

**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).

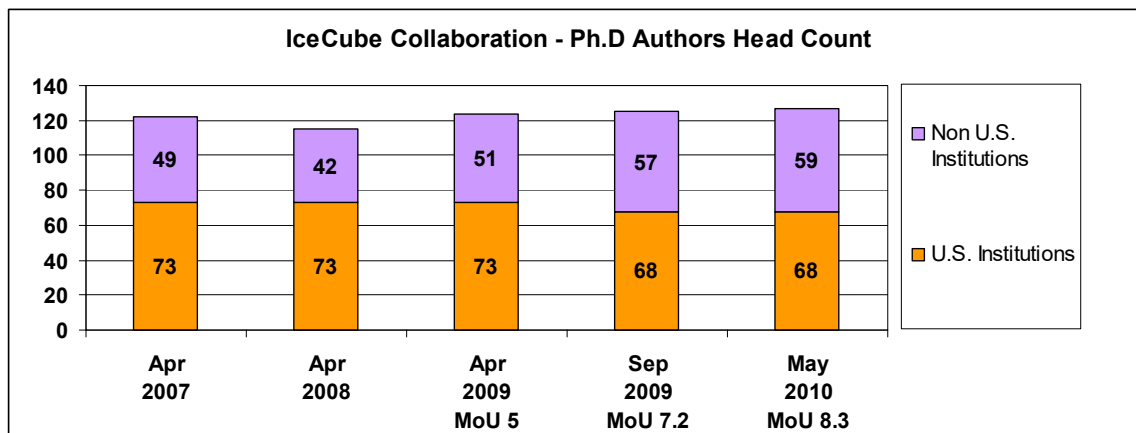


Figure 1: Ph.D. Authors Head Count Profile for the Initial Three Years of M&O

Section II: Years 4-13 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 2010-2020.

**Table 2. Planned and Actual CF Contributions (\$000)
For Years 4-13 of M&O, April 1st, 2010 – March 31st, 2020**

| | 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 |
|--------------------------------------|--------------------------------|---------------------------|---------------------------------|---------------------------|
| Total CF Planned | 151 | \$2,048 | 147 | \$1,993 |
| U.S. Contribution | 78 | \$1,064 | 75 | \$1,024 |
| Non-U.S. Contribution | 73 | \$983 | 72 | \$969 |
| | | Actual | | Actual |
| Total CF Contributions | | \$1,877 | | TBD |
| U.S. Cash Transfer | | \$1,064 | | |
| Non-U.S. Cash Transfer | | \$716 | | |
| Non-U.S. In-Kind | | \$96 | | |
| Difference (Actual - Planned) | | -\$170 | | |

Actual Common Fund contributions are \$35K less in 2018, and are currently \$170K less in 2019. The differences displayed above indicate balances in a given year and are not cumulative. The remaining non-U.S. PY13 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 151 in May 2019 to 150 in September 2019, to 147 in June 2020 due to retirement of several members.

