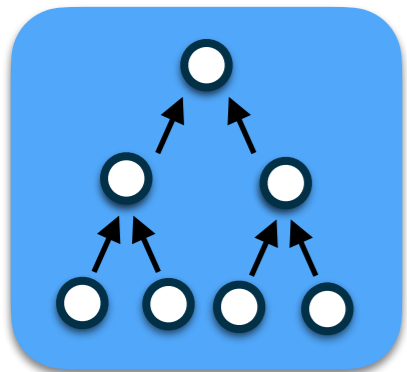


September 24, 2021

Computational Frontier at Snowmass Day 2021

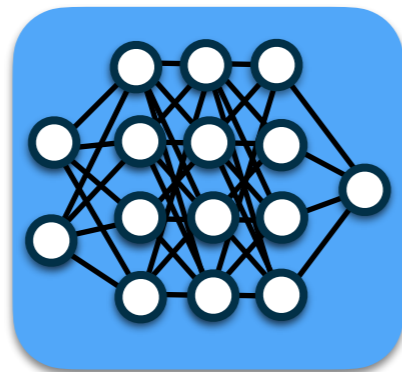
Steve Gottlieb

Indiana University



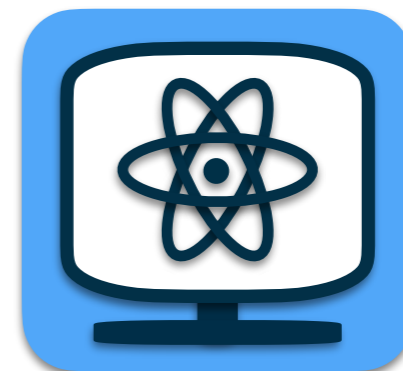
Oli Gutsche

Fermilab



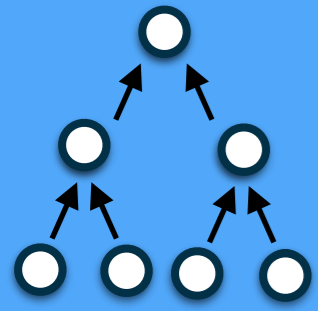
Ben Nachman

*Lawrence Berkeley
National Laboratory*



Computational Frontier Organization

2



CompF01

Experimental
Algorithm
Parallelization

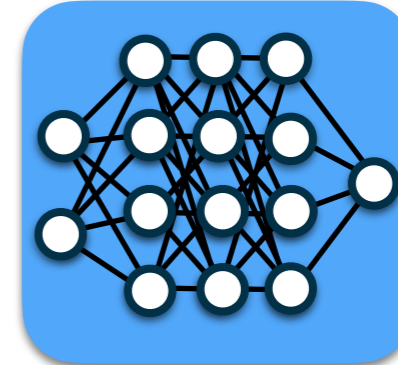
Giuseppe Cerati (FNAL), Katrin
Heitmann (ANL), Walter Hopkins (ANL)



CompF02

Theory
Calculations
& Simulation

Peter Boyle (BNL), Daniel Elvira
(FNAL), Ji Qiang (LBNL)



CompF03

Machine
Learning

Phiala Shanahan (MIT), Kazu Terao
(SLAC), Daniel Whiteson (Irvine)



CompF04

Storage and Processing
Resource Access
(Facility and Infrastructure R&D)

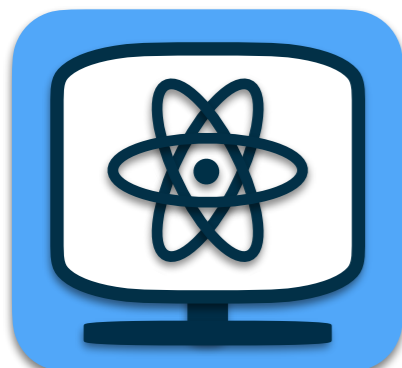
Wahid Bhimji (NERSC), Frank
Würthwein (UCSD)



CompF05

End User
Analysis

Gavin Davis (U. Mississippi),
Peter Onyisi (U. Texas at Austin),
Amy Roberts (UC Denver)



