



# IceCube Maintenance & Operations

## Financial Management and Common Fund

Presenter:

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Resource Coordinator, IceCube M&O Program

Project Controls Manager, IceCube Gen-2 Phase 1

March 11, 2019

IceCube Maintenance & Operations Mid-Term Review

# Presenter's Background



- IceCube Maintenance and Operations Resource Coordinator
- Project Controls Manager, IceCube Gen-2 Phase 1
- 8+ years with IceCube Collaboration (2010-present)
- CMB PolarBear Project Control & Systems Manager (2015-2016)
- 12+ years of financial & project management experience in academia and private industry
- Master of Business Administration (MBA) degree (2008)
- Project Management Professional (PMP), license ID 1820230
- Member of Project Management Institute, PMI (2014–present)



# Outline

- **IceCube M&O Sources of Funds**
- NSF M&O Core award financial status
- NSF M&O Subawards and monitoring process
- Memorandum of Understanding and Common Fund

# IceCube M&O Sources of Funds



## NSF M&O Core

This 5-Year NSF award mostly covers Core M&O tasks, travel, M&S and service agreements for UW and eight U.S. sub-awardee institutions and contribution to the M&O Common Fund.

## NSF Base Grants

NSF IceCube analysis grants support M&O activities done by U.S. graduate students and postdocs.

## U.S. Institutional In-Kind

Institutional contribution mostly covers M&O activities done by faculty members, different fellowships and university funded activities.

## Europe & Asia Pacific In-Kind

Institutional contribution from Non U.S. collaborators including labor and travel and contribution to the M&O Common Fund.

# IceCube M&O Sources of Funds (cont'd)



Definitions of M&O Task Categories: (2009 NSF Panel Summary Review)

**1. Core M&O Tasks:** Technical tasks required for the continuing efficient operation of the detector, and its associated data acquisition, transmission, analysis and archiving systems.

Examples: South Pole overwinter personnel, computer system administration, software engineering to improve the performance of production code, running simulation production.

**2. Collaboration Service:** Additional tasks that are essential for the collaboration to achieve its scientific goals.

Examples: service on collaboration committees and subgroups, working on data reduction and filtering, shift-taking, and other tasks that benefit the collaboration as a whole.

NSF Core M&O funding is used for Category 1 tasks.

# IceCube Maintenance & Operations Program

## Money Flow Diagram

### Revenue Sources


**NSF IceCube M&O Awards**

2007-10 Initial award MSN106834/ANT-0639286  
 2010-15 5-Year renewal MSN126790/ANT-0937462  
 2016-21 5-Year renewal MSN 191507/PLR-1600823

**Non U.S. In-Kind**

**NSF IceCube Analysis Grants**

**U.S. Institutional In-Kind**

|   |                           |                                    |                         |                             |
|---|---------------------------|------------------------------------|-------------------------|-----------------------------|
| <br><b>UW Accounting System (WISDM)</b> | <b>UW Accounts</b>        | <b>U.S. Core</b>                   | <b>U.S. Common Fund</b> | <b>Non U.S. Common Fund</b> |
|   | <b>Initial M&amp;O</b>    | 144-QC21                           | 144-QS76                | 233-KJ11                    |
|   | <b>5-Year Renewal</b>     | 144-39XW                           | 144-39XX                |                             |
|   | <b>2nd 5-Year Renewal</b> | 144-AAA9616                        | 144-AAA9617             |                             |
|   |                           | <b>IceCube M&amp;O Common Fund</b> |                         |                             |

**IceCube Accounting System (Masterpiece)**

Reconciliation

**Core activities of UW & eight U.S. sub-awardees:**

- Program Management
- Detector Operations
- Computing & Data Mgmt.
- Core coordination roles
- Distributed computing

**Agreed supported activities and infrastructure upgrades:**

- WinterOver personnel
- Acquiring & filtering data
- Transmitting data north
- Archiving in data warehouse
- UW Data Center operations

**Activities mostly done by Grads & Postdocs:**

- Reconstruction software
- Simulations tools
- Filtering & Triggering
- Monitoring, Calibration
- Verification, Data quality

**Activities mostly done by Faculty and Sr. Scientists:**

- Committee chair/member
- Working Groups chairs
- Coordinators
- Overseeing group work
- Hosting meetings

### Expenditures



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- Memorandum of Understanding and Common Fund

