



Collider Community Building toward IRIS-HEP

Peter Elmer - Princeton University

IRIS-HEP - PI: Peter Elmer (Princeton), co-PIs: Brian Bockelman (Morgridge Institute), Gordon Watts (U.Washington) with UC-Berkeley, University of Chicago, University of Cincinnati, Cornell University, Indiana University, MIT, U.Michigan-Ann Arbor, U.Nebraska-Lincoln, New York University, Stanford University, UC-Santa Cruz, UC-San Diego, U.Illinois at Urbana-Champaign, U.Puerto Rico-Mayaguez and U.Wisconsin-Madison

S2I2-HEP - Peter Elmer (Princeton), Mike Sokoloff (U.Cincinnati), Mark Neubauer (UIUC)

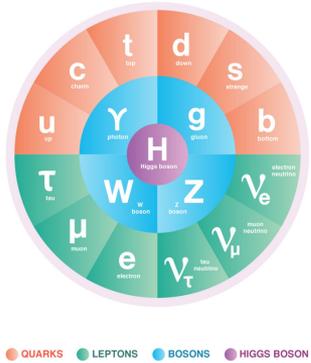


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<http://iris-hep.org>

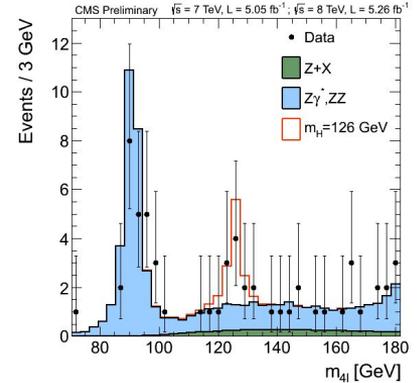


Science Driver: Discoveries beyond the Standard Model of Particle Physics

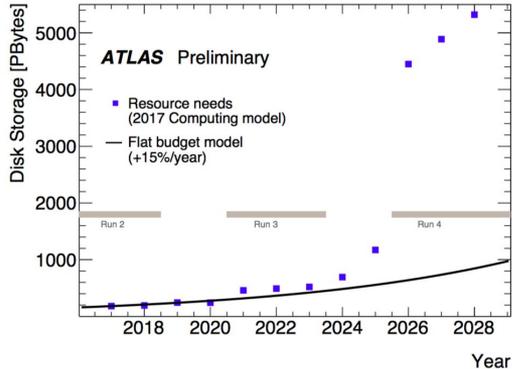


From “Building for Discovery - Strategic Plan for U.S. Particle Physics in the Global Context” - Report of the Particle Physics Project Prioritization Panel (P5):

- 1) Use the Higgs boson as a new tool for discovery
- 2) Pursue the physics associated with neutrino mass
- 3) Identify the new physics of dark matter
- 4) Understand cosmic acceleration: dark matter and inflation
- 5) Explore the unknown: new particles, interactions, and physical principles

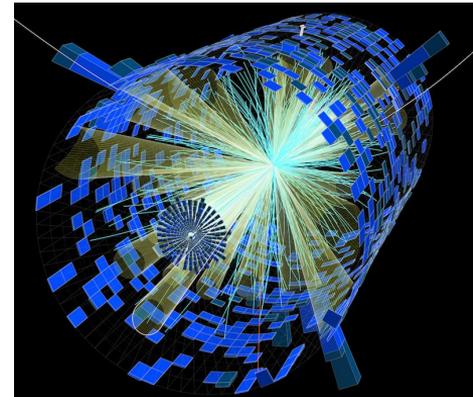


Computational and Data Science Challenges of the High Luminosity Large Hadron Collider (HL-LHC) and other HEP experiments in the 2020s

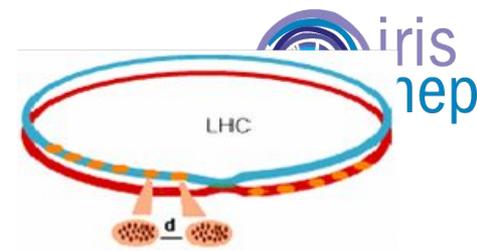


The HL-LHC will produce exabytes of science data per year, with increased complexity: an average of 200 overlapping proton-proton collisions per event.

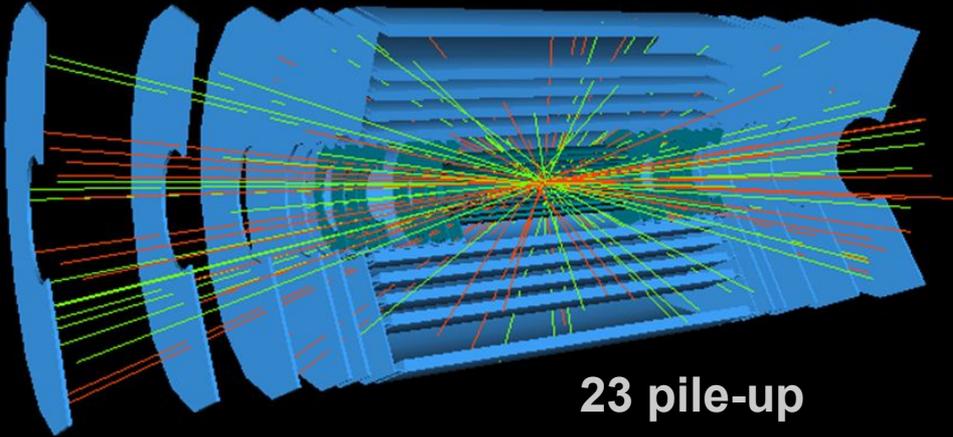
During the HL-LHC era, the ATLAS and CMS experiments will record ~10 times as much data from ~100 times as many collisions as were used to discover the Higgs boson (and at twice the energy).



