

Panel discussion on: **“What are the immediate and long-term applications of, challenges associated with, and the roadmaps for, achieving quantum advantage in HEP?”**

Panelists: **Stefano Carrazza, Natalie Klco, Christine Muschik, Jesse Stryker, Federica Surace, Sofia Vallecorsa**

## **SLACK poll questions:**

- Can entanglement measures provide a window into physics beyond the Standard Model in high-energy and low-energy experimental searches? [Y/N/Maybe]
- Do you agree or disagree with this statement: Practical quantum advantage in simulating the Standard Model will be more costly/challenging than other applications such as cracking RSA-2048, chemical precision predictions for quantum chemistry, or quantum machine-learning applications [agree/disagree]
- Over the years, there have been several specific challenges that have remained elusive in quantum simulations of gauge theories: magnetic interactions and non-Abelian symmetries in primis. How do you judge recent progress in tackling them? [ranking]

1) What are the first applications of analog and hybrid analog-digital quantum simulation in HEP that go beyond the already performed proof-of-principle experiments? What problems have to await fault-tolerant universal quantum computers?

2) Over the years, there have been several specific challenges that have remained elusive in quantum simulations of gauge theories: magnetic interactions and non-Abelian symmetries in particular. How do you judge recent progress in tackling them?

3) If fault-tolerant quantum computing becomes available tomorrow, what would be the next major issue that could block the road to use these computers to advance HEP?

4) Do you agree or disagree with this statement: Practical quantum advantage in simulating the Standard Model will be more costly/challenging than other applications such as cracking RSA-2048, chemical precision predictions for quantum chemistry, or quantum machine-learning applications.

5) What role does entanglement play in HEP? Can entanglement measures provide a window into physics beyond the Standard Model in high-energy and low-energy experimental searches?