CompF06

Quantum
Computing

Travis Humble (ORNL), Gabriel Perdue
(FNAL), Martin Savage (U. Washington)



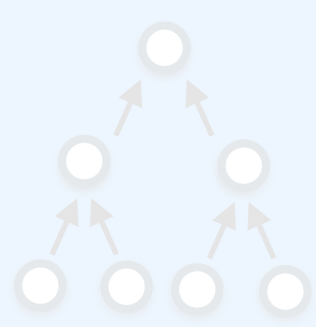
CompF07

Reinterpretation & Long-term
Preservation of Data and Code

Kyle Cranmer (NYU), Matias Carrasco Kind
(Illinois/NCSA)

Computational Frontier Organization

3



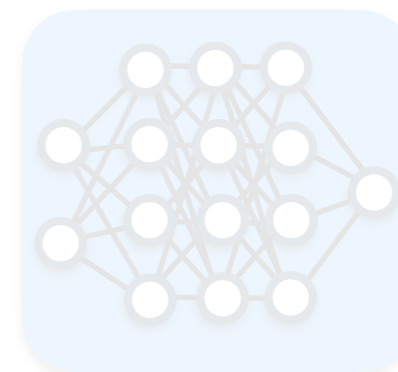
CompF01
Experimental
Algorithm
Parallelization

Giuseppe Cerati (FNAL), Katrin
Heitmann (ANL), Walter Hopkins (ANL)



CompF02
Theory
Calculations
& Simulation

Peter Boyle (BNL), Daniel Elvira
(FNAL), Ji Qiang (LBNL)



CompF03
Machine
Learning

Phiala Shanahan (MIT), Kazu Terao
(SLAC), Daniel Whiteson (Irvine)

Cosmic Calculations
Accelerator Simulation
Beam and Detector Simulation
Physics Generators
Perturbative Calculations
Lattice QCD

CompF05
End User
Analysis

Kevin Davis (U. Mississippi),
Onyisi (U. Texas at Austin),
Amy Roberts (UC Denver)

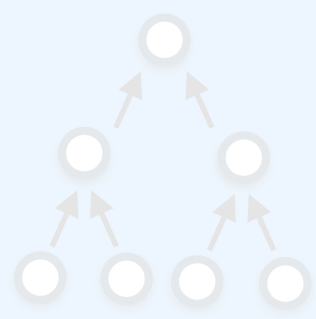
CompF07

Short- & Long-term
Data and Code

(other groups also have sub-topics - this is just for illustration)

Computational Frontier Organization

4



CompF01

Experimental
Algorithm
Parallelization

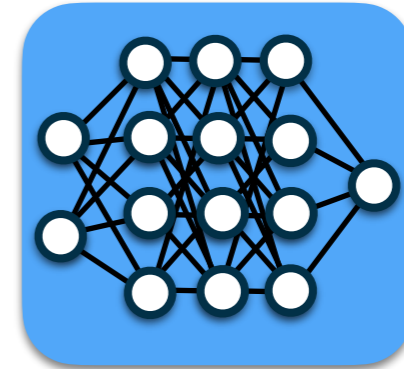
Giuseppe Cerati (FNAL), Katrin Heitmann (ANL), Walter Hopkins (ANL)



CompF02

Theory
Calculations
& Simulation

Peter Boyle (BNL), Daniel Elvira (FNAL), Ji Qiang (LBNL)



CompF03

Machine
Learning

Phiala Shanahan (MIT), Kazu Terao (SLAC), Daniel Whiteson (Irvine)

Physics-specific ML
Simulations

Interpretability & Validations
Community Tools & Standards
Resource Needs & Management
Education & Engagement

CompF05

End User
Analysis

Gavin Davis (U. Mississippi),
Peter Onyisi (U. Texas at Austin),
Amy Roberts (UC Denver)

CompF07

Interpretation & Long-term
Preservation of Data and Code

(other groups also have sub-topics - this is just for illustration)

