

**IceCube Neutrino Observatory
Maintenance & Operations
Common Fund Status Report**

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Introduction

The IceCube M&O Common Fund was created in April 2007, the start of formal operations, to enable collaborating institutions to contribute to the costs of maintaining the computing hardware and software required to manage experimental data prior to processing for analysis. Each institution contributes to the Common Fund based on the total number of the institution's Ph.D. authors.

The Collaboration updates the Ph.D. author count twice a year at the collaboration meetings in conjunction with the update to the IceCube M&O Scope of Work and responsibilities in the Institutional Memorandum of Understanding. Effective April 1, 2010, the annual established rate per Ph.D. author is \$13,650.

The M&O activities identified as appropriate for support from the Common Fund are those core activities that are agreed to be of common necessity for reliable operation of the IceCube detector and computing infrastructure. The activities directly support the functions of winterover technical support at the South Pole, hardware and software systems for acquiring and filtering data at the South Pole, hardware and software systems for transmitting data via satellite and tape to the UW data center, systems for archiving the data in the central data warehouse at UW and UW Data Center Operations as listed in the Cooperative Agreement with NSF.

Section I: Initial Three Years of M&O Common Fund

Common Fund Contributions

The following table summarizes the Common Fund (CF) contributions for the first three years of IceCube Maintenance and Operations:

**Table 1. Planned and Actual CF Contributions (\$000)
For the Initial Three Years of M&O – April 2007 - March 2010**

	PhD. authors Apr. '07	Year1 2007 Planned	PhD. authors Apr. '08	Year2 2008 Planned	PhD. authors Apr. '09	Year3 2009 Planned
Total CF Planned	122	\$1,110	115	\$1,046	124	\$1,128
U.S. Contribution	73	\$664	73	\$664	73	\$664
Non-U.S. Contribution	49	\$446	42	\$382	51	\$464
		Actual		Actual		Actual
Total CF Contributions		\$1,110		\$1,046		\$1,128
U.S. Cash Transfer		\$664		\$664		\$664
Non-U.S. Cash Transfer		\$360		\$343		\$426
Non-U.S. In-Kind		\$86		\$39		\$38
Balance		\$0		\$0		\$0

All expected contributions for the initial three years of IceCube M&O were fulfilled.

The following bar chart presents the Ph.D. authors head count profile over the initial three years of IceCube M&O. The total number of Ph.D. authors has increased from 122 in April 2007 to 127 in May 2010 (U.S. decreased from 73 to 68 while Non U.S. increased from 49 to 59).

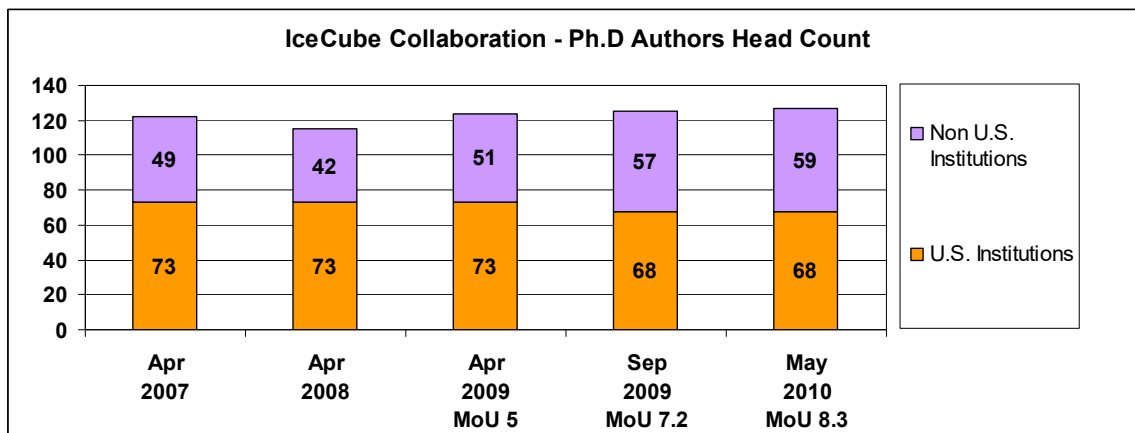


Figure 1: Ph.D. Authors Head Count Profile for the Initial Three Years of M&O

Section II: Years 4-11 of M&O Common Fund

Common Fund Contributions

The actual contribution during these years of IceCube operations is larger than in preceding years primarily due to the 50% increase to the Ph.D. author fee. The following table summarizes the planned vs. actual received contribution in 2010-2018.