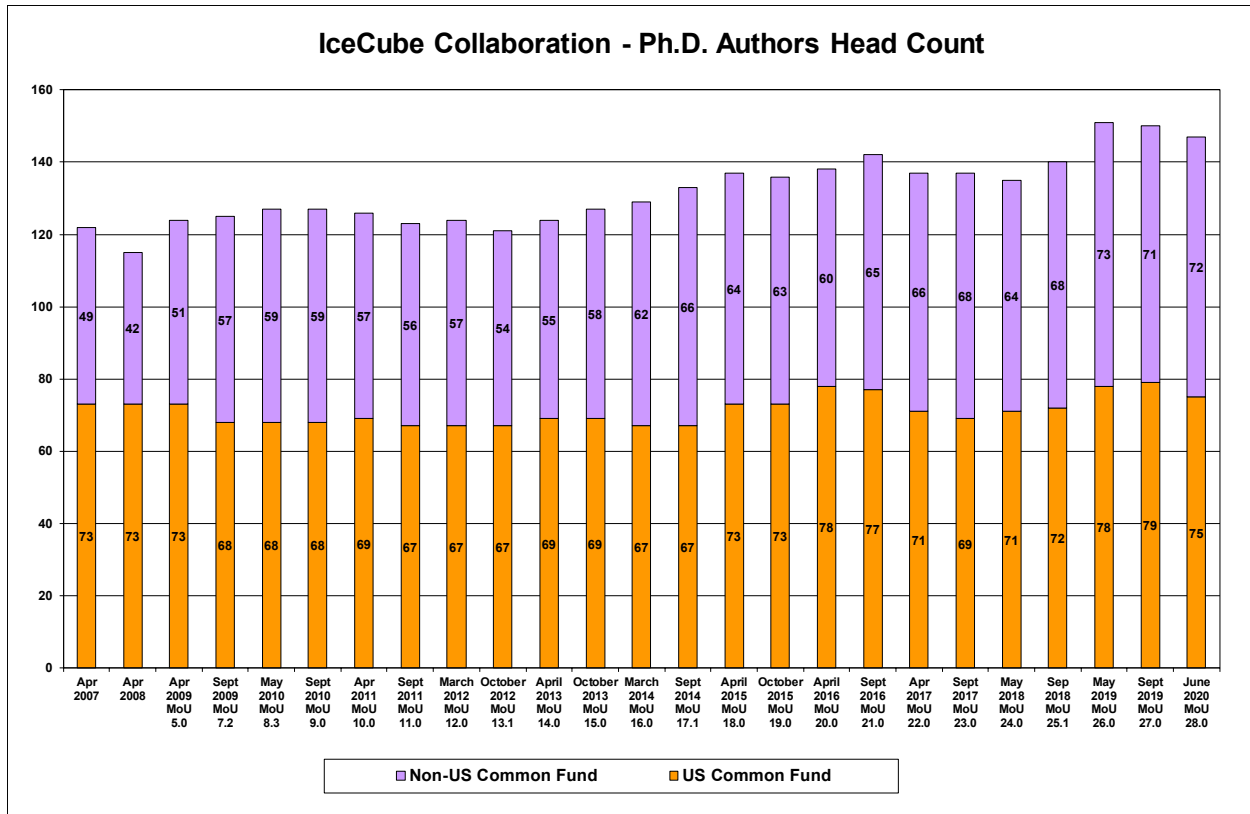


Figure 2: Ph.D. Authors Head Count Profile as of June 2020

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 v28.0 (June 2020)

| | Total Ph.D. Authors | Faculty | Scientists / Post Docs | Ph.D. Students |
|----------------------------------|---------------------|-----------|------------------------|----------------|
| U.S. Institutions Subtotal | 75 | 45 | 30 | 56 |
| Non-U.S. Institutions Subtotal | 72 | 43 | 29 | 74 |
| Total U.S. & Non-U.S. | 147 | 88 | 59 | 130 |

Summary of changes over the last six months:

- US Institutions: the number of Faculty decreased by 3, Scientists / Post Docs decreased by 1, and the number of Students increased by 6.
- Non-US Institutions: number of Faculty decreased by 1, Scientists / Post Docs remained unchanged, Students decreased by 9.

Common Fund Support of IceCube Operations 2019/2020

The following list (Tables 4) includes ongoing operations and major purchases for the 2019/2020 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 - 2019/2020

