

LHCC Report presented to the LHC Resources Review Boards October 11, 2017



Francesco Forti
University and INFN, Pisa

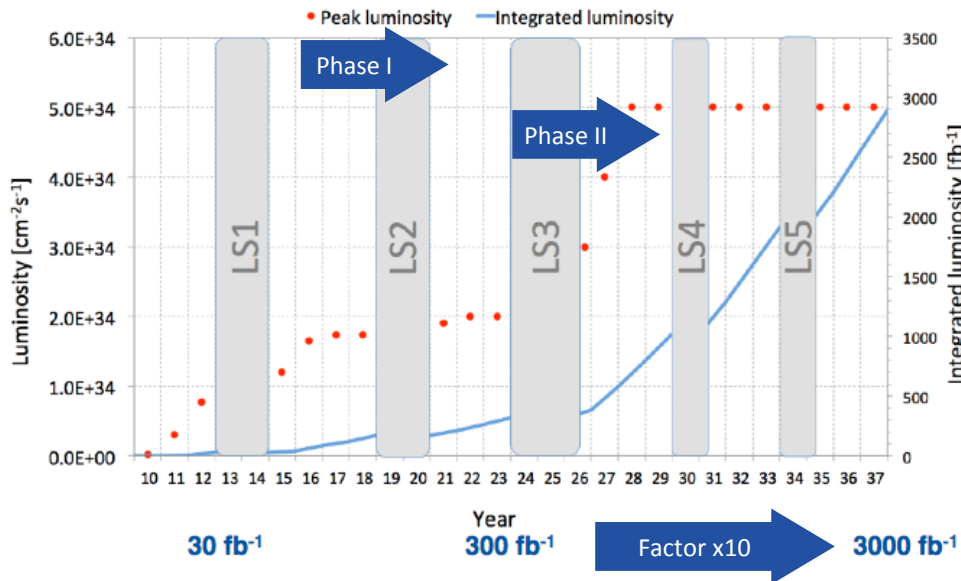


Outline

- Reminder: Phase II upgrades
- Status of the Phase II review process
- Update on the plan for next year

HL-LHC Goals and Running Conditions

- 3000 fb^{-1} is the target integrated luminosity
- 5×10^{34} → 140 Pile-up is the nominal peak luminosity
- 7×10^{34} → 200 Pile-up is the ultimate peak luminosity (>LS4)



Phase I Upgrades

- All approved and funded
- On-going construction overall on budget and on schedule

Phase II Upgrades

- Scoping document presented and approved
- Technical Design Reports currently being reviewed



Phase II Detectors Upgrades

- Why**
- **Maintain detector performance** in the presence of high radiation doses, increased pile-up, and challenging trigger rates.
 - Possibly introduce moderate performance improvements that will allow to take fully advantage of the HL-LHC physics program, e.g. extended coverage
 - Detectors must work well at nominal luminosity (140PU) and only moderately degrade at ultimate luminosity (200PU)
- When**
- For the most part upgraded detectors will be **installed during LS3**, currently scheduled for 2.5 years starting in 2024
 - Some limited and mature elements may be installed in LS2, with some advantage in terms of schedule: CMS FWD GEM, beam pipes, ...
- What**
- **Many detector elements**, readout electronics, data acquisition system and online computing will require significant upgrades → part of this review
 - Also distributed offline computing will require significant redesign and improvements → part of a separate review process

Phase II Upgrades Approval Process

- **Document** detailing the process prepared in consultation with DRC and the experiments (CERN-LHCC-2015-007)

DONE
NOW
>2018

- **Step1:** Approval of preliminary design for the complete set of Phase-II upgrades
 - Concluded in September 2015 → presented to Oct 2015 RRB
 - Including scoping options
 - Reasonable matching of cost to funding availability
- **Step2:** Approval of baseline design, cost and schedule
 - TDRs submission foreseen between end 2016 and end 2017
 - Regular monitoring of LHCC and UCG
- **Step3:** Approval for construction
 - After Engineering Design Review or equivalent

