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).

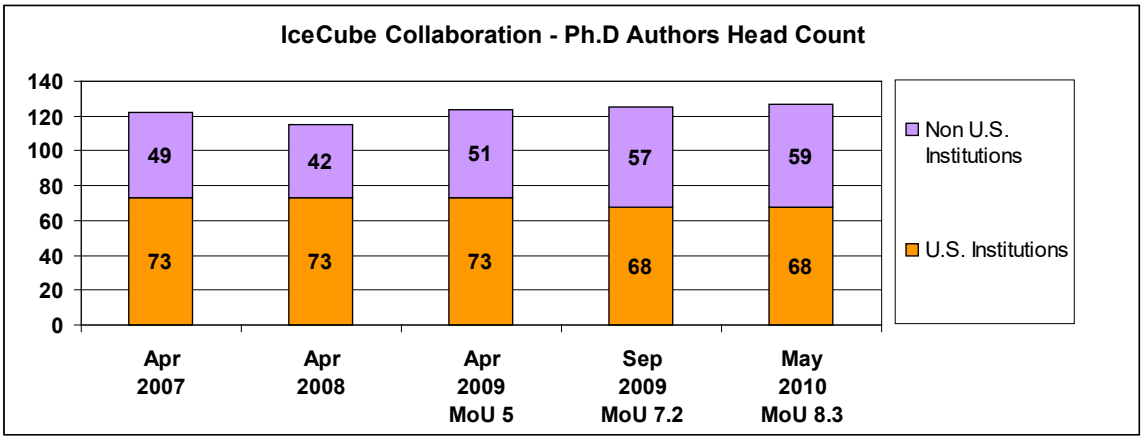

Figure 1: Ph.D. Authors Head Count Profile for the Initial Three Years of M&O

Section II: Years 4-12 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 2010-2019.

Table 2. Planned and Actual CF Contributions ($000)
For Years 4-12 of M&O, April 1st, 2010 – March 31st, 2019

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

	PhD. authors Apr. '13	Year7 2013 Planned	PhD. authors Mar. '14	Year8 2014 Planned	PhD. authors Apr. '15	Year9 2015 Planned
Total CF Planned	**124**	**$1,693**	**129**	**$1,777**	**137**	**$1,870**
U.S. Contribution	69	$942	67	$915	73	$996
Non-U.S. Contribution	55	$751	62	$862	64	$873
		Actual		**Actual**		**Actual**
Total CF Contributions		**$1,671**		**$1,734**		**$1,848**
U.S. Cash Transfer		$942		$915		$996
Non-U.S. Cash Transfer		$671		$680		$715
Non-U.S. In-Kind		$58		$139		$137
Difference (Actual - Planned)		**-$21**		**-$43**		**-$22**

	PhD. authors Apr. '16	Year10 2016 Planned	PhD. authors Apr. '17	Year11 2017 Planned	PhD. authors May '18	Year12 2018 Planned
Total CF Planned	**138**	**$1,904**	**137**	**$1,843**	**137**	**$1,870**
U.S. Contribution	78	$1,065	71	$969	71	$969
Non-U.S. Contribution	60	$839	66	$874	66	$901
		Actual		**Actual**		**Actual**
Total CF Contributions		**$1,931**		**$1,839**		**$1,606**
U.S. Cash Transfer		$1,065		$969		$969
Non-U.S. Cash Transfer		$786		$692		$582
Non-U.S. In-Kind		$80		$177		$96
Difference (Actual - Planned)		**$27**		**-$4**		**-$223**

Actual Common Fund contributions are $27k higher than planned in 2016, and are currently $4K less in 2017 and $264K less in 2018. The final non-U.S. PY12 contributions are underway, and it is anticipated that most of the planned contributions will be fulfilled. The following bar chart presents the Ph.D. authors head count profile since the beginning of IceCube M&O. 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, and to 152 in May 2019.

