

**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 disk 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).

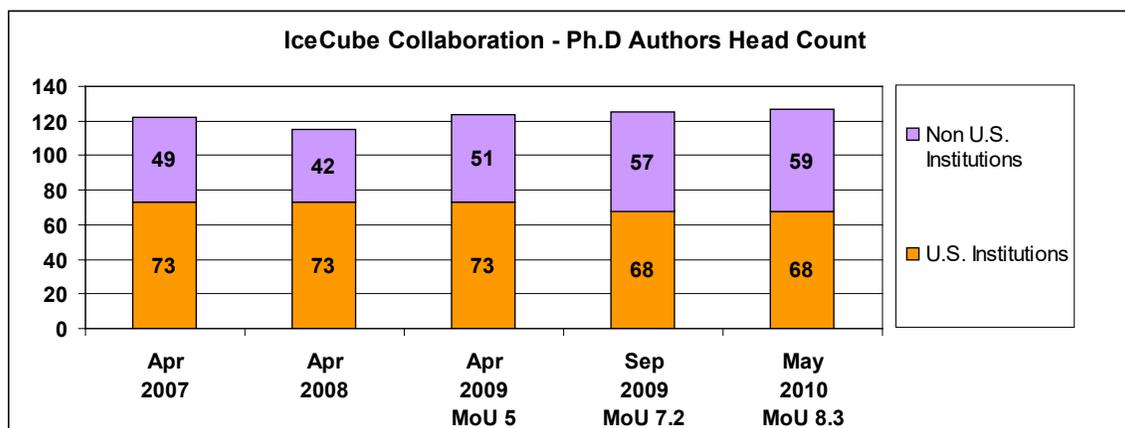


Figure 1: Ph.D. Authors Head Count Profile for the Initial Three Years of M&O

Section II: Years 4-14 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 2010-2021.

**Table 2. Planned and Actual CF Contributions (\$000)
For Years 4-14 of M&O, April 1st, 2010 – March 31st, 2021**

	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 April 2016	Year10 2016 Planned	PhD. authors April 2017	Year11 2017 Planned	PhD. authors May 2018	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	\$874
		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		\$743
Non-U.S. In-Kind		\$80		\$177		\$96
Difference (Actual - Planned)		\$27		-\$4		-\$35

	PhD. authors May 2019	Year13 2019 Planned	PhD. authors June 2020	Year14 2020 Planned	PhD. authors March 2021	Year15 2021 Planned
Total CF Planned	150	\$2,048	146	\$1,993	162	\$2,204
U.S. Contribution	78	\$1,064	75	\$1,024	88	\$1,201
Non-U.S. Contribution	72	\$983	71	\$969	74	\$1,003
		Actual		Actual		Actual
Total CF Contributions		\$1,972		\$1,870		\$1,945
U.S. Cash Transfer		\$1,064		\$1,024		\$1,201
Non-U.S. Cash Transfer		\$798		\$696		\$607
Non-U.S. In-Kind		\$109		\$150		\$137
Difference (Actual - Planned)		-\$76		-\$123		-\$259

Actual Common Fund contributions are \$123K less in 2020, and are currently \$259K less in 2021. The differences displayed above indicate balances in a given year and are not cumulative. The remaining non-U.S. PY14 and PY15 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.

