# IceCube Maintenance & Operations
# Fiscal Year 2012 Mid-Year Report

## October 1, 2011 - March 31, 2012

**Submittal Date: April 10, 2012**

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University of Wisconsin–Madison

This report is submitted in accordance with the reporting requirements set forth in the IceCube Maintenance and Operations Cooperative Agreement, ANT-0937462.

# Foreword

This FY2012 Mid-Year Report is submitted as required by the NSF Cooperative Agreement ANT-0937462. This report covers the six month period beginning October 1, 2011 and concluding March 31, 2012. The status information provided in the report covers actual common fund contributions received through March 31, 2012 and the full 86-string IceCube detector (IC86) performance through March 15, 2012.

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# Section I – Maintenance and Operations Status and Performance

***Program Management***

***Management & Administration*** – The primary management and administration effort is to ensure that tasks are properly defined and assigned and that the resources needed to perform each task are available when needed. Efforts include monitoring resources use and adjusting plans as needed to achieve IceCube's scientific objectives.

- Operations Management and Science Support: The detailed M&O institutional responsibilities and Ph.D. authors head count were revised as part of the institutional Memorandum of Understanding (MoU) Scope Of Work (SOW) planning. The MoU-SOW documents were revised in March 2012 for the Spring collaboration meeting in Berkeley, CA. Updates and changes to the personnel plan are made in consultation with the Operations Director and Associate Director for Science & Instrumentation, Collaboration Spokesperson, and the Leads at the Collaborating Institutions to ensure coverage on all critical M&O tasks.
- Computing Infrastructure Management: IceCube continues to manage computing resources to maximize uptime of all computing services and ensure the availability of required distributed services, including storage, processing, database, grid, networking, interactive user access, user support, and quota management.
- Financial Management: The IceCube Research Center (IRC) at the University of Wisconsin–Madison created three separate accounts for collecting IceCube M&O funding and collecting and reporting related costs: 1) NSF M&O Core Account; 2) U.S. Common Fund Account; and 3) Non-U.S. Common Fund Account. NSF released a total of $6,900,000 to UW–Madison to support M&O expenses during FY2012, including a total contribution of $941,850 to the U.S. Common Fund. A total amount of $1,736,000 was committed during the first half of the fiscal year to the six U.S. sub-awardee institutions. Sub-awards were issued through the established University of Wisconsin–Madison requisition process (details in Section III).

***Engineering, Science & Technical Support*** – Ongoing support for the IceCube detector continues with the maintenance and operation of the South Pole Systems, the South Pole Test System and the Cable Test System. The latter two systems are located at the University of Wisconsin–Madison and enable the development of new detector functionality as well as investigations into various operational issues such as communication disruptions and electromagnetic interference. Technical support provides for coordination, communication, and assessment of impacts of activities carried out by external groups engaged in experiments or potential experiments at the South Pole. The IceCube detector performance continues to improve as we restore individual DOMs to the array at a faster rate than problem DOMs are removed during normal operations.

***Software Coordination*** **–** A review panel for permanent code was assembled for the IceTray-based software projects and to address the long-term operational implications of recommendations from the Internal Detector Subsystem Reviews of the online software systems. The permanent code reviewers are working to unify the coding standards and apply these standards in a thorough and timely manner. The internal reviews of the online systems mark an important transition from a development mode into steady-state maintenance and operations. The reviews highlight the many areas of success as well as identify areas in need of additional coordination and improvement.

Work continues on the core analysis and simulation software to rewrite certain legacy projects and improve documentation and unit test coverage. The event handling in IceTray is being modified to solve two related problems: 1) the increasing complexity of the triggered events due to the size of the detector and the sophistication of the online triggers, and 2) the increasing event size due to different optimizations of the hit selections used in different analyses.

***Education & Outreach*** – IceCube researchers and staff continue to engage learners of all ages in small classroom setting and large venues. Major outreach accomplishments during the period include South Pole centennial events, IceCube involvement in "Science in the Theater" at the Berkeley Repertory Theater, international outreach activities, and participation at the National Science Teachers Association (NSTA) annual conference, E&O talks at the April APS meeting. Many of these activities were presented at a well-attended E&O session at the Spring 2012 IceCube collaboration meeting.

