

Quantum Computing Topical Group

Submitting White Papers for the Snowmass Process

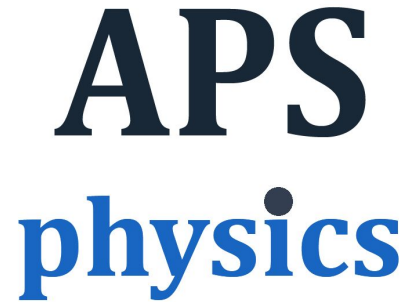
POC: Travis Humble, Gabe Perdue, and Martin Savage

https://snowmass21.org/computational/quantum_computing

These slides are available here: bit.ly/QCSnowmassSlides

Particle Physics Community Planning Exercise (Snowmass)

- Organized by the Division of Particles and Fields, American Physical Society
- A Community Planning Process to identify and document a scientific vision for the future of particle physics in the U.S. and its international partners
 - *define the most important questions for the field of particle physics and identify promising opportunities to address them*
 - *executed over a 10 year timescale, in the context of a 20-year global vision for the field*



Snowmass Input Collected Across 10 Frontiers

1. Energy Frontier
2. Neutrino Physics Frontier
3. Rare Processes and Precision
4. Cosmic Frontier
5. Theory Frontier*
6. Accelerator Frontier
7. Instrumentation Frontier*
8. Computational Frontier*
9. Underground Facilities
10. Community Engagement

Computational Frontier Conveners

Computational	Steve Gottlieb	Indiana University
	Oliver Gutsche	Fermilab
	Ben Nachman	Lawrence Berkeley Nat. Lab.

Computational Frontier Topical Groups

Assess the software and computing needs of the High Energy Physics community emphasizing common needs and common solutions across the frontiers.

- CompF1: Experimental algorithm parallelization
- CompF2: Theoretical calculations and simulation
- CompF3: Machine learning
- CompF4: Storage and processing resource access
- CompF5: End user analysis
- **CompF6: Quantum computing**
- CompF7: Reinterpretation and long-term preservation of data and code

Quantum Computing Topical Group

Functional areas

- Impact of quantum computing on our community
- Not quantum sensing (IF) or QIS theory (TF)

Mandate (Scope)

- What is the potential impact of quantum computing on the science goals of the stakeholders?
- What technologies/resources are needed to progress on the path to utilize quantum technologies for the stakeholders?
- How do the needs of the stakeholders overlap with other science domains and industry?

Travis Humble	ORNL
Gabriel Perdue	FNAL
Martin Savage	U. Washington

Collecting Input on Quantum Computing

- Two-page letters of intent were submitted in August 2020
 - 34 LOIs were submitted
 - Multiple technical areas identified including cross listings
 - PDFs available https://snowmass21.org/computational/quantum_computing
- Conveners now coordinating white paper team development
 - 14 teams identified, including duplicates
 - Delayed process to August 2021
- **Next step** is white paper submission
 - Soft deadline 31 Jan 2022 for arxiv submission
 - Instructions: <https://snowmass21.org/submissions/start>
 - *define the most important questions for the field of particle physics and identify promising opportunities to address them*
 - *executed over a 10 year timescale, in the context of a 20-year global vision for the field*
 - Remember, these white papers are not proposals for you to do work

Known White Paper Teams and POCs

QC for HEP Data Analysis	Andrea Delgado and Jean Roch Variant
Quantum Networks for HEP	Nick Peters
Quantum Software Tools and Testbeds for HEP	Travis Humble and Raphael Pooser
Quantum Simulation of Field Theories for HEP	Zohreh Davoudi, Christian Bauer, and Hank Lamm
Quantum Simulation of Open Systems	Adam Lyon and Jim Kowalkowski
Quantum Materials Science Research for HEP	Mattia Chechin and Silvia Zorzetti
Tensor Networks for HEP	Yannick Meurice and James Osborn
Gravity, Black Holes, and Quantum Computing	Simon Catterall, Veronika Hubeny, and Dan Harlow
Machine Learning and Architectural Perspectives for Quantum HEP Applications	Koji Terashi

Additional white paper teams welcomed - please contact the Topical Group conveners

Topical Group Report feeds into Frontier Report

- January 31, 2022: White Paper submission to arXiv
 - No latex template required but these will be referenced by the Topical Group report
 - I am thinking about how to use “copy-paste” effectively here
- May 31, 2022: Preliminary reports by the Topical Groups
 - 20-50 pages per Group, reference white papers
- June 30, 2022: Preliminary reports by the Frontiers
 - 20-50 pages per Frontier, reference Topical Group report
- July, 2022: Snowmass Community Summer Study (CSS) at UW-Seattle
- September 30, 2022: All final reports by TGs and Frontiers
- October 31, 2022: Snowmass Book and the on-line archive documents