

Resources Review Board 25/10/2017

- M&O Cat.A budget 2016
- M&O Cat.A received funds for 2017 and status
- M&O Cat.A Strategy for LS2 and Upgrade
 - M&O Cat.A proposed 2018 budget

- M&O Cat.B status

- Conclusions

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Budget 2016

2016 Budget	Expenditures*	Difference
2,480	2,845	-365

Budget presents an overspending, mainly due to:

- **Late bills** from 2015, paid beginning 2016
- **Core computing**: small overspending due to an extremely efficient LHC. This line had been increased to 190 kCHF from 2015.
- **Online Computing**: Acquisition of new farm slice and extra contribution to the online account (CERN-RRB-2016-113).

The strategy of asking to keep **surpluses as buffers** for difficult years has paid. The present year overspending has equaled last year underspending, as expected. We thank RRB for their flexibility and foresight.

*In kCHF

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Budget forecasts for 2017

- @31August: 1880 kCHF excluding open commitments;
- Expect a well balanced budget for the end of 2017;
- PhD equivalent numbers keep on increasing, reducing the cost/PhD equiv. to ~5000 CHF

Category A M&O received funds for 2017

About **90%** of the expected contributions for M&O Cat.A in 2017 has been received at present. That is a total of ~2.35 MCHF. Together with the carryover of funds from previous years and a few late payments, these contributions have ensured that there has been no cash flow problem.

Thanks to all FAs for their warm support!

Comparison **partial budgets** main lines (without Power) @31 August

Year	kCHF	% of Tot.	Budget yearly result
2012	1716	0.67%	Slight underspending
2013	2174	0.84%	LS1 Years: Overspending, offset by using surplus
2014	2282	0.88%	
2015	1567	0.62%	Underspending
2016	2155	0.87%	Overspending, offset by using year 2015 surplus
2017	1880	0.76%	Balanced

In general, we expect ~5 – 10 % cost increase in M&O cat. A, from a shutdown year with respect to a collision year. In 2013/14, the main deviations are on detector related and general services lines. All values include the 300 kCHF/year for the online account (RRB-2011-088).

The sum for 2016 reflects the late arrival of 2015 bills, paid in 2016 and includes 200 kCHF in extra contribution to the online buffer (see CERN-RRB-2016-038).

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Proposed strategy to finance LHCb LS2 and Upgrade M&O Cat.A Phases

The **construction cost** of the present LHCb was ~70 MCHF.

The LHCb **Upgrade costs** are fixed at a total of ~57 MCHF, of which 15.7 MCHF in **Common Funds for Common Projects**.

During LS2, old infrastructures, sub-detector parts and online hardware will go (**de-installation**), To make place to the new parts and pieces (**installation**). **Online and offline** will continue to operate for physics analysis while getting ready for upgrade.

In 2021 an essentially new LHCb will start running at up to $2 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$ luminosity.

The M&O cat. A and B and Service Level Agreements will have to be adjusted **for LS2 and for Run III** Owing to our principle of (as much as possible) **constant budget**, we would like to try to **minimize “bumps”** and to **assure a proper level of funding** for the M&O of the upgraded LHCb.

Main factors which will increase M&O cat.A during LS2*

Detector related and infrastructure and General Services:

Temporary infrastructure and services;

Storage space;

Manpower for heavy utilities;

Manpower for de-cabling, etc;

Online Systems:

Extra system manager/expert (2019 – 2022), to help maintaining the full online and core computing lines active and start with the upgrade infrastructure

* Years 2019 and 2020

M&O cat.A LS2 levels **proposal***

For the **LS2 transitional phase**, a realistic assessment shows that the expenses will ramp up to a factor **~1.3** with respect to the present 2017 M&O cat.A budget.

However, in order to **control the increase** over the whole period and to **smoothly merge** to the 2021 years values, we propose to use **our pluri-annual surplus** (~0.5 MCHF) to compensate part of the extra expenditure.

We also propose to **gently start this process already in 2018**.

* Years 2019 and 2020

Main factors which will increase **M&O cat.A for the future** (2021 onwards)

Detector related and infrastructure:

New and complex cooling systems;

Safety and Radiation areas and tools;

Online Systems:

More complex farm, event builder, network and TFC;

General maintenance of the containers (electric and cooling systems, ventilation, etc.);

Core Computing (HLT and triggerless acquisition need higher levels of support).

