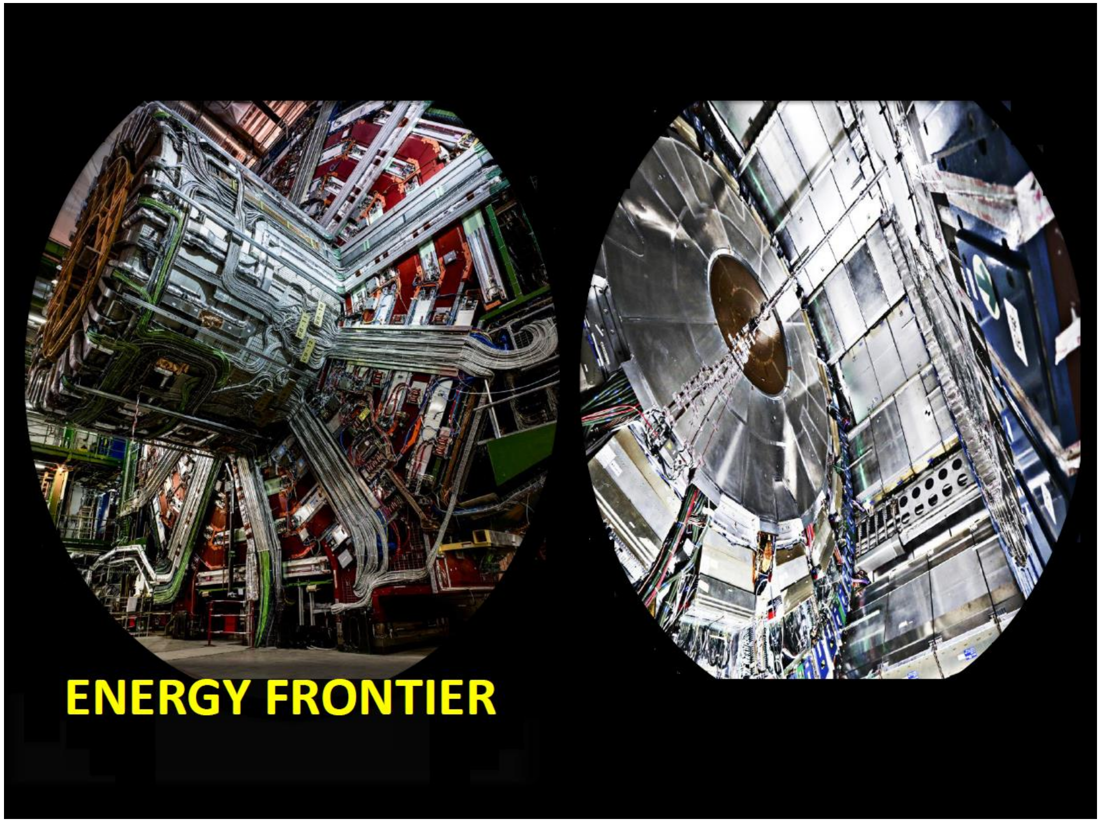
High Energy Physics Portfolio Review

Report of the HEPAP LHC Subpanel

Hugh Montgomery

May 14, 2018



LHC Subpanel Charge – From Crawford to HEPAP:

- The LHC program (including HL-LHC) was the highest-priority near-term project in the P5 plan and we do not intend to abandon the US commitment to LHC
  - We take pains to point this out in the Charge
  - Note that the LHC subpanel is not asked for Recommendations, only Findings
  - We do not need to review further the impact of LHC on the P5 drivers, so that evaluation criteria is dropped for LHC experiments

- **LHC Detectors subpanel** will assess the scientific merits and impact of DOE-supported contributions to the multipurpose LHC detectors ATLAS and CMS
  - ATLAS and CMS have been successfully operating since 2008
  - High-Luminosity LHC detector upgrades are in the advanced planning stages
  - DOE intends to support LHC operations and research through the HL-LHC era
  - U.S. contributions to LHC detector operations are regularly reviewed by the DOE and the NSF in a separate process
  - This subpanel will focus primarily on the efficiency and impact of DOE-supported contributions to ATLAS and CMS research efforts

LHC Subpanel Members :

• **Marina Artuso**	*Syracuse University*
• **Tom Browder**	*University of Hawaii*
• **Bonnie Fleming**	*Yale University*
• **Roger Forty**	*European Organization for Nuclear Research (CERN)*
• **Hassan Jawahery**	*University of Maryland*
• **Kay Kinoshita**	*University of Cincinnati*
• **Salman Habib**	*Argonne National Laboratory*
• **Tao Han**	*University of Pittsburgh*
• **Klaus Honscheid**	*Ohio State University*
• **Hugh Montgomery**	*Thomas Jefferson National Accelerator Facility*
• **Kevin Pitts**	*University of Illinois at Urbana-Champaign*

Acknowledgements:

The sub-panel would like to express its appreciation of the efforts of the collaborations in preparing and delivering the considerable body of information which formed the basis of the review. This material was considerably enhanced by the very informative presentations and responses to questions by the collaborations.