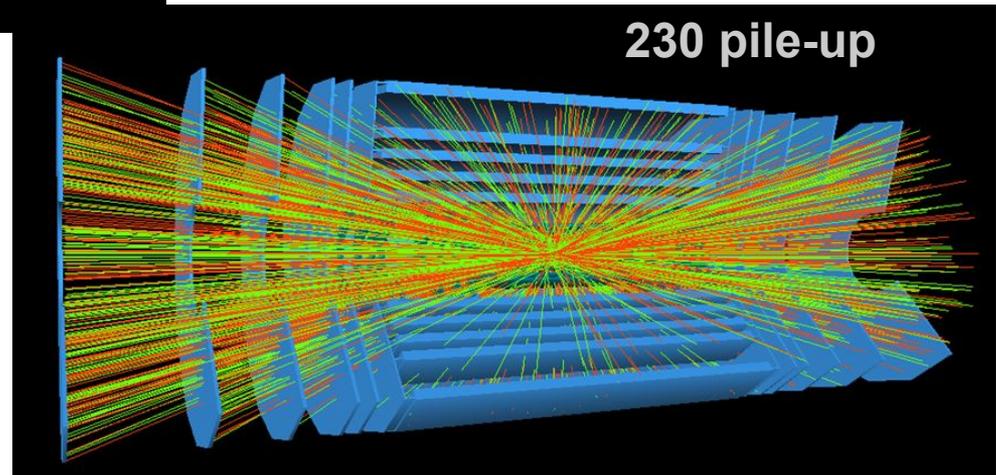
The HL-LHC Challenge



Multiple proton-proton interactions per beam bunch crossing (“pile-up”) as seen in a simulation of the ATLAS Inner Tracker



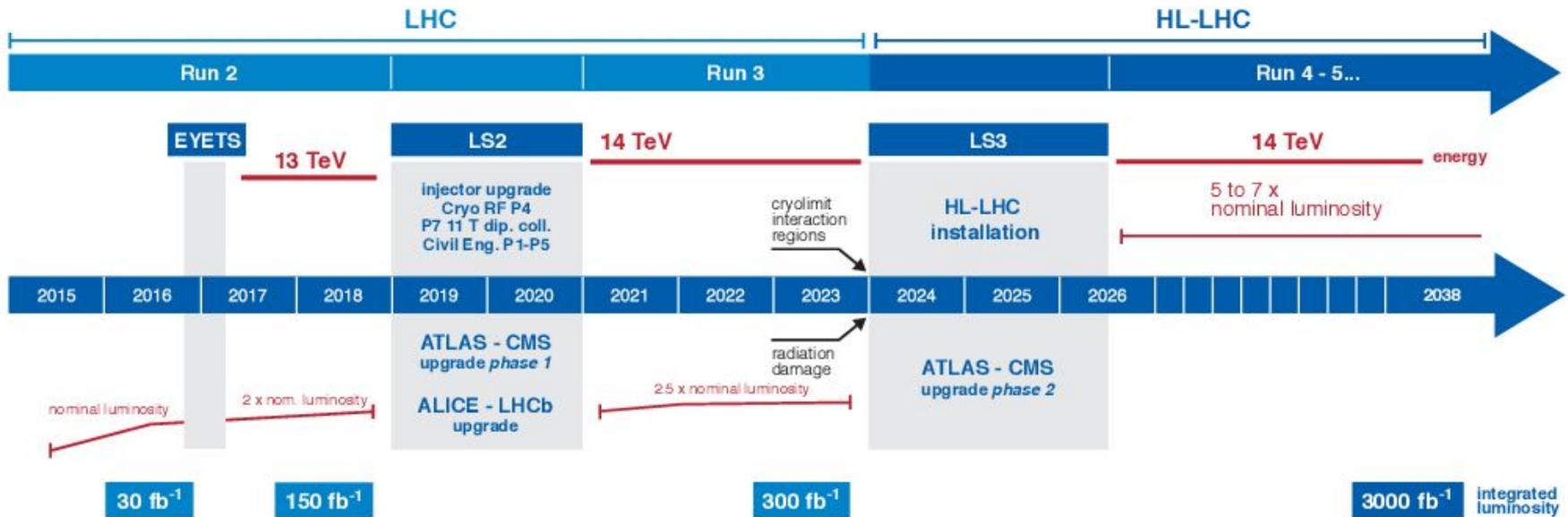
Higher probability of an interesting interaction, but with consequences: detectors/electronics need to handle the higher rate, higher radiation dose and significantly more complex events



High Luminosity LHC



LHC / HL-LHC Plan



IRIS-HEP Institute

HL-LHC Detector Upgrades

Summary of CMS HL-LHC Upgrades

Trigger/HLT/DAQ

- Track information in L1-Trigger
- L1-Trigger: 12.5 ms latency – output 750 kHz
- HLT output 7.5 kHz



New Endcap Calorimeters

- Rad. tolerant – high granularity
- 3D capable



New Tracker

- Rad. tolerant – high granularity – significant less material
- 40 MHz selective readout ($p_T > 2$ GeV) in Outer Tracker for L1 -Trigger
- Extended coverage to $h=4$



MIP Precision Timing Detector

- Barrel: Crystal +SiPM
- Endcap: Low Gain Avalanche Diodes



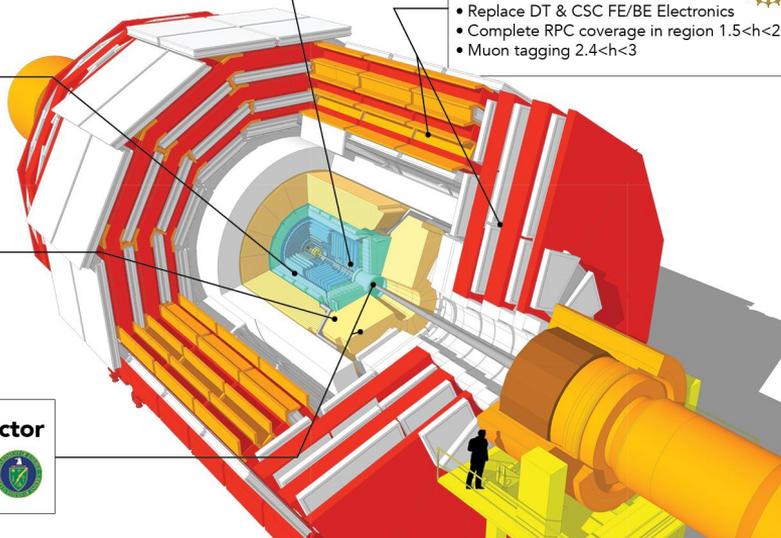
Barrel ECAL/HCAL

- Replace FE/BE electronics
- Lower ECAL operating temp. (8 °C)



Muon Systems

- Replace DT & CSC FE/BE Electronics
- Complete RPC coverage in region $1.5 < \eta < 2.4$
- Muon tagging $2.4 < \eta < 3$



In addition to LHC accelerator upgrades, significant hardware (detector) investments are planned for HL-LHC to handle the high-rate environment and expected radiation dose.

