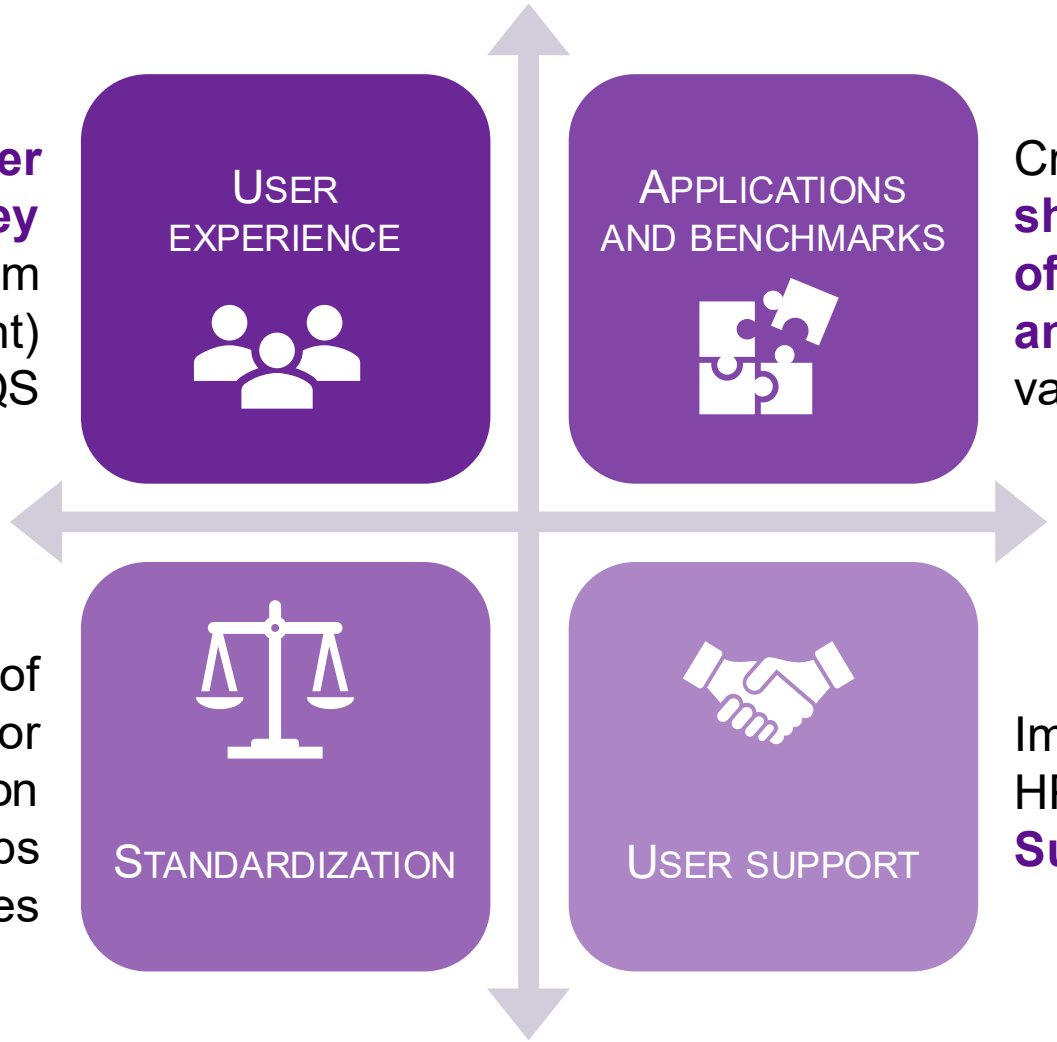
- Harmonize the respective HPC-QC integration strategies
- Bridge the differences between all EuroHPC quantum devices
- Connect the work and the users of all systems
- Towards common technologies



THE EUROQHPC-INTEGRATION PROJECT

Key Drivers and Goals

Harmonization of the user experience and journey for the EuroHPC quantum systems across the six (eight) Hosting Entities and HPCQS



Creation of a repository of **shared collection of proof-of-concept applications and benchmarks** running on various hybrid systems

Collaboration with/Creation of **standardization bodies** for key interfaces and participation in relevant working groups and committees