# IceCube Maintenance & Operations Program

## NSF M&O Award: Baseline Budget by Cost Categories and Project Years



| UW-Madison<br>and U.S. Sub-Awards | YEAR1              | YEAR2              | YEAR3              | YEAR4              | YEAR5              | TOTAL               |
|-----------------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|
|                                   | Apr '16 - Mar '17  | Apr '17 - Mar '18  | Apr '18 - Mar '19  | Apr '19 - Mar '20  | Apr '20 - Mar '21  | Apr '16 - Mar '21   |
| Labor                             | \$6,214,583        | \$6,259,716        | \$6,230,959        | \$6,172,008        | \$6,163,558        | \$31,040,824        |
| Capital Equipment                 | \$80,950           | \$154,947          | \$220,579          | \$162,777          | \$243,431          | \$862,684           |
| Materials & Supplies              | \$115,090          | \$115,159          | \$108,161          | \$153,582          | \$152,691          | \$644,683           |
| Travel                            | \$361,926          | \$364,268          | \$362,206          | \$360,977          | \$360,842          | \$1,810,219         |
| Service Agreements                | \$147,951          | \$105,910          | \$78,095           | \$150,656          | \$79,479           | \$562,090           |
| Subaward Setup Fee                | \$79,500           | \$0                | \$0                | \$0                | \$0                | \$79,500            |
| <b>NSF M&amp;O Award Total</b>    | <b>\$7,000,000</b> | <b>\$7,000,000</b> | <b>\$7,000,000</b> | <b>\$7,000,000</b> | <b>\$7,000,000</b> | <b>\$35,000,000</b> |

The NSF IceCube M&O award provides funds for M&O Core activities and for the U.S. portion of the M&O Common Fund.



# IceCube NSF M&O Award Budget, Actual Cost and Forecast



| (a)  | (b)  | (c)  | (d) = a - b - c                                  | (e)  | (f) = d - e  |
|--|--|--|--|--|--|
| <b>YEARS 1-3 Budget</b><br>(Apr.'16-Mar.'19) | <b>Actual Cost To Date</b><br>through<br>Dec. 31, 2018 | <b>Open Commitments</b><br>on<br>Dec. 31, 2018 | <b>Current Balance</b><br>on<br>Dec. 31,<br>2018 | <b>YEAR3 Remaining Projected Expenses</b><br>through<br>March 2019 | <b>End of YEAR 3 Forecast Balance</b><br>March 31,<br>2019 |
| <b>\$21,360K</b>                             | <b>\$18,908K</b>                                       | <b>\$842K</b>                                  | <b>\$1,609K</b>                                  | <b>\$1,645K</b>  | <b>-\$36K</b>  |

This second five-year NSF M&O renewal award started in April 2016.

NSF award of **\$7M** per year: **\$35M total**

NSF Supplemental funding of **\$292K** to develop a multimessenger INCLUDES program and **\$68K** for SDSM&T

This negative balance will be addressed by increasing efficiency in the remaining two years of the program.



# Outline

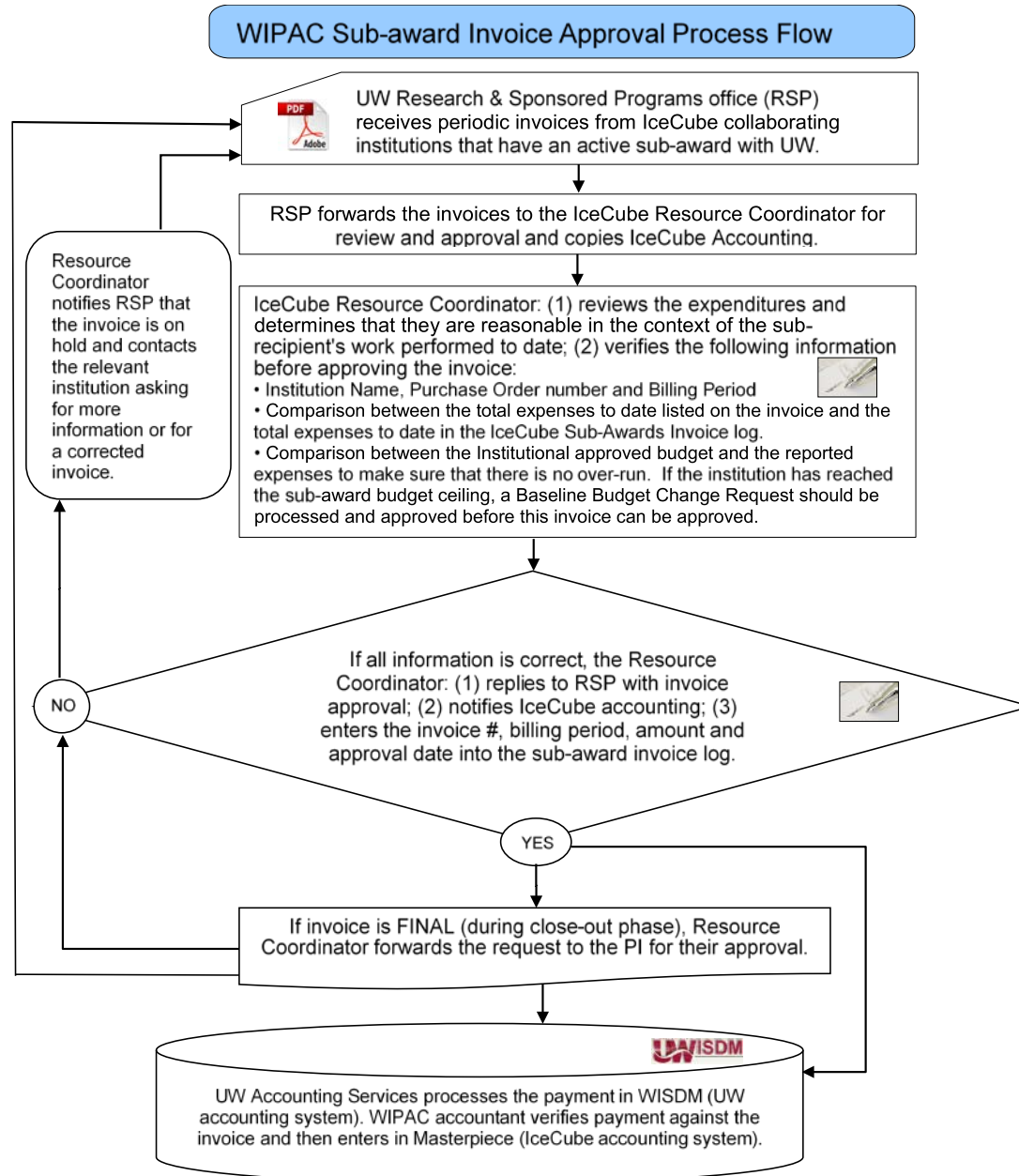
- IceCube M&O Sources of Funds
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- Memorandum of Understanding and Common Fund