Review process

1. Final draft submission (complete and final for the collaboration) - available to all LHCC referees and extended panel members
2. LHCC Scientific and technical review
3. Submission of the UCG cost and schedule package
4. LHCC provisional approval (with comments and requests)
5. Submission of the final public TDR
6. UCG Cost, Schedule and Organizational Review
7. UCG approval
8. Formal LHCC+UCG approval of the TDR
9. Submission to the RB for endorsement

New

Specific guidelines for reviews
CERN-LHCC-2017-016

LHCC Scientific and Technical Review

- The main goals of the LHCC review are the following:
 - Evaluate the scope of the project versus scientific reach and cost and evaluate its methodology
 - Assess the technical readiness of the upgrade project
 - Identify the key technical risks in the project
- The review will be conducted with a mixture of remote and in-person meetings. A typical structure of the interaction with the experiment is the following:
 - A kickoff remote meeting to clarify the scope of the review and the interaction plan
 - The panel formulates questions to the experiment which are communicated in writing
 - An intermediate remote meeting where the experiment presents answers to the questions
 - Further questions and requests for information are formulated by the panel
 - A final in-person meeting at CERN where the TDR LHCC review is finalized

UCG Cost, Schedule and Management Review

- The main goals of the UCG review are the following:
 - Evaluate the reliability of the cost estimate for the project
 - Assess the feasibility of the schedule and the availability of the manpower necessary to execute the project
 - Evaluate the project management structure and the risk analysis, including proposed levels of cost realism and schedule contingency.
- The review will be conducted with a mixture of remote and in-person meetings. A typical structure of the interaction with the experiment is the following:
 - A kickoff in-person meeting to clarify the scope of the review and the interaction plan
 - The panel formulates questions to the experiment which are communicated in writing
 - An intermediate remote meeting where the experiment presents answers to the questions
 - Further questions and requests for information are formulated by the panel
 - A final in-person meeting at CERN where the TDR UCG review is finalized

Phase II TDRs review status

- Process progressing as planned, in the “Fast Forward” mode agreed in April 2017 RRB
- TDR submission closely follows planned schedule
- Large number of panels set-up, to carry out the reviews
 - LHCC members, returning LHCC members, external experts
 - UCG panels are a superset of the LHCC panels, with the addition of scrutiny group experts
- Target conclusion of review process by the April 2018 RRB.
 - This requirement is at the limit of our reviewing bandwidth

TDRs planned submission dates and CORE values (as of APRIL 2017)

Experiment	System	Date	CORE _{MCHF}	SOURCE
ATLAS	ITkStrip	Dec-16	61	TDR ITkStrip
ATLAS	Muon	Jun-17	34	SD
ATLAS	LAr	Sep-17	36	SD - sFCal
ATLAS	Tile	Sep-17	9	SD
ATLAS	TDAQ	Dec-17	43	SD
ATLAS	ITkPixel+common	Dec-17	59	SD ⁽²⁾
CMS	Tracker	Jul-17	112	SD
CMS	Barrel Cal	Sep-17	11	SD
CMS	Muon	Sep-17	25	SD
CMS	Endcap Cal	Nov-17	64	SD
CMS	Trigger DAQ/HLT ⁽¹⁾	>2019	24	SD