General Power Consumption.

Proposed M&O A: forecast (in kCHF)

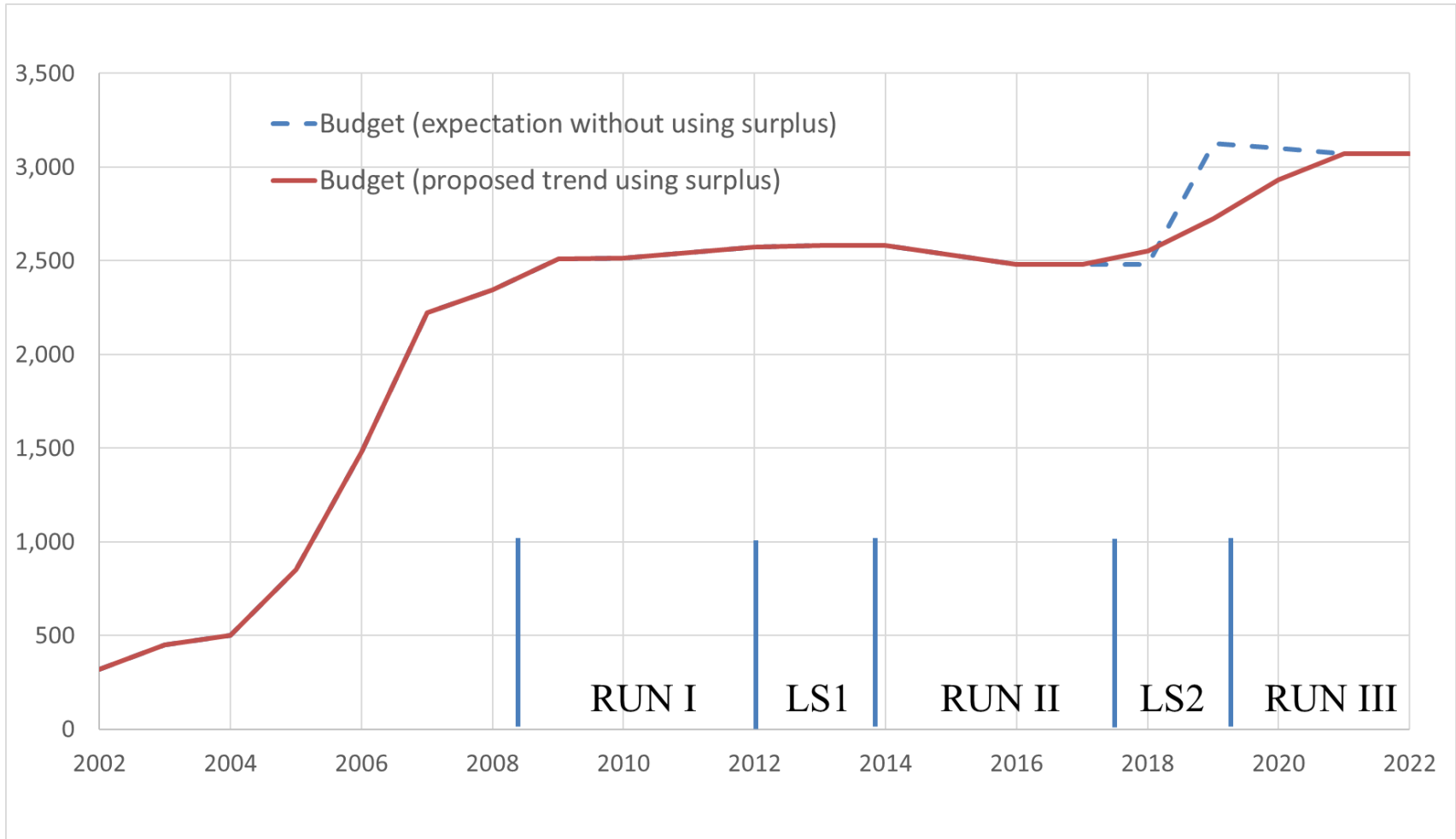
Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Detector related costs	986	914	920	920	880	920	920	880	880	880	950	945	1030	1015	1015
Secretariat	192	192	192	185	185	185	185	185	180	180	180	180	190	190	190
Communications	12	12	50	30	50	10	10	10	10	10	10	10	10	10	10
Core Computing	0	100	150	150	150	170	170	190	190	190	190	190	190	220	220
Online Computing	705	850	750	810	900	890	890	890	860	860	860	860	930	1150	1150
Test beams, cal. facilities	30	20	30	30	30	35	35	25	20	20	20	30	30	30	30
Laboratory operations	60	60	60	60	50	50	50	40	40	40	40	40	40	50	50
General services	360	360	360	360	330	320	320	310	300	300	300	470	510	405	405
Total	2345	2508	2512	2545	2575	2580	2580	2530	2480	2480	2550	2725	2930	3070	3070

