

**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).

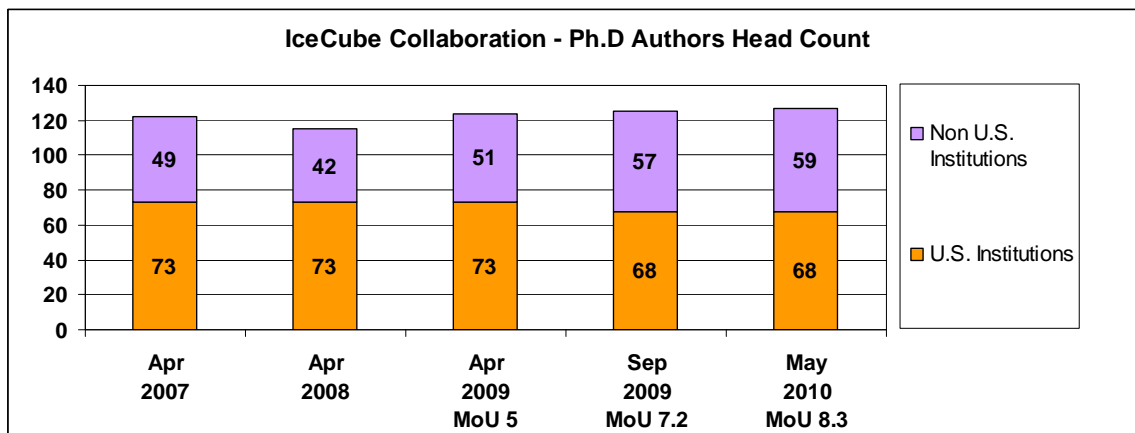


Figure 1: Ph.D. Authors Head Count Profile for the Initial Three Years of M&O

Section II: Years 4-10 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 2010-2014.

**Table 2. Planned and Actual CF Contributions (\$000)
For Years 4-8 of M&O, April 1st, 2010 – March 31st, 2017**

	PhD. authors May '10	Year4 2010 Planned	PhD. authors Apr. '11	Year5 2011 Planned	PhD. authors Mar. '12	Year6 2012 Planned		Year7 2013 Planned	PhD. authors Apr. '13	PhD. authors Mar. '14	Year8 2014 Planned	PhD. authors Apr. '15	Year9 2015 Planned	PhD. authors Apr. '16	Year10 2016 Planned
Total CF Planned	127	\$1,728	126	\$1,720	124	\$1,693		124	\$1,693	129	\$1,777	137	\$1,870	138	\$1,904
U.S. Contribution	68	\$928	69	\$942	67	\$915		69	\$942	67	\$915	73	\$996	78	\$1,065
Non-U.S. Contribution	59	\$799	57	\$778	57	\$778		55	\$751	62	\$862	64	\$873	60	\$839
		Actual		Actual		Actual		Actual		Actual		Actual		Actual	
Total CF Contributions		\$1,726		\$1,720		\$1,709		\$1,671		\$1,734		\$1,848		\$1,877	
U.S. Cash Transfer		\$928		\$942		\$915		\$942		\$915		\$996		\$1,065	
Non-U.S. Cash Transfer		\$744		\$730		\$794		\$671		\$680		\$715		\$732	
Non-U.S. In-Kind		\$54		\$47		\$75		\$58		\$139		\$137		\$80	
Difference (Actual - Planned)		-\$2		\$0		\$16		-\$21		-\$43		-\$22		-\$27	

Actual Common Fund contributions are \$22k less than planned in 2015, and are currently \$27k less in 2016. 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 increased from 137 in April 2015 to 138 in April 2016, and decreased back to 137 in April 2017 (U.S. decreased by 2, Non-U.S. increased by 2 over the course of two years).