SD = Scoping Documents

ATLAS
Letter of Intent +
Scoping Document
CERN-LHCC-2012-022
CERN-LHCC-2015-020

CMS
Technical Proposal +
Scoping Document
CERN-LHCC-2015-010
CERN-LHCC-2015-019

⁽¹⁾ Interim document in September 2017

Oct 11, 2017

F. Forti - LHCC Report

⁽²⁾ As modified in ITkStrip TDR

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Experiment		ATLAS	ATLAS	ATLAS	ATLAS	ATLAS	CMS	CMS	CMS	CMS	
System		Muon	LAr	Tile	TDAG	ITk-Pixels	Tracker	BarrelCal	Muon	EndcapCal	
CORE		34	36	9	43	59	112	11	25	64	
Chair		Rob Roser	Claudia Cecchi		Rainer Mankel	Rob Roser	Marcel Demarteau	Franco Bedeschi	Mario Martinez-Perez	TBD	
Week	Comments	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG	LHCC	UCG
26-Jun-17											
3-Jul-17	TDR#7-Jul						TDR#1-Jul				
10-Jul-17											
17-Jul-17	Koff#27-Jul						Koff#21-Jul				
24-Jul-17											
31-Jul-17											
7-Aug-17							Iter#4-Aug	UCGP#4-Aug			
14-Aug-17								UCGP#6-Aug			
21-Aug-17							Iter#1-Sep				
28-Aug-17	Iter#1-Sep		UCGP#1-Sep								
4-Sep-17			UCGP#8-Sep								
11-Sep-17	Rev#1-Sep	LHCC					Rev#1-Sep				
18-Sep-17	App#4-Sep		Koff#2-Sep				App#4-Sep	Koff#2-Sep			
25-Sep-17											
2-Oct-17			UCGP#29-Sep								
9-Oct-17				TDR#30-Sep	TDR#30-Sep				TDR#2-Sep	TDR#2-Sep	
16-Oct-17				Koff#6-Oct	Koff#6-Oct				Koff#2-Oct	Koff#9-Oct	
23-Oct-17	UCG#RB								UCGP#26-Oct		UCGP#16-Oct
30-Oct-17		TDR#8-Nov					Iter#27-Oct				
6-Nov-17				Iter#10-Nov	UCGP#11-Nov	Iter#5-Nov		Iter#30-Oct		Iter#31-Oct	
13-Nov-17											
20-Nov-17								Iter#21-Nov			
27-Nov-17	LHCC			Rev#27-Nov	App#30-Nov	Rev#27-Nov	App#30-Nov	Rev#28-Nov	Koff#29-Nov	Rev#28-Nov	App#30-Nov
4-Dec-17	Dec#RB		RB#5-Dec				RB#5-Dec				
11-Dec-17											
18-Dec-17								Iter#18-Dec		Iter#19-Dec	Koff#18-Dec
25-Dec-17	Christmas										
1-Jan-18											
8-Jan-18				Iter#8-Jan		Iter#8-Jan					
15-Jan-18											Iter#11-Jan
22-Jan-18	Jan#11-Mtg			Rev#25-Jan		Rev#25-Jan	UCGP#26-Jan	UCGP#26-Jan		Rev#23-Jan	Rev#24-Jan
29-Jan-18											Rev#22-Jan
5-Feb-18							Iter#5-Feb				
12-Feb-18											
19-Feb-18											
26-Feb-18	Feb#LHCC						Rev#26-Feb	App#1-Mar	Koff#2-Mar	Rev#27-Feb	App#1-Mar
5-Mar-18			RB#7-Mar		RB#7-Mar				RB#7-Mar		RB#7-Mar
12-Mar-18											App#1-Mar
19-Mar-18							Iter#4-Mar				Iter#3-Mar
26-Mar-18	EasterWeek										
2-Apr-18											
9-Apr-18	Apr#11-Mtg						Rev#12-Apr			Rev#13-Apr	
16-Apr-18							RB#18-Apr			RB#18-Apr	

Timeline detail

TODAY

Panels

- Several panels setup
- Very strong teams and chairs
- Large contingent of experts

