HEP Oriented Quantum Computing Platform in IHEP

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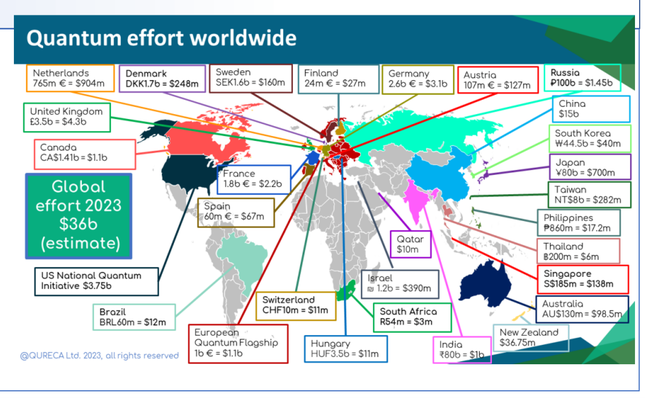
Why to Build Such A Platform?

Quantum computers have a significant acceleration advantage over electronic computing

- One of the most promising directions of scientific computing
- A possible solution of problems difficult for classical computers
- Over 25 countries/regions launched Quantum Initiatives
- Developing quantum programs has a relatively high barrier to entry

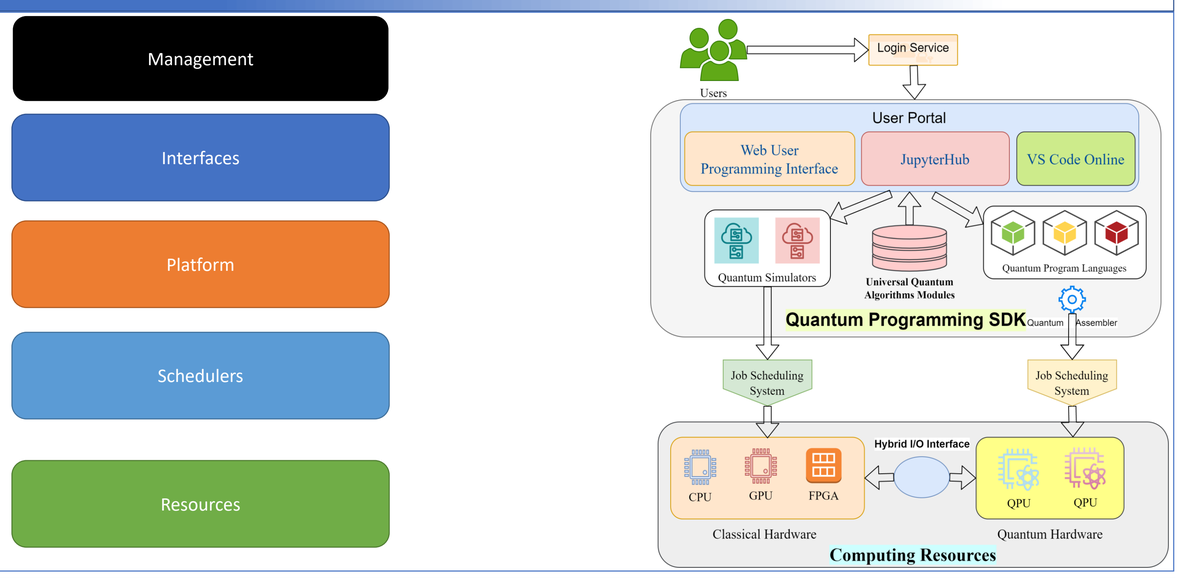


Platform Overview

A computing & simulation platform targeted for HEP

- Focusing on quantum computing in HEP analysis
  - Assist to explore quantum algorithm in LQCD , BES, LHAASO…
- Full-stack computing quantum platform including
  - Frameworks, interactive GUI, Simulators and Assemblers
- Integrated with various interactive developing interfaces
  - Jupyter, composer and coder online
- A distributed heterogeneous computing platform
  - Joint CPU/GPU resources, classical and quantum computing resources