The execution of the review was facilitated by support from the DOE Office of Science, Office of High Energy Physics, and in particular by the Energy Frontier Program Manager, Abid Patwa.

Although the review was oriented toward the DOE supported components of the program, it is clear that the US-NSF Programs also play a vital role.

LHC Subpanel Meetings :

Monday, February 26, 2018

Item	Time	Session and Description
1	07:00 – 08:00	Continental Breakfast – Outside Lobby of Regency Room [Panelists]
2	08:00 – 09:00	Executive Session: Introductions and Discussion of Process – No Call-In [Panel and DOE-agency only]
3	09:00 – 10:30	LHC Collaboration #1: ATLAS – Presentations (with ATLAS Call-In)
4	10:30 – 10:45	Break
5	10:45 – 11:45	Executive Session – Discussion of Collaboration #1 [ATLAS] Presentations; Questions – No Call-In [Panel and DOE-agency only]
6	11:45 – 12:30	Discussion of Questions, Verbal Clarifications with Collaboration #1 [ATLAS]; (with ATLAS Call-In)
7	12:30 – 13:30	Working Lunch
8	13:30 – 15:00	LHC Collaboration #2: CMS – Presentations (with CMS Call-In)
9	15:00 – 15:15	Break
10	15:15 – 16:15	Executive Session – Discussion of Collaboration #2 [CMS] Presentations; Questions – No Call-In [Panel and DOE-agency only]
11	16:15 – 17:00	Discussion of Questions, Verbal Clarifications with Collaboration #2 [CMS]; (with CMS Call-In)
12	17:00 – 17:15	Break
13	17:15 – 18:15	Executive Session; Discussion Towards Conclusions – No Call-In [Panel and DOE-agency only]
14	Evening	Dinner [TBD]

Tuesday, February 27, 2018 – Panel and DOE-agency only

LHC Subpanel Deliberation and Report Preparation

Second LHC Subpanel Session: In-person Meeting

Monday, March 26, 2018 – Panel and DOE-agency only

US DOE LHC Program [Patwa in Exec Session]:

U.S. LHC Detectors Operations Program

The LHC at CERN is the centerpiece of the U.S. Energy Frontier program and an integral component of the DOE HEP program

- **Scope of U.S. ATLAS, U.S. CMS Operations Programs; joint DOE and NSF coordination**
  - **Operations Program Management; Detector Maintenance and Operations (M&O)**
    - M&O of U.S.-built detectors or detector components
    - Meet U.S. obligations to international CMS and ATLAS by contributions to common fund costs
    - Upon completion of fabrication of U.S.-built detector components, and delivery to CERN of the initial [Phase-1] ATLAS and CMS detector upgrades, complete installation and commissioning activities for each international collaboration
  - **Software and Computing (S&C)**
    - Support U.S. Tier-1 (DOE) and Tier-2 (NSF) computing facilities
    - DOE support of ESnet Transatlantic network for transfer of data from Tier-0 to U.S. Tier-1s
    - Contribute to the software tools and provisions to enable all phases of physics analyses by U.S. physicists on CMS and ATLAS via support for computing hardware and core software
  - **For NSF: conduct project planning and R&D leading to a construction-ready proposal (MREFC) for the HL-LHC CMS and ATLAS detector upgrades**

U.S. agencies' review of operations held every ~24 months for the above scope; and resources coordinated through the CERN LHC Resources Review Boards (RRB)

US DOE LHC Program [Patwa in Executive Session]:

DOE/HEP Energy Frontier

Experiment	Location	Center-of-Mass Energy; Status	Description of Science	# Institutions; # Countries	# U.S. Institutions	#U.S. Coll.
ATLAS (A Toroidal LHC ApparatuS)	CERN, Large Hadron Collider [LHC; Geneva, Switzerland / Meyrin, Switzerland]	7-8 TeV; 13-14 TeV Run 1: 2009-2012 Run 2: 2015-2018 Run 3 to begin: 2021 Run 4 to begin: mid-2026	Higgs, Top, Electroweak, SUSY, New Physics, QCD, B-physics	183 Institutions; 38 Countries	31 DOE Univ., 4 DOE National Labs; (10 NSF Univ.)	620
CMS (Compact Muon Solenoid)	CERN, Large Hadron Collider [LHC; Geneva, Switzerland / Cessy, France]	7-8 TeV; 13-14 TeV Run 1: 2009-2012 Run 2: 2015-2018 Run 3 to begin: 2021 Run 4 to begin: mid-2026	Higgs, Top, Electroweak, SUSY, New Physics, QCD, B-physics	217 Institutions; 47 Countries	36 DOE Univ., 1 DOE National Lab; (17 NSF Univ.)	650

LHC data provided by U.S. LHC collaborations, as of February 2018.

