

Addendum No. 01

to the

Memorandum of Understanding

for Collaboration in the Construction of the

LHCb Detector

The Upgrade of the LHCb Detector:

Common Project Items

Considering that:

- the construction of the LHCb detector is governed by the Memorandum of Understanding for Collaboration in the Construction of the LHCb detector dated 24 November 2000, setting out the responsibilities of CERN as the Host Laboratory and of the different participating Institutes and Funding Agencies for the construction of the LHCb detector (the “Construction MoU”)¹;
- the Maintenance and Operation of the LHCb detector is governed by the Memorandum of Understanding for Maintenance and Operation of the LHCb detector dated 24 May 2002 (the “M&O MoU”)²;
- in order to be able to take full advantage of LHC luminosity, the LHCb Collaboration (the “Collaboration”) has proposed, in the document CERN/RRB 2012-119, an upgrade programme of the LHCb detector (the “LHCb Upgrade”), based on readout of the detector at 40 MHz rate, and a flexible software-based trigger system, which also involves modifications or replacements of existing sub-systems;
- this process has started in 2011 with the Letter of Intent (the “LoI”, CERN/LHCC 2011-001), endorsed by the LHC Committee (LHCC) (CERN/LHCC 2011-004 and CERN/LHCC 2011-008), followed by the Framework Technical Design Report (the “Framework TDR”, CERN/LHCC 2012-007), and it is expected to be completed in time for installation during the second long shutdown of the LHC, on a similar timescale as the Phase I upgrades of the other LHC experiments;
- based on the aforementioned documents, the Framework TDR for the LHCb Upgrade has been reviewed by the LHCC and endorsed for approval to the CERN Research Board (CERN/LHCC 2012-017);
- the CERN Research Board has approved the upgrade of LHCb to be part of the long term exploitation of the LHC on 28 November 2012 (see CERN/RB 2012-433).
- a TDR will be produced for each of the individual sub-system upgrades, and will constitute the basis for the drafting of the specific sub-system addenda to the Construction MoU, to be signed between the Funding Agencies contributing to these upgrades and CERN as the Host Laboratory;

¹ Memorandum of Understanding for Collaboration in the Construction of the LHCb Detector, CERN/LHCb RRB-D-2000-24 rev.

² Memorandum of Understanding for Maintenance and Operation of the LHCb Detector, CERN/RRB 2002-032

- this document (the “Addendum”) constitutes an addendum to the Construction MoU for the Common Projects of the LHCb Upgrade; In case of discrepancy between the terms of the Construction MoU and the terms of this Addendum, the latter shall apply;
- a preliminary evaluation of the cost of the LHCb Upgrade has been documented in the Framework TDR, both for the modifications or replacements of existing sub-systems, and for the Common Project items, whose costs the Collaboration has agreed to bear as its common expense.

It is agreed as follows

Article 1: Purpose

- 1.1 The purpose of this Addendum and its annexes is to lay down the rules governing contributions to and execution of the Common Projects of the LHCb Upgrade in conformity with the Construction MoU.
- 1.2 The signing parties agree to participate to the LHCb Upgrade, consisting of specific contributions to sub-systems.
- 1.3 Financial responsibilities and sharing of the sub-systems specific investment costs for the LHCb Upgrade will be defined upon approval of respective TDRs and preparation of the corresponding addenda to the Construction MoU.
- 1.4 The Annexes are an integral part of the Addendum.

Article 2: Parties

- 2.1 The parties to this Addendum shall be all the Institutes members of the Collaboration (the “Institutes”) and their Funding Agencies, and CERN as the Host Laboratory. The current list of Institutes and the current list of Funding Agencies contributing to LHCb Upgrade are given, respectively, in Annex 1 and in Annex 2.

Article 3: Duration

- 3.1 This Addendum takes effect from the date of signature by CERN and shall remain valid until the LHCb Management declares the end of the LHCb Upgrade project.