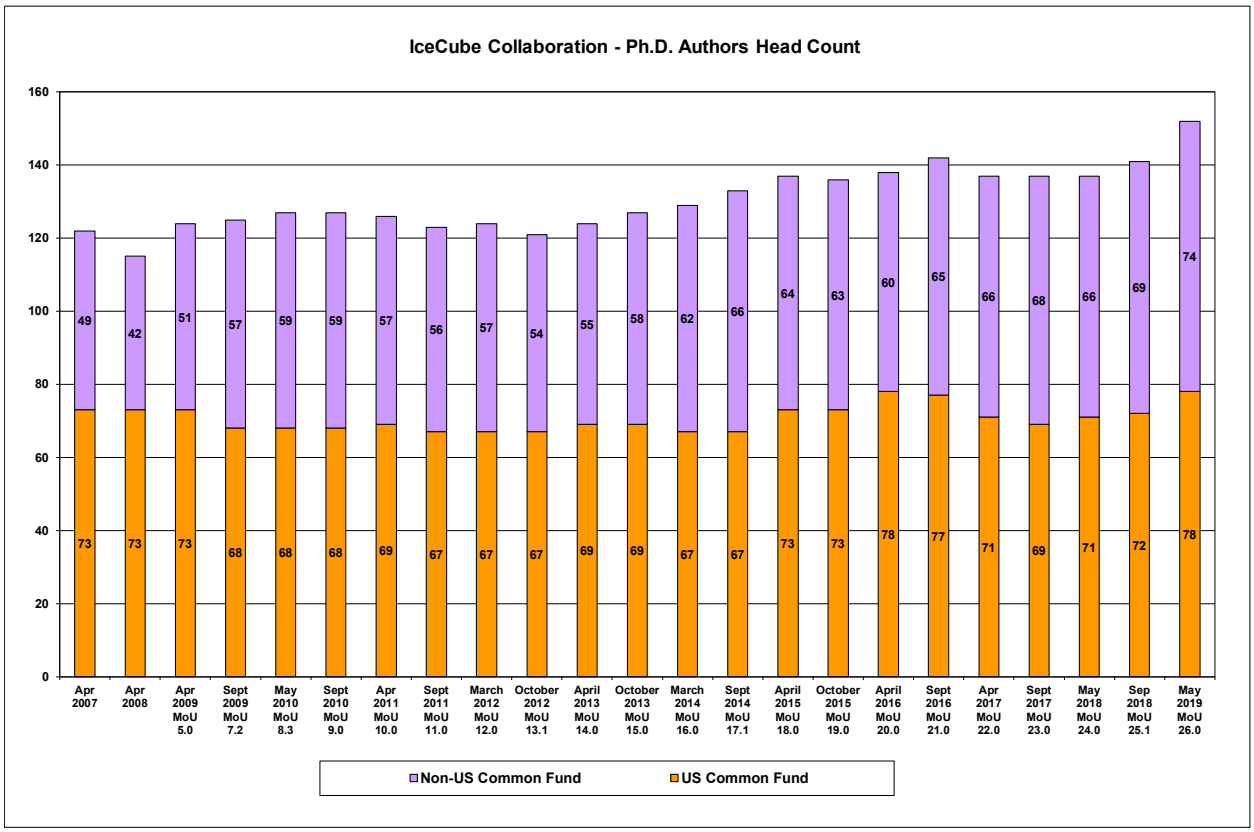

Figure 2: Ph.D. Authors Head Count Profile as of May 2019

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 v27.0 (September 2019)

	Total Ph.D. Authors	Faculty	Scientists / Post Docs	Ph.D. Students
U.S. Institutions Subtotal	79	48	31	50
Non-U.S. Institutions Subtotal	73	44	29	83
Total U.S. & Non-U.S.	**152**	**92**	**60**	**133**

Summary of changes over the last year:

- US Institutions: the number of Faculty increased by 6, Scientists / Post Docs increased by 3, and the number of Students increased by 7.
- Non-US Institutions: number of Faculty decreased by 1, Scientists / Post Docs increased by 3, Students increased by 1.

IceCube M&O Computing Infrastructure Upgrade - 2018/2019

The following list (Tables 4) includes the major purchases for the 2018/2019 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 - 2018/2019