This includes a proposed ~\$150M NSF MREFC to upgrade key elements of ATLAS and CMS (see figure), with a ~2020 start date.

A key goal of the Institute is to maximize the physics reach and impact of this detector investment

Developing a Global R&D Roadmap



NSF funded the S2I2-HEP Conceptualization Project (s2i2-hep.org/) in July 2016

Community charge from the Worldwide LHC Computing Grid in July 2016:

- Anticipate a “software upgrade” in preparation for the HL-LHC
- Identify and prioritize the software research and developments investments
 1. to achieve improvements in software efficiency, scalability and performance and to make use of the advances in CPU, storage and network technologies
 2. to enable new approaches to computing and software that could radically extend the physics reach of the detectors
 3. to ensure the long term sustainability of the software through the lifetime of the HL-LHC

The HSF (<http://hepsoftwarefoundation.org>) was created in early 2015 as a means for organizing our community to address the software challenges of future projects such as the HL-LHC. The HSF has the following objectives:

- Catalyze new common projects
- Promote commonality and collaboration in new developments to make the most of limited resources
- Provide a framework for attracting effort and support to S&C common projects (new resources!)
- Provide a structure to set priorities and goals for the work

Growing a Global Collaboration



UCSD/SDSC
January, 2017
HSF CWP



Annecy
June, 2017
HSF CWP

JLab
March, 2018
HSF/OSG/WLCG



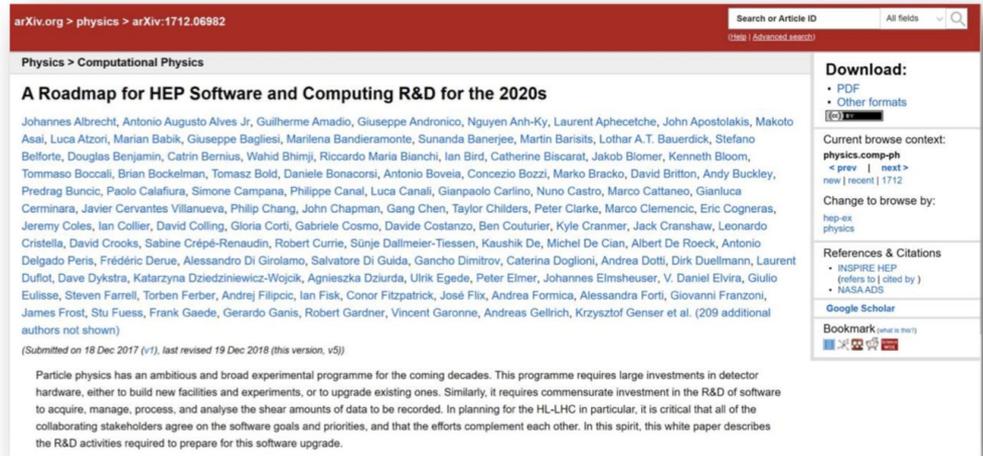
Naples
March, 2017
WLCG/HSF



All CWP and S2I2 Workshops

- 26-27 Apr, 2018 - Reconstruction, Trigger, and Machine Learning for the HL-LHC
 - *Massachusetts Institute of Technology, Boston*
- 26-29 Mar, 2018 - Joint WLCG/HSF Workshop 2018
 - *Centro Congressi Federico II, Naples, Italy*
- 14 Dec, 2017 - Mini-workshop on Building Collaborations for ML in HEP
 - *Massachusetts Institute of Technology, Boston*
- 28-29 Nov, 2017 - S2I2/DOE-lab mini-workshop on HL-LHC Software and Computing R&D
 - *Catholic University of America, Washington DC*
- 16-17 Nov, 2017 - Data Organisation, Management and Access (DOMA) in Astronomy, Genomics and High Energy Physics
 - *Flatiron Institute (Simons Foundation), New York City*
- 23-26 Aug, 2017 - S2I2-HEP Workshop
 - *University of Washington, Seattle*
- 26-30 Jun, 2017 - HEP Software Foundation Workshop
 - *LAPP (Annecy)*
- 5-6 Jun, 2017 - CWP Event Processing Frameworks Workshop
 - *FNAL*
- 22-24 May, 2017 - HEP Analysis Ecosystem Retreat
 - *Amsterdam*
- 8-12 May, 2017 - DS@HEP 2017 (Data Science in High Energy Physics)
 - *FNAL*
- 1-3 May, 2017 - 2nd S2I2 HEP/CS Workshop
 - *Princeton University*
- 28-30 Mar, 2017 - CWP Visualization Workshop
 - *CERN (and Vidyo)*
- 23 Mar, 2017 - Community White Paper Follow-up at FNAL
 - *FNAL*
- 20-22 Mar, 2017 - IML Topical Machine Learning Workshop
 - *CERN, The workshop includes a CWP session on Machine Learning*
- 9 Mar, 2017 - Software Triggers and Event Reconstruction WG meeting
 - *LAL/Orsay, session at Connecting The Dots workshop*
- 8 Mar, 2017 - S2I2-HEP/OSG/USCMS/USAtlas Panel at OSG All Hands Meeting
 - *SDSC/UCSD*
- 23-26 Jan, 2017 - HEP Software Foundation Workshop
 - *University of California at San Diego / San Diego Supercomputer Center*
- 7-9 Dec, 2016 - S2I2 HEP/CS Workshop
 - *University of Illinois at Urbana-Champaign*