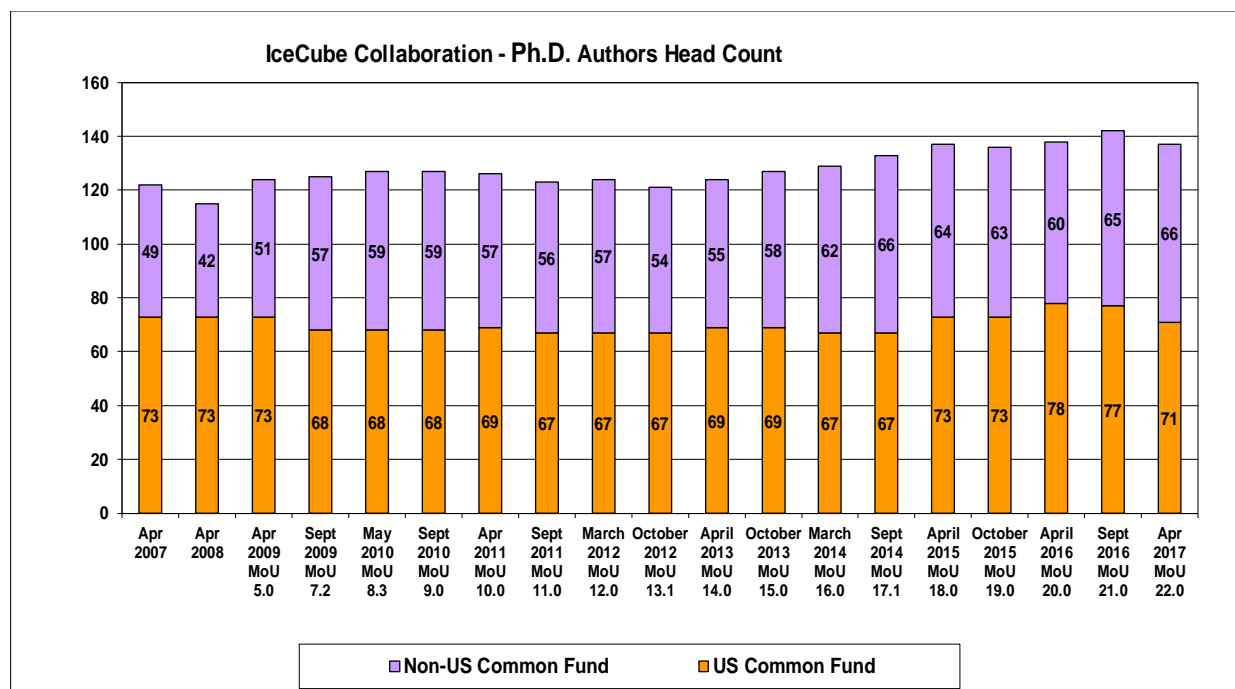


Figure 2: Ph.D. Authors Head Count Profile as of April 2017

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 v22.0 (April 2017)

	Total Ph.D. Authors	Faculty	Scientists / Post Docs	Ph.D. Students
U.S. Institutions Subtotal	71	41	30	41
Non-U.S. Institutions Subtotal	66	41	25	83
Total U.S. & Non-U.S.	137	82	55	124

Summary of changes over the last six months:

- US Institutions: the number of Faculty increased by 1, Scientists / Post Docs decreased by 5, and the number of Students remained unchanged.
- Non-US Institutions: number of Faculty increased by 1, Scientists / Post Docs remained unchanged, Students increased by 2.

IceCube M&O Computing Infrastructure Upgrade - 2015/2016 and 2016/2017

The following list (Tables 4 and 5) includes the major purchases for the 2015/2016 and 2016/2017 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 - 2015/2016

Sub-System	Item	Description	Qty	Unit	Total \$	
Data Center	Firewall	Dell SonicWALL NSA 4600 - new network firewall system for the 222 datacenter	1	ea	\$8,654	
	Memory	8GB DDR3R replacement memory	5	ea	\$560	
	Servers	Supermicro Storage server with 36x 8TB drives + Warranty to deploy a disk-based backup system for the IceCube servers data		1	ea	\$13,216
		Power Edge R320 server + Warranty Upgrade of infrastructure fileservers		2	ea	\$6,566
		Power Edge R430 servers + warranty for the Vmware appliance at 222		5	ea	\$35,804
		Power Edge R430 servers + Warranty upgrade in the IceCube data center		4	ea	\$14,093
		Supermicro TwinBlade chassis with 20 blade servers + Warranty to expand the capacity IceCube CPU cluster		6	ea	\$233,746
	UPS	APC SMART-UPS - replace UPS's in the 222 DataCenter,		33	ea	\$166,831
UPS for evaluation to replace all UPS's in our 222 Data Center		1	ea	\$5,056		
Data Center Total					\$484,527	
Data Warehouse	Servers	Dell SCv2080 Fibre Channel Storage Array + Warranty storage system to expand our Lustre filesystems	1	ea	\$76,624	
		PowerVault MD3460, PowerVault MD3060e, PowerEdge R430 Servers, and Warranty for expansion for the Icecube disk space in the data warehouse	4	ea	\$85,415	
	Memory	Upgrade the memory in 6 vmhost machines	36	ea	\$2,709	
	Service	One year maintenance and support for the Qualstar XLS tape library and five LTO4 tape drives	1	ea	\$23,018	
	Tapes	LTO-4 Tapes for backup system for 222 Data Warehouse	80	ea	\$2,602	
Data Warehouse Total					\$190,367	
Networking	Network	Network equipment to upgrade the connectivity from 222 to Chamberlin	25	ea	\$19,660	
	Service	IceCube Annual Maintenance Contract for Cisco networking hardware/software.	1	ea	\$18,085	
Networking Total					\$37,744	
South Pole Systems	Labor	04/2015 to 03/2016 Winter Overs and 50% Run Coordinator	12	Months	\$443,687	
	Controller	H710P Controller, additional components for South Pole System	5	ea	\$1,680	
	Disk Storage	Seagate 4TB 64MB CACHE SATA 3.5" Hard Drives for storing the RAW data taken by IceCube	400	ea	\$75,735	
	Modem	Dual-modem Iridium installation at SPS (RUDICS) + 1 set of spares	3	ea	\$5,361	
South Pole Systems Total					\$526,462	
South Pole Test Systems	DOMHubs	44W6973 (Advantech PCA-6012G2-00A1E SBC) DOMHub upgrade single-board computers spares for SPTS	10	ea	\$5,870	
South Pole Test Systems Total					\$5,870	
Grand Total					\$1,244,971	