To celebrate the 100th anniversary of South Pole exploration, the IceCube Research Center hosted an evening of exploration and learning at the Wisconsin Institutes for Discovery on the campus of the University of Wisconsin–Madison on December 13, 2011. The theme of the event was "100 Years of Discovery: From the South Pole to the Edge of the Universe" and it showcased the history of Antarctic exploration and science. Presenters included individuals from UW-Madison's Geology Museum, the Space Science and Engineering Center, IceCube, and the Department of Norwegian Studies, as well as a local dog-sled expert. The event attracted roughly 200 visitors. Event participants learned about Antarctica's volcanic rocks, animals, meteorology, and melting ice sheets through interactive displays, static/graphic displays, and conversations with those doing the research.

The centennial was also celebrated at the South Pole, where IceCube staff interacted with the Norwegian Prime Minister and engaged tourists in the Visitor Center. Nearly 100 tourists were at the South Pole during the event. Norwegian Prime Minister Jens Stoltenberg conducted a formal observance at the ceremonial South Pole marker, an event that was preceded by a Visitor Center "open house." During that gathering, IceCube staff members were on hand to talk about neutrinos, answer questions about the detector, and discuss their research with the international group of visitors. In addition, IceCube winterover Sven Lindstrom was later asked to give a presentation at the tourist camp specifically on the IceCube Neutrino Observatory.

In February 2012, collaborator Spencer Klein presented at a "Science in the Theater" event in Berkeley, California. The theme was "Extreme Science," and speakers included researchers from different disciplines that study in extreme environments. The IceCube presentation included a phone call with the IceCube winterovers and a question-and-answer session. The crowd of nearly 500 people was mostly made up of the general public, with a large number of high school students attending.

In Belgium, University of Gent researchers participated in a local "Children's University," an event that included approximately 300 children aged 9 to 12. They gave a talk about Antarctica and the IceCube Neutrino Observatory, and conducted an ice drilling workshop where students drilled through a 50 cm ice block.

At the Vrije Universiteit Brussel in Brussels, Belgium, IceCube collaborators provided a workshop at the university-organized "Autumn Camp in Sciences" held in November. Researchers also set up cosmic ray detectors in a few local schools and gave talks at local astronomical societies, the Royal Academy, and other locations.

IceCube had a significant presence at the NSTA meeting, helping staff a booth hosted by the NSF Office of Polar Programs and conducting a workshop. In addition to IceCube collaborators, several Knowles Science Teaching Foundation fellows who worked for IceCube at the South Pole and other teachers who have worked with the IceCube project were there to share their experiences and help teachers connect to the project.

Other education and outreach activities included:

- Science Saturday at the Wisconsin Institutes for Discovery. The theme was Antarctica, and the event included representatives from Antarctic weather stations and biological research. The morning event was aimed at families and included a bilingual component, with presentations on IceCube and meteorology in English and Spanish.
- The Lawrence Berkeley National Laboratory annual open house. With a combination of hardware, models, and an electronic display, the IceCube team engaged over 400 visitors.
- IceCube After Dark, an outreach presentation and question-and-answer session held at a popular nightclub in Madison, Wisconsin.
- Trial of a new workshop activity called "Seeing the Universe Through Different Eyes" at the University of Wisconsin–Madison Physics Fair.
- Began development of a new cosmic ray LED activity.
- Regular small-scale presentations at schools, rotary clubs, civic groups, alumni associations, and amateur planetarium societies.

### *Detector Operations and Maintenance*

***Detector Performance –*** During the period 1 October 2011 through 15 March 2012 the full 86 string detector configuration (IC86) operated in standard physics mode 92.1% of the time. Figure 1 below shows the cumulative detector time usage over the reporting period ending 15 March 2012. The time expended on maintenance, commissioning and verification tasks totals no more than 3.2%. A large set of general-purpose verification data was obtained using DOM flasher LEDs collected over 45 hours of run time. Normal hardware failures resulted in running with 84 or 85 strings 4.2% of the time. The unexpected downtime due to failures was 0.5%.