400 **100** **from previous surplus**

Budget still kept **constant for RUN III**, but increased of a factor **~1.23** with respect to Run II. During the transitional LS2, **budget increase kept as smooth as possible**, with the proposal of using our surplus to complement the 2019 and 2020 budgets.

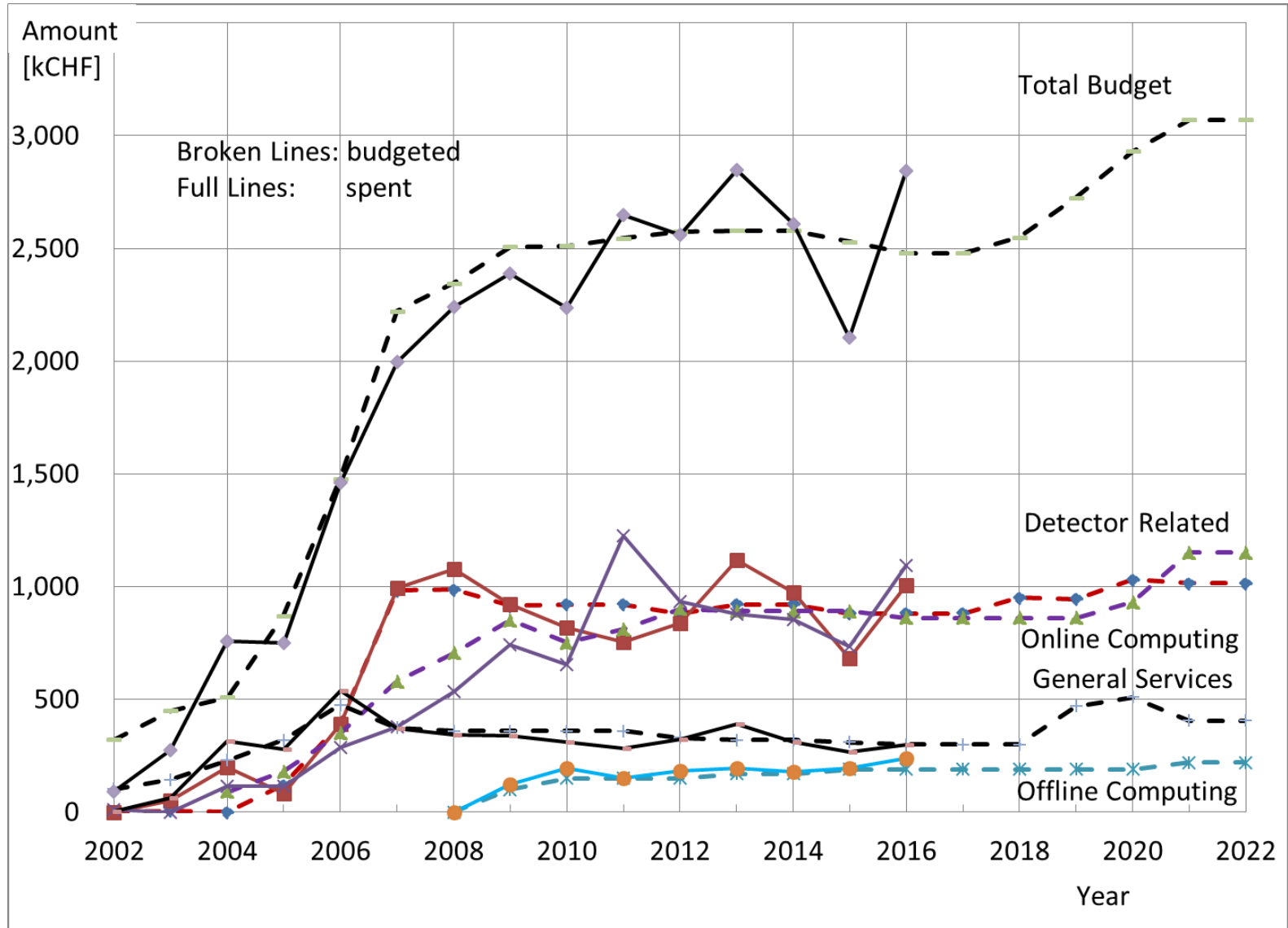
The strategy of asking to keep **surpluses as buffers** for difficult years will again serve LHCb well.