- One main scientific thrust – LHC at CERN (*pp* collider): ATLAS and CMS Collaborations
- Modest support for studies on future collider initiatives:
  - mainly ~3-4 FTEs on ILC/Japan *or* FCC/CERN physics studies and detector R&D
- U.S. is the single largest collaborating nation in both the ATLAS and CMS experiments at LHC
  - U.S.-ATLAS: ~19% of the international ATLAS Collaboration (~15.3% DOE + ~3.6% NSF)
    - Brookhaven National Laboratory is U.S. ATLAS host lab for DOE
  - U.S.-CMS: ~27% of the international CMS Collaboration (~21.5% DOE + ~5.7% NSF)
    - Fermi National Accelerator Laboratory is U.S. CMS host lab for DOE
- DOE Nuclear Physics supports heavy-ion research on ALICE, ATLAS, and CMS
- NSF supports research on ATLAS, CMS, and LHCb

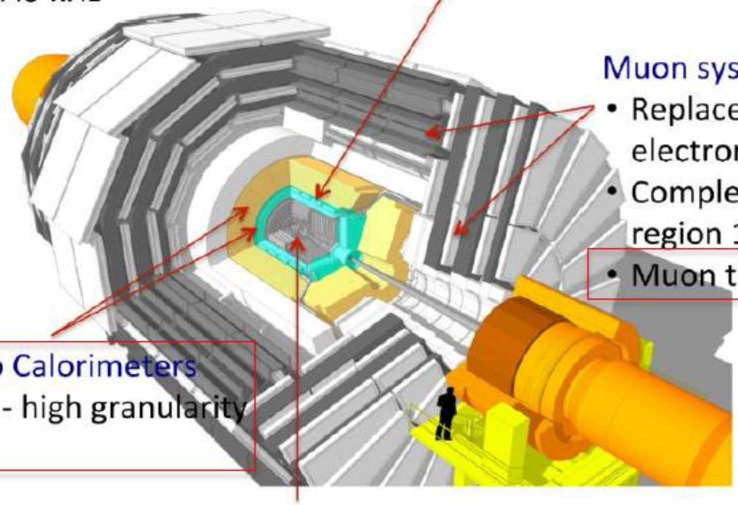
US DOE LHC Program [Patwa in Executive Session]:

CMS HL-LHC Upgrade

- **DOE and U.S. National Science Foundation coordinating U.S. contributions with CERN and international partners on CMS**
- **Scope of the U.S. deliverables leverages expertise by U.S. scientists**

DOE **NSF**
Trigger/HLT/DAQ
- Track information at L1-Trigger
- L1-Trigger: 12.5 μs latency - output 750 kHz
- HLT output ≃7.5 kHz

Barrel EM calorimeter
- Replace FE/BE electronics **NSF**
- Lower operating temperature (8°)



Muon systems
- Replace DT & CSC FE/BE electronics **NSF**
- Complete RPC coverage in region 1.5 < η < 2.4 **DOE**
- Muon tagging 2.4 < η < 3

DOE
*Replace Endcap Calorimeters
- Rad. tolerant - high granularity
- 3D capability

Replace Tracker *
- Rad. tolerant - high granularity - significantly less material
- 40 MHz selective readout (Pt≥2 GeV) in Outer Tracker for L1-Trigger **DOE**
- Extend coverage to η = **3.8** **NSF**

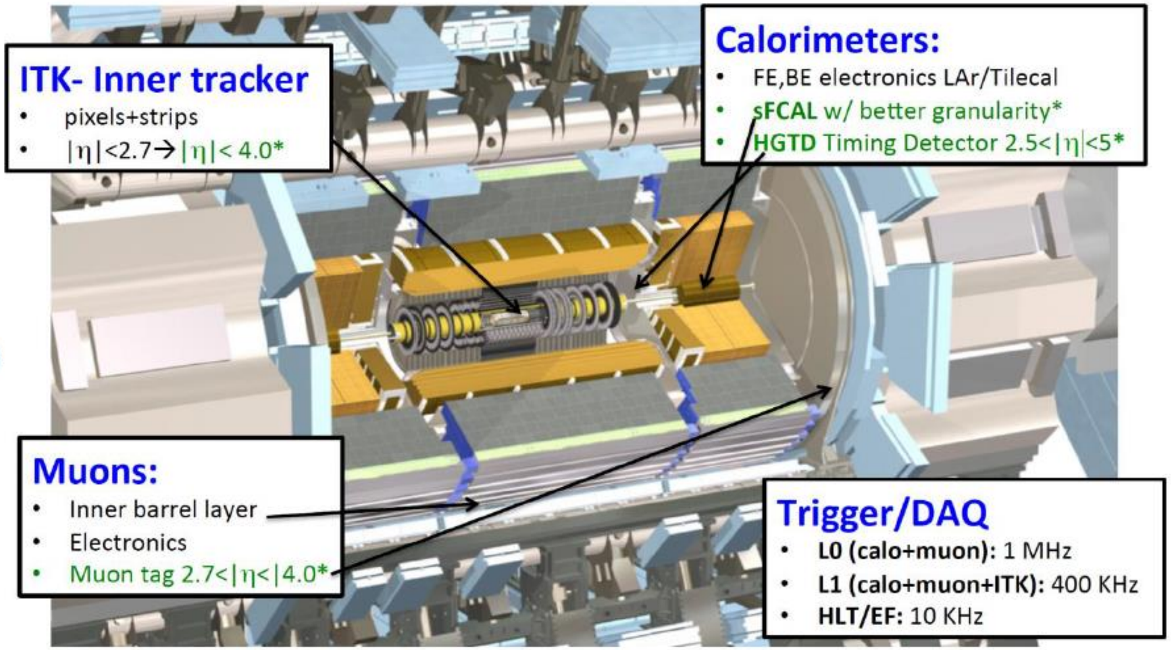
US DOE LHC Program [Patwa in Executive Session]:

ATLAS HL-LHC Upgrade

- Similarly, U.S. ATLAS is defining the scope of its contributions to HL-LHC by leveraging interests and experience of U.S. groups, coordinating with international ATLAS

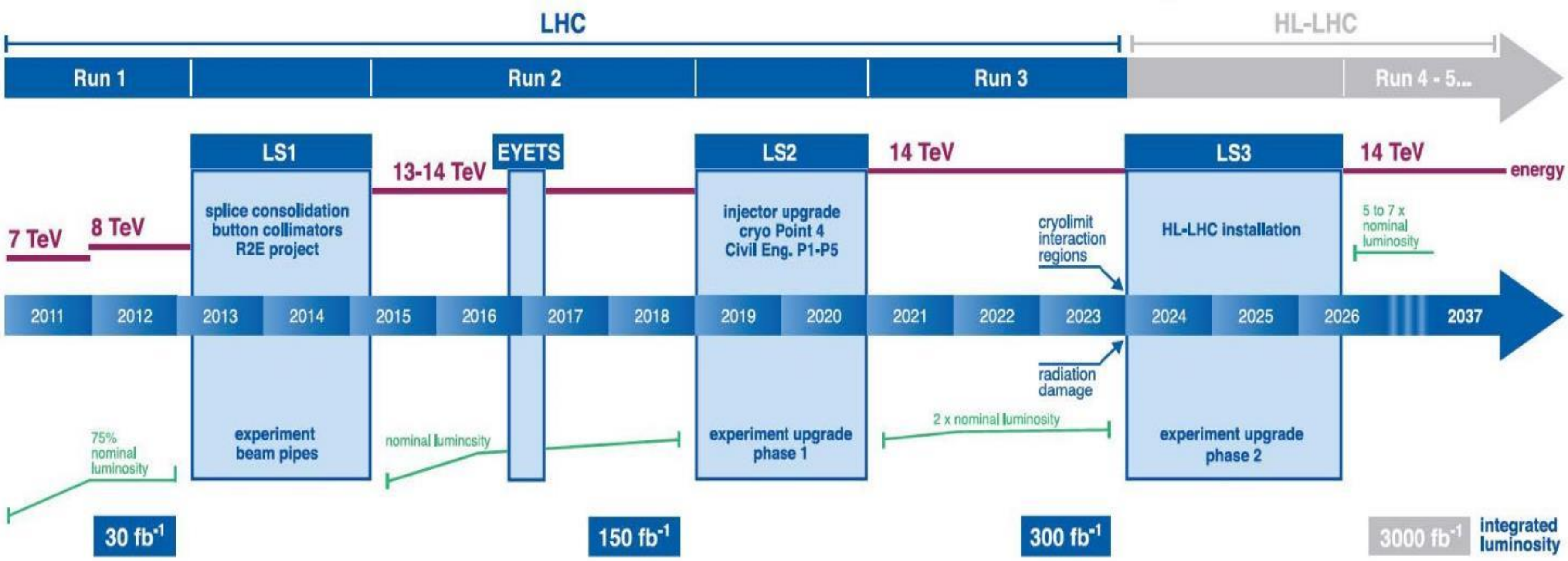
- DOE Scope:
  - Barrel Inner Tracker (pixel & strip detector)
  - LAr Calorimeter front-end analog chip development
  - DAQ hardware (data flow elements)

- NSF Scope:
  - 'Triggering' at high luminosities
  - Readout electronics for LAr, Tile, Muons



** Large forward rapidities, as described in the 2015 ATLAS HL-LHC scoping document (for the reference 275 MCHF CORE total cost scenario)*

LHC Schedule [Patwa in Executive Session]:



Top 5 Science & Technology Goals:

- **US-ATLAS**

- Collect and Prepare Data for Physics Analysis
- Measure the Properties of the Higgs Boson
- Search for Beyond Standard Model Signatures
- Probe New Physics via Precision Measurements
- Develop Efficient Detector Technology for HL-LHC

- **US-CMS**

- Foundations for Discovery
- The Higgs Boson as a Tool for Discovery
- Exploring the Unknown: New Particles, Interactions, Physical Principles
- The New Physics of Dark Matter
- Preparing for the HL-LHC . . .