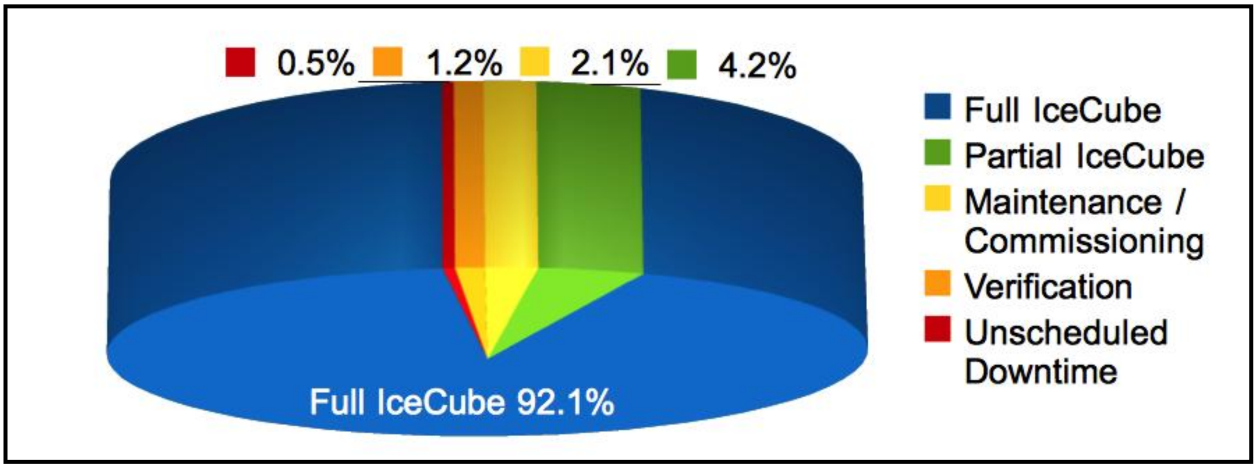


**Figure 1: Cumulative IceCube Detector Time Usage, 1 October 2011 – 15 March 2012**

An average detector uptime of 98.9% was achieved. This is significantly higher than in previous winter seasons, as shown in Figure 2. The completion of IceCube construction during the previous austral summer and improved hardware and software stability are credited for improving uptime. Of the average uptime, 87.7% was clean uptime standard analysis.

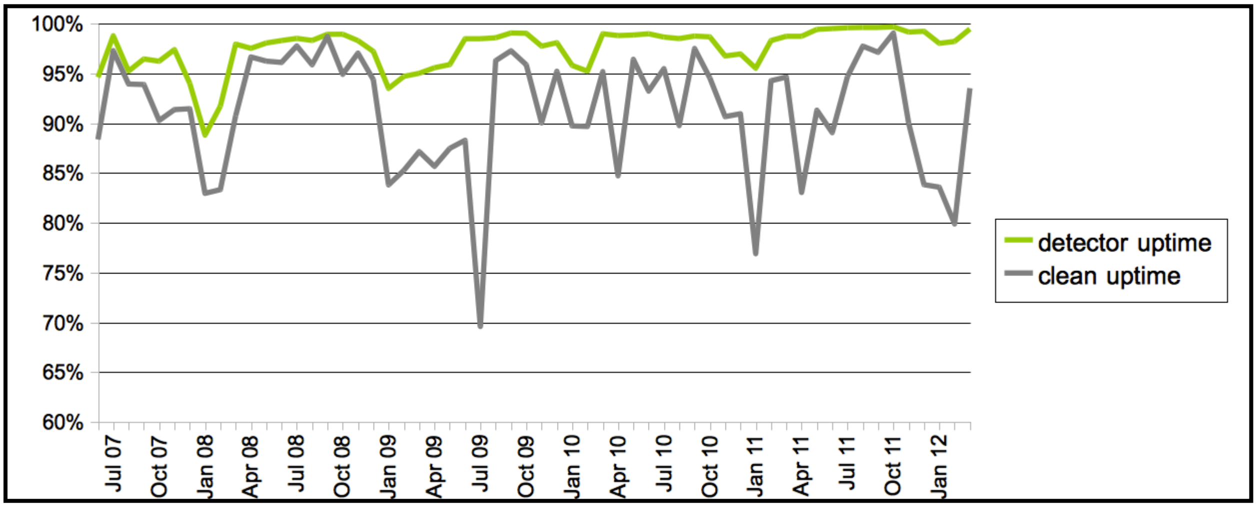


**Figure 2: Total IceCube Detector Uptime and Clean Uptime**

The preliminary good run list for IC86, including May 2011 through February 2012, found 96.9% of the data suitable for physics analysis. The remaining 3.1% primarily consisted of calibration runs using non-standard triggers and in-situ light sources such as the LED flashers whose data are not suitable for normal analysis. However, a portion of the detector is operated with full physics triggers during calibration runs and these data would be analyzed in the event of an extraordinary astrophysical transient event. An internal document that describes the good run list procedures has been posted at the following location:
http://internal.icecube.wisc.edu/reports/data/icecube/2011/09/002/icecube_201109002_v1.pdf.

IceCube Live Experiment Control is running release v1.7. Most features and bug fixes have focused on updates to improve the Run Monitoring and Verification functionality. The Supernova *Light Curve* display is a significant new feature in which the time profile of a detected signal can be viewed in near real time on the IceCube Live web pages.