**Table 2. Planned and Actual CF Contributions (\$000)
For Years 4-11 of M&O, April 1st, 2010 – March 31st, 2018**

	PhD. authors May '10	Year4 2010 Planned	PhD. authors Apr. '11	Year5 2011 Planned	PhD. authors Mar. '12	Year6 2012 Planned	PhD. authors Apr. '13	Year7 2013 Planned
Total CF Planned	127	\$1,728	126	\$1,720	124	\$1,693	124	\$1,693
U.S. Contribution	68	\$928	69	\$942	67	\$915	69	\$942
Non-U.S. Contribution	59	\$799	57	\$778	57	\$778	55	\$751
		Actual		Actual		Actual		Actual
Total CF Contributions		\$1,726		\$1,720		\$1,709		\$1,671
U.S. Cash Transfer		\$928		\$942		\$915		\$942
Non-U.S. Cash Transfer		\$744		\$730		\$794		\$671
Non-U.S. In-Kind		\$54		\$47		\$75		\$58
Difference (Actual - Planned)		\$-2		\$0		\$16		\$-21

	PhD. authors Mar. '14	Year8 2014 Planned	PhD. authors Apr. '15	Year9 2015 Planned	PhD. authors Apr. '16	Year10 2016 Planned	PhD. authors Apr. '17	Year11 2017 Planned
Total CF Planned	129	\$1,777	137	\$1,870	138	\$1,904	137	\$1,843
U.S. Contribution	67	\$915	73	\$996	78	\$1,065	71	\$969
Non-U.S. Contribution	62	\$862	64	\$873	60	\$839	66	\$874
		Actual		Actual		Actual		Actual
Total CF Contributions		\$1,734		\$1,848		\$1,931		\$1,812
U.S. Cash Transfer		\$915		\$996		\$1,065		\$969
Non-U.S. Cash Transfer		\$680		\$715		\$786		\$665
Non-U.S. In-Kind		\$139		\$137		\$80		\$177
Difference (Actual - Planned)		\$-43		\$-22		\$27		\$-31

Actual Common Fund contributions are \$27k higher than planned in 2016, and are currently \$31K less in 2017. The following bar chart presents the Ph.D. authors head count profile since the beginning of IceCube M&O. The final non-U.S. contributions are underway, and it is anticipated that most of the planned contributions will be fulfilled. The total number of Ph.D. authors has decreased from 138 in April 2016 to 137 in April 2017, and increased back to 138 in May 2018.

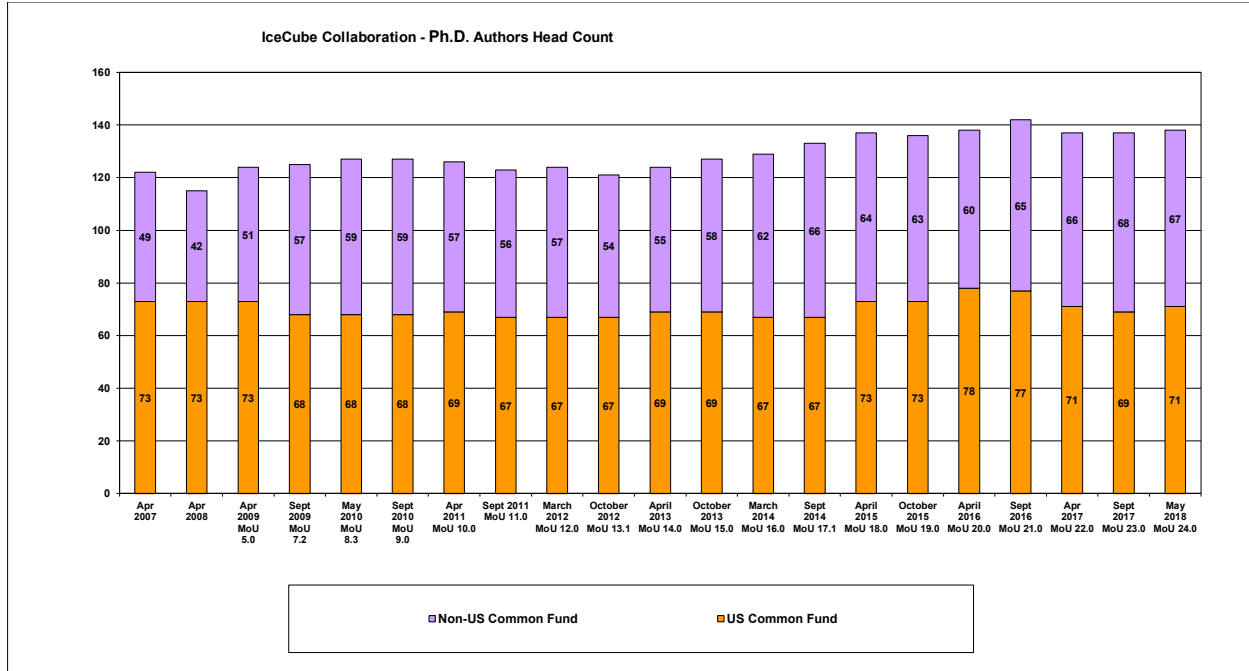


Figure 2: Ph.D. Authors Head Count Profile as of May 2018

The following table provides a more detailed breakdown of the authors head count including faculty, scientists and postdocs, and Ph.D. students based on the most recent MoU update.