# IceCube NSF M&O Sub-Awards

## Major Responsibilities and Funds

| <b>Institution</b>  | <b>Major Responsibilities</b>   | <b>Effort and coverage</b>  | <b>Total PY1-5</b> |
|---|---|---|--------------------|
| <b>Lawrence Berkeley National Laboratory</b>                            | Data Acquisition maintenance, computing infrastructure  | <i>Institutional PI 5%, Engineer 15%</i>  | <b>\$445,626</b>   |
| <b>Pennsylvania State University</b>                                    | Data acquisition firmware support, simulation production  | <i>Postdoctoral Researcher 25% Scientist 25%</i>  | <b>\$354,313</b>   |
| <b>University of Delaware, Bartol Institute</b>                         | IceTop calibration, monitoring & maintenance, OnIce field work  | <i>Scientist 70%-80%, Engineer 17%</i>  | <b>\$773,285</b>   |
| <b>University of Maryland at College Park</b>                           | Overall IceCube software coordination, IceTray software framework, simulation software, maintain and test PnF software and online filters | <i>Institutional PI 2%, Scientist 75%, Computer Science 90%, Software Engineer 75%, Admin Support 4%, Capital Equip. for sim. prod. &amp; maintenance of PnF software</i> | <b>\$3,017,448</b> |
| <b>University of Alabama at Tuscaloosa</b>                              | Detector calibration, reconstruction and analysis tools   | <i>Institutional PI 8%,</i>   | <b>\$122,990</b>   |
| <b>Michigan State University</b>  | Simulation software, simulation production  | <i>Postdoctoral Researcher 25%</i>  | <b>\$142,481</b>   |
| <b>South Dakota School of Mines and Technology</b> (added in July 2017) | Simulation production and reconstruction  | <i>Graduate Student for 12 months fulltime</i>  | <b>\$54,749</b>    |
| <b>Total</b>  |   |   | <b>\$4,910,892</b> |