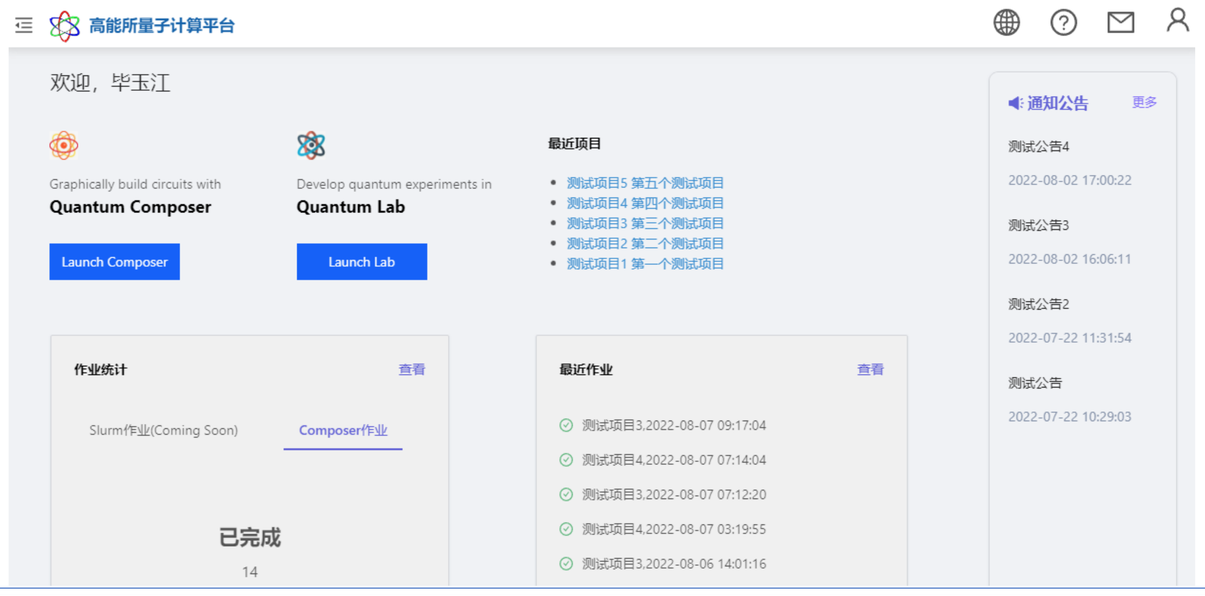
Platform Architecture



Dashboard

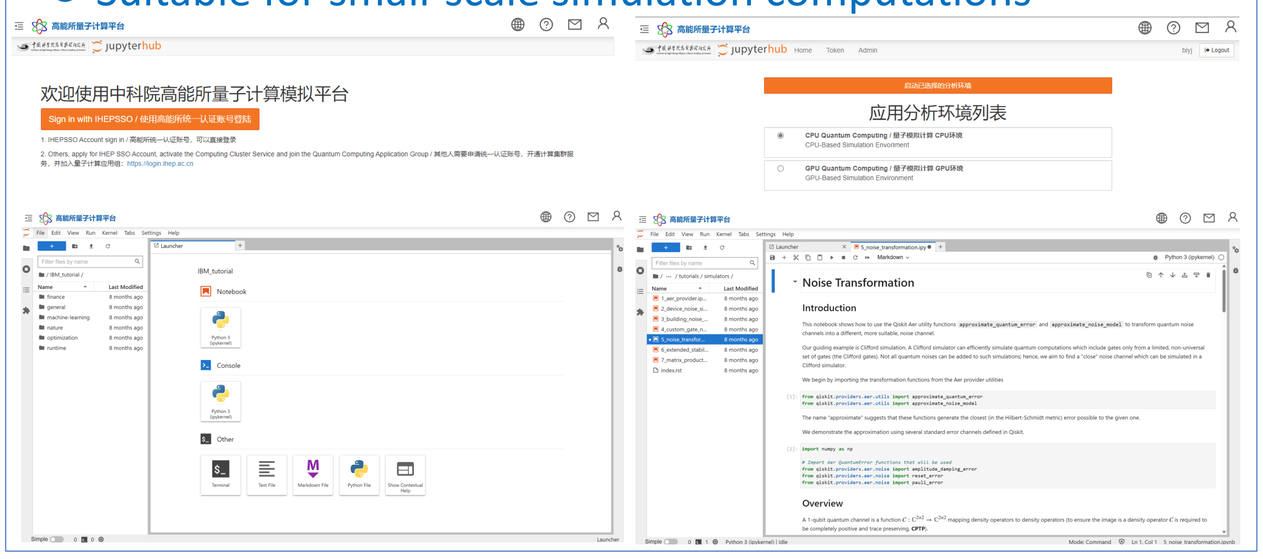
Default interface of cloud platform, including

