

A Proposal for a Mu2e Operations Common Fund

D. Glenzinski, March 06, 2018

Overview

HEP experiments hosted at laboratories often charge users for some fraction of the associated operations costs. The operations costs and the associated user charges are managed via an operations common fund. Examples include the LHC experiments at CERN, Belle II at KEK, T2K at JPARC, BABAR at SLAC, and CDF and D0 at Fermilab. This is a proposal for establishing a Common Fund in support of Mu2e operations.

The proposed strategy will distribute the operations burden by charging a fixed amount for each qualifying collaborator. The relevant operations burden will be evaluated by costing an agreed upon list of contributing materials and services. The cost will be aggregated by funding agency. Oversight will be provided, at least initially, by a Mu2e International Finance Committee.

Oversight

At least initially, we propose that oversight be provided by a formal Mu2e International Finance Committee (IFC). Once the details of the common fund have been agreed upon, then the mechanisms for oversight could be relaxed if the international agencies prefer (e.g. an annual written report). Alternative suggestions for establishing a sufficient degree of oversight are welcome. For the time being, we assume the formation of a formal IFC.

The International Finance Committee will consist of one representative from each of the relevant funding agencies (FA). Each FA will appoint their own representative, which could be a PI from one of their participating institutions, or an official representative of the funding agency itself. The representatives will internally determine a chair from within their own membership. The chair shall not be the DOE representative and will, ideally, be a representative from one of the non-US agencies. The Mu2e co-spokespersons and the head of the Fermilab Mu2e Operations Group will serve in an *ex-officio* capacity. The IFC shall meet as needed, but no less than once per year.

The IFC shall determine the list of Qualifying Operations Costs, shall review the list of qualifying collaborators, and shall approve the resulting required contribution per qualifying collaborator. The IFC shall also review and approve proposed methods of payment. The costs and contributions will be aggregated over each US fiscal year, which begin 01-October (e.g. FY2018 covers 01-October-2017 : 30-September-2018). Since participating (US and Non-US) funding agencies operate under a wide variety of constraints, a reasonable degree of flexibility should be allowed concerning the manner in which contributions to the Common Fund are made.

Qualifying Collaborators

Everyone on the Mu2e Collaboration List ([mu2e-doc-db-529](#) / [cert.](#)) shall be a Qualifying Collaborator. PhD scientists and other senior scientific staff shall carry a weight of 1 Qualifying Collaborator unit (qcu), while engineers, graduate and undergraduate students, and technicians shall carry a weight of 0 qcu.

The Mu2e Collaboration List is updated annually as specified in the Mu2e Bylaws ([mu2e-doc-db-208](#) / [cert.](#)). The Collaboration List shall be available for review upon request.

Qualifying Operations Costs

Any cost associated with the commissioning, maintenance, and operation of the Mu2e experiment is eligible for inclusion in the cost list. The final list of Qualifying Operations Costs shall be determined in consultation with the IFC.

The list of costs shall be revisited annually. This will be especially important in the near term when the costs are expected to rise as Mu2e begins commissioning and ramp-up to full-scale operations by US FY2021.

A preliminary list of Qualifying Operations Costs for FY2018-20 is included in Appendix A. An updated list with estimated costs will be presented before the official start of the Common Fund.

Required Common Fund Contribution

The contribution per qcu shall be determined by summing over the list of Qualifying Operations Costs and dividing by the sum of qcu determined from the list of Qualifying Collaborators. The Required Common Fund Contribution for each agency shall be determined by multiplying the contribution per qcu by the total qcu

supported by that agency. The IFC shall approve the resulting list of agency contributions

Acceptable Methods of Contribution

As stated earlier, since participating (US and Non-US) funding agencies operate under a wide variety of constraints, a reasonable degree of flexibility should be allowed concerning the manner in which contributions to the Common Fund are made. In previous experiments, typical acceptable methods of contributions included direct money transfer to the host laboratory or in-kind contributions in the form of specific hardware (e.g. new computing processors, storage disks, or photomultipliers) or consumables (e.g. nitrogen or helium for cryogenic systems, argon or CO₂ for drift chambers). Other methods may also be allowed. The IFC will review and approve the proposed contribution of each agency.

Proposed Start-up of Common Fund

Since Mu2e operations costs have already begun to accrue, we propose to begin collecting common fund contributions in US FY2019 (01-Oct-2018 : 30-Sep-2019). This implies that details of this arrangement get discussed and finalized during CY2018.