# M&O Sub-Award Monitoring Process



# M&O Sub-Award Monitoring Process

## Sub-Award Invoice Log Rev 2019.0215

| Maryland                       |          |                       |                     | Penn State                     |           |                     |                     |
|--------------------------------|----------|-----------------------|---------------------|--------------------------------|-----------|---------------------|---------------------|
| Award 677K390                  | NEW M&O  | Sub Ceiling           |                     | Award 673K444                  | NEW M&O   | Sub Ceiling         |                     |
| Initial, June 22 '16           | 293,789  | \$293,789.00          | PY1 1st             | Initial, Nov 7 '16             | \$ 34,386 | \$34,386.00         | PY1 1st             |
| mod 1 Nov 4 '16                | 293,789  | \$587,578.00          | PY1 2nd             | mod 1, Dec 5 '16               | \$ 34,386 | \$68,772.00         | PY1 2nd             |
| mod 2 June 5 '17               | 595,413  | \$1,182,991.00        | PY2                 | mod 2, Sept 8 '17              | \$ 69,800 | \$138,572.00        | PY2                 |
| mod 3 May 31 '18               | 603,369  | \$1,786,360.00        | PY3                 | mod 3, July 31 '18             | \$ -      | \$138,572.00        | PY3                 |
| mod 4                          |          | \$1,786,360.00        |                     | mod 4                          |           | \$138,572.00        |                     |
| mod 5                          |          | \$1,786,360.00        |                     | mod 5                          |           | \$138,572.00        |                     |
| mod 6                          |          | \$1,786,360.00        |                     | mod 6                          |           | \$138,572.00        |                     |
| mod 7                          |          | \$1,786,360.00        |                     | mod 7                          |           | \$138,572.00        |                     |
| mod 8                          |          | \$1,786,360.00        |                     | mod 8                          |           | \$138,572.00        |                     |
| <b>Total Budget to date</b>    |          | <b>\$1,786,360.00</b> |                     | <b>Total Budget to date</b>    |           | <b>\$138,572.00</b> |                     |
| Invoice                        | Period   | Payment               | Comment             | Invoice                        | Period    | Payment             | Comment             |
| <b>Actual Payments to Date</b> |          | <b>\$1,606,862.27</b> |                     | <b>Actual Payments to Date</b> |           | <b>\$48,505.69</b>  |                     |
| <b>Budget to date</b>          |          | <b>\$1,786,360.00</b> |                     | <b>Budget to date</b>          |           | <b>\$138,572.00</b> |                     |
| <b>Balance to date</b>         |          | <b>\$179,497.73</b>   |                     | <b>Balance to date</b>         |           | <b>\$90,066.31</b>  |                     |
|                                |          |                       |                     |                                |           |                     |                     |
| 314471-1                       | Apr-2016 |                       |                     |                                | Apr-2016  |                     |                     |
|                                | May-2016 | \$113,937.55          | Approved 7/18/16    |                                | May-2016  |                     |                     |
|                                | Jun-2016 |                       |                     | 2DY80-1                        | Jun-2016  | \$12,172.84         | Approved 12/15/2016 |
| 314471-2                       | Jul-2016 | \$37,876.62           | Approved 9/28/16    |                                | Jul-2016  |                     |                     |
| 314471-3                       | Aug-2016 | \$39,766.72           | Approved 9/28/16    |                                | Aug-2016  |                     |                     |
| 314471-4                       | Sep-2016 | \$42,130.06           | Approved 10/26/16   |                                | Sep-2016  |                     |                     |
| 314471-5                       | Oct-2016 | \$44,217.70           | Approved 11/11/16   | 2DY80-2                        | Oct-2016  | \$1,573.31          | Approved 12/20/2016 |
| 314471-6                       | Nov-2016 | \$49,167.61           | Approved 12/15/16   |                                | Nov-2016  |                     |                     |
| 314471-7                       | Dec-2016 | \$76,201.39           | Approved 1/23/2017  | 2DY80-3                        | Dec-2016  | \$2,826.56          | Approved 1/23/2017  |
| 314471-8                       | Jan-2017 | \$41,542.33           | Approved 2/15/2017  | 2DY80-4                        | Jan-2017  | \$3,673.17          | Approved 2/16/2017  |
| 314471-9                       | Feb-2017 | \$42,640.88           | Approved 3/16/2017  |                                | Feb-2017  |                     |                     |
| 314471-10                      | Mar-2017 | \$88,068.13           | Approved 5/8/2017   | 2DY80-5                        | Mar-2017  | \$3,839.84          | Approved 5/8/2017   |
|                                | Apr-2017 |                       |                     | 2DY80-6                        | Apr-2017  | \$3,293.18          | Approved 10/30/2017 |
| 314471-11                      | May-2017 | \$21,221.85           | Approved 7/17/2017  |                                | May-2017  |                     |                     |
| 314471-12                      | Jun-2017 | \$4,650.00            | Approved 8/10/2017  |                                | Jun-2017  |                     |                     |
| 314471-13                      | Jul-2017 | \$44,234.50           | Approved 8/23/2017  | 2DY80-7                        | Jul-2017  | \$4,474.10          | Approved 2/26/2018  |
| 314471-14                      | Aug-2017 | \$48,484.48           | Approved 10/3/2017  |                                | Aug-2017  |                     |                     |
| 314471-15                      | Sep-2017 | \$47,463.51           | Approved 11/13/2017 |                                | Sep-2017  |                     |                     |
| 314471-16                      | Oct-2017 | \$61,953.06           | Approved 12/27/2017 | 2DY80-8                        | Oct-2017  | \$4,511.28          | Approved 2/26/2018  |
| 314471-17                      | Nov-2017 | \$73,276.79           | Approved 2/12/2018  |                                | Nov-2017  |                     |                     |
| 314471-18                      | Dec-2017 | \$59,108.96           | Approved 2/22/2018  | 2DY80-9                        | Dec-2017  | \$985.68            | Approved 2/26/2018  |
| 314471-19                      | Jan-2018 | \$47,191.32           | Approved 2/22/2018  |                                | Jan-2018  |                     |                     |
| 314471-20                      | Feb-2018 | \$74,522.35           | Approved 3/28/2018  |                                | Feb-2018  |                     |                     |
| 314471-21                      | Mar-2018 | \$64,486.06           | Approved 6/7/2018   | 2DY80-10                       | Mar-2018  | \$1,637.97          | Approved 4/27/2018  |
|                                | Apr-2018 |                       |                     | 2DY80-11                       | Apr-2018  | \$6,054.30          | Approved 9/5/2018   |
| 314471-22                      | May-2018 | \$123,486.01          | Approved 6/20/2018  |                                | May-2018  |                     |                     |
| 314471-23                      | Jun-2018 | \$67,714.06           | Approved 7/19/2018  | 2DY80-12                       | Jun-2018  | \$2,080.34          | Approved 9/5/2018   |
| 314471-24                      | Jul-2018 | \$34,997.23           | Approved 9/5/2018   |                                | Jul-2018  |                     |                     |
| 314471-25                      | Aug-2018 | \$45,680.47           | Approved 9/20/2018  | 2DY80-13                       | Aug-2018  | \$128.06            | Approved 9/20/2018  |
| 314471-26                      | Sep-2018 | \$48,459.53           | Approved 12/10/2018 | 2DY80-14                       | Sep-2018  | \$594.22            | Approved 11/13/2018 |
| 314471-27                      | Oct-2018 | \$51,697.07           | Approved 12/10/2018 |                                | Oct-2018  |                     |                     |
| 314471-28                      | Nov-2018 | \$62,684.29           | Approved 2/6/2019   | 2DY80-15                       | Nov-2018  | \$660.84            | Approved 1/29/2019  |
| 314471-29                      | Dec-2018 | 50,001.74             | Approved 2/6/2019   |                                | Dec-2018  |                     |                     |
|                                | Jan-2019 |                       |                     |                                | Jan-2019  |                     |                     |
|                                | Feb-2019 |                       |                     |                                | Feb-2019  |                     |                     |
|                                | Mar-2019 |                       |                     |                                | Mar-2019  |                     |                     |



