

ECFA HL-LHC: Concluding Remarks & Future Workshops

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Aix-les-Bains: 3rd October

<https://indico.cern.ch/conferenceDisplay.py?confId=252045>

- Reminder of aims of the workshop
- Physics potential and future studies
- Existing areas of common detector R&D, potential future areas and synergies
- Thanks to everyone who helped make this workshop possible

ECFA High Luminosity LHC Experiments Workshop
Physics and technology challenges
1st – 3rd October
Aix-les-Bains
France

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Programme Committee
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Logos at the bottom: aix-les-bains centre des congrès, ECFA, High Luminosity LHC, ALICE, CMS, ATLAS, LHCb, CERN.

Reminder of aims of the workshop

- The ECFA HL-LHC Experiments Workshop has been a first meeting of the ALICE, ATLAS, CMS and LHCb collaborations **to develop a common approach to the HL-LHC programme and to identify synergies and possible effort to collaborate in areas of common interest**
- It has aimed to outline the physics goals, detector upgrade requirements and subsequent Technology R&Ds, with talks in the following areas, each with a preparatory group to identify the key topics for discussion and to organize the sessions in the workshop with common presentations of the 4 experiments.
 - Physics goals, theoretical developments and performance reach
 - Tracking devices and associated electronics and readout
 - Calorimetry and associated electronics and readout
 - Muon systems and associated electronics and readout
 - Trigger/DAQ/Offline/Computing
 - Electronics and read-out systems
 - Long Shutdown constraints and radiation and activation effects
 - Accelerator and Experiment interface
- The Preparatory Groups are also preparing the report to R-ECFA and Plenary ECFA (on 21-22/11/13) to inform SPC and Council as described by Manfred in the introduction to the workshop.



Physics potential and future studies

- The physics communities in all experiments have made huge progress in exploring their physics reach.
- There are a wide range of interesting theoretical scenarios and channels that can be further studied in the future.
- The studies themselves are challenging, and require significant effort. Detailed descriptions are needed to identify where the current detectors start to encounter difficulties as the pile-up increases and as their performance degrades with integrated dose and instantaneous fluence.
- Few of the upgrade detector components are implemented in simulation and many are not yet sufficiently defined, so the expected improvements are often not available to the physics studies.
- There looks to be a strong enthusiasm to follow up this workshop with more dedicated meetings between the experiments and theorists to further develop the physics programme and refine the combined performance reach for precision measurements and search capabilities.



Existing areas of common detector R&D, potential future areas and synergies ⁴

- Some assumptions, and proposed requirements, benefit from being discussed between the experiments, and from any differences being understood to help optimize performance in terms of cost effective designs and technical solutions.
- Modeling of radiation levels and radiation damage are clearly important, and in some cases more results are needed to identify where upgrades are required.
- Many systems would benefit from more common facilities for irradiations and test beam as well as greater coordination for use of those already available.
- There are a number of existing and new RDs (eg RD42, RD50, RD51, RD52, RD53) and activities (eg the GBT, VL projects) where common programmes already exist which serve several LHC experiments.
- Nevertheless, there are R&D programmes and work with cutting edge commercial technologies within each experiment which do not find a natural forum for discussion with the other experiments.
- There are existing forums for interaction between the machine and the experiments but it is always helpful to provide updates on this to a larger forum to be sure key parameters are understood across experiments.



Existing areas of common detector R&D, potential future areas and synergies ⁵

- Long shutdown durations and schedule need further definition.
- Tools for dealing with the very challenging environments at and after LS3 should be developed in common with the machine and realistic timescales presented for interventions that take full account of the overriding ALARA principle.
- Computing models and resource requirements will also benefit from a common approach between experiments.
- In some areas a common CERN interface with industries developing key technologies of importance to several experiments is beneficial to minimize development costs.
- There can also be cost benefits to enlarge the number of common standards early in this context.
- Experience gained and expertise from building and operating the current experiments should be retained and transmitted to those developing the new systems.



Follow-up on this workshop

- In a number of the preparatory group areas, the interaction this process has engendered between the experiments has been felt to be extremely positive to identify areas of common interest with potential for joint effort. There is also a feeling that even more could have been achieved with more time and wider involvement in the process.
- In such areas, dedicated common meetings, possibly building on the existing preparatory groups, could be of interest (maybe targeting a future workshop).
- There could be a further “Aix-les-Bains” style workshop where improved results would be reported, perhaps before the start of Run-2.
- More detailed proposals will be included in the workshop report to ECFA after discussion with the Preparatory Groups and the workshop steering committee.
You are strongly invited to also provide feedback and suggestions.
- It is anticipated that 3-4 years of R&D and prototyping, followed by 5-6 years of construction, are needed to complete the largest upgrades.
Funding Agencies will need to invest now in targeted R&D to develop cost-effective technical solutions, which CERN can help facilitate, and this needs to proceed rapidly and with adequate resources.