Role	ATLAS [?] ITk-Pixels	ATLAS [?] LAR+Tile	ATLAS [?] Muon	ATLAS [?] TDAQ	CMS [?] BarrelCal	CMS [?] EndCapCal	CMS [?] Muon	CMS [?] Tracker	Grand [?] Total
⊕ Chair	1	1	1	1	1	1	1	1	8
⊕ LHCC-ExpTeam		2	2	1	1	2	1	2	11
⊕ LHCC-OtherTeam	1	1	1	1	1	1	1	1	8
⊕ LHCC-Returning			1		1	1	1		4
⊕ Technical [?] Expert	3	5	3		4		5	4	24
⊕ UCG [?] Expert			3					2	5
Grand[?]Total	5	9	11	3	8	5	9	10	60

Panel chairs

TDR	Last Name	First Name
ATLAS ITk-Pixels	ROSER	Rob
ATLAS LAr+Tile	CECCHI	Claudia
ATLAS Muon	ROSER	Rob
ATLAS TDAQ	MANDEL	Rainer
CMS Barrel Cal	BEDESCHI	Franco
CMS End Cap Cal	TBD	
CMS Muon	MARTINEZ-PEREZ	Mario
CMS Tracker	DEMARTEAU	Marcel

Some examples of panels

TDR			CMS Tracker				
Count of Status	Role	Last Name	First Name	Count of Status	Role	Last Name	First Name
	Chair	DEMARTEAU	Marcel		Chair	ROSER	Rob
	LHCC-ExpTeam	Denisov	Dmitri		LHCC-ExpTeam	Burrows	Philip
		Kajfasz	Eric			Wisniewski	William
	LHCC-OtherTeam	Kuze	Masahiro		LHCC-OtherTeam	Sfienti	Concettina
	TechnicalExpert	Casse	Gianluigi		LHCC-Returning	RATCLIFF	Blair
		Gemme	Claudia		TechnicalExpert	Karchin	Paul
		Riedler	Petra			Paolucci	Pierluigi
		Riegler	Werner		ScrutinyGroupExp	Wood	Darien
		Stanitzki	Marcel			Vasseur	George
	ScrutinyGroup	Stapnes	Steinar			Brient	Jean-Claude
						Danielsson	Hans

TDR			CMS Muon				
Count of Status	Role	Last Name	First Name	Count of Status	Role	Last Name	First Name
	Chair	MARTINEZ-PEREZ	Mario		Chair	MARTINEZ-PEREZ	Mario
	LHCC-ExpTeam	Waters	David		LHCC-ExpTeam	Waters	David
	LHCC-OtherTeam	Newman	Paul		LHCC-OtherTeam	Newman	Paul
	LHCC-Returning	Dalla Torre	Silvia		LHCC-Returning	Dalla Torre	Silvia
	TechnicalExpert	Bauer	Florian		TechnicalExpert	Bauer	Florian
		Cardini	Alessandro			Cardini	Alessandro
		Polini	Alessandro			Polini	Alessandro
		Sasaki	Osamu			Sasaki	Osamu
		Kroha	Hubert			Kroha	Hubert

TDR			CMS Barrel Cal				
Count of Status	Role	Last Name	First Name	Count of Status	Role	Last Name	First Name
	Chair	BEDESCHI	Franco		Chair	BEDESCHI	Franco
	LHCC-ExpTeam	Kuzmin	Alexander		LHCC-ExpTeam	Kuzmin	Alexander
	LHCC-OtherTeam	Eigen	Gerald		LHCC-OtherTeam	Eigen	Gerald
	TechnicalExpert	Delmastro	Marco		TechnicalExpert	Delmastro	Marco
		Glenzinski	Doug			Glenzinski	Doug
		Kluge	Alexander			Kluge	Alexander
		Lanni	Francesco			Lanni	Francesco

Depth of review

- Very careful scrutiny of the scientific motivation for the technical choices
- In-depth examination of the cost, schedule, and management structure of the project
- Analysis of the technical, schedule, and cost risk of the project
 - Risks are unavoidable on such large project.
 - Verify that collaborations have solid plans to cope with the risks
- Some example of risks:
 - Exchange rate
 - Procurement of silicon sensors
 - Availability of the readout IC for the pixels
 - Reduction of greenhouse gases emissions

Evolution

- Projects are evolving as the TDRs are prepared
- Elements are added and removed optimizing
 - Physics case
 - Cost
 - Technical feasibility
- Constant tracking of the global envelope to ensure financial viability.
- Constant scrutiny on the physics requirements for the proposed solutions
- New idea of adding a dedicated timing layer to improve pileup rejection
 - Technical Proposals will be submitted to the LHCC November 2017
 - A special LHCC session will be convened to review the proposal for the Timing Detector. Conclusion expected in February 2018.

