

University and INFN of Ferrara

Hybrid quantum graph neural networks for particle tracking in high energy physics

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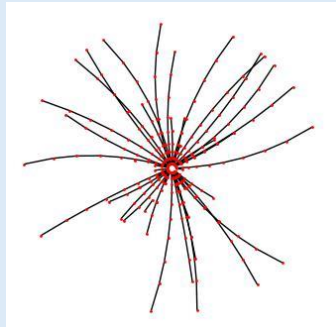
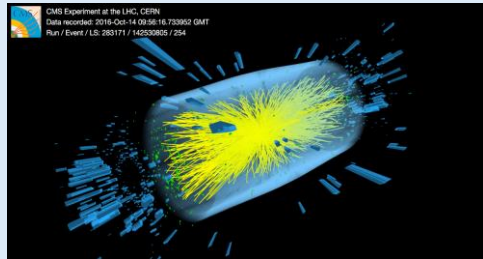
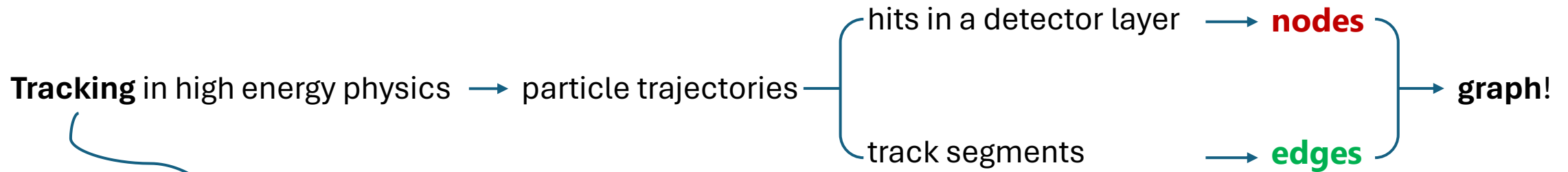
Enrico Calore



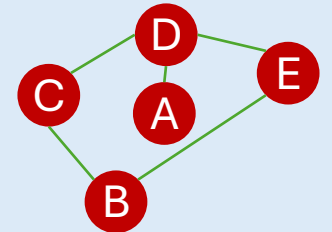
Sebastiano Fabio Schifano



Context



can be seen as

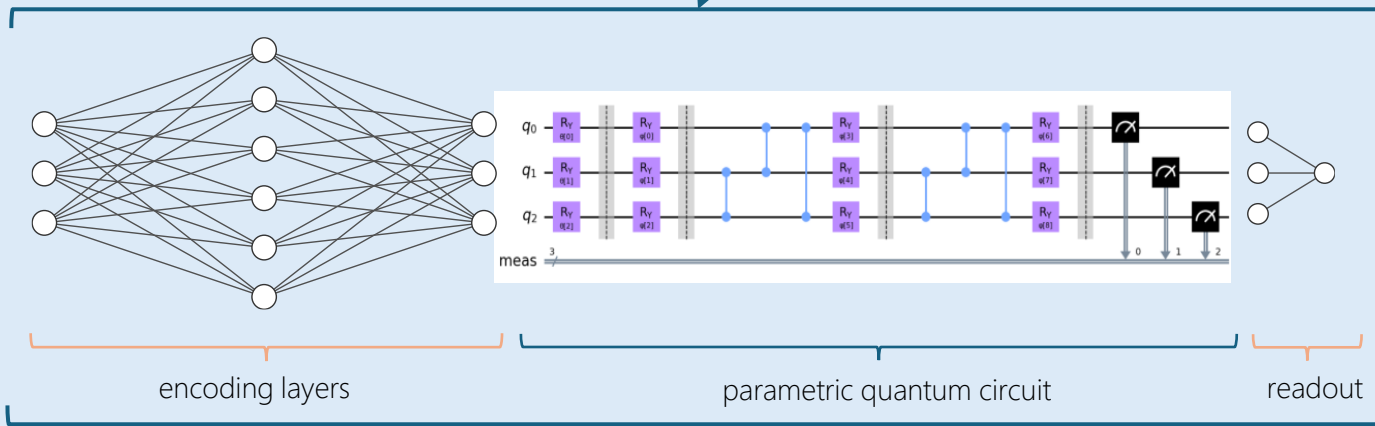
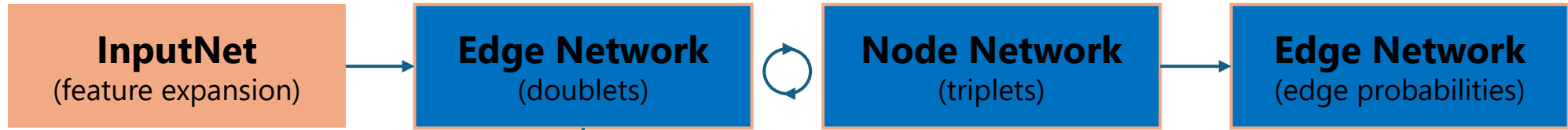


In the coming years at LHC we expect a great increase in particle density per event → research on new technologies:

Graph neural networks + **Quantum technologies**

Quantum GNN

The network



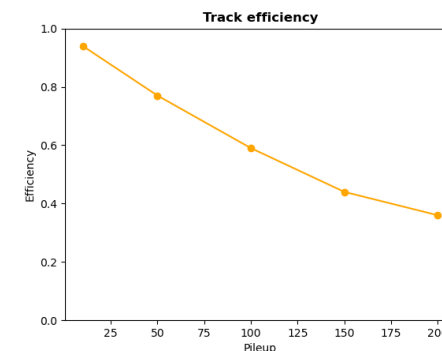
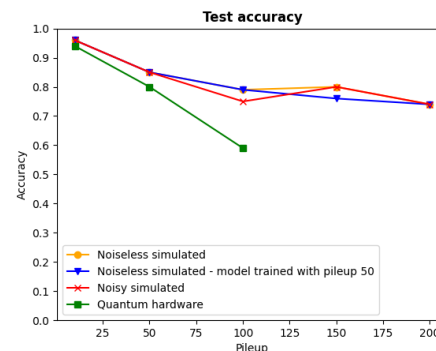
The hybrid architecture

- Sequence of node and edge layers
- Classical weights
- Attention mechanism + information passing
- Operators acting on **quantum states**
- Quantum circuit parameters
- **Entanglement + quantum parallelism**

Results

Network accuracy vs pileup

- Quantum simulator
- Quantum hardware



- Track efficiency vs pileup