- 3.2 Any Institute that joins the Collaboration subsequent to the signature of this Addendum shall accept the agreements in force.
- 3.3 New joining Institutes, not belonging to Funding Agencies already in LHCb, shall be expected to make an appropriate contribution to the Common Project items as shall be specified in a corresponding Annex to this Addendum, in the ways described in Article 4. This shall be negotiated by the LHCb Management and endorsed by the Resource Review Board.
- 3.4 New joining Institutes, belonging to Funding Agencies already in LHCb, shall be expected to make an appropriate contribution to LHCb upgrades. This shall be negotiated by the LHCb Management and endorsed by the Resource Review Board.

Article 4: Common Projects

- 4.1 The Common Projects of the LHCb Upgrade are: the Common Electronics, the General Infrastructure and the Online System. They are listed in Annex 3 together with their estimated costs, while their expenditure profile is given in Annex 4.
- 4.2 An Upgrade Common Fund (the “UCF”) is established, to the level of the combined cost of the Common Electronics, the General Infrastructure, and for the Online System. This will allow the preparation of the Common Projects needed for the LHCb Upgrade.
- 4.3 Upgrade Common Fund sharing among Institutes.
 - 4.3.1 The obligations of the Institutes and their Funding Agencies towards the Common Projects will be shared in accordance with the principle defined in Article 9 of the M&O MoU, stipulating that they are proportional to the number of scientists holding PhD or equivalent qualifications at the date of the April 2014 Resource Review Board. The yearly contributions per Funding Agency, based on expenditure profile presented in Article 4.1, together with the global UCF sharing, are reported in Annex 5.
 - 4.3.2 The contribution of the Institutes and their Funding Agencies to the UCF, in the ways described in Article 4.4 below, is considered an integral part of their commitment to the LHCb Upgrade.
 - 4.3.3 Funding Agencies can negotiate through usual Resource Review Board procedures, a different contribution profile over the period 2014-2020, in agreement with the LHCb Management and Collaboration Board.

- 4.4 Contributions to the Common Projects can be made in three ways:
 - 4.4.1 By cash payment to the UCF which has been established for the Common Projects through a dedicated account at CERN. The UCF is managed and operated by the LHCb Resource Manager, taking advice from the LHCb Management together with the CERN Finance and Procurement Department.
 - 4.4.2 By cash payment for a Common Project item or part of an item, in agreement with the LHCb Management and Collaboration Board and endorsed by the Resource Review Board.
 - 4.4.3 By taking responsibility for a Common Project item or part of an item, in agreement with the LHCb Management and Collaboration Board and endorsed by the Resource Review Board. This is commonly referred to as an “in-kind contribution”.
- 4.5 All Common Fund operations are monitored by the Resources Review Board.
- 4.6 Procedures for contributions and contracts follow the procedures set out in the Construction MoU.

ANNEXES

- Annex 1: List of Institutes currently participating in LHCb and Contact Persons
- Annex 2: List of Funding Agencies currently contributing to LHCb and Representatives
- Annex 3: Common Project expenditure
- Annex 4: Common Project expenditure time profile
- Annex 5: Yearly and global contributions per Funding Agency to the Common Projects for the LHCb Upgrade

The European Organization for Nuclear Research (CERN)

and

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declare that they agree on the Present Addendum to the Memorandum of Understanding for Collaboration in the Construction of the LHCb Detector

Done in Geneva

Done in

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for CERN

for

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S. Bertolucci
Director of Research and
Scientific Computing

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Annex 1 - List of Institutes currently participating in LHCb and Contact Persons