A Worked Example and Lessons Learned

A worked example is provided in Appendix B to illustrate the methodology proposed in the previous sections. The names are taken from the Mu2e Collaboration List as of November 2017. The numbers are the current estimates of operating costs. Both the names and the numbers will be updated prior to initiating the common fund.

The experience of CDF is summarized in Appendix C. Perhaps most useful is the list of lessons learned provided at the end.

Next Steps

We propose convening an IFC meeting before the end of calendar year 2018. At this first meeting the IFC can:

1. review the procedures proposed above and, in consultation with the other relevant stakeholders, modify as needed to reach consensus
2. determine the list of Qualifying Operations Costs for FY2019 and FY2020

3. discuss when it is reasonable to begin collecting Mu2e Common Fund contributions
4. decide when to hold the next meeting.

The Mu2e co-spokespersons will work with the relevant senior scientists and their funding agency to identify the corresponding Mu2e IFC representative and to establish a date for this first meeting. Some possible dates are listed in Appendix D.

DRAFT

Appendix A – Preliminary List of Eligible Operations Costs

List of eligible operations costs - FY2018 - 2020						
Category	Item	Type	FY18 (US\$ k)	FY19 (US\$ k)	FY20 (US\$ k)	Comment
Solenoids			44.0	83.0	171.0	
	Nitrogen	consumable	30.0	60.0	120.0	based on g-2 FY17 actuals
	Helium	consumable	8.0	15.0	30.0	based on g-2 FY17 actuals
	Trailer certification	other	0.0	0.0	10.0	based on g-2 FY17 actuals
	Filters	consumable	1.0	1.0	1.0	based on g-2 FY17 actuals
	Spare parts	hardware	5.0	7.0	10.0	based on g-2 FY17 actuals
Detectors			62.0	142.0	327.0	
	Tracker gas	consumable	0.0	5.0	15.0	estimate from Tracker L2 manager
	SIPMs	hardware			20.0	estimate from CRV L2 manager
	Spare repairs	hardware		10.0	25.0	guess - RO electronics, power supplies, misc.
	Spare pumps, septa, e	hardware	60.0	125.0	125.0	total spares spread over 5y
	Target change	hardware			140.0	quote from Accelerator Division/RAL
	Filters	consumable	2.0	2.0	2.0	estimate
Computing			257.5	298.9	427.3	
	TDAQ cpu	hardware			150.0	quote from R. Rivera
	TDAQ disk	hardware	5.0	10.0	10.0	guess
	Analysis cpu	hardware	217.2	251.6	222.8	from Computing Division
	Analysis disk & tape	hardware	25.4	27.3	29.5	from Computing Division
	Lisences	other	10.0	10.0	15.0	based on FY17; in FY20 add'l lisences
Services			205.1	305.1	405.1	
	Power	consumable	200.0	300.0	400.0	1600k for all on-site experiments; ~25% for MC
	Cooling water	consumable				
	Compressed air	consumable				
	Dry air	consumable				
	Lifts & Cranes	other	3.6	3.6	3.6	based on FY17
	PPE	hardware	0.5	0.5	0.5	estimate
	UPS M&O	other	1.0	1.0	1.0	estimate
Experimental Hall			7.2	7.8	8.1	
	Elevator M&O	other		0.5	0.5	first year free
	Lighting	consumable	1.0	1.0	1.0	based on FY17
	Janitorial	other	6.0	6.0	6.0	contract \$500/mo
	Drinking water	consumable	0.2	0.3	0.6	quote from Hinkley
Total			575.8	836.8	1338.5	

Table 1: A preliminary list of eligible operations costs. The final list of Qualifying Operations Costs is determined by the IFC. An updated list will be provided prior to initiating the Common Fund and annually thereafter. The table above is a preliminary list of eligible operations costs. As described above, the IFC can decide to include all or just a subset of these items for inclusion in the list of Qualifying Operations Costs. An updated list will be provided at the first IFC meeting.