Evaluation Criteria:

Science Merit and Productivity (including training and mentoring of junior researchers)

- What is the scientific scope and impact of the top research and technology goals?
- How might the results of the proposed work impact the direction, progress, and thinking in relevant scientific fields of research?
- What is the likelihood of achieving valuable results?
- How does the merit of the proposed research, both in terms of scientific and/or technical merit and originality, compare with other efforts within the same research area for the overall HEP field?
- How productive has the experiment been in terms of science or technology results?
- How effective has the experiment been in terms of training and mentoring students and junior researchers?
- Will the proposed research plan deliver significant productivity in terms of science/technology results and student training?

Efficiency and Impact of DOE-supported contributions to the physics analysis efforts

- Are the proposed staffing levels well-matched to the proposed work, for each of the top science and technology goals?
- Is the balance of effort by job type (faculty/staff, postdocs, graduate students) appropriate and well-matched to the proposed work, for each of the top science and technology goals?
- Does the proposed work take advantage of unique or leading facilities, personnel and capabilities at DOE-supported institutions?
- Are DOE-supported groups efficiently deployed to maximize their impact on the physics analysis effort?
- Do the DOE-supported groups have appropriate leadership roles in the physics analysis effort?
- Do the DOE-supported groups have critical impacts on the top science and technology goals?

The Report :

- Executive Summary

- Introduction

- Program (Findings and **Comments**)
  - US-ATLAS
  - US-CMS
  - Programmatic Considerations

- Conclusions

- Appendices

Comments : ATLAS 1

- The U.S. ATLAS collaboration contributes to the analysis effort, detector maintenance and operations, computing, and detector upgrades, demonstrating leadership in all these components.

- The U.S. ATLAS objectives and planning are aligned with the P5 priorities and the three science drivers that map onto the Energy Frontier program in particle physics.

- The U.S. ATLAS teams have a strong presence in physics analysis, investing their efforts judiciously in topics such as Higgs physics, exotica, dark matter, and hidden sectors. Overall the ATLAS experiment is well-poised to record collision data in the next phase of the program and extract physics results in a broad range of physics areas.

Comments : ATLAS 2

- The development, operation and physics exploitation of ATLAS has been instrumental in advancing new detector technologies, state of the art radiation-hard electronics, large-scale computing techniques, and data analysis methods, including machine learning; these have influenced the whole field. Exploiting these advances, the U.S. ATLAS collaboration provides key contributions to the operation of the current detector as well as to its planned upgrades, utilizing technical infrastructure available at the four DOE National Laboratory partners and universities equipped with technical capabilities.

- The path for an analysis from idea to publication is long and complex. Such a high level of effort may be required for highly complex and high priority studies, but a mature experiment like ATLAS could also be expected to facilitate creative and less complicated analyses that are doable in less time and by significantly smaller teams. Such an approach could broaden the experience, skills, and physics perspectives of the participating students and postdocs.

Comments : ATLAS 3

- Mentoring and advising of these early career scientists is an important responsibility of the collaboration. Evidence for significant methodical or organized professional development of young scientists, which could be considered as a role for the ATLAS Centers (ATCs), was not presented. In order to assess mentoring success, U.S. ATLAS is encouraged also to make efforts in longitudinal tracking of postdoctoral research associates and accumulate statistics on the fractions pursuing careers in academia, laboratories, industry, and other sectors.

- On average, the DOE-supported university balance of activities is consistent with the stated priorities, and the contributions to operations are important. There is some concern that the educational mission of the four ATCs is not clearly articulated and that the impact on the mentoring of junior scientists could be enhanced. U.S. ATLAS should consider re-evaluating the current ATC implementation.

Comments : ATLAS 4

- It is important that additional effort be directed towards a new computing model, including a cost model for funding agencies, which ensures data processing and efficient analysis throughput in the HL-LHC running period. In particular, newly emerging computer architectures should be studied and their impact on the performance of the existing code base should be evaluated. Additional burdens for the funding agencies should be identified early and carefully assessed.

- A clear articulation of unique contributions to the ATLAS experiment could serve to identify priorities in challenging times. In addition, the committee encourages ATLAS to further pursue synergies with CMS and other experiments that are addressing similar experimental challenges, including detector technologies and computing. Increasing the efficiency of analysis or delaying analyses could also be routes to consider in the prioritization.

Comments : CMS 1

- Overall, the U.S. CMS team has a broad footprint and plays a leading role within the international CMS collaboration activities.

- The U.S. CMS Research program impacts a number of research areas in particle physics. Results and publications for CMS are central to the field of particle physics overall and are therefore followed closely by the rest of the particle physics community, both experimental and theoretical.

- As the integrated luminosity increases in Run 3, including the Phase-I upgrades, with long runs and increasing accelerator performance, the potential for discoveries of new weakly interacting particles improves; enhancements in precision measurements are also enabled. The U.S. CMS contributions are critical for the overall success of the CMS HL-LHC upgrades.

