The state-of-the-art quantum technology

The Transformer & its Applications to High Energy Physics Problems

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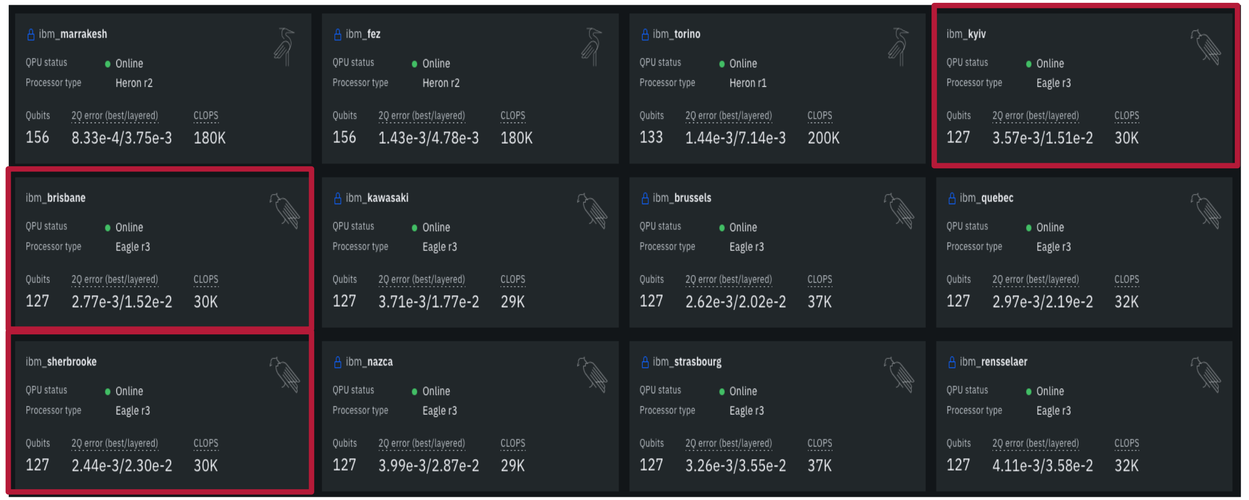
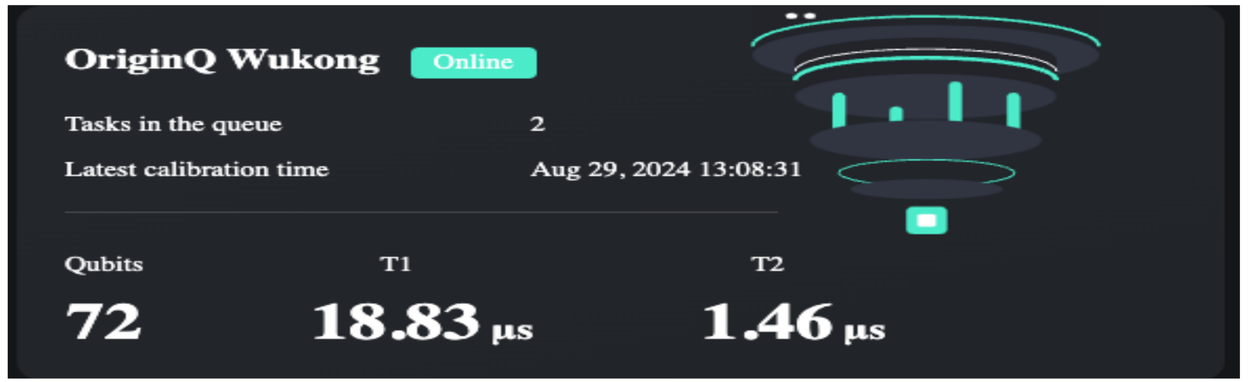
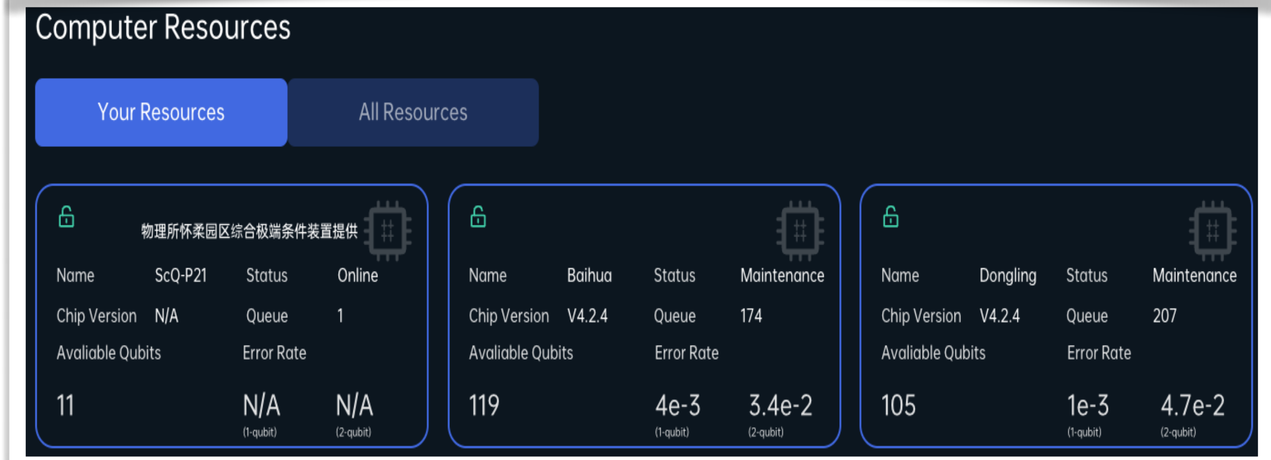
Quantum computer hardware

- **IBM hardware:**
  - Log in here: https://quantum.ibm.com
  - Username: Abdualazem.Fadol@gmail.com
  - Password: Ihep@2024-2025
  - Three devices are available with 127 qubits.
- **OriginQ hardware:**
  - Log in here: https://qcloud.originqc.com.cn
  - There's no free quota. We have up to 72 qubits.
  - We can use Chen's account.
  - Remaining time: 55657.709 s
- **Quafu hardware:**
  - Log in here: https://quafu.baqis.ac.cn
  - You need to create an account.
  - Task quota: 1k/month.
- The best approach is to experiment with IBM & Quafu.







Validating the model in a quantum hardware

- **Training a quantum model on quantum hardware is not feasible:**
  - Quantum hardware constraints: noise, decoherence, and gate fidelity.
  - Time complexity: training is significantly slower compared to simulators.
  - Cost and queue: running a large circuit on hardware involves long wait times, even with free access.
- **A practical approach would involve a hybrid strategy:**
  - Train the model (or part of it) on a simulator to optimise parameters.
  - Test the trained model on hardware to validate its performance on a real quantum system.
- Training should be done on a simulator with a noise model to mimic real hardware behaviour.

Summary

- ☐ Modifying the framework to include noise model in the simulator.
- ☐ Understanding the discrepancies when using a pre-trained model:
  - Add a module to handle loading the trained model
  - Figure out how to apply the model & what metric to use.
  - Should one use the score or flow Pan's implementation?