Liaisons

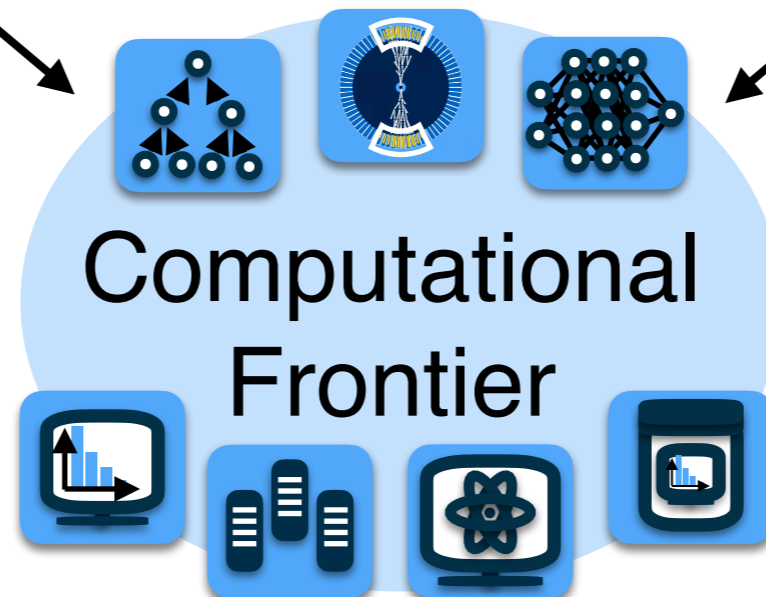


**Rare Processes
& Precision**
Stefan Meinel (Arizona)

Energy Frontier
Daniel Elvira (FNAL)

Neutrino Frontier
Alex Himmel (FNAL)

Cosmic Frontier
Deborah Bard (NERSC)
Brian Yanny (FNAL)



Underground facilities
Eric Dahl
(Northwestern)

Theory Frontier
Steven Gottlieb (Indiana)

**Accelerator
Science/Technology**
Jean-Luc Vay (LBNL)

**Instrumentation
Frontier**
Darin Acosta (Florida)

**Community
Engagement**
David Bruhwiler
(RadiaSoft)

Computational Frontier Scope

6

Our main time horizon is ~10 years (HL-LHC, DUNE, LSST, etc.), but it is also useful to think about the next-to-next experiments and what R&D/funding opportunities we may need to be ready for the computing of the future.

DUNE

Hilumi
HL-LHC PROJECT

VERA C. RUBIN
OBSERVATORY

Computational Frontier Scope



Our main time horizon is **~10 years (HL-LHC, DUNE, LSST, etc.)**, but it is also useful to think about the next-to-next experiments and what R&D/funding opportunities we may need to be ready for the computing of the future.

On this same timescale, we need theory calculations which are growing increasingly (computationally) expensive to match or exceed experimental precision

Cosmic simulations, accelerator modeling, lattice QCD, perturbative QCD, ...

Time to “Think Big”



We should not be afraid to think about $O(1)$ challenges and solutions to the physics of our future.

Relevant for theorists & experimentalists!

Some things to think about:

- Quantum computing was not part of the last Snowmass and machine learning was only briefly mentioned.
- Computing of the future will likely be much more heterogenous than the computing of today.
- The “intensity” and cosmic frontiers will soon have comparable data challenges to the energy frontier.
- Computing is a catalyst for building bridges to other areas of science and society at large.

...but also we need to be concrete



What are actionable needs for tomorrow's computing?

Many of the topical groups have organized into smaller subgroups along particular directions. These activities will be restarting soon and it is a great time to get involved!

Our Plan for Today



We will “visit” the parallel sessions of other frontiers

Our questions for you:

- What are your concerns about software and computing, what keeps you up at night?
- What do we (the Computational Frontier) need to be aware of so that it ends up in our report?
- What are your (the other frontiers) requirements/projections related to software and computing that we should be aware of? Is there existing documentation for them?
- Are there new developments on the horizon that would drive software and computing challenges? New physics, new instrumentation, new simulations?
- Would you like to have a follow up meeting with a longer time schedule? (like the recent Energy Frontier meeting)

Our Plan for Today

11

2:30 EDT

Accelerator

<https://fnal.zoom.us/j/98015925729?pwd=K01JWDV1NndTZXhva2IDd1YyUGNwUT09>

(or Meeting ID: 980 1592 5729 , Passcode: 512846)