Comments : CMS 2

- The computing model will need to be transformed, to accommodate the increase in data and simulation expected from the coming runs and the HL-LHC upgrade. This challenge is exacerbated by the complexity of the event environment.

- The CMS program is excellent: along with ATLAS, the experiment is a world-leader at the Energy Frontier. In terms of technology, CMS has pushed the frontiers for large-area silicon detectors and crystal calorimetry, and the scientific output by the collaboration is impressive.

- Improved communication and synergies with ATLAS could produce significant benefits. Areas of cooperation may include Monte Carlo generators, Application Specific Integrated Circuit (ASIC) and firmware development for fast-timing upgrades and Grid computing middleware with distributed data management.

Comments : CMS 3

- The proposed U.S. CMS research plan will deliver significant productivity in terms of student and postdoctoral fellow training. However, the committee sees a need for improved coordination and communication (such as seminar series, etc.) to help young people find career paths inside and outside of academia. The U.S. CMS groups could also be more proactive both with respect to tracking where students and postdocs go after their time on CMS, and the professional development for those who will transition to careers in industry.

- The proposed staffing levels appear to be well matched to the proposed work, for each of the top science and technology goals. CMS computing appears to benefit greatly from leveraging resources from the Fermilab Scientific Computing Division (SCD). There is a reasonable balance between the roles of physicist, graduate student, engineer and technician for the proposed work in the next four years.

Comments : CMS 4

- The U.S. is capitalizing on its investment very effectively. Some additional coordination and streamlining within U.S. CMS amongst physics topics may benefit the scientific output of U.S. CMS while continuing to ensure alignment with the P5 science drivers.

- U.S. CMS is taking advantage of strong and special capabilities which have significant impact on CMS overall. The role of Fermilab, as the single center for U.S. CMS in the United States, is excellent. As Fermilab develops its laboratory program in the Intensity and Cosmic Frontier programs, its continued support for U.S. CMS is essential.

Comments : CMS 5

- Obtaining good data on tape must be the absolute priority. The HL-LHC upgrade cannot be delayed too long because of the eventual reduction in performance of the existing detector in the high radiation environment, along with the need to remain in step with the accelerator upgrades, and with international obligations. Increasing the efficiency of analysis, or possibly delaying analyses, could be routes to consider. Synergies should continue to be exploited as much as possible to increase efficiency. U.S. CMS supported by DOE could explore the potential for its computing contributions to international CMS to offset its operations obligations.

Comments : Programmatic 1

- Overall, the US-ATLAS and US-CMS support places the DOE Energy Frontier research program in a world-leading position within particle physics.

- The panel strongly encourages U.S. ATLAS and U.S. CMS to pursue an aggressive “advanced computing” R&D program. In view of the critical role of data handling and processing to the success of these programs, this challenge should not be underestimated.

- We continue to dream of the small university-based group led by a faculty member being able to do a complete analysis. The development of a new analysis paradigm, through some major transformation of the current approach, would be highly desirable.

Comments : Programmatic 2

- The explicit attention paid to the development of junior participants in a diverse and inclusive environment by the U.S. ATLAS and U.S. CMS collaborations is very important; further enhancement of such activities should be considered.

- The experiments should consider the opportunities to more aggressively exploit the synergies.

- It is important that the collaborations consider, discuss, and share the impacts of their work with a wide spectrum of audiences that range from the broad scientific community, to policy makers, and to “people-on-the-street”.

Executive Summary 1 :

The most prominent experimental particle physics program in the world currently is that at the CERN Large Hadron Collider. Collider experiments probe the fundamental laws of nature at the highest energy scales, or the shortest distances. Experiments at the LHC have led us to explore the microscopic world at scales less than 10^{-18} meters. The U.S. Department of Energy supported programs have contributed to the construction of the collider itself and to the two general-purpose detectors, ATLAS and CMS. In each experiment, the strength of the support for the Operations and Research Programs surpasses that of any single country. An important component of the contributions is the intellectual talent provided by faculty, scientists, technical and professional staff, postdoctoral appointees, graduate students and undergraduates. Together, there are approximately 1,000 United States authors on the scientific publications from the two experiments. Significant U.S. intellectual, technical, and resource contributions ensure that the United States continues to play a world-leading role in this important program of physics, even as the facility is located offshore. The program was featured as a high priority in the Particle Physics Project Prioritization Panel Report of 2014. The schedule of the LHC, including the experimental program, is summarized in Figure 1.

Executive Summary 2 :

The subpanel found that the scientists of the U.S. DOE programs in ATLAS and CMS pay considerable attention to understanding the resources needed to match their prorated contributions to the construction, operations, and computing for the experiments. In general, the program contributes at, or, in the case of computing, slightly above the pledges within the international collaborations. The resources needed to maintain this level are broadly justified. The emphases in the Physics Research programs of the two groups map well on to those aspects of the program highly recommended by the High Energy Physics Advisory Panel.