- Grey items: physics need still to be reviewed
- Blue items: approved

ATLAS Phase II Upgrade Cost Update

Experiment	Subsystem	TDR Date	CostFull	CostInter	CostLow	TDR Sub	8/10/17 Cost
	DELTA			-42.6	-71.2		-4.7
ATLAS	TOTAL		271.0	228.5	199.9	156.6	266.3
	TDAQ	Dec-17	43.3	31.9	25.1		44.6
	ITKStrip	Dec-16	72.1	65.8	53.3	61.0	60.7
	ITKPixel	Dec-17	32.2	31.3	27.4		44.4
	ITKCommon	Dec-17	16.1	16.1	16.1		15.6
	Muon	Jul-17	30.6	25.3	21.3	31.6	28.1
	High-eta muon tagger		3.5	0.0	0.0		3.5
	Lar	Sep-17	41.4	32.4	32.4	28.8	28.1
	Timing Detector		4.6	0.0	0.0		4.6
	Tile	Sep-17	8.6	8.6	8.6	10.8	11.0
	Forward		1.3	1.3	1.3		1.3
	Integration/Installation	MOU Oct-17	17.4	15.9	14.4	24.4	24.4

- Funding deficit in the few % range
- Cost mitigation options are under study
- More details in the ATLAS session

- Grey items: physics need still to be reviewed
- Blue items: approved

CMS Phase II Upgrade Cost Update

Experiment	Subsystem	TDR Date	Cost Full	Cost Inter	Cost Low	TDR Sub	Current Cost
	DELTA			-23.4	-56.7		13.85
CMS	TOTAL		265.05	241.65	208.35	151.9	278.9
	Tracker	Jul-17	112.3	108.4	95.7	111.9	111.9
	Barrel CAL	Sep-17	11.45	11.45	11.45	15.1	15.1
	ECAL	Nov-17	63.6	56.6	50.6		66
	Muon	Sep-17	24.4	19.9	5.3	24.9	24.9
	Beam monitor BRIL	Jun-20	4	4	4		2.6
	Trigger	Dec-19	7.3	7.3	7.3		5.9
	DAQ	Dec-19	17	9	9		12.6
	MIP STD						14.9
	Infrastructure (CF)	MOU Oct-17	25	25	25		25

- Expected funding deficit in the few % range
- Preparing a cost mitigation plan at a level of 10% consistent with the current knowledge of the funding discussion at FAs.
- More details in the CMS session

Money matrix

- The review process is ongoing and is likely to cause an update of the costs
 - Going in both directions
- The financial coverage of the upgrade costs is very good for both experiments.
 - Considering the overall funding considered by the Funding Agencies, the deficit of expected funding is in the range of a few percent.
- A large fraction of Funding Agencies are processing the requests and will be able to provide solid number during the course of 2018
- Alignment between expected funding and systems is good, but requires further optimization
 - Ongoing negotiations with groups and funding agencies

Outlook

- The Phase II upgrade plan put forward in **2015** is holding, both technically and cost-wise.
- By **Apr 2018** nearly all the TDRs should be approved and the full envelope of the Phase II upgrades can be defined
 - Nearly final money matrix will be available for discussion with Funding Agencies
 - Timing Detectors TDRs will be submitted later in 2018 (if physics case is endorsed)
 - CMS TDAQ TDR planned for 2019
- By **Oct 2018** we expect to have the final money matrix and consider Step 2 concluded.