Computing Infrastructure Upgrade - 2018/2019					
System	**Category**	**Description**	**Qty**	**Unit**	**Total Dollars**
Data Warehouse	**Computing Infrastructure**	iDRAC9 Enterprise Perpetual Digital License, All Poweredge Platforms - CusKi licenses for remote console management of five storage servers recently purchased to be deployed at OneNeck	6	ea	785
		4 Intel SSD DC S4500 Series (960GB, 2.5in SATA 6Gb/s, 3D1, TLC)drives for upgrading four servers in the IceCube datacenter to reconfigure them as kubernetes (container cluster) servers and host various databases and IceCube software build infrastructure	4	ea	1,432
		Smartnet maintenance - 1yr - Maintenance and support contract for core network equipment.	1	Year	12,047
		Overleaf Pro Bundle - 40 licenses (annual licenses) - Overleaf is a web-based collaborative document-creation tool based on the LaTeX document format. It will allow IceCube project members to collaborate on documents (papers/posters/proposals) in real-time, and via the web.	40	ea	1,952
		2U Cable Management Arm,CusKit 770-BBIPRequired for non-disruptive maintenance of Ceph storage servers	5	ea	471
		These systems will act as the metadata servers for our Lustre filesystem at OneNeck.			
		Dell R640 - Hardware	2	ea	17,870
		MD3420 - Hardware	1	ea	9,754
		Mellanox LinkX Passive Copper Cables - 10ft	4	ea	303
		ProSupport Maintenance Total	3	3 Year	3,641
		An expansion and update of our storage systems for the IceCube data warehouse. Several of the servers in our current distributed disk system are now beyond their 5 year support lifetime. The reason for purchasing these new storage servers is in part for renewing this old equipment, and being able to decommision it, and also for increasing the net capacity of the IceCube data warehouse in order to handle the increasing amount of accumulatied data.			
		Storage server unit composed by: 2 PE R640 servers, 2 MD3460 disk arrays and 2 MD3060e disk expansions	4	ea	550,696
		Cables	4	ea	523
		Shipping	1	ea	484
		5 years NBD support	4	5 Year	62,399
	Computing Infrastructure Total				**662,357**
Data Warehouse Total					**662,357**
South Pole System	**Computing Infrastructure**	Laptops for Winterovers	2	ea	7,264
		Purchase of 70 Seagate 6TB 64MB Cache SATA 3.5" Hard Drives to ship to the South Pole and archive the IceCube raw data taken during 2019	70	ea	20,349
		Spare parts for the new Dell servers that will come online at Pole this summer season. Memory, Hard drives, controllers, power supplies, etc Total			16,331
		Two replacement batteries for one of the desktop UPSes in ICL. Necessary so the WOs can communicate with the North while the power is out in ICL Total	2	ea	66
		UPSes - Dell 1000W UPS (H919N) - qty 2; Dell 4200W UPS (J730N) qty 3 for use at Pole	5	ea	4,600
		Servers for the first half of the South Pole System data center upgrade.			
		PowerEdge R740	19	ea	122,680
		ProSupport Maintenance Total	18	3 Year	1,453
		Dell 2Pc Fans Module 7920 Rack (Kit) Total	15	ea	416
		Heatsink for R740/R740XD, 125W or lower CPU (low profile, low Total	15	ea	393
		Intel Xeon gold 6126 2.6G 12C/24T, 10.4GT/S 10.25M Cache, Turbo, HT(125W) DDR4-2666	15	ea	32,782
		Shipping Total			45
		2nd half of South Pole System server upgrade			
		PowerEdge R740 Server	13	ea	72,223
		PowerEdge R740 Server	7	ea	28,479
		OME Server Configuration Mgmnt	19	ea	1,574
		R740 Warranty Service	20	3 Year	1,992
	Computing Infrastructure Total				**310,647**
	Detector Infrastructure	Multiple Purchases for Scintillator Array and Scintillator Test Array Fabrication			1,741
		Reach RS+ GNSS RTK system for ability to carry out our own surveying at South Pole. Will allow marking of IceCube potential hole locations, scintillator panels, hubs, and antennas in the field. Improve flexibility in surveying at South Pole	2	ea	3,245
		Adapter pigtails for Mean Well DOMHub power supplies at SPS	200	ea	1,896
		Alternative (non-Acopian) DOM power supplies for SPS (Mean Well MSP-200-48 power supply 48V)	80	ea	7,559
		Master clock DC power supplies and supplies for doghouse grounding			684
		Master clock option cards for IceCube backward compatibility, for SPS and spare	4	ea	5,325
		Master clock upgrade for SPS and spare (OCXO SecureSync GPS + dual power, RS232 ASCII time code option card, additional 10 MHz output option card, GPS/GNSS antenna	2	ea	13,480
		Misc. cables and adpaters needed in ICL	1	ea	312
		Postage for return of repaired item			66
		Replace our SAS controller cards at SP(T)S. These cards also need different cables (Dell YJXMR ESG-X Mini SAS Hard Drive Cable HD2MINI 2M).	6	ea	116
		Shipping from PSL to Port Hueneme			5,355
		Spare (SPECTRACOM CF CARD for SECURESYNC 1200) industrial-grade compact flash card for SPS master clocks with software installed	1	ea	118
		Spares (Dell X7K8W 3.5" Gen14 HDD Tray Caddy R740) for Pole	5	ea	83
		White Rabbit cabling, SPS	2	ea	367
		Winter Over Training Travel, Gear Purchases, Travel to Pole			40,994
	Detector Infrastructure Total				**81,343**
	Labor	Run Coordinator			49,649
		Winterover Labor			344,768
		Winterovers coordination, SPS / SPTS networking and security			77,968
		Maintainance of data handling software (JADE)			101,972
	Labor Total				**574,357**
South Pole System Total					**966,347**