# Outline

- IceCube M&O Sources of Funds
- NSF M&O Core award financial status
- NSF M&O Subawards and monitoring process
- **Memorandum of Understanding and Common Fund**

# Memorandum of Understanding (MoU) and Common Fund (CF) Contribution



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 as indicated in the Institutional MoU.
- The Collaboration updates the Scope of Work and M&O Responsibilities in the MoUs twice a year at the collaboration meetings.
- As of April 1<sup>st</sup> 2010, the annual established rate per Ph.D. author is \$13,650.

| IceCube M&O Common Fund |                      |
|-------------------------|----------------------|
| U.S. Common Fund        | Non U.S. Common Fund |

# Memorandum of Understanding (MoU) and Common Fund (CF) Contribution



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:

- Winter Over 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.

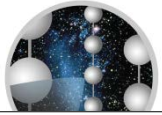
IceCube M&O MoU's are posted on:

Docushare: <https://docushare.icecube.wisc.edu/dsweb/View/Collection-6627>

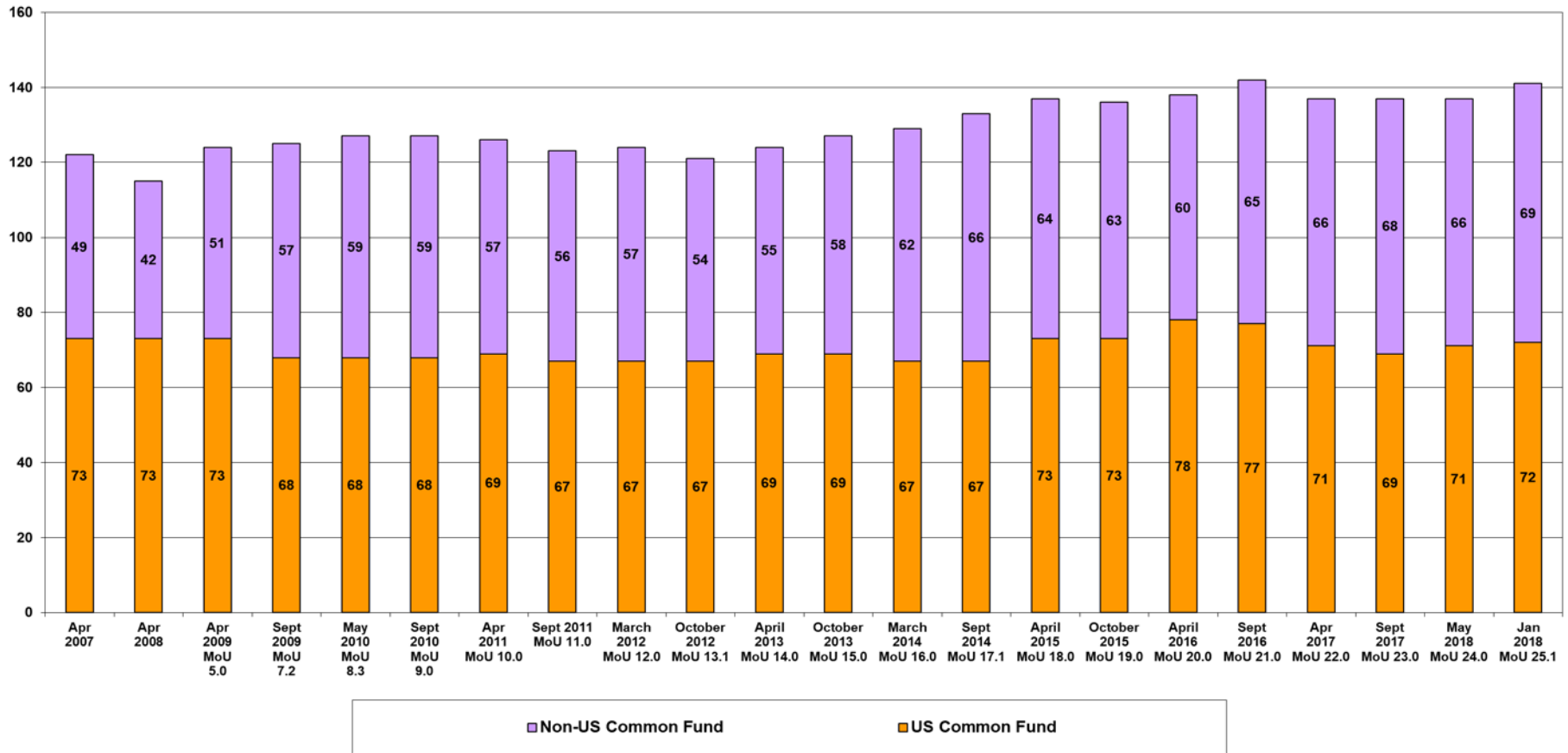
ICC Wiki: [http://wiki.icecube.wisc.edu/index.php/Official\\_posted\\_Scope\\_Of\\_Work\\_documents](http://wiki.icecube.wisc.edu/index.php/Official_posted_Scope_Of_Work_documents)