M&O Cat.A Budgets with or without using surplus



We propose to start in year 2018 and to use our ~0.5 MCHF pluri-annual surplus to further smooth the transition between RUN II and RUN III.

Main lines and M&O A budget (in kCHF)

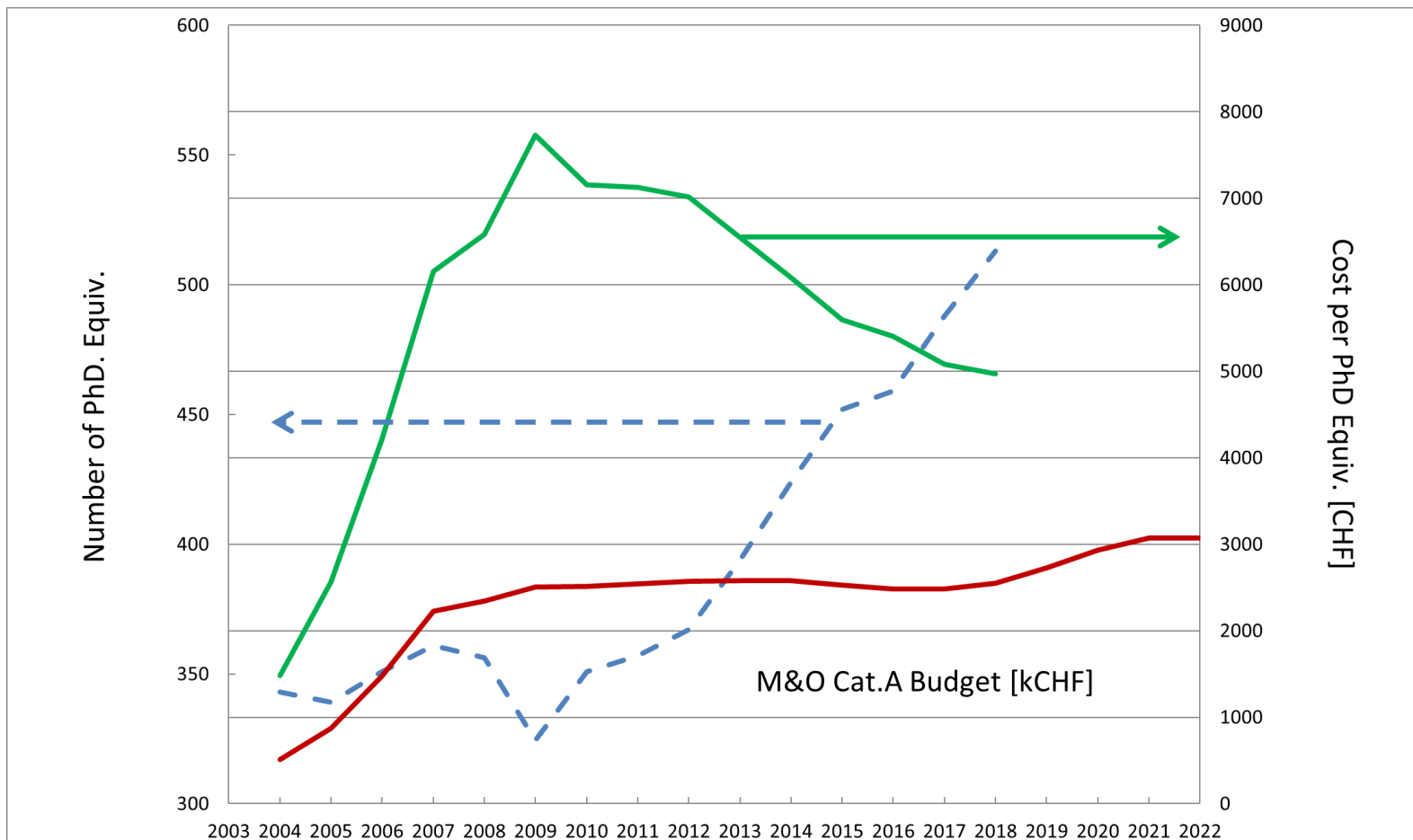


2017 Category A M&O Budget

2017	PhD eq. total/ funding auth.			M&O A	Power	
				kCHF	kCHF	
				2,480	900	Total
		%	CHF	CHF	CHF	
BRAZIL	23	4.7	116,885	42,418	159,303	
COLOMBIA	2	0.4	10,164	3,689	13,852	
FRANCE	50	10.2	254,098		254,098	
BMBF GERMANY	23	4.7	116,885		116,885	
MPG, GERMANY	4	0.8	20,328		20,328	
IRELAND	1	0.2	5,082	1,844	6,926	
INFN ITALY	78	16.0	396,393		396,393	
NETHERLANDS	12	2.5	60,984		60,984	
P. R. CHINA	12	2.5	60,984	22,131	83,115	
POLAND	17	3.5	86,393		86,393	
HHNIPNE ROMANIA	3	0.6	15,246		15,246	
RUSSIA	38	7.8	193,115	29,694	222,808	
SPAIN	20	4.1	101,639		101,639	
SWITZERLAND	26	5.3	132,131		132,131	
TURKEY						
UKRAINE	3	0.6	15,246	5,533	20,779	
UK	89	18.2	452,295		452,295	
USA	21	4.3	106,721	36,677	143,398	
CERN	66	13.5	335,410		335,410	
TOTAL	488	100.0	2,480,000	141,985	2,621,985	

PROPOSED Sharing and 2018 Category A M&O Budget

2018	PhD eq. total/ funding auth.			M&O A	Power	
				kCHF	kCHF	