Appendix B – Details of a Worked Example

Qualifying Collaborators - An Example					
No.	Institution	Agency	Name	Position	qcu
1	Argonne	DOE	Byrum, Karen	Scientist	1.0
2	Argonne	DOE	Drake, Gary	Engineer	0.0
3	Argonne	DOE	Goodenough, Lisa	Post-doc	1.0
4	Argonne	DOE	Magill, Stephen R.	Scientist	1.0
5	Argonne	DOE	Talaga, Richard L.	Scientist	1.0
6	Argonne	DOE	Wagner, Robert G.	Scientist	1.0
7	Argonne	DOE	Winter, Peter	Scientist	1.0
8	Argonne	DOE	Xia, Lei	Scientist	1.0
9	Boston	DOE	Mott, James	Post-doc	1.0
10	Boston	DOE	Carey, Robert M	Scientist	1.0
11	Boston	DOE	Miller, James P.	Scientist	1.0
12	Boston	DOE	Quirk, John	Grad. Student	0.0
13	Boston	DOE	Roberts, B. Lee.	Scientist	1.0
14	Boston	DOE	Tran, Nam	Post-doc	1.0
15	Boston	DOE	Wang, Yaqian	Post-doc	1.0
16	Brookhaven	DOE	Crnkovic, Jason	Post-doc	1.0
17	Brookhaven	DOE	Kirby, Brian	Post-doc	1.0
18	Brookhaven	DOE	Marciano, William J.	Scientist	1.0
19	Brookhaven	DOE	Polychronakos, Venetios	Scientist	1.0
20	Brookhaven	DOE	Tishchenko, Vladimir	Scientist	1.0
21	Brookhaven	DOE	Yamin, Peter	Scientist	1.0
22	UC Berkeley & LBNL	DOE	Bonventre, Richard	Post-doc	1.0
23	UC Berkeley & LBNL	DOE	Brown, David	Scientist	1.0
24	UC Berkeley & LBNL	DOE	McClave, Thomas	Undergrad	0.0
25	UC Berkeley & LBNL	DOE	Edmonds, Andrew	Post-doc	1.0
26	UC Berkeley & LBNL	DOE	Provasoli, Davide	Undergrad	0.0
27	UC Berkeley & LBNL	DOE	Kolomensky, Yury G.	Scientist	1.0
28	UC Davis	DOE	Prebys, Eric J.	Scientist	1.0
29	UC Irvine	DOE	Libeiro, Terence	Post-doc	1.0
30	UC Irvine	DOE	Molzon, William	Scientist	1.0
31	UC Irvine	DOE	Zhang, Yumei	Post-doc	1.0
32	Caltech	DOE	Echenard, Bertrand	Scientist	1.0
33	Caltech	DOE	Hitlin, David G.	Scientist	1.0
34	Caltech	DOE	Kim, Jae-Hong	Grad. Student	0.0
35	Caltech	DOE	Li, Yunxuan	Grad. Student	0.0
36	Caltech	DOE	Miyashita, Tomonari	Post-doc	1.0
37	Caltech	DOE	Porter, Frank	Scientist	1.0
38	Caltech	DOE	Roehrken, Markus	Post-doc	1.0
39	Caltech	DOE	Trevor, Jason	Engineer	0.0
40	Caltech	DOE	Zhu, Ren-yuan	Scientist	1.0

Table 2: An excerpt of the first forty entries of the Qualifying Collaborators, taken from the Mu2e Collaboration List. Each person is assigned a weight (qcu) as discussed in the text above. A roll-up for each institution and funding agency is provided on the next page. The Table above illustrates the first forty entries of the Qualifying Collaborators, taken from the Mu2e Collaboration List, and assigns the qcu for each person as discussed above. A roll-up for each institution and funding agency is provided on the next page.

QCU Summary by Funding Agency			
Row Labels	QCU Sum	QCU Fraction	Head Count
China	1	0.59%	4
Sun Yat-Set University	1	0.59%	4
DOE	106	62.35%	142
Argonne	7	4.12%	8
Boston	6	3.53%	7
Brookhaven	6	3.53%	6
Caltech	6	3.53%	9
City University of York	2	1.18%	3
Duke	2	1.18%	2
Fermilab	37	21.76%	38
Houston	3	1.76%	6
KSU	5	2.94%	7
Lewis	2	1.18%	2
Louisville	2	1.18%	7
Minnesota	4	2.35%	10
Northwestern	4	2.35%	6
Purdue	4	2.35%	5
South Alabama	2	1.18%	2
UC Berkeley & LBNL	4	2.35%	6
UC Davis	1	0.59%	1
UC Irvine	3	1.76%	3
Virginia	5	2.94%	12
Yale	1	0.59%	2
Germany	2	1.18%	2
HZDR	2	1.18%	2
INFN	22	12.94%	32
INFN Genova	3	1.76%	4
INFN Lecce & Salento	5	2.94%	5
INFN Pisa	6	3.53%	8
LNF	6	3.53%	11
LNF & Marconi Roma	2	1.18%	4
Misc	4	2.35%	4
Muons Inc	4	2.35%	4
NSF	9	5.29%	12
NIU	7	4.12%	10
Washington	2	1.18%	2
Russia	19	11.18%	19
IHEP Protvino	6	3.53%	6
INR Moscow	2	1.18%	2
JINR, Dubna	10	5.88%	10
Novosibirsk/Budker	1	0.59%	1
STFC	7	4.12%	9
Liverpool	3	1.76%	3
Manchester	3	1.76%	3
UCL	1	0.59%	3
(blank)		0.00%	
(blank)		0.00%	
Grand Total	170	100.00%	224

Table 3: Summary that provides sum over the list of Qualifying Collaborators and provides the qcu sum, fraction, and head count for each participating institution and funding agency.