# Memorandum of Understanding



IceCube Collaboration - Ph.D. Authors Head Count



The total number of Ph.D. authors has increased from 122 in April 2007 to 141 in January 2019. Several institutions are in transition of hiring new Post Doctorial fellows.

# M&O Responsibilities

## Head Count / FTE



| MoU v.25.1<br>January 2019 | U.S.<br>Head Count | U.S.<br>FTE | Non-U.S.<br>Head Count | Non-U.S.<br>FTE |
|----------------------------|--------------------|-------------|------------------------|-----------------|
| Key Personnel              | 34                 | 9.95        | 33                     | 9.10            |
| Scientists                 | 29                 | 8.38        | 17                     | 1.75            |
| Post Docs                  |                    | 5.55        |                        | 4.05            |
| Grad Students *            | 40                 | 11.18       | 62                     | 19.86           |
| Other Professionals **     | 28                 | 24.65       | 1                      | 1.00            |

- Grad Students' Full Time Employment equals to 0.50 FTE
- Other professionals include engineers, data science, software engineers, winterovers, program mngt

# Common Fund Contribution

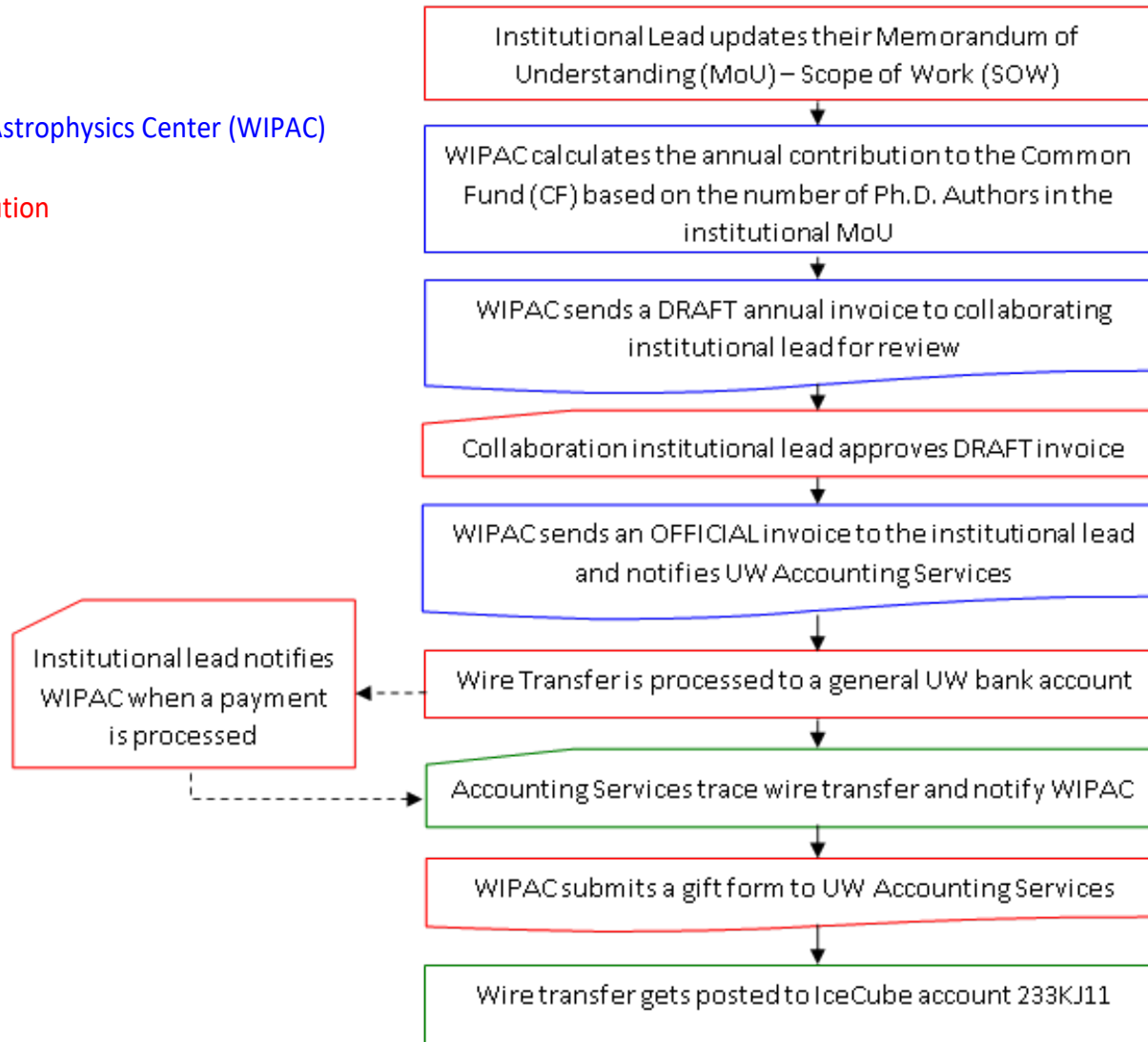
## Wire Transfer from Non U.S. Institutions