The Community White Paper Process (2016-2017)



The screenshot shows the arXiv page for the paper "A Roadmap for HEP Software and Computing R&D for the 2020s". The page includes a search bar, navigation links, and a list of authors. The abstract text is visible at the bottom of the page.

arXiv.org > physics > arXiv:1712.06982

Search or Article ID All fields

Download:

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Current browse context:

physics.comp-ph

Change to browse by:

References & Citations

Google Scholar

Bookmark

A Roadmap for HEP Software and Computing R&D for the 2020s

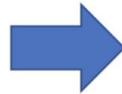
Johannes Albrecht, Antonio Augusto Alves Jr, Guilherme Amadio, Giuseppe Andronico, Nguyen Anh-Ky, Laurent Aphecetche, John Apostolakis, Makoto Asai, Luca Atzori, Marian Babik, Giuseppe Bagliesi, Marielena Bandieramonte, Sunanda Banerjee, Martin Barisits, Lohar A.T. Bauerdick, Stefano Belforte, Douglas Benjamin, Catrin Bernius, Wahid Bhimji, Riccardo Maria Bianchi, Ian Bird, Catherine Biscarat, Jakob Blomer, Kenneth Bloom, Tommaso Boccali, Brian Bockelman, Tomasz Bold, Daniele Bonacorsi, Antonio Boveia, Concezio Bozzi, Marko Bracko, David Britton, Andy Buckley, Predrag Buncic, Paolo Calafura, Simone Campana, Philippe Canal, Luca Canali, Gianpaolo Carlino, Nuno Castro, Marco Cattaneo, Gianluca Cerminara, Javier Cervantes Villanueva, Philip Chang, John Chapman, Gang Chen, Taylor Childers, Peter Clarke, Marco Clemencic, Eric Cogneras, Jeremy Coles, Ian Collier, David Colling, Gloria Corti, Gabriele Cosmo, Davide Costanzo, Ben Couturier, Kyle Cranmer, Jack Cranshaw, Leonardo Cristella, David Crooks, Sabine Crépe-Renaudin, Robert Currie, Sünje Dalmeier-Tiessen, Kaushik De, Michel De Cian, Albert De Roeck, Antonio Delgado Peris, Frédéric Derue, Alessandro Di Girolamo, Salvatore Di Guida, Gancho Dimitrov, Caterina Doglioni, Andrea Dotti, Dirk Duellmann, Laurent Duflot, Dave Dykstra, Katarzyna Dziedziewicz-Wojcik, Agnieszka Dziurda, Ulrik Egede, Peter Elmer, Johannes Elmsheuser, V. Daniel Elvira, Giulio Eulisse, Steven Farrell, Torben Ferber, Andrej Filipcic, Ian Fisk, Conor Fitzpatrick, José Flix, Andrea Formica, Alessandra Forti, Giovanni Franzoni, James Frost, Stu Fuess, Frank Gaede, Gerardo Ganis, Robert Gardner, Vincent Garonne, Andreas Gellrich, Krzysztof Genser et al. (209 additional authors not shown)

(Submitted on 18 Dec 2017 (v1), last revised 19 Dec 2018 (this version, v5))

Particle physics has an ambitious and broad experimental programme for the coming decades. This programme requires large investments in detector hardware, either to build new facilities and experiments, or to upgrade existing ones. Similarly, it requires commensurate investment in the R&D of software to acquire, manage, process, and analyse the shear amounts of data to be recorded. In planning for the HL-LHC in particular, it is critical that all of the collaborating stakeholders agree on the software goals and priorities, and that the efforts complement each other. In this spirit, this white paper describes the R&D activities required to prepare for this software upgrade.

Involved A Diverse

- Computing Management from the Experiments and Labs
- Individuals interested in the problems
- Members of other compute intensive scientific endeavors
- Members of Industry



Individual Papers on the arXiv:

Careers & Training, Conditions Data, DOMA, Data Analysis & Interpretation, Data and Software Preservation, Detector Simulation, Event/Data Processing Frameworks, Facilities and Distributed Computing, Machine Learning, Physics Generators, Security, Software Development, Deployment, Validation, Software Trigger and Event Reconstruction, Visualization

Community White Paper & the Strategic Plan

Community White Paper (CWP)



A Roadmap for HEP Software and Computing R&D for the 2020s

HEP Software Foundation¹

ABSTRACT: Particle physics has an ambitious and broad experimental programme for the coming decades. This programme requires large investments in detector hardware, either to build new facilities and experiments, or to upgrade existing ones. Similarly, it requires commensurate investment in the R&D of software to acquire, manage, process, and analyse the shear amounts of data to be recorded. In planning for the HL-LHC in particular, it is critical that all of the collaborating stakeholders agree on the software goals and priorities, and that the efforts complement each other. In this spirit, this white paper describes the R&D activities required to prepare for this software upgrade.

Many of our collaborators and colleagues at U.S. CMS universities and laboratories have contributed to the CWP process and papers

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U.S. S2I2-HEP Conceptualization: Additional Criteria



Impact - Physics: Will efforts in this area enable new approaches to computing and software that maximize, and potentially radically extend, the physics reach of the detectors?

Impact - Cost/Resources: Will efforts in this area lead to improvements in software efficiency, scalability and performance and make use of the advances in CPU, storage and network technologies, that allow the experiments to maximize their physics reach within their computing budgets?

Impact - Sustainability: Will efforts in this area significantly improve the long term sustainability of the software through the lifetime of the HL-LHC?

Interest/Expertise: Does the U.S. university community have strong interest and expertise in the area?

Leadership: Are the proposed focus areas complementary to efforts funded by the US-LHC Operations programs, the DOE, and international partners?

Value: Is there potential to provide value to more than one HL-LHC experiment and to the wider HEP community?

Research/Innovation: Are there opportunities for combining research and innovation as part of partnerships between the HEP and Computer Science/Software Engineering/Data Science communities?