				2,550	600	Total
		%	CHF	CHF	CHF	CHF
BRAZIL	21	4.1	104,386	24,561	128,947	
COLOMBIA	2	0.4	9,942	2,339	12,281	
FRANCE	49	9.6	243,567	0	243,567	
BMBF GERMANY	25	4.9	124,269	0	124,269	
MPG, GERMANY	5	1.0	24,854	0	24,854	
IRELAND	1	0.2	4,971	1,170	6,140	
INFN ITALY	85	16.6	422,515	0	422,515	
NETHERLANDS	13	2.5	64,620	0	64,620	
P. R. CHINA	21	4.1	104,386	24,561	128,947	
POLAND	17	3.3	84,503	0	84,503	
HHNIPNE ROMANIA	5	1.0	24,854	0	24,854	
RUSSIA	40	7.8	198,830	19,822	218,653	
SPAIN	24	4.7	119,298	0	119,298	
SWITZERLAND	26	5.1	129,240	0	129,240	
TURKEY	0	0.0	0	0	0	
UKRAINE	2	0.4	9,942	2,339	12,281	
UK	85	16.6	422,515	0	422,515	
USA	21	4.1	104,386	23,260	127,646	
CERN	71	13.8	352,924	0	352,924	
TOTAL	513	100.0	2,550,000	98,053	2,648,053	



PhD equivalent numbers together with the M&O Cat.A cost for 1 PhD equivalent.

Also shown the M&O Cat.A budget in kCHF constant before and after the LS2 transition.

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Category B M&O status

Cat. B M&O 2017 budgets are given in the Table. The total is **~970 kCHF** including in-kind contributions, a bit less than half of the M&O Cat.A total. Category B M&O spent funds show to be constant over time inside ~10% *.