| Computing Infrastructure Upgrade - 2019/2020 | | | | | | | |
|--|---------------------------------------|--|--|------|----------------|----------------|----------------|
| System | Category | Description | Qty | Unit | Total Dollars | | |
| Data Warehouse | Computing Infrastructure | OVERLEAF SERVICE GROUP LICENSE - Cloud-based collaborative authoring service used by WIPAC project members | 1 | | 1,276 | | |
| | | Annual renewal of Slack service for IceCube workspace | 348 | | 4,158 | | |
| | | Networking equipment and USB accessories to allow for hard-wired network connections for participants at NSF meetings - TRIPPLITE ETHERNET PATCH CABLE (CAT6, 25') | 40 | | 198 | | |
| | | SAS controllers and cables for JADE archival system | 2 | | 2,099 | | |
| Computing Infrastructure Total | | | | | 7,732 | | |
| Data Warehouse Total | | | | | 7,732 | | |
| South Pole System | Computing Infrastructure | Winterover computing supplies | 2 | ea | 6,632 | | |
| | Computing Infrastructure Total | | | | 6,632 | | |
| South Pole System | Detector Infrastructure | Multiple Purchases for Scintillator Array and Scintillator Test Array Fabrication | | | 1,038 | | |
| | | DOM power supply upgrade for SPS - MSP-200-48 POWER SUPPLIES (MEAN WELL) | 140 | ea | 10,706 | | |
| | | disks to store the IceCube/ARA data at South Pole for the 2019/20 season - SEAGATE 6TB SATA 3.5" HARD DRIVE | 215 | ea | 38,485 | | |
| | | Lifetime DOMHub disk replacement for SPS - SEG90YF 18984.00 ST4000NM0245 - 20PK | 6 | PK | 19,109 | | |
| | | Replacement power supply fans for SPS - Noctua fans - NF-A4X20 FLX FANS | 220 | ea | 3,517 | | |
| | | SHIPPING FROM PSL TO PORT HUENEME | | | 10,040 | | |
| | | Rechargeable USB hand warmers for South Pole for the Winterovers | 5 | pk | 239 | | |
| | | Replacement workstations, monitors, and misc. spare parts for South Pole data center | | | 13,741 | | |
| | | Scintillator station deployment to SOUTH POLE - 2019/2020 season | | | 5,864 | | |
| | | Winter Over Interview Travel, PQ Costs - 2019-2020 Season | | | 7,123 | | |
| | | Winter Over Interview Travel - 2020-2021 Season | | | 7,798 | | |
| | | Winter Over Training Travel, Gear Purchases, Travel to South Pole | | | 52,544 | | |
| | | Detector Infrastructure Total | | | | | 170,205 |
| | | Labor | Run Coordinator | | | | 46,932 |
| | | | Winterover Labor | | | | 319,675 |
| | | | Winterovers coordination, SPS / SPTS networking and security | | | | 70,053 |
| | | | Maintenance of data handling software (JADE) | | | | 74,965 |
| Labor Total | | | | | | 511,625 | |
| South Pole System Total | | | | | 688,462 | | |
| South Pole Test System | Detector Infrastructure | Renewal of service contract for SPTS SonicWall firewalls - SONICWALL 3 YEAR CONTRACT | 1 | | 1,630 | | |
| | | Auer - Network Security certification | 1 | | 2,100 | | |
| Detector Infrastructure Total | | | | | 3,730 | | |
| South Pole Test System Total | | | | | 3,730 | | |
| UW Data Center | Computing Infrastructure | This machine will act as a testbed for developing and evaluating GPU accelerated machine learning algorithms | | | | | |
| | | COMPUTE NODE-8GPU CAPABLE SYSTEM | 1 | ea | 27332 | | |
| | | 3 YR PARTS/LABOR WARRANTY | 1 | ea | 1250 | | |
| | | Expand IceCube GPU computing - GPU SERVER 4.5U CCPU / GPU NODE W/RAILS (PCI-E 3.0) | 2 | ea | 50,776 | | |
| | | Cloud services used during FY2019/2020 to do various tests for running IceCube workload in the Cloud | | | 935 | | |
| | | Hosting of servers at the campus OneNeck facility | | | 7,326 | | |
| | | Expanding storage for IceCube | | | | | |
| | | POWEREDGE R740XD2 SERVER | 6 | ea | 175,970 | | |
| | | DELL 1.6TB NVME MIX USE EXPRESS FLASH HHHL AIC PM1725B | 6 | ea | 5,515 | | |
| | | DELL PEC STATIC RAILS | 6 | ea | 409 | | |
| DELL MEMORY UPGRADE - 8GB - 1R X8 DDR4 RDIMM | 24 | ea | 2,671 | | | | |
| 5 YR PRO SUPPORT | 6 | ea | 8,800 | | | | |
| Transceivers to use fiber-optic network cables at the new data center at OneNeck | 16 | ea | 2,600 | | | | |
| Computing Infrastructure Total | | | | | 283,584 | | |
| UW Data Center Total | | | | | 283,584 | | |
| Grand Total | | | | | 983,508 | | |