S2I2-HEP Strategic Plan - Priority Areas

- Development of advanced algorithms for data reconstruction and triggering, including those that take advantage of new, powerful computing architectures, such as GPUs, FPGAs, etc.
- Development of highly performant analysis computing systems, potentially with specialized hardware, that reduces "time-to-insight" and maximizes the HL-LHC physics potential
- Development of data organization, management and access systems for the exabyte-scale datasets of the HL-LHC
- Leveraging the recent advances in machine learning and data science and taking advantage of industry developments in "big data" to make more efficient use of computing resources
- Sustaining the investments in the fabric for distributed high-throughput computing

IRIS-HEP

Intellectual Hub for the HEP Community



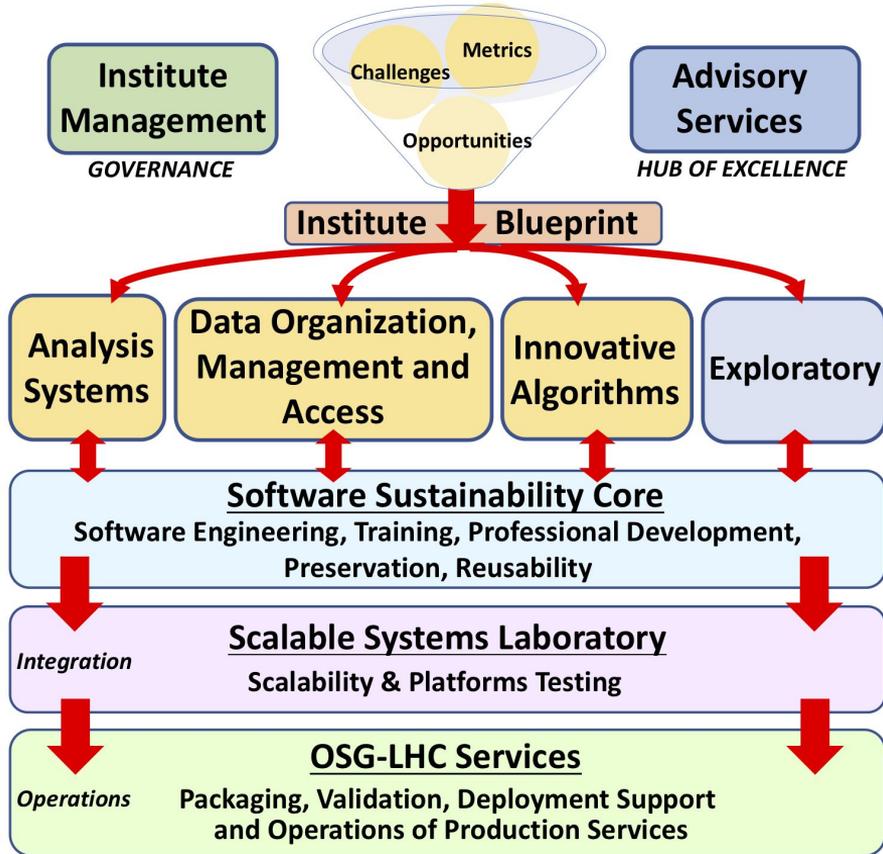
Sustainable Software R&D objectives

- 1) Development of [innovative algorithms](#) for data reconstruction and triggering;
- 2) Development of highly performant [analysis systems](#) that reduce “time-to-insight” and maximize the HL-LHC physics potential; and
- 3) Development of [data organization, management and access systems](#) for the community’s upcoming Exabyte era.
- 4) Integration of software and scalability for use by **the LHC community on the Open Science Grid**, the Distributed High Throughput Computing infrastructure in the U.S.



The plan for IRIS-HEP reflects a community vision developed by an international community process organized by the HEP Software Foundation (<https://hepsoftwarefoundation.org>). The S2I2-HEP conceptualization project (<http://s2i2-hep.org>) derived a Strategic Plan from the community roadmap which would leverage the strengths of the U.S. university community. IRIS-HEP aims to function as an intellectual hub for the national and international HEP community, through training, community workshops and the development of wider collaborations with the larger computer and data science communities.

IRIS-HEP Structure and Executive Board



Executive Board

The IRIS-HEP Executive Board manages the day to day activities of the Institute.

				
Peter Elmer Princeton University <i>Peter.Elmer@cern.ch</i>	Gordon Watts University of Washington <i>Institute co-PI and Deputy Executive Director</i>	Brian Bockelman Morgridge Institute <i>Institute co-PI and DOMA R&D Area Lead</i>	Heather Gray University of California, Berkeley <i>Innovative Algorithms Area co-Lead</i>	David Lange Princeton University <i>David.Lange@cern.ch</i> <i>Innovative Algorithms Area co-Lead</i>
				
Kyle Cranmer New York University <i>Analysis Systems Area Lead</i>	Sudhir Malik University of Illinois at Mayaguez <i>Training, Education and Outreach Coordinator</i>	Mark Neubauer University of Illinois at Urbana-Champaign <i>Blueprint Coordinator</i>	Rob Gardner University of Chicago <i>SSL Area Lead</i>	Frank Wuerthwein University of California, San Diego <i>OSG-LHC Area Lead and OSG Executive Director</i>