2:45 EDT

Community Engagement

<https://cern.zoom.us/j/97666429141?pwd=N0lCTmlPcnAyd215Sk5ycExFTIZoQT09#success>

3:00 EDT

Rare Processes and Precision

<https://wayne-edu.zoom.us/j/5403604689?pwd=em1GTThocnBWN05XdzFaSVZFaXdJUT09>

3:15 EDT

Neutrino

<https://duke.zoom.us/j/93345230433?pwd=UUpwM3lhZWFDWHR3aEd5RmVjZIRjdz09>

3:30 EDT

Theory

Meeting ID: 982 1761 9173

Passcode: 795677

<https://cornell.zoom.us/j/98217619173?pwd=elpVbkc1WnhWRUV5VTF6aHoxUUJodz09>

4:50 EDT

Cosmic

<https://us02web.zoom.us/j/81792942395?pwd=ZTN3UEZWN1orQ0RoMXV0TmpGVmVHUT09>

CompF session at the energy frontier workshop a few weeks ago:

<https://indico.fnal.gov/event/49756/timetable/#b-22484-parallel-session-b-joi>

Software and Computing for Small HEP Experiments

15-16 November 2021

US/Pacific timezone

Overview

Registration

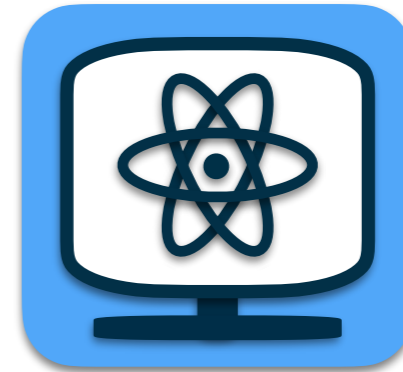
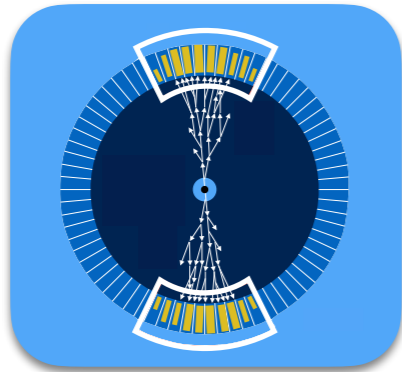
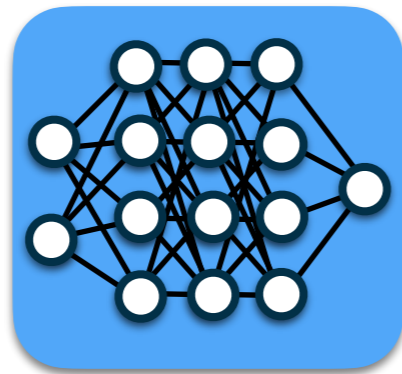
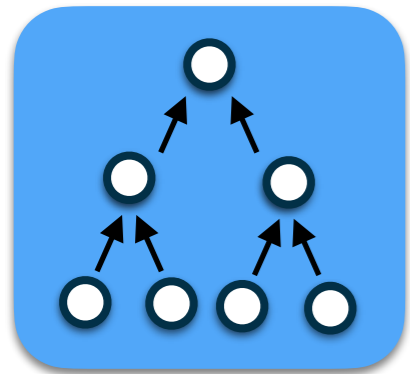
This workshop hosted by the [Snowmass Computational Frontier](#) (CompF) is centered around software and computing for the “small” experiments in our community. The mandate for this workshop is:

- Identify unique computational challenges of the “small” experiment community
- Gather input about what is needed in terms of computation for these experiments to be successful
- Connect members of the “small” experiment community to the computational frontier in Snowmass and encourage participation in topical groups
- Foster the development and re-use of open-source software, building on the work of the [HEP Software Foundation](#) and other collaborative efforts within the community.

In order to be inclusive, we are not imposing a definition of “small” and have asked experiments to self-select.

Nov. 15-16
2021, virtual

<https://indico.physics.lbl.gov/event/1756/>



Looking forward to a productive day!