Nevertheless, the scale of resources involved is large. The programs should feel motivated to continue to seek synergies that can be exploited to reduce effort across the program. It may also be that such synergies exist with other physics and science programs.

Executive Summary 3:

Thirty years ago, the recognition of the peculiar, event structured, data in particle physics, permitted the use of multiple modest, even commodity, computers in large numbers at significantly lower cost than mainframes. The scale of the future needs for Run 3 of the LHC and particularly for the high luminosity phase, HL-LHC, probably demands an analogous change of approach. What is recognized is the need to use diverse and heterogeneous architectures and to exploit high performance computing facilities, cloud services and data center facilities. The experiments should not underestimate the resources needed to ensure success in this new environment. A paradigm shift in the manner in which the analyses are performed, to enhance the productivity of the experiments, could perhaps be envisaged.

Executive Summary 4 :

The breadth of opportunities that are available to junior scientists in high technology detectors, computing, machine learning, collaborative endeavors, and scientific discovery, is impressive. It is important that the collaborations prioritize the training and mentoring of junior scientists. Increased efforts in enhancing the diversity and inclusion of this experience could ensure not only benefits for society but also the attraction of the brightest and best to enter the field. The potential for the junior scientists who participate in this DOE program to influence society is amplified by them enjoying a good experience as students and postdoctoral fellows.

The overall performance of the programs covering the challenging experimentation, the large-scale management, and most importantly, the physics outcome is excellent. The stage is set for a world-leading program during the next two decades.

Conclusion:

The U.S. ATLAS and U.S. CMS programs are distinctive and excellent; the experiments are world-leaders at the Energy Frontier of particle physics, and a strong future, spanning the next two decades, is foreseen.

Spares Follow:

ATLAS and CMS: M&O Obligations

- **Cost of maintaining and operating [M&O] the ATLAS and CMS experiments is divided into three categories:**
  - **M&O – A**
    - Expenses that are shared by the entire collaboration in proportion to the number of scientific staff holding PhD or equivalent qualification and are entitled to be names as authors of scientific publications of the collaboration.
    - Article 7.1.1 & Article 9.2, CERN-RRB-2002-033 (CMS); CERN-RRB-2002-035 (ATLAS)
    - DOE/HEP payment in 2017: CMS = 3.090 MCHF; ATLAS = 2.509 MCHF
  - **M&O – B**
    - Expenses borne by part of the collaboration for common costs related to the maintenance and operation of sub-detectors/systems that are the responsibility of individual institutes or groups of institutes.
    - Article 7.1.2 & Article 6.3.2, CERN-RRB-2002-033 (CMS); CERN-RRB-2002-035 (ATLAS)
    - DOE/HEP payment in 2017: CMS = 1,334 kCHF; ATLAS = 891 kCHF
  - **M&O – C**
    - General maintenance and operation expenses that are provided to the Collaboration by CERN, acting in its role as the Host Laboratory for the LHC experiments.
    - Article 7.1.3, CERN-RRB-2002-033 (CMS); CERN-RRB-2002-035 (ATLAS)

US-ATLAS Appendix A:

DOE Laboratory Effort FY17	operations (FTEs)	physics Research (FTEs)	upgrades (FTEs)	TOTAL Lab FTEs
Scientist	6.9	18.7	12.2	37.8
POSTDOC/TERM PHD	5.3	6.8	5.4	17.5
Grad student	0.9	4.9	1.6	7.4
Undergraduate	0.3	0.4	0.2	0.9
ENGINEER/computing professional	37.1	0.1	14.3	51.5
ADMIN/technician	3.1	2.1	2.2	7.4
TOTAL	53.6	33.0	35.9	122.5

DOE University Effort FY17	operations (FTEs)	physics Research (FTEs)	upgrades (FTEs)	TOTAL Univ FTEs
Faculty	9.9	49.5	23.4	82.8
Postdoc	17.0	40.8	7.9	65.6
Grad student	19.9	69.2	14.8	103.9
Undergraduate	0.1	2.3	5.2	7.6
Research scientist	5.2	1.6	4.6	11.4
ENGINEER/computing professional	32.1	0.2	19.2	51.4
ADMIN/technician	2.8	0.4	4.83	8.0
TOTAL	86.9	164.0	79.9	330.7

US-CMS Appendix A:

FNAL Effort FY17	operations (FTEs)	physics Research (FTEs)	upgrades (FTEs)	TOTAL LAb FTEs
Scientist	5.7	11.3	20.0	37.0
POSTDOC/TERM PHD	1.7	8.1	8.2	17.9
Grad student				0.0
ENGINEER/computing professional	27.0		5.3	32.3
ADMIN/technician	3.5		3.5	7.0
TOTAL	37.8	19.4	37.0	94.2