Wisconsin IceCube Particle Astrophysics Center (WIPAC)

IceCube Collaborative Institution

UW Accounting Services



# M&O Common Fund Contributions in 2014-2017 Planned and Actual (\$000)



|                                    | 2014         |                | 2015         |                | 2016         |                | 2017         |                |
|------------------------------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
|                                    | PhD. authors | Planned        | PhD. authors | Planned        | PhD. authors | Planned        | PhD. authors | Planned        |
| <b>Total CF Planned</b>            | <b>129</b>   | <b>\$1,777</b> | <b>137</b>   | <b>\$1,870</b> | <b>138</b>   | <b>\$1,904</b> | <b>137</b>   | <b>\$1,843</b> |
| U.S. Contribution                  | 67           | \$915          | 73           | \$996          | 78           | \$1,065        | 71           | \$969          |
| Non-U.S. Contribution              | 62           | \$862          | 64           | \$873          | 60           | \$839          | 66           | \$874          |
|                                    |              | <b>Actual</b>  |              |                |              |                |              |                |
| <b>Total CF Contributions</b>      |              | <b>\$1,767</b> |              | <b>\$1,848</b> |              | <b>\$1,931</b> |              | <b>\$1,839</b> |
| U.S. Cash Transfer                 |              | \$915          |              | \$996          |              | \$1,065        |              | \$969          |
| Non-U.S. Cash Transfer             |              | \$713          |              | \$715          |              | \$786          |              | \$692          |
| Non-U.S. In-Kind                   |              | \$139          |              | \$137          |              | \$80           |              | \$177          |
| <b>Difference (Actual-Planned)</b> |              | <b>-\$10</b>   |              | <b>-\$22</b>   |              | <b>+\$27</b>   |              | <b>-\$4</b>    |

Actual Common Fund contributions were 10k lower than planned in 2014 and 22k in 2015, \$27k higher than planned in 2016, and \$4k lower than planned in 2017. It is anticipated that most of the planned contributions for 2017 will be fulfilled.

# IceCube M&O Computing Infrastructure Upgrade - 2017/2018, funded by Common Fund



| System Upgrade         | Computing Infrastructure | Detector Infrastructure | Labor            | Total            |
|------------------------|--------------------------|-------------------------|------------------|------------------|
| South Pole System      |                          | \$148,501               | \$385,638        | <b>534,139</b>   |
| South Pole Test System |                          | \$6,760                 |                  | <b>6,760</b>     |
| Data Warehouse         | \$679,917                |                         |                  | <b>679,917</b>   |
| UW Data Center         | \$159,870                |                         |                  | <b>159,870</b>   |
| <b>Total</b>           | <b>\$839,787</b>         | <b>\$155,261</b>        | <b>\$385,638</b> | <b>1,380,686</b> |

This summary 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.