IceCube Live v2.0 is due by the third quarter of 2012. It will increase by approximately 200 times the messaging system's data flow. This will allow the eventual consolidation and simplification of run monitoring within the SPS subsystems, with IceCube Live playing the predominant role for both data collection and the display of diagnostic and status information to detector operators and collaborators.

The IceCube Data Acquisition system (DAQ) added new features and fixed issues in both the Kirala and La Costeña releases. Experimental support for buffering up to several hours of the complete pre-trigger data stream was added in the current Kirala release. This feature was requested by the Supernova working group in order to extract a full record of all activity in the detector during future galactic core collapse events. Kirala has also been upgraded to quickly cycle between physics runs to lessen the stop-start interval downtime between eight hour runs, what now amounts to a major component of the 0.1% detector downtime.

The La Costeña release will be deployed for the start of the 2012 IC86 physics run. A new FixedRate trigger was added to the trigger subsystem to capture large (10s of ms) windows of unbiased detector activity for detailed offline study of background. The SlowParticle trigger algorithm was updated to increase efficiency for very non-relativistic particles. La Costeña will also enable continuous running of the detector and fully eliminate the downtime between runs during the third quarter of 2012.

The online filtering system performs real-time reconstruction and selection of events collected by the DAQ. System development concentrated on preparing for planned DAQ triggers that will read out extended periods of data as a single event. These long events will each be composed of several DAQ events of interest to physics analyses. The updated software will allow these events to be considered both as a long event and as many single events during filtering. Future development work will be aimed at revisions in support of the run monitoring system with the direct reporting of quantities from the online filtering system to IceCube Live. Version V12-03-00 will be used for the 24 hour IC86 physics test run in April. It includes a new set of filters from the physics working groups, and improved, compressed data formats allowing for the transfer of a wider variety of physics data to the north.

Supernova DAQ found 97.3% of the available data from 1 August 2011 through 10 March 2012 met the minimum analysis criteria for run duration and data quality. Of the 142 hours of trigger downtime, 39% was from physics runs under 10 minutes in duration. Supernova candidates in these short runs can be recovered offline should the need arise. In general, uptime had suffered from development and testing activities during the austral summer. Uptime outside of the austral summer was above 98%.

A supernova escalation scheme, providing a detailed flow chart of actions in case of internal and/or external supernova triggers, was discussed and is being implemented. It provides clear responsibilities, defines procedures and technical means for immediate data quality checks, and lays out the path for quick announcement and publication. The transmission of a neutrino light curve via Iridium (Figure 3), sending SMS messages for supernova alarms, and improvements to data quality monitoring have been implemented.