DOE University Effort FY17	operations (FTEs)	physics Research (FTEs)	upgrades (FTEs)	TOTAL University FTEs
Faculty	18.0	47.7	28.1	93.7
Postdoc	28.7	49.6	16.8	95.0
Grad student	40.3	79.4	18.7	138.4
Undergraduate	2.5	5.0	9.1	16.5
Research scientist	9.2	4.8	2.3	16.3
ENGINEER/computing professional	8.1	1.5	10.1	19.6
ADMIN/technician	4.6	2.0	6.6	13.2
TOTAL	111.2	189.9	91.6	392.7

The Review [Patwa in Exec Session]:

Day 1 Agenda: ATLAS and CMS Sessions

- ATLAS Experiment Session [9:00 – 10:30 am U.S. Eastern Time, February 26, 2018]
  - — Remarks by ATLAS Management – by Andreas Hoecker (CERN) [10’]
  - — U.S. ATLAS Overview – by Srini Rajagopalan (BNL) [25’]
  - — U.S. ATLAS Physics, Accomplishments & Goals – by Jason Nielsen (UC Santa Cruz) [25’]
  - — Analysis Workflow & Resources – by Stephane Willocq (U. Mass-Amherst) [25’]
  - — Concluding Remarks [5’]

- CMS Experiment Session [1:30 – 3:00 pm U.S. Eastern Time, February 26, 2018]
  - — Introduction by CMS Management – by Joel Butler (Fermilab; remote) [10’]
  - — U.S. CMS Overview: Science Goals – by Lothar Bauerdick (Fermilab) [20’]
  - — Science Goals, Past and Future Impact on P5 Drivers – by James Olsen (Princeton) [35’]
  - — U.S. Contributions to CMS Physics and Operations – by Meenakshi Narain (Brown) [20’]
  - — Concluding Remarks [5’]

The Review [Patwa in Exec Session]:

Morning ATLAS Session: Participants

ATLAS Experiment Session Participants

- **In-person attendees**
  - — David Lissauer (Deputy Associate Lab Director for HEP, Brookhaven National Laboratory)
  - — Srini Rajagopalan (U.S. ATLAS Operations PM & DOE NCP for ATLAS, Brookhaven National Laboratory)
  - — Sarah Demers (U.S. ATLAS Institutional Board Deputy Chair, Yale University)
  - — Andreas Hoecker (Deputy Spokesperson of ATLAS Collaboration, CERN)
  - — Jason Nielsen (Upgrade Physics Coordinator for International ATLAS, UC Santa Cruz)
  - — Stephane Willocq (Physics Publication Committee Chair for International ATLAS, U. Mass-Amherst)
- **Remote participants**
  - — Isabelle Wingerter-Seez (Deputy Spokesperson of ATLAS Collaboration, Annecy LAPP)
  - — Jim Cochran (U.S. ATLAS Operations Deputy PM & NSF NCP for ATLAS, Iowa State University)
  - — Ayana Arce (Physics Support Manager for U.S. ATLAS, Duke University)
  - — John Butler (U.S. ATLAS Management Advisory Committee Chair, Boston University)
  - — Paolo Calafiura (Software and Computing Manager for U.S. ATLAS, Lawrence Berkeley National Lab)
  - — Hal Evans (Technical Coordinator for U.S. ATLAS HL-LHC, Indiana University)
  - — George Redlinger (Risk Manager for U.S. ATLAS HL-LHC Upgrade, Brookhaven National Laboratory)
  - — Eric Torrence (U.S. ATLAS M&O Manager, University of Oregon)

The Review [Patwa in Exec Session]:

Afternoon CMS Session: Participants

CMS Experiment Session Participants

- **In-person attendees**
  - Patricia McBride (Director of Particle Physics Division, Fermi National Accelerator Laboratory)
  - Lothar Bauerdick (U.S. CMS Operations PM & DOE NCP for CMS, Fermi National Accel. Laboratory)
  - Markus Klute (Physics Performance and Dataset Co-coordinator for International CMS, MIT)
  - Meenakshi Narain (Upgrade Performance Studies Co-coordinator for Int. CMS, Brown University)
  - James Olsen (former CMS Physics Co-coordinator, Princeton University)
  - Gregory Snow (U.S. CMS Collaboration Board Chair, University of Nebraska)

- **Remote participants**
  - Joel Butler (Spokesperson of CMS Collaboration, Fermilab)
  - Guenther Dissertori (Deputy Spokesperson of CMS Collaboration, ETH Zürich)
  - Daniel Marlow (U.S. CMS Operations Deputy PM & NSF NCP for CMS, Princeton University)
  - Tulika Bose (present CMS Physics Co-Coordinator, Boston University)
  - Max Chertok (U.S. CMS Collaboration Board Deputy Chair, UC Davis)
  - Bob Cousins (former Deputy Spokesperson of CMS Collaboration, UCLA)
  - Vivian O'Dell (U.S. CMS HL-LHC Upgrade Project Manager, Fermi National Accelerator Laboratory)
  - Paul Padley (U.S. CMS Detector M&O Manager, Rice University)