Countries	Institutes	Team Leaders
Brazil	Rio de Janeiro, CBPF	Ignacio De Bediaga Hickman
	Rio de Janeiro, UFRJ	Leandro De Paula
	Rio de Janeiro, PUC (associate member)	Carla Gobel Burlamaqui de Mello
China	Beijing, Tsinghua University	Gao Yuanning
	Wuhan, CCNU (associate member)	Yuehong Xie
France	Annecy, LAPP	Vincent Tisserand
	Clermont-Ferrand, LPC	Pascal Perret
	Paris, LPNHE	Eli Ben Haim
	Marseille, CPPM	Giampiero Mancinelli
	Orsay, LAL	Marie Helene Schune
Germany	Aachen, RWTH	Stefan Schael
	Dortmund, Univ.	Bernhard Spaan
	Heidelberg, MPIK	Michael Schmelling
	Heidelberg, Univ.	Ulrich Uwer
	Rostock, Univ. (associate member)	Roland Waldi
Ireland	University College Dublin	Ronan McNulty
Italy	Bari, INFN and Univ.	Antimo Palano
	Bologna, INFN and Univ.	Umberto Marconi
	Cagliari, INFN and Univ.	Alessandro Cardini
	Ferrara INFN and Univ.	Concezio Bozzi
	Florence INFN and Univ.	Giovanni Passaleva
	Frascati, Laboratori Nazionali - INFN	Matteo Palutan
	Genoa, INFN and Univ.	Alessandro Petrolini
	Milan Bicocca, INFN and Univ.	Marta Calvi
	Milan Univ. and INFN	N. Neri
	Padua, INFN and Univ.	Donatella Lucchesi
Netherlands	Pisa, INFN, Univ. and SNS	Giovanni Punzi
	Rome La Sapienza, INFN and Univ.	Roberta Santacesaria
	Rome Tor Vergata, INFN and Univ.	Giovanni Carboni
	Amsterdam, NIKHEF	Marcel Merk
Poland	Amsterdam, Free Univ.	Gerhard Raven
	Groningen Univ. (associate member)	Cornelis Onderwater
	Kracow AGH, Univ. of Science and Tech.	Tomasz Szumlak
Romania	Kracow HN Inst. for Nuclear Physics	Mariusz Witek
	Warsaw, Soltan Inst. for Nuclear Studies	Wojciech Wislicki
Romania	Bucharest-Magurele, IFIN-HH	Florin Maciuc
Russia	Gatchina, PNPI	Alexei Vorobyev
	Moscow, INR	Evgeny Gushchin
	Moscow, ITEP	Victor Egorychev
	Moscow, State Univ.	Alexander Leflat
	Novosibirsk, INP and State Univ.	Alexander Bondar
	Protvino, IHEP	Vladimir Obraztsov
Spain	Kurchatov Institute (associate member)	Vladimir Shevchenko
	Barcelona, Univ.	Eugeni Grauges Pous
	Santiago de Compostela, Univ.	Abraham Gallas Torreira
	IFIC Valencia (associate member)	Fernando Martinez Vidal
Switzerland	CERN	Monica Pepe Altarelli
	Lausanne, EPFL	Tatsuya Nakada
	Zürich, Univ.	Ulrich Straumann
Turkey	Celal Bayar Univ. (associate member)	Erhan Pesen
Ukraine	Kharkiv, KIPT	Iurii Raniuk

	Kyiv, KINR	Valery Pugatch
United Kingdom	Birmingham, Univ.	Nigel Watson
	Bristol, Univ. and H.H. Wills Physics Lab.	Jonas Rademacker
	Cambridge, Univ.	Valerie Gibson
	Rutherford Appleton Laboratory	Fergus Wilson
	Edinburgh, Univ.	Franz Muheim
	Glasgow, Univ.	Paul Soler
	Liverpool, Univ.	Tara Shears
	London, Imperial College	Ulrik Egede
	Manchester, Univ.	Christopher Parkes
	Oxford, Univ.	Neville Harnew
	Warwick, Univ.	Tim Gershon
United States	MIT	Michael J. Williams
	Maryland, Univ.	Hassan Jawahery
	Syracuse, Univ.	Sheldon Stone
	Cincinnati, Univ.	Michael Sokoloff