CERN (CA, MU, ON, RI, VE)	200
CH (STs, VE)	80
ES (CA, STs)	29
FR (CA, L0)	105
GE (OT, STs)	75
IT (L0, MU, RI, ST)	110
NL (OT, VE)	76
RU (CA, MU, VE)	105
UK (RI, VE)	190

CALO (CERN, ES, FR, RU)	200
Level_0 (FR, IT)	50
Muons (CERN, IT, RU)	120
On Line (CERN)	100
Outer Tracker (GE, NL, PL, PRC)	100
RICH (CERN, IT, UK, RO, PL)	130
Silicon Trackers (CH, ES, GE, IT, UKR)	70
VELO (CERN, CH, EI, NL, RU, UK, USA)	200

Cat. B M&O budgets for 2017 in kCHF and per FA (>10 kCHF)

*Fluctuating exchange rates increase the approximation for these figures

M&O Cat. B 2010 - 2017 and projected preliminary 2018 - 2019

M&O Cat. B REQUESTS 2010 - 17 and PROJECTED 2018 - 19

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Mechanics	111	65	65	65	110	57	57	57	57	57
Gas-system	10	10	10	10	10	10	10	10	10	10
Cryo-system	0	0	0	0	0	0	0	0	0	0
Cooling system	15	15	15	15	15	15	15	15	15	15
FE electronics	124	125	125	125	125	115	115	115	115	115
Standard electronics, PS (LV, HV), Crates, RO Modules	229	224	224	225	240	200	200	200	200	200
Controls, (DCS, DSS)	68	70	71	70	70	55	55	55	55	55
Sub-Detector Spares	200	200	170	200	180	170	160	150	150	150
Maintenance of clean rooms, active and passive storage (including rentals), workshops	45	45	45	45	45	40	40	40	40	40
Communications (Piquet tools (ACB, GSM, etc...))	31	37	36	30	30	30	30	30	30	30
Store Items (Materials (screws, washers, tools, etc...))	25	25	25	25	25	18	18	18	18	18
Hired Manpower @ CERN (in CHF (Industrial Support))	0	0	0	0	0	0	0	0	0	0
Technical Manpower @CERN (in FTE (Technicians from Collaboration Institutes))	290	295	280	280	280	280	290	280	280	280
Totals (CHF)	1148	1111	1066	1090	1130	990	990	970	970	970

Conclusions

The **basic principle** of LHCb M&O Cat.A policy is to keep budgets as constant as possible:

- foresee what is foreseeable and budget for it;
- provide a mechanism to compensate between “collision years” and “shutdown years” (essentially by asking to keep surpluses as buffers for difficult years);
- smooth as much as possible Online CPU replacement needs (“just-in-time” principle) and, in any case, smear their cost over a few years;
- as LHCb is running to optimize physics throughput, effects on the related expenditures have to be carefully studied and taken into account for the coming years budgets.

The **same policy** is applied to the coming LS2 phase and the following Run III period with the upgraded LHCb. However, owing to the **increased complexity of the experiment**, adjustments have to be forecasted and applied accordingly.

A **total cost** of a bit more than 3.1 MCHF for each year of LS2 and from 3.07 MCHF to ~2.90 MCHF during the RUN III years for M&O cat.A is forecasted.

Apart from the non-negligible growth, our funding agencies would have to raise the total budget to ~3.1 MCHF as from year 2019 and beyond, from a budget of 2.48 MCHF in 2018. That is an abrupt increase in a short time. Therefore, a **gradual approach** has been proposed, by starting the transition already in 2018 and by using our present surplus (about 0.5 MCHF) to partly finance LS2 dismantling costs. The resulting transition is gradual and should help our FAs to support the bill.

The overall increase per PhD equivalent is reduced by the forecasted increase in total numbers of LHCb collaborators, impacting as little as possible on costs.

We would like to submit this plan to you and receive your approval.

The **2017 M&O cat.A Budget** seems to be very well balanced and, thanks to our motivated and punctual FAs, pluri-annual contributions were collected and there are no cash flow issues.

Cat.B funds and resources are healthy. Following our study for LS2 **and future M&O cat.A** budget levels, we have recommended a similar analysis to be carried out on the sub-detector projects, as Cat. B funds are mostly managed by the projects. We expect that first results will be available in year 2018 and we will **report to SG and to RRB**.

A big thanks to the **RRB and to the SG** for their warm support and advices.