Implementation of an HPC-QC **Technical Support Team**

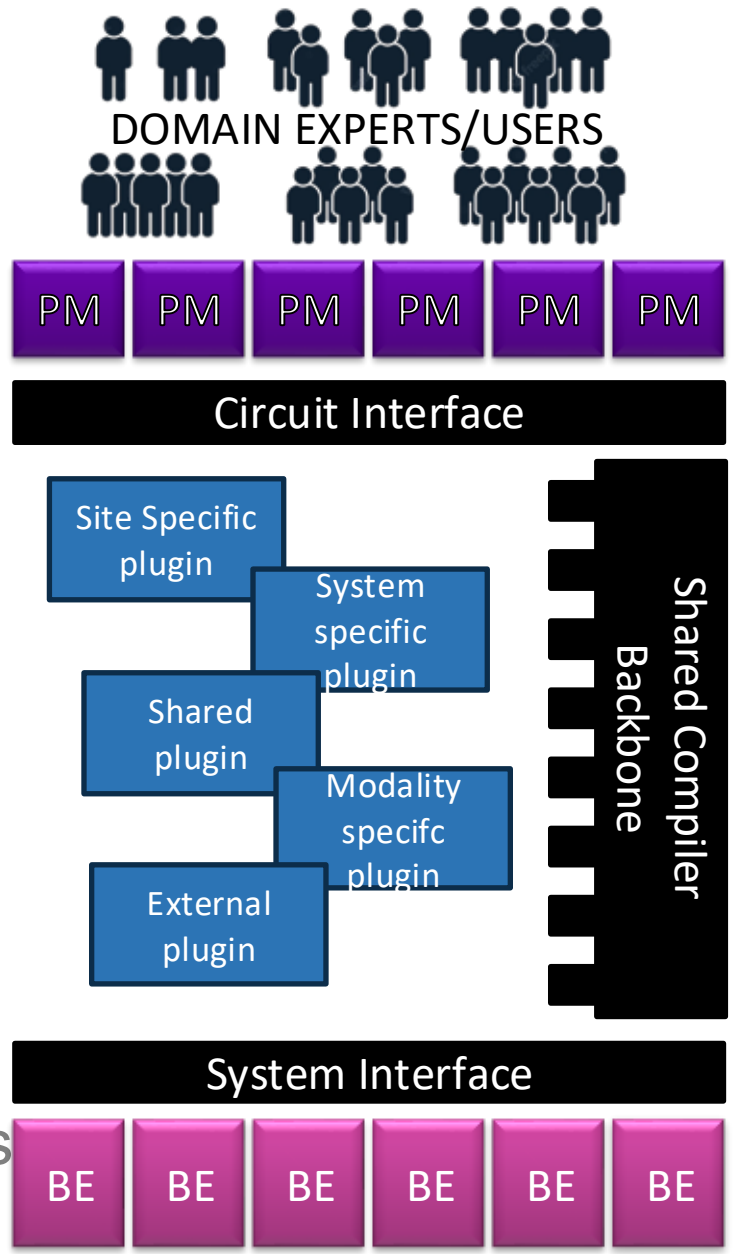
THE EUROHPC QUANTUM COMPUTING INITIATIVE

The Technical Vision Towards a Shared Software Stack

- EU Compare and share **local developments**
  - Draw from **national and regional efforts**
  - Identify **common elements**
  - Embrace **local differences** (e.g., system setup, coupling, etc.)

Vision: shared core infrastructure that is adjustable to site requirments to support sharing of local developments

- 🎯 Central: shared **interfaces** and **representations**
  - Towards **common programming models** & **abstractions**
  - **Support/Backends** for all EuroHPC systems
  - **Merging functionality** (e.g., compiler passes)
- 🎯 Common scheduling environment for hybrid workflows



THE EUROHPC QUANTUM COMPUTING INITIATIVE

Defining Shared Interfaces Across the EU Communities (and Beyond)

EU Integrate national and regional efforts

🚀 Feedback to standardization efforts

- 💡 As we are jointly moving forward with the HPC-QCS integration in Europe, it's crucial our experience and learnings are integrated in standards

🎯 Liaise with existing **standardization bodies** and participate in **relevant working groups** and/or **support grass-root standardization efforts**

IEEE QUANTUM

CEN CENELEC

Focus Group on Quantum Technologies

QUANTUM FRANCE 2030

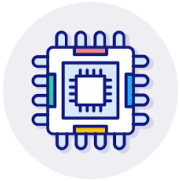
BACQ

MetriQs-France

openQSE

EUROPEAN QUANTUM EFFORTS

Summary of Major Thrust Areas



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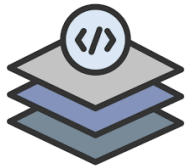

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