Annex 2 - List of Funding Agencies currently contributing to LHCb

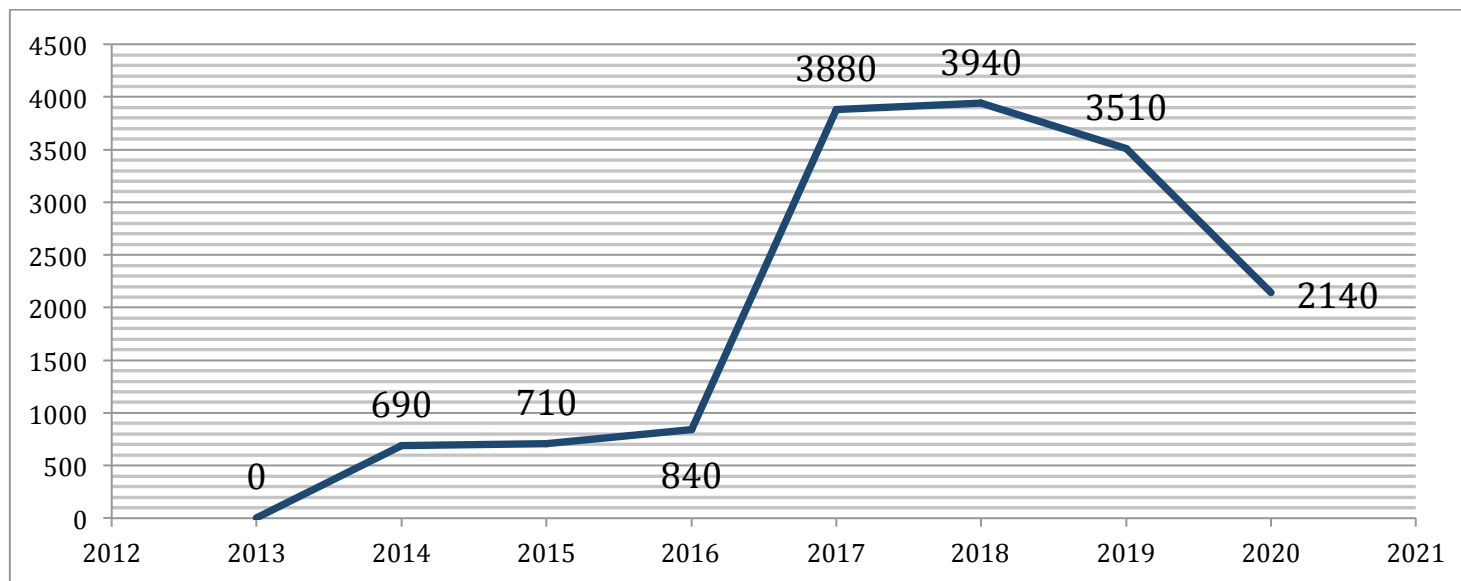
Countries	Funding Agency	Representative
Brazil	CNPq, FINEP	Arthur Maciel
China	NSFC	Yinglan Zhang
France	CNRS/IN2P3	Ursula Bassler
Germany	BMBF	Heike Prasse
	MPI für Kernphysik, Heidelberg	Werner Hofmann
Ireland	University College, Dublin	
Italy	INFN	Fernando Ferroni
Netherlands	NIKHEF	Frank Linde
Poland	Ministry of Science and Higher Education	
Romania	Ministry of National Education - Institute of Atomic Physics	Florin Buzatu
Russia	Ministry of Education and Science	Evgeniy Masterskih
	NRC "Kurchatov Institute"	Vladimir Shevchenko
Spain	Ministerio de Economia y Competitividad	Francisco del Aguila Gimenez
Switzerland	SNSF	Pascal Fischer
Turkey	Turkish Atomic Energy Authority	
Ukraine	KIPT (NASU), Kharkiv	Volodymyr Chyzhov
	KINR (NASU), Kyiv	
United Kingdom	STFC	Tony Medland
United States	NSF	Saul Gonzales, Randi Ruchti

Annex 3 - Common Projects expenditure (in kCHF).

<i>Common Projects</i>		kCHF	15710
Common Electronics			2500
	Timing & Fast control	500	
	Cables, fibres and connectors	500	
	Common Electronics/Spares	700	
	Power Supplies	60	
	Crates	90	
	Racks, Monitoring, Fire Detection	300	
	DC-DC converter, GBT, VTT & VTR	350	
General Infrastructure			2500
	Civil Engineering and buildings	450	
	Cooling and Ventilation	380	
	General assembly	230	
	Electrical power supply	110	
	Radiation shielding	200	
	Survey	120	
	Gas and fluids piping	120	
	Cabling long distance	590	
	Safety	300	
Online System			10710
	Event builder	3600	
	Optical Fibres	1700	
	Controls network	905	
	Controls system	930	
	PC farm	2800	
	Infrastructure	775	

Annex 4. Table 1 - Common Projects expenditure time profile (in kCHF).