IRIS-HEP Team

<http://iris-hep.org/about/team>

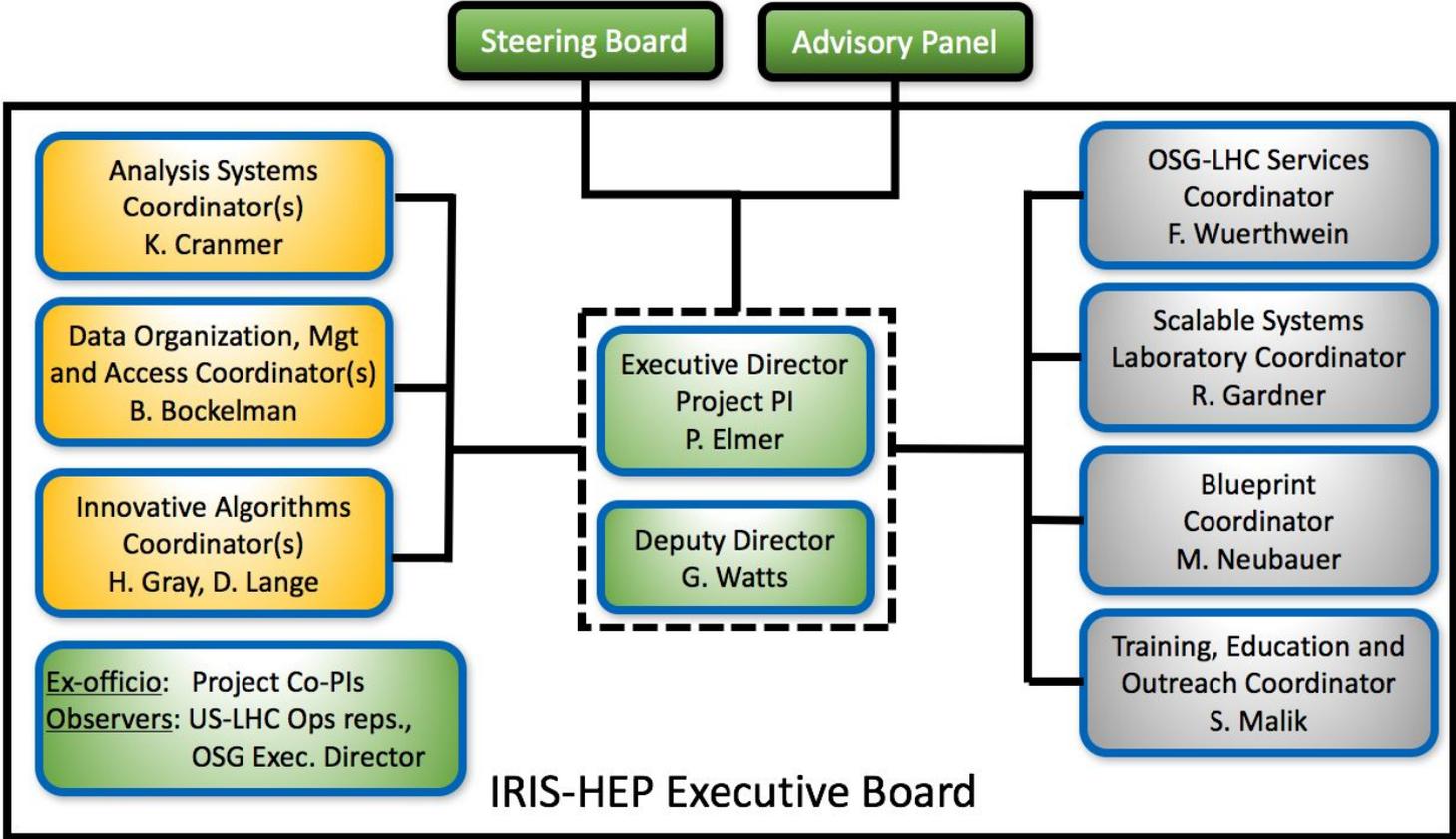
About 28 FTEs of funded effort spread over a larger number of people from 18 universities/institutions

 Peter Weisch Cornell University	 Dan Riley Cornell University	 Steve Lantz Cornell University	 Michael (Trev) Bell Cornell University PhD Student	 Susan Sons Indiana University
 Zafar Shah Indiana University Systems Analyst	 Mike Williams Massachusetts Institute of Technology	 Markus Kuba Massachusetts Institute of Technology	 Philip Harris Massachusetts Institute of Technology Postdoctoral Research Associate	 Daniel Crank Massachusetts Institute of Technology
 Dylan Barkin Massachusetts Institute of Technology	 Evan Massaro Massachusetts Institute of Technology	 Brian Beckelman MIT Roller co-PI and OSCAR R&D Area Lead	 Kyle Cranmer New York University Analysis Systems Area Lead	 Johann Brauner New York University
 Sebastian Macke New York University	 Alexander Held New York University	 Krina Espada New York University Institute PI and Executive Director	 Peter Eimer Princeton University Innovative Algorithms Area co-Lead	 David Lange Princeton University Innovative Algorithms Area co-Lead
 Jim Phair Princeton University	 Nesli Vassili Princeton University DIANA/NER LSCMS collaborator	 Flora Fialin-Wischusen Princeton University PICoE Institute Lead	 Maureen Crothers Princeton University Project Office	 Henry Schreier Princeton University
 Bei Wang Princeton University HPC Software Engineer	 Savannah Thais Princeton University Post-doctoral researcher	 Lauren Tompkins Stanford University SSL Area Lead	 Rob Gardner University of Chicago SSL Area Lead	 Lincoln Bryant University of Chicago DevOps Engineer

 Andrew Chen University of Chicago	 Marc Weinberg University of Chicago	 Miss Schuloff University of Chicago	 Marlan Stahl University of Chicago Budget Coordinator	 Mark Neubauer University of Illinois at Urbana-Champaign
 Daniel S. Katz University of Illinois at Urbana-Champaign	 Ben Galloway National Center for Supercomputing Applications	 Markus Atkinson University of Illinois at Urbana-Champaign	 Matthew Feldret University of Illinois at Urbana-Champaign Postdoctoral researcher OSS Networking Area Coordinator	 Shawn Motke University of Michigan Ann Arbor
 Kon Bloom University of Nebraska - Lincoln	 Derek Weitzel University of Nebraska - Lincoln	 Oksana Shadrin University of Nebraska - Lincoln DIANA/HEP collaborator	 Marlan Zaida University of Nebraska - Lincoln Systems Integrator	 Huijun Zhu University of Nebraska - Lincoln
 Heather Gray University of California, Berkeley Innovative Algorithms Area co-Lead	 Xiaoning Ai University of California, Berkeley Postdoc and ACTS	 Nicholas Cirko University of California, Berkeley Graduate Student	 Carlos Mattabio University of California, Santa Cruz	 Jeff LeFevre University of California, Santa Cruz
 Xiaocai (Aaron) Chu University of California, Santa Cruz Ph.D. Student	 Edgar Fajardo University of California, San Diego OSS Software Team Developer	 Arif Yagci University of California, San Diego OSS LHC Area Lead and OSS Executive Director	 Frank Worthwein University of California, San Diego OSS LHC Area Lead and OSS Executive Director	 Matevo Tadel University of California, San Diego
 Slava Krut'evy University of California, San Diego	 Mario Masio University of California, San Diego Lead Scientific Software Developer and Researcher	 Igor Sfiligi University of California, San Diego Lead Scientific Software Developer and Researcher	 Diego Davila University of California, San Diego Scientific Software Developer and Researcher	 Sudhir Malik University of California, San Diego Training, Education and Outreach Coordinator