- Entries of main interfaces, monitoring and announcement



Jupyter Interface

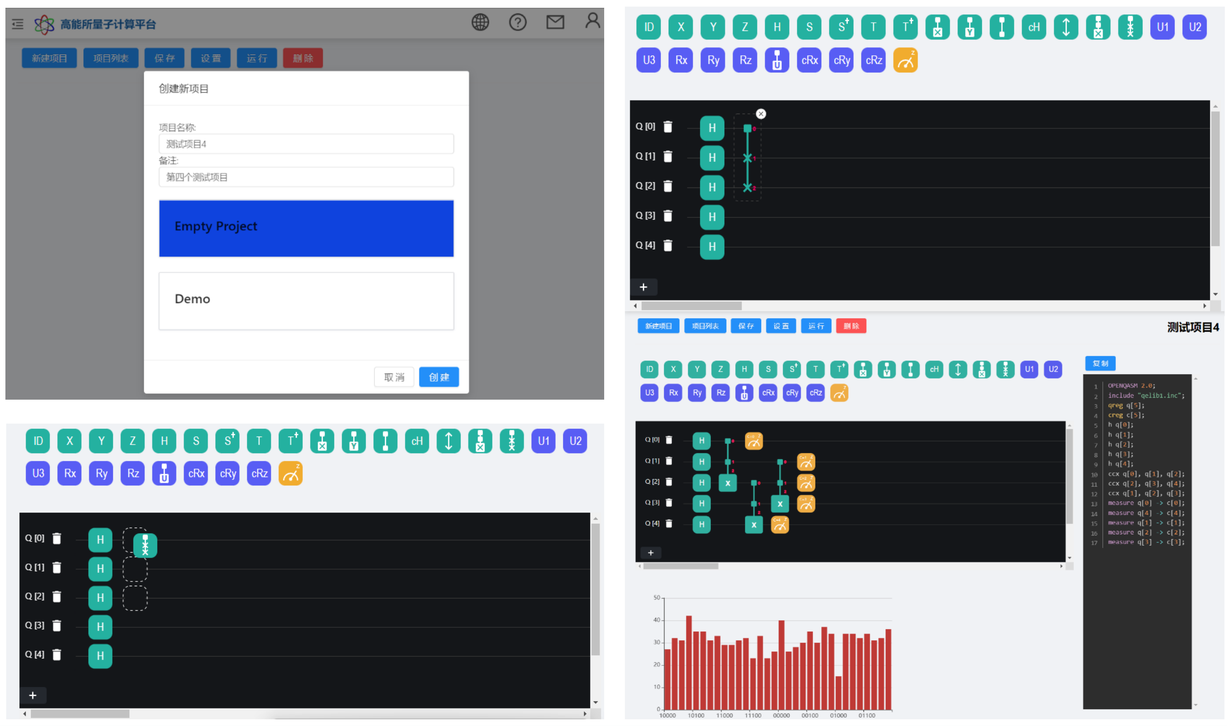
- Combined with IHEP SSO and AFS
- Two computing environments: CPU and GPU
- Suitable for small-scale simulation computations



Composer Interface

A drag-and-drop interactive developing interface

- Manage through project-based methodology
- Providing templates to help users get started quickly
- Five major sections
  - Gates, composer, taskbar, QASM section and display area



JupySlurm Plugin

A Python module that combines Jupyter and Slurm

- Allowing user to submit job from container to Slurm cluster
  - In a console or a Jupyter notebook
- Using Slurm Restful API to interact with Slurm
- Providing a user client

```
class Slurm():
    def __init__(self, host:str = "http://slurm06.ihep.ac.cn",
                 port:int = 443, krb5:bool = True, krb5cc:str = ""):
        if host is None or port is None:
            raise ValueError("host and port cannot be both None")
        self.host:str = host
        self.port:int = port
        self.token:Union[str,None] = ""
        self.ttl:int = 0
        self.token_tm:int = int(time.time())
        self.groups:List[int] = os.getgroups()
        self.headers:Dict[str,Any] = {"Content-Type":"application/json", 'X-SLURM-USER-NAME':self.user, 'X-SLURM-USER-TOKEN':self.token, "Connection": "Close"}
```

```
┗[~/cc/slurm.py/slurm]─|> cli.py -h
usage: pyslurm [-h] [-s [SERVER]] [-p [PORT]] [-k] [-f [KRB5CC]] cmd [arg [arg ...]]

positional arguments:
  cmd                   Slurm subcmd
  arg                   Args for subcmd

optional arguments:
  -h, --help            show this help message and exit
  -s [SERVER], --server [SERVER]
                        Restful Slurm API Server. Default: https://slurm06.ihep.ac.cn
  -p [PORT], --port [PORT]
                        Restful Slurm API Port. Default: 443
  -k, --krb5            KRB5 Authentication
  -f [KRB5CC], --krb5cc [KRB5CC]
                        KRB5CC file name
```

Outlook

- Collaborating in quantum computing application
  - Quantum ML, quantum field simulation…
- Assist physicists in quantum simulation calculations
  - To improve the speed and efficiency of simulations
- Education and Training on Quantum Computing