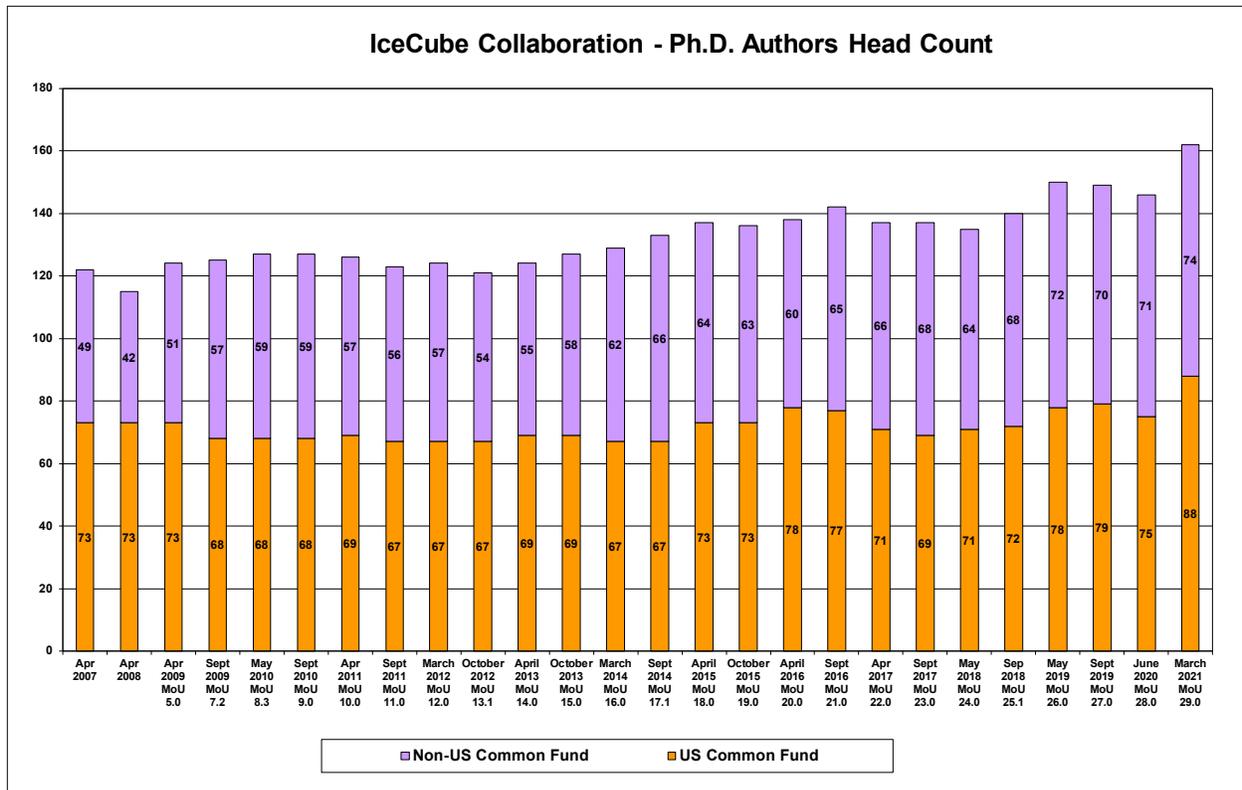


Figure 2: Ph.D. Authors Head Count Profile as of March 2021

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 v29.0 (March 2021)

	Total Ph.D. Authors	Faculty	Scientists / Post Docs	Ph.D. Students
U.S. Institutions Subtotal	88	45	43	58
Non-U.S. Institutions Subtotal	74	42	32	87
Total U.S. & Non-U.S.	162	87	75	145

Summary of changes over the last nine months:

- US Institutions: the number of Faculty remained unchanged, Scientists / Post Docs increased by 13, and the number of Students increased by 2.
- Non-US Institutions: number of Faculty decreased by 1, Scientists / Post Docs increased by 3, Students increased by 13.

Common Fund Support of IceCube Operations 2020/2021

The following list (Tables 4) includes ongoing operations and major purchases for the 2020/2021 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 – April 2020 – March 2021

Computing Infrastructure Upgrade - April 2020 through March 2021					
System	Category	Description	Qty	Unit	Total Dollars
Data Warehouse	Computing Infrastructure	Annual renewal (2020-2021) of Slack service for IceCube workspace	399	ea	5,031
	Computing Infrastructure Total				5,031
Data Warehouse Total					5,031
South Pole System	Computing Infrastructure	Winterover computing supplies - 2 buy back (-8342) 2 purchases 20-21 season - (8699)	4	ea	357
	Computing Infrastructure Total				357
	Detector Infrastructure	Multiple Purchases for Scintillator Array and Scintillator Test Array Fabrication			18,709
		Fanout boards for IceTop hybrid TAXI+microDAQ system	9	ea	2,163
		Disks to store the IceCube/ARA data at South Pole for the 2020/21 season - SEAGATE 6TB SATA 3.5" HARD DRIVE	40	ea	6,850
		Spare power supplies to ship to South Pole to replace units that have failed over the course of the season	3	ea	640
		RED HAT ENTERPRISE LINUX SERVER SELF-SUPPORT - This is a license to access support materials for several Red Hat servers we have running at Pole	1	ea	427.8
		Shipping			179
		Winter Over Interview travel - 2019-2020 Season			575
		Winter Over travel to South Pole - 2019-2020 Season			7,824
		Winter Over Interview Travel - 2020-2021 Season - all tickets refunded because of COVID			-7,263
		Winter Over PQ Costs - 2020-21 Season			413
		Winter Over Training Travel, Gear Purchases, Travel to South Pole			16,845
	Detector Infrastructure Total				47,362
	Labor	Run Coordinator			103,404
		Winterover Labor			405,451
		Winterovers coordination, SPS / SPTS networking and security			169,697
		Maintainance of data handling software (JADE)			52,352
	Labor Total				730,904
South Pole System Total					778,624
South Pole Test System	Detector Infrastructure	Two UPSes for testing and evaluation for SPS deployment (these units will stay at SPTS)	2	ea	7,170
	Detector Infrastructure Total				7,170
South Pole Test System Total					7,170
UW Data Center	Computing Infrastructure	Cloud services used during FY20120/21 to do various tests for running IceCube workload in the Cloud			7,847
		Hosting of servers at the campus OneNeck facility			12,370
		Motorized lift for computers and disk arrays in Chamberlin data centers			13,554
		Suite of software for cloud-based IT project-tracking - Atlassian - Jira Software			1398
		VEEM ESSENTIALS VUL 1 YR license- Replace our existing backup software which is no longer supported by VMWare	10	ea	4,968
	Computing Infrastructure Total				40,137
UW Data Center Total					40,137
Grand Total					830,962