Table 3. IceCube Collaboration – Authors Head Count Based on Institutional MoUs-SOW v24.0 (May 2018)

	Total Ph.D. Authors	Faculty	Scientists / Post Docs	Ph.D. Students
U.S. Institutions Subtotal	71	42	29	39
Non-U.S. Institutions Subtotal	67	41	26	75
Total U.S. & Non-U.S.	138	83	55	114

Summary of changes over the last six months:

- US Institutions: the number of Faculty increased by 1, Scientists / Post Docs increased by 1, and the number of Students decreased by 2.
- Non-US Institutions: number of Faculty increased by 1, Scientists / Post Docs decreased by 1, Students increased by 1.

IceCube M&O Computing Infrastructure Upgrade - 2017/2018

The following list (Tables 4) includes the major purchases for the 2017/2018 upgrades of the South Pole System (SPS), South Pole Test System (SPTS), UW Data Center, UW Data Warehouse and networking equipment that are funded by IceCube M&O Common Fund.

Table 4: Computing Infrastructure Upgrade - 2017/2018

Computing Infrastructure Upgrade - 2017/2018					
Sub System	Item	Description	Qty	Unit	Total \$
Data Center	Servers	Disk Servers for the IceCube filesystems at 222 to provide 600TB of usable space which will be needed for continuing data processing operations (Pass2 and Long term Archive to MERSC/DESY) + Warranty Support	12	ea	\$59,536
		One chassis with four servers with local SSD storage. One of the servers will become the main IceCube software build server, and the other three will be deployed as a database cluster (elasticsearch) for storing Iceprod and Condor accounting information + 3 Yr Warranty Service	1	ea	\$21,186
		This is a memory upgrade for six servers that we purchased in 2015 to host our Vmware appliance. In order to be able to cope with the memory requirements increase for the next few years, we see it will be convenient to upgrade them from their current 128GB RAM per server to twice that capacity.	20	ea	\$8,500
	Service	Maintenance of APC-branded climate-controlled enclosure in 3216 Chamberlin	1	ea	\$18,526
	Supplies	Cloud Services to test running IceCube workload in the Cloud.	12	Months	\$173
		solid state drives to improve performance of two servers we have	2	ea	\$1,178
		GPU Cards to replace old cards in 7 IceCube GPU Servers purchased in 2013	64	ea	\$38,368
Data Center Total					\$147,466
Data Warehouse	Disk Storage	An expansion and update of storage systems for the IceCube data warehouse. The reason for purchasing these new storage servers is in part for renewing old equipment, and for increasing the net capacity of the IceCube data warehouse in order to handle the increasing amount of accumulated data + 5 Years NBD Support	32	ea	\$613,618
		Two SuperMicro storage servers chassis model 6048R-E1CR36L for providing operational space for the archiving of IceCube data + 5 Yr Warranty Support	2	ea	\$40,918
		3TB replacement drives for Hitachi storage arrays.	4	ea	\$1,917
	Service	One year maintenance and support for the Qualstar XLS tape library and five LTO4 tape drives	1	ea	\$12,470
	Supplies	Disks for storage of RAW data taken by IceCube	100	ea	\$10,995
Data Warehouse Total					\$679,917
Networking	Network	Annual Cisco Network Maintenance FY2018	1	ea	\$12,404
Networking Total					\$12,404
South Pole Systems	Labor	04/2017 to 03/2018 Winter Overs and 50% Run Coordinator	12	Months	\$385,638
	Supplies	Replacement Battery Cells for SPS UPSes	360	ea	\$9,799
		Mean Well DOM power supplies (trial Acopian replacement for SPS)	39	ea	\$4,086
		DOMHub pigtails for Acopian / MeanWell replacement	36	ea	\$743
		LapTop Computers for Winter Overs	2	ea	\$8,880
		DOMHub Acopian replacement wiring	1	ea	\$1,239
Travel	Winter Over Training Travel, Gear Purchases, Travel to Pole,	2	ea	\$44,015	
South Pole Systems Total					\$454,400
Testing	Supplies	OTDR for fiber testing at pole	1	ea	\$6,760
Testing Total					\$6,760
Spicecore	Supplies	Connectors for the SpiceCore Cable and mating to that connector on our vessel	3	ea	\$2,114
Spicecore Total					\$2,114
Scintillator	Fabrication	Multiple Purchases for Scintillator Array and Scintillator Test Array Fabrication			\$77,624
Scintillator Total					\$77,624
Grand Total					\$1,380,686