Table 5: Computing Infrastructure Upgrade - 2016/2017

Sub System	Item	Description	Qty	Unit	Total \$
Data Center	Servers	GPU compute node in SuperMicro 4027GR-TR chassis + Warranty for expansion of the GPU capacity for IceCube simulation.	8	ea	\$100,992
		2028R-E1CR24L + Warranty with 24 high-speed disks each for renewing the fileservers that currently serve Home directories	2	ea	\$24,223
		GPU compute node in SuperMicro 4027GR-TR chassis + Warranty - expansion of the GPU capacity in the IceCube UW Data Center	7	ea	\$94,525
		Storage server 6048R-E1CR36L + Warranty to provide a dedicated space for IceCube simulation production temporary files	1	ea	\$20,936
	Disk Storage	Two additional slots for systemd disks, and the disk drives.	6	ea	\$454
	Service	Preventative maintenance service plans covering the APC/Schneider Electric enclosure	7	ea	\$19,397
		Support service for the storage part of our VMware infrastructure for our two Equallogic PS6100's	2	ea	\$6,102
Software	One year renewal for the support contract for our Vmware licenses.	13	ea	\$5,921	
Data Center Total					\$272,549
Data Warehouse	Servers	Dell R340 Server, MD3460 Array, MD3060e - Expansion Chassis + warranty for Lustre Storage Expansion	4	ea	\$139,091
		SC4020 to replace current storage systems for our VMWare infrastructure	1	ea	\$45,732
		SCv2080 FC (controller), SC180 Enclosure , Warranty to expand the lfs1 filesystem by .5 PB.	2	ea	\$66,252
		Storage Server 6048R-E1CR36 L+ Warranty to provide operational space for archiving of IceCube Data	2	ea	\$40,918
	Disk Storage	7YX58 Dell 600-GB 6G 10K 2.5 SAS w/G176J disk drives to increase the storage capacity of two Dell servers	12	ea	\$2,279
		Disk Drives to increase the storage capacity of two Dell servers in the data warehouse	12	ea	\$2,279
	Service	One year maintenance and support for the Qualstar XLS tape library and five LTO4 tape drives	1	ea	\$19,079
	Software	Intel Enterprise Edition for Lustre - software -L3 support contract for the machines serving the lfs1 filesystem	1	ea	\$21,945
Tapes	Quantum LTO Universal Cleaning Tapes to clean drives in 222 tape library during archive project	5	ea	\$311	
Data Warehouse Total					\$337,886
Networking	Service	Annual CISCO Network Maintenance FY2017	1	ea	\$18,655
Networking Total					\$18,655
South Pole Systems	Labor	04/2016 to 03/2017 Winter overs and 50% Run Coordinator	12	Months	\$363,074
	DOMHubs	Custom WN12554-1 48V DC power supply - replacement of all DOM power supplies at South Pole	220	ea	\$89,100
		TC-400R8A 400W mini-redundant ATX PSUs DOMHub ATX power supply spares	40	ea	\$10,400
South Pole Systems Total					\$462,574
Testing	Graphic Card	GIGABYTE GeForce GTX 1080 Founders Edition GV-N1080D5X-8GD-B, one of Nvidia's latest graphics cards for benchmarking and testing	1	ea	\$1,158
Testing Total					\$1,158
Grand Total					\$1,092,822