Funding Agency Contributions by FY						
Row Labels	QCU Fraction	QCU Sum	Head Count	FY18 Costs (US\$ k)	FY19 Costs (US\$ k)	FY20 Costs (US\$ k)
DOE	62.35%	106	142	359.04	521.76	834.61
INFN	12.94%	22	32	74.52	108.29	173.22
Russia	11.18%	19	19	64.36	93.52	149.60
NSF	5.29%	9	12	30.48	44.30	70.86
STFC	4.12%	7	9	23.71	34.46	55.12
Misc	2.35%	4	4	13.55	19.69	31.49
Germany	1.18%	2	2	6.77	9.84	15.75
China	0.59%	1	4	3.39	4.92	7.87
(blank)	0.00%			0.00	0.00	0.00
Grand Total	100.00%	170	224	575.82	836.79	1338.53

Table 4: The common fund contribution for each funding agency as a function of US fiscal year. These numbers are illustrative and will be updated prior to the initiation of the common fund and annually thereafter. This table shows the common fund contribution for each funding agency as a function of fiscal year.

Total Costs and Costs/QCU by FY			
	FY2018 (US\$ k)	FY2019 (US\$ k)	FY2020 (US\$ k)
Total Qualifying Costs	575.82	836.79	1338.53
Cost / QCU	3.39	4.92	7.87

Table 5: The common fund cost per qcu as a function of US fiscal year. These numbers are for illustration but give an approximate sense of the associated costs. The operating costs are expected to stabilize around the FY2020 level shown here, assuming no significant issues arise. This table shows the common fund cost per qcu as a function of fiscal year. The operating costs are expected to stabilize at around the FY2020 levels for the duration of Mu2e data taking, assuming no significant issues arise.

Appendix C – A Summary of the CDF Experience¹

The CDF experiment at Fermilab established an International Finance Committee (IFC) in 2002. Most of the organizational concepts were taken from the experience of the BABAR experiment at SLAC. The CDF IFC had an invited representative from each country and meetings were held twice a year initially moving to once a year as the process became routine. A subset of the IFC members formed the financial scrutiny group which went over the proposed operations costs and author lists to decide upon the shared costs that would be paid by international partners. To avoid any conflict of interest, it was decided that the chair of the scrutiny group should not be from the USA. Paolo Giubellino served as chair for the entire duration of Run II.

In initially setting up the CDF system a spreadsheet of all costs that it took to operate CDF was formed. The costs were roughly half detector operations and half computing. From this spreadsheet a set of items were picked to share as a proposal for the first year where the 50/50 detector ops/computing split was maintained. The rate that each country would pay was determined by the number of PhD authors (i.e. students were exempt). The set of costs were selected such that the cost per PhD in the first year was about \$6k. The ops/computing split and the accounting (ie. per PhD) are arbitrary choices. The main point is for there to be a consensus among the IFC.

The experience of operating the CDF IFC for a decade led to a number of key observations

- The system benefitted greatly from being flexible and nimble.
- The traditions established when CDF was small continued to serve them well later. It was a lot easier to grow a small system than it would have been to set up a large system later.
- Groups were allowed to pay forward in favorable (for them) exchange rates
- Some countries needed to make in kind contributions in the form of hardware or consumables.
- The international agencies seemed more concerned that they were not paying more than their fair share than they were with the actual cost (within reason).
- The international agencies wanted value – it was always very important to tie the money to the science and enable the agencies to tell a clear, simple story to their stakeholders.

¹ The information in the section comes from conversations with Rob Roser, past CDF Co-Spokesperson

Appendix D – Possible Dates for First IFC Meeting

Possible dates for the first IFC meeting are (all in 2018):

- In concert with the June User's meeting (20-21 June)
- In concert with June Mu2e Collaboration meeting (26-29 June)
- In concert with Mu2e DOE annual review (expected ~July)
- In concert with October Mu2e Collaboration meeting (17-20 October)
- In parallel with another large meeting

DRAFT