Thank you:

To the Workshop Steering Committee for all their support



ALICE: P. Giubellino (SP), H. Wessels (Deputy SP)

ATLAS: P. Allport (Upgrades Coord.), D. Charlton (SP),
B. Di Girolamo (Tech. Coord.)

CMS: A. Ball (Tech. Coord.), D. Contardo (Upgrades Coord.),
J. Incandela (SP)

LHCb: P. Campana (SP), B. Schmidt (Deputy SP)

Sergio Bertolucci (CERN Dir. Research), Manfred Kramer
(ECFA Chair), Peter Jenni (ATLAS) Michelangelo Mangano
(LPCC), Steve Myers (Dir. Accelerators), Jim Virdee (CMS)

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Picture Credit: OT Aix-les-Bains / Gilles Lansard

Logos: aix-les-bains centre des congrès, ECFA, High Luminosity LHC, ALICE, ATLAS, CMS, LHCb, CERN

Thank you:

To the Preparatory Group members with many other contributors for all their hard work

- Physics goals and performance reach
 - CERN Theory: **G.Salam, A. Weiller**
 - ALICE: Peter Braun Munzinger, Andrea Dainese
 - ATLAS: **Leandro Nisati**, Pippa Wells, Bill Murray
 - CMS: **Chris Hill**, Markus Klute, Isabell Melzer-Pellmann
 - LHCb: Tim Gershon, Guy Wilkinson
- Tracking devices and associated electronics and readout
 - ALICE: Vito Manzari, Werner Riegler
 - ATLAS: **Ingrid Gregor**, Didier Ferrere, Craig Buttar
 - CMS: **Duccio Abbaneo**, Francois Vasey, Stefano Mersi
 - LHCb: Massimiliano Ferro-Luzzi
- Calorimetry and associated electronics and readout
 - ALICE: David Silvermyr
 - ATLAS: **Francesco Lanni**, Alberto Valero
 - CMS: **Marcello Mannelli**, Dave Barney, Pawel. De Barbaro
 - LHCb: Frederic Machefert
- Muon Systems and associated electronics and readout
 - ALICE: Pascal Dupieux
 - ATLAS: **Christoph Amelung**, Oliver Kortner, Stefano Veneziano
 - CMS: **Marcello Abbrescia**, Kerstin Hoepfner, Alexei Safonov
 - LHCb: Alessandro Cardini

Thank you:

To the Preparatory Group members with many other contributors for all their hard work

- Trigger/DAQ/Offline/Computing
 - ALICE: Pierre Vande Vyvre, Thorsten Kollegger, Predrag Buncic
 - ATLAS: **David Rousseau**, Benedetto Gorini, Nikos Konstantinidis
 - CMS: **Wesley Smith**, Christoph Schwick, Ian Fisk, Peter Elmer
 - LHCb: Renaud Legac, Niko Neufeld
- Electronics and read-out systems
 - ALICE: Alex Kluge
 - ATLAS: **Philippe Farthouat**, Maurice Garcia-Sciveres, Tony Weidberg
 - CMS: **Magnus Hansen**, Jorgen Christiansen
 - LHCb: Ken Wyllie
- Long Shutdown constraints and radiation and activation effects
 - ALICE: Werner Riegler
 - ATLAS: **Olga Beltramello**, Beniamino Di Girolamo
 - CMS: **Wolfram Zeuner**, Christoph Schaefer
 - LHCb: Rolf Lindner, Gloria Corti
- Accelerator and Experiment interface
 - CERN Accelerator: L. Rossi, O. Bruning
 - ALICE: Hannes Wessels
 - ATLAS: **Christoph Rembser**, Beniamino Di Girolamo, Antonio Sbrizzi
 - CMS: **Maria Chamizo Llatas**, Wolfram Zeuner
 - LHCb: Burkhard Schmidt

Thank you:

This has been a very full and productive workshop.

Many thanks to all the speakers for the high quality for presentations which will surely provide a very useful resource for the future.

And thanks to everyone for the lively discussion. We have more than 320 people registered ! We are looking forward to see you again on the next occasion.



Also thanks to the team at the Congress centre and to the caterers, to Youlia, Dawn and Connie for all their support during the conference, but particularly **Dawn and Connie for their hard work in making the workshop such a success.**

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Thanks to Nanni Darbo
for all the nice pictures

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