 Gordon Watts University of Washington Institute co-PI and Deputy Executive Director	 Mason Proffitt University of Washington PhD student	 Emma Torro University of Washington Post-doc	 Tim Cartwright University of Wisconsin-Madison OSS Deputy Executive Director	 Brian Lin University of Wisconsin-Madison OSS Software Team Manager
 Tim Thelken University of Wisconsin-Madison OSS Release Manager	 Mayuka (Mat) Salmied University of Wisconsin-Madison Software Integration Developer	 Carl Edquist University of Wisconsin-Madison Systems Administrator	 Aaron Monte University of Wisconsin-Madison Systems Administrator	

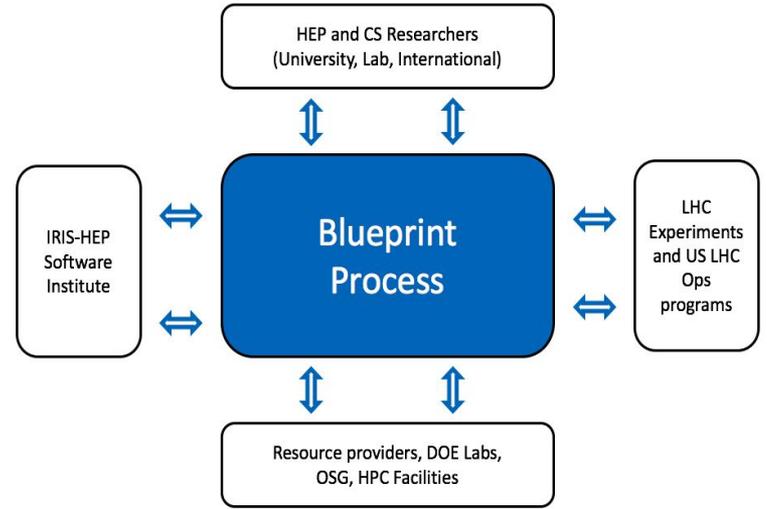
Management and Coordination



Blueprint Activity - Maintaining a Common Vision

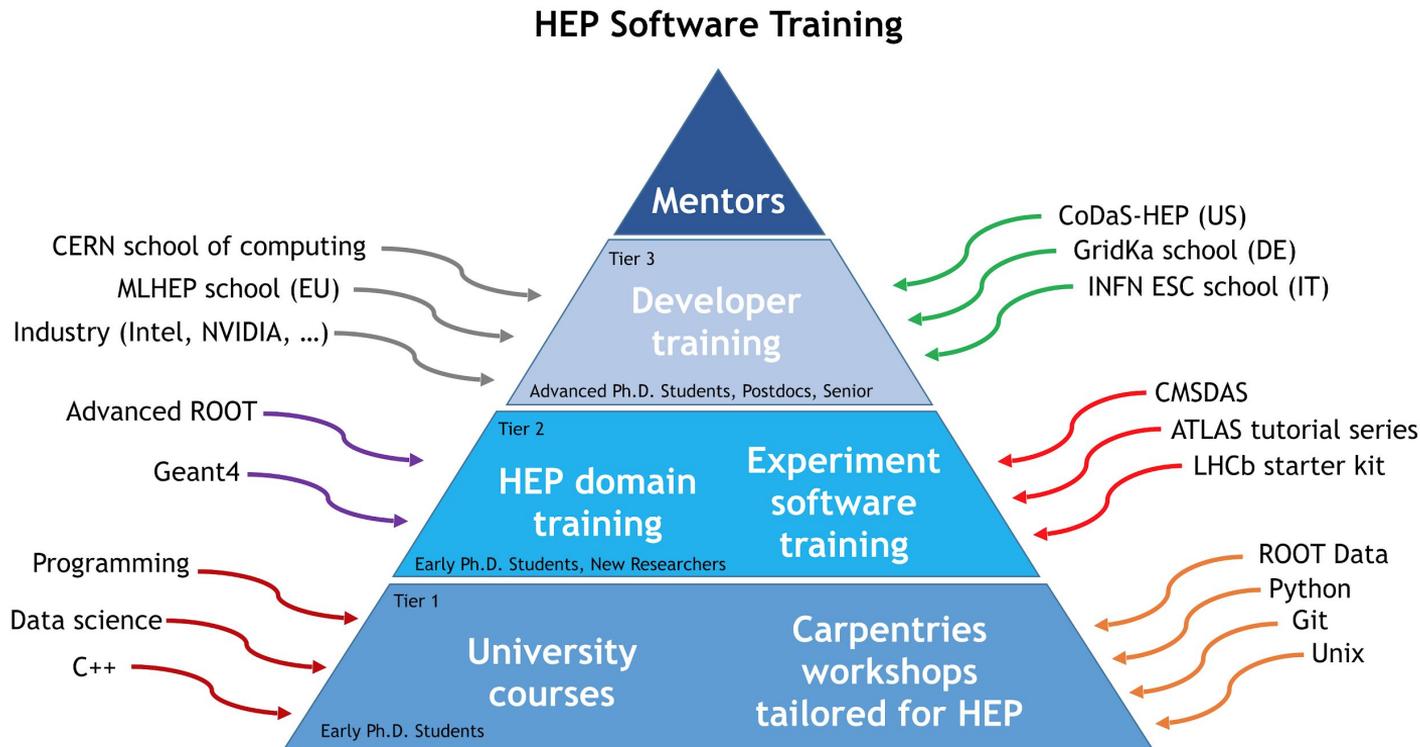


- Small **"blueprint" workshops** 3-4 times per year with key personnel and experts
- Facilitate effective collaborations by building and maintaining a common vision
- Answer specific questions within the scope of the Institute's activities or within the wider scope of HEP software & computing.
- 21 Jun - 22 Jun, 2019 - [Blueprint: Analysis Systems R&D on Scalable Platforms](#) (NYU)
- 10 Sep - 11 Sep, 2019 - [Blueprint: Accelerated Machine Learning and Inference](#) (Fermilab)



- 23 Oct - 25 Oct, 2019 - [Blueprint: A Coordinated Ecosystem for HL-LHC Computing R&D](#) (Catholic University of America, Washington DC)
- Others (e.g. Training) in planning

Training and Education - Sustainability/Scalability



This is a general framework for training, but from the NSF we have funds from both IRIS-HEP (OAC-183665) and a separate project FIRST-HEP (OAC-1829707, OAC-1829729, <http://first-hep.org>) which can work towards implementing this model.