Common Projects		2014		2015		2016		2017		2018		2019		2020	
		%	kCHF	%	kCHF	%	kCHF	%	kCHF	%	kCHF	%	kCHF	%	kCHF
Total	15710		690		710		840		3880		3940		3510		2140
Common Electronics	2500		440		490		170		770		480		150		
Timing & Fast control	500			20	100	20	100	30	150	20	100	10	50		
Optical Fibres & Connectors	500	5	20					75	380	20	100				
Common Electronics/Spares	700	40	280	35	250			15	100	10	70				
Power Supplies	60					5		25	10	60	40	10	10		
Crates	90							10	10	60	50	30	30		
Racks, Monitoring, Fire Detection	300							40	120	40	120	20	60		
DC-DC converter	350	40	140	40	140	20	70								
General Infrastructure	2500		170		170		360		560		820		320		100
Civil Engineering and buildings	450	30	140	30	140	30	130	10	40						
Cooling and Ventilation	380					30	110	40	150	30	110				
General assembly	230							30	70	40	90	30	70		
Electrical power supply	110			25	30	25	30	50	60						
Radiation shielding	200							10	20	80	160	10	20		
Survey	120							10	10			60	70	30	40
Gas and fluids piping	120							22	30	68	80	10	10		
Cabling long distance	590	5	30			15	90			60	350	20	120		
Safety	300							60	180	10	30	10	30	20	60
Online System	10710		80		50		310		2550		2640		3040		2040
Event builder	3600							10	360	30	1080	50	1800	10	360
Optical Fibres	1700	5	80			5	90	70	1190	20	340				
Controls network	905					10	90	30	270	30	270	30	270		
Controls system	930			5	50	10	90	30	280	45	420	10	90		
PC farm	2800							5	140	5	140	30	840	60	1680
Infrastructure	775					5	40	40	310	50	390	5	40		

Annex 4. Figure 1 - Common Projects global expenditure time profile (in kCHF).

Annex 5 - Yearly and global contributions (in kCHF) per Funding Agency to the Common Projects for the LHCb Upgrade.

		BRASIL	CHINA	FRANCE	GERMANY BMBF	GERMANY MPG	IRELAND	ITALY	NETHERLANDS	POLAND	ROMANIA	RUSSIA	SPAIN	SWITZERLAND	TURKEY	UK	UKRAINE	USA NSF	CERN		
	eq. 2014	19	5	43	26	6	1	78	17	13	5	33	17	25	1	78	3	16	62	448 FTE	
	%	4.2	1.1	9.6	5.8	1.3	0.2	17.4	3.8	2.9	1.1	7.4	3.8	5.6	0.2	17.4	0.7	3.6	13.8	100.0 %	
2014	690	29	8	66	40	9	2	120	26	20	8	51	26	39	2	120	5	25	95	690	kCHF
2015	710	30	8	68	41	10	2	124	27	21	8	52	27	40	2	124	5	25	98	710	kCHF
2016	840	36	9	81	49	11	2	146	32	24	9	62	32	47	2	146	6	30	116	840	kCHF
2017	3880	165	43	372	225	52	9	676	147	113	43	286	147	217	9	676	26	139	537	3880	kCHF
2018	3940	167	44	378	229	53	9	686	150	114	44	290	150	220	9	686	26	141	545	3940	kCHF
2019	3510	149	39	337	204	47	8	611	133	102	39	259	133	196	8	611	24	125	486	3510	kCHF
2020	2140	91	24	205	124	29	5	373	81	62	24	158	81	119	5	373	14	76	296	2140	kCHF
	15710	666	175	1508	912	210	35	2735	596	456	175	1157	596	877	35	2735	105	561	2174	15710	kCHF