System	Category	Description	Qty	Unit	Total Dollars
South Pole Test System	**Detector Infrastructure**	Parts to test new WR+Cisco fiber configuration at SPTS	2	ea	1,164
		Master clock option cards for IceCube backward compatibility, for SPS and SPTS + spare Total	3	ea	3,994
		Master clock upgrade for SPS and SPTS + spare (OCXO SecureSync GPS + dual power, RS232 ASCII time code option card, additional 10 MHz output option card, GPS/GNSS antenna	1	ea	6,740
	Detector Infrastructure Total				**11,898**
	Computing Infrastructure	**Servers for the first half of the SPTS data center upgrade**			
		PowerEdge R740 Total	18	ea	116,223
		ProSupport Maintenance Total	17	3 Year	1,373
		Dell 2Pc Fans Module 7920 Rack (Kit) Total	15	ea	416
		Heatsink for R740/R740XD, 125W or lower CPU (low profile, low Total	15	ea	393
		Intel Xeon gold 6126 2.6G 12C/24T, 10.4GT/S 10.25M Cache, Turbo, HT(125W) DDR4-2666	15	ea	32,782
		Shipping			45
		2nd half of South Pole (Test) system server upgrade			
		PowerEdge R740 Server	13	ea	72,223
		PowerEdge R740 Server	7	ea	28,479
		OME Server Configuration Mgmnt Total	18	ea	1,490
		R740 Warranty Service Total	20	3 Year	1,992
	Computing Infrastructure Total				**255,415**
South Pole Test System Total					**267,313**
UW Data Center	**Computing Infrastructure**	Disk drives to replace some failed drives and to stock spare parts for database servers that we use for the IceCube Live application Total	4	ea	1,022
		Vmware as part of our core infrastructure vCenter Server Standard and Vsphere Enterprise Production through 2/14/21	1	2 year	25,113
		7 GPU compute node in SuperMicro 4027GR-TR chassis with 8x GTX 1080 2x Xeon E5-2637 v4, 64 GB RAM and 2TB disk servers including the last generation Nvidia consumer grade GPU cards. These will be deployed at WIDMIR, similar to what we did with an equivalent purchase in August 2016. The goal for these servers is to add up as an expansion of the GPU capacity in the IceCube UW Data Center at UW-Madison.	7	ea	103,418
		Warranty for 7 GPU Servers	7	3 Year	1,607
		Appropriate lengthed cables for new GPU servers located at WIDMIR Total	27	ea	91
		Maintenance renewal for APC power and cooling in 3216 Chamberlin Hall Total	7	ea	16,114
		Repair tasks for Liebert cooling units in 222 room 5308 Total			341
		Cloud services to be used during 2019 to do various tests for running IceCube workload in the Cloud			4,125
		Cincopa image and video gallery hosting Plus plan to host the images and video galleries for the IceCube web page			344
		These machines will host services moved from the 222 data center to OneNeck			
		Data Transfer Servers - PowerEdge R6415	6	ea	21,838
		Database Servers - PowerEdge R6415	6	ea	24,874
		Storage Servers - PowerEdge R640	2	ea	14,476
		Warranty - 5 Yr Pro support	2	5 Year	3,857
		Warranty - 3 Yr NBD Support	12	3 Year	1,777
		An expansion and update of the storage systems we use for database and for simulation production temporary storage in the IceCube data warehouse. The plan is to configure these five servers using the CEPH filesystem which will allow us to do: a) provide SSD block storage for database servers and other core servers, b) provide bulk object storage for Icecube simulation production. For b) we need this expansion in order to be able to increase the throughput of simulation production. The current system used by Iceprod to store temporary files is getting close to its limit capacity as we increase the number of datasets and jobs that Iceprod handles simultaneously.			
		PowerEdge R740XD storage server with 2x Xeon 4116, 192 GB RAM, 16x 10TB HD, 4x 800GB SSD, 2x 25GbE NIC	5	ea	94,292
		Warranty - 5 Yrs NBD Support	5	5 Year	4,902
	Computing Infrastructure Total				**318,190**
UW Data Center Total					**318,190**
Grand Total					**2,214,207**