Training, Education and Outreach Events



Upcoming events:

- 27-29 Nov, 2019 - Software Carpentry at CERN
 - CERN, Geneva, Switzerland
 - [Indico page](#)

Past events:

- 9-21 Aug, 2019 - ATLAS Software Carpentries Training
 - Lawrence Berkeley National Laboratory
 - [Indico page](#)
- 22-26 Jul, 2019 - Computational and Data Science for High Energy Physics (CoDaS-HEP) 2019 School
 - Princeton University
 - [Webpage](#)
- 10 Jun, 2019 - FIRST-HEP/ATLAS Software Training
 - Argonne National Laboratory
 - [Indico page](#)
- 3-4 Jun, 2019 - An introduction to programming for STEM teachers
 - University of Puerto Rico at Mayaguez
 - [Indico page](#)
- 24-26 Apr, 2019 - Machine Learning Hackathon for UPRM Students
 - University of Puerto Rico at Mayaguez
 - [Indico page](#)
- 1-2 Apr, 2019 - Software Carpentry Workshop
 - Fermi National Accelerator Laboratory
 - [Indico page](#)

In collaboration with FIRST-HEP (<http://first-hep.org>), the Carpentries (<https://carpentries.org>) and others

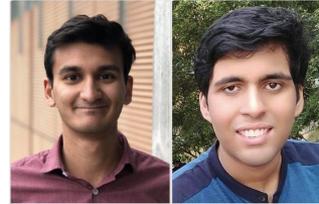


CoDaS-HEP 2017



CoDaS-HEP 2018

Current IRIS-HEP Fellows



Raghav Kansal
University of California,
San Diego

IRIS-HEP Fellow
Jun-Aug 2019

**Pratyush (Reik)
Das**
Institute of Engineering
& Management
(Kolkata)

IRIS-HEP Fellow
Jun-Sep 2019



ML Hackathon UPRM
2019



CoDaS-HEP 2019

IRIS-HEP Community Activities and Events



Upcoming Events:

IRIS-HEP team members are involved in organizing the following events:

- 29 Jul, 2019 - [IRIS-HEP Tutorial: Fast columnar data analysis with data science tools](#) (*Northeastern University / APS DPF 2019*)
- 19 Aug - 23 Aug, 2019 - [ATLAS Software Carpentries Training](#) (*LBNL*)
- 10 Sep - 11 Sep, 2019 - [Blueprint: Accelerated Machine Learning and Inference](#) (*Fermilab*)
- 23 Oct - 25 Oct, 2019 - [Blueprint: A Coordinated Ecosystem for HL-LHC Computing R&D](#) (*Catholic University of America, Washington DC*)
- 13 Dec - 14 Dec, 2019 - [Machine Learning and the Physical Sciences at NeurIPS 2019](#) (*Vancouver Convention Centre*)
- 15 Jan - 17 Jan, 2020 - [ML4Jets2020](#) (in planning) (*New York University*)

Recent Events:

- 22 Jul - 26 Jul, 2019 - [CoDaS-HEP 2019](#) (*Princeton University*)
- 1 Jul - 2 Jul, 2019 - [TrackML Challenge: Grand Finale](#) (*CERN*)
- 21 Jun - 22 Jun, 2019 - [Blueprint: Analysis Systems R&D on Scalable Platforms](#) (*NYU*)
- 19 Jun - 20 Jun, 2019 - [Analysis Systems Topical Workshop](#) (*NYU*)
- 10 Jun, 2019 - [FIRST-HEP/ATLAS Software Training](#) (*Argonne National Lab*)
- 3 Jun - 4 Jun, 2019 - [An introduction to programming for STEM teachers](#) (*University of Puerto Rico at Mayaguez*)
- 6 May - 8 May, 2019 - [Analysis Description Languages Workshop](#) (*Fermilab*)

IRIS-HEP Topical Meeting Series



Home » Projects » IRIS-HEP » Topical Meetings

Topical Meetings

Two weekly time slots are available for IRIS-HEP topical meetings:

- Mondays - 17:30-18:30GVA (Vidyo and 40-R-B10 at CERN)
- Wednesdays - 18:00-19:00GVA (Vidyo only)

There is one event in the future. [Hide](#)

April 2019

 15 Apr [Development of new Histogram tools](#)

March 2019

 25 Mar [Introduction to modern CDN Architectures](#)

 04 Mar [The FAST project](#)

February 2019

 25 Feb [Analysis Description Languages](#)

 18 Feb [Integration of C++ Modules into CMSSW](#)

 13 Feb [HLS4ML: Using ML on FPGAs to enhance reconstruction output](#)

 04 Feb [Training for Software, Computing, Computational and Data Science in HEP](#)

January 2019

 28 Jan [FuncX: High Performance Function as a Service for Science](#)

<https://indico.cern.ch/category/10570/>

Meetings are announced on the announcements@iris-hep.org mailing list

Recorded videos are available in Youtube (see links on the individual agenda pages)

Connecting with IRIS-HEP



Website: <http://iris-hep.org>

Public announcement mailing list: announcements@iris-hep.org [[Subscribe](#)]

Topical meetings: <https://indico.cern.ch/category/10570/>

We will be continuing to organize, co-organize and host various events going forward, see the main project website above.