What can Snowmass13 teach us about Snowmass21?

T. Blum (UConn), Snowmass21 topical group convener
for Fundamental Physics in Small Experiments

Planning the Future of U.S. Particle Physics

Report of the 2013 Community Summer Study

Chapter 9: Computing

Conveners: L. A. T. Bauerdick and S. Gottlieb

Study Conveners: M. Bardeen, W. Barletta, L. A. T. Bauerdick, R. Brock, D. Cronin-Hennessy, M. Demarteau, M. Dine, J. L. Feng, M. Gilchriese, S. Gottlieb, J. L. Hewett, R. Lipton, H. Nicholson, M. E. Peskin, S. Ritz, I. Shipsey, H. Weerts

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Lattice field theory for the energy and intensity frontiers: Scientific goals and computing needs

Conveners: T. Blum (U. Connecticut), R. S. Van de Water (FNAL)
Observer: D. Holmgren (FNAL)

R. Brower (Boston U.), S. Catterall (Syracuse U.), N. Christ (Columbia U.), A. Kronfeld (FNAL), J. Kuti (UCSD), P. Mackenzie (FNAL), E. T. Neil (U. Colorado), S. R. Sharpe (U. Washington), R. Sugar (UCSB)

1.1 Introduction

One of the foremost goals of high-energy physics is to test the Standard Model of particle physics and to search for indications of new physics beyond. Towards this aim, the experimental high-energy physics program is pursuing three complementary approaches: experiments at the "energy frontier" try to directly produce non-Standard Model particles in collisions at large center-of-mass energies; experiments at the "cosmic frontier" look for astronomical evidence of new interactions and aim to detect cosmically-produced non-Standard-Model particles through their interaction with ordinary matter; while experiments at the "intensity frontier" [1] make precise measurements of rare processes and look for discrepancies with the Standard Model. In many cases, interpretation of the experimental measurements requires a quantitative of understanding the nonperturbative dynamics of the quarks and gluons in the underlying process. Lattice gauge theory provides the only known method for *ab initio* quantum chromodynamics (QCD) calculations with controlled uncertainties, by casting the fundamental equations of QCD into a form amenable to high-performance computing. Thus, facilities for numerical lattice QCD are an essential theoretical adjunct to the experimental high-energy physics program. This report describes the computational and software infrastructure resources needed for lattice gauge theory to meet the scientific goals of the future energy- and intensity-frontier experimental programs. We focus on the efforts and plans in the US, but comparable efforts are ongoing in Europe and Japan.

- Community Planning Meeting 2012 at FNAL, Oct. 2012
  - Group discussions on the second day
- Community Summer Study Meeting 2013, University of Minnesota (Snowmass on the Mississippi)
- Separate Report of the Snowmass 2013 Computing Frontier working group on Lattice Field Theory: 23 pages + 7 pages of references (11 citations).
  - Based on USQCD White Paper: 42 pages + 7 pages of references

LATTICE QCD AT THE INTENSITY FRONTIER

Thomas Blum, Michael Buchoff, Norman Christ, Andreas Kronfeld,
Paul Mackenzie, Stephen Sharpe, Robert Sugar and Ruth Van de Water

(USQCD Collaboration)

(Dated: October 22, 2013)

- Lot’s of effort by many people!
- Snowmass21 will have more workshops/meetings
- What was gained in terms of physics? computing?

Table 1-2. *Available resources for lattice-QCD simulations assumed for the planned program of physics calculations. The conversion factors for lattice-QCD sustained Tflop/sec-years, assuming 8000 hours per year, is 1 Tflop/sec-year = 3.0M core-hour on BlueGene/Q hardware, and 1 Tflop/sec-year = 6.53M core-hour on BlueGene/P and Cray hardware.*

Year	Leadership Class (Tflop/sec-yrs)	Dedicated Capacity Hardware (Tflop/sec-yrs)
2015	430	325
2016	680	520
2017	1080	800
2018	1715	1275
2019	2720	1900

20 B BlueGene Q core hours!

- Doing a lot more already than in 2012
  - RBC/UKQCD collab already had 2-3 long discussions on LOI’s
    - will submit several LOI’s
  - topical groups planning one or more dedicated workshops
- Is this the best way to spend our time?
  - Bottom up inclusive
  - Do we break through?
- Snowmass21 report goes to (?)
  - P5
  - HEPAP
- There are no lattice people on either (any computational scientists?)
- Better to focus on physics? (several lattice conveners)
- or better to focus on computing? (several lattice conveners)