Detailed expenditures information by cost category, vendor, quantity and line item description can be found in the annual Common Fund Status reports on Docushare:

<https://docushare.icecube.wisc.edu/dsweb/View/Collection-8986>

# IceCube Maintenance & Operations: Opportunities & Challenges



- Tracking in-kind labor pledges from multiple institutions
  - Complex program funding profile
  - Communication management: different needs of various stakeholders worldwide
  - Meet hard deadlines in environment of academic bureaucracy
  - Cultural differences (holidays, languages)
  - High visibility program => financial audits (federal, state, etc.)
- 
- Despite many challenges associated with running the business aspect of the program, it has been running smoothly
  - Part of a large collaboration => more diversity and resources (human, computing, financial) => better scientific results

# Summary



- The Collaboration updates the Scope of Work and M&O Responsibilities in the MoU's twice a year.
- The total number of Ph.D. authors has increased from 122 in April 2007 to 141 in January 2019. Several institutions are in transition of hiring new Post Doctorial fellows.
- Actual Common Fund contributions are on track and were either exactly as planned or negative balances in some of the years were offset by positive balances in other years.
- The 5-year NSF M&O award started in April 2016 and renewed the previous 5-year program.
- Current negative balance will be addressed by increasing efficiency in the remaining two years of the program.



Thank You



# IceCube Maintenance & Operations Program

## NSF M&O Award: Baseline Budget by WBS and Project Years



| WBS                                       | YEAR1 \$        | YEAR2 \$        | YEAR3 \$        | YEAR4 \$        | YEAR5 \$        | TOTAL            | %           |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|-------------|
| 2.1.1 Management & Administration         | \$825k          | \$758k          | \$769k          | \$781k          | \$793k          | \$3,927k         | 11.2%       |
| 2.1.2 Engineering Support                 | \$255k          | \$259k          | \$205k          | \$196k          | \$187k          | \$1,102k         | 3.1%        |
| 2.1.3 Usap Support                        | \$65k           | \$53k           | \$54k           | \$54k           | \$55k           | \$282k           | 0.8%        |
| 2.1.4 Education & Outreach                | \$262k          | \$266k          | \$270k          | \$251k          | \$255k          | \$1,303k         | 3.7%        |
| 2.2 Detector Operations & Maintenance     | \$2,608k        | \$2,591k        | \$2,666k        | \$2,611k        | \$2,569k        | \$13,046k        | 37.3%       |
| 2.3 Computing And Data Management         | \$2,615k        | \$2,699k        | \$2,657k        | \$2,721k        | \$2,751k        | \$13,444k        | 38.4%       |
| 2.4 Triggering And Filtering              | \$81k           | \$82k           | \$84k           | \$85k           | \$86k           | \$418k           | 1.2%        |
| 2.5 Data Quality, Reco. & Sim. Tools      | \$287k          | \$291k          | \$296k          | \$300k          | \$305k          | \$1,479k         | 4.2%        |
| <b>NSF IceCube M&amp;O Proposal Total</b> | <b>\$7,000k</b> | <b>\$7,000k</b> | <b>\$7,000k</b> | <b>\$7,000k</b> | <b>\$7,000k</b> | <b>\$35,000k</b> | <b>100%</b> |

The two major WBS areas supported by NSF M&O program are WBS 2.2 Detector Operations and Maintenance (37.3%), and WBS 2.3 Computing and Data Management (38.4%).

# M&O Common Fund Contributions in 2010-2013 Planned and Actual (\$000)



|                                    | 2010         |                | 2011         |                | 2012         |                | 2013         |                |
|------------------------------------|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
|                                    | PhD. authors | Planned        | PhD. authors | Planned        | PhD. authors | Planned        | PhD. authors | Planned        |
| <b>Total CF Planned</b>            | <b>127</b>   | <b>\$1,734</b> | <b>126</b>   | <b>\$1,720</b> | <b>124</b>   | <b>\$1,693</b> | <b>124</b>   | <b>\$1,693</b> |
| U.S. Contribution                  | 68           | \$928          | 69           | \$942          | 67           | \$915          | 69           | \$942          |
| Non-U.S. Contribution              | 59           | \$805          | 57           | \$778          | 57           | \$778          | 55           | \$751          |
|                                    |              | <b>Actual</b>  |              | <b>Actual</b>  |              | <b>Actual</b>  |              | <b>Actual</b>  |
| <b>Total CF Contributions</b>      |              | <b>\$1,726</b> |              | <b>\$1,720</b> |              | <b>\$1,709</b> |              | <b>\$1,671</b> |
| U.S. Cash Transfer                 |              | \$928          |              | \$942          |              | \$915          |              | \$942          |
| Non-U.S. Cash Transfer             |              | \$744          |              | \$730          |              | \$719          |              | \$671          |
| Non-U.S. In-Kind                   |              | \$54           |              | \$47           |              | \$75           |              | \$58           |
| <b>Difference (Actual-Planned)</b> |              | <b>\$0</b>     |              | <b>\$0</b>     |              | <b>+\$16</b>   |              | <b>-\$21</b>   |

Actual Common Fund contributions were exactly as planned in 2010 and 2011, \$16k higher than planned in 2012, and \$21k lower than planned in 2013.