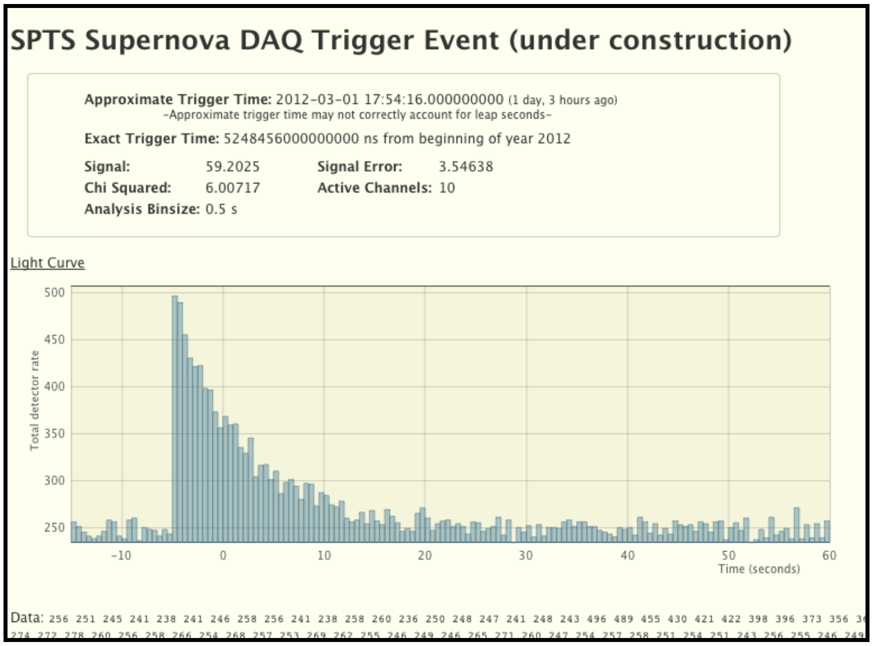


**Figure 3: Display of a Light Curve in IceCube Live from a Simulated Supernova Event**

A full redesign of supernova DAQ was installed on 18 January 2012 mainly to improve the software maintainability and the data quality monitoring. The redesign follows a strictly object-oriented development paradigm combined with several defensive programming techniques, e.g., const-correctness. The trigger downtime due to short runs under 10 minutes was reduced by more than 60% and the overall data quality has been improved. The system monitors the total detector rate in 2 ms intervals and analyzes the data in 4 time bins optimized for the detection of the core collapse supernovae. No information on the neutrino energy can be retrieved with this system and the reach for supernova detection is limited; therefore, the DAQ is being extended to collect the time stamps of all DOM hits for a period around the time of highly significant triggers and to transmit these data via satellite. By applying coincident criteria between adjacent DOMs, a measure of the neutrino energy can be extracted and the noise level can be reduced.

A weekly calibration call keeps members abreast of issues in both in-ice and offline DOM calibration. A major change has been made in the handling of average pedestal baselines in IceCube. Since February 2012, baselines are programmed from the DOM configuration files in the DAQ rather than being calculated in the DOM's firmware, domapp. The pedestal pattern (individual binwise deviation of pedestal from the baseline) is still calculated and subtracted in the DOM. The use of programmed baselines eliminates temperature-dependent baseline drifts in IceTop and run-to-run baseline fluctuations due to integer arithmetic in domapp. Upcoming plans include refinement of the pedestal pattern calculation in domapp to eliminate occasional light contamination of the pedestal pattern. Studies of DOM efficiency using both in-ice muon data and data from the laboratory are ongoing in order to reduce the systematic uncertainty of DOM efficiency. A 24 hour set of flasher data was collected in January 2012 to calibrate the detector at various locations and brightnesses. These data used the full detector readout and standard run configuration to maximize the usefulness of the data for both calibration and physics analyses. An effort is underway to refine the gain calibration using muon data which is collected continuously throughout the year.

Calibration of IceTop tanks with the ambient muon flux has now been automated so that special VEMcal calibration runs have not been necessary since mid-2009. The VEMcal project is also used for monitoring the charge extraction quality of IceTop DOMs in addition to its primary function for tank calibration. Some anomalies appeared in the VEMcal plots starting in austral spring of 2011. The problem was traced to a new method of establishing baselines that had been in use since June 2011. Baselines began drifting with the seasonal increase in temperature in November. The implementation of the new method has been corrected by making more frequent baseline measurements. The IceTop working group will implement a run-based monitoring of IceTop DOM charges.

A procedure for tracking IceTop snow depths between physical measurements was established last year and is working well. Discussions with the South Pole station contractor to modify the snow management plans began at Pole in December 2011. A modified plan was proposed by the contractor and is currently under discussion.

The two remote-controlled camera systems deployed at the bottom of the final string at 2450 meters were turned on for 15-20 minutes each month throughout 2011. The observed hole structure of mainly clear ice with a white bubbly-looking ice column in the middle remains unchanged. There were no observed changes to the ice structure throughout the past year. The camera systems will be turned on once every six months through 2012 to observe any long-term changes.

***IC86 Physics Run* –** The second season of the 86 string physics run is scheduled to begin on 18 April 2012. The Triggering, Filtering and Transmission (TFT) has finalized the physics filter content. Online improvements include the revised SlowParticle and new FixedRate triggers, the new SuperDST data compression format, and a simplified implementation for filters running on the SPS.

***TFT Board* –** The TFT board is in charge of adjudicating SPS resources according to scientific need. Working groups within IceCube submitted approximately 20 proposals requesting data processing, satellite bandwidth, and the use of various IceCube triggers for the next physics run. More sophisticated online filtering data selection techniques are used on the SPS to preserve bandwidth for other science objectives. New data compression algorithms (SuperDST) have allowed IceCube to send a larger fraction of the triggered events over TDRSS than in previous seasons. The additional data will enhance the science of IceCube in the study of cosmic ray anisotropy and the search for neutrino sources towards the galactic center.

### *Computing and Data Management*

***Computing Infrastructure –*** The data movement servers and supporting storage systems were upgraded during the 2011/2012 austral summer. The lifecycle replacement of the ERM battery packs in all racks was completed. Many smaller subsystems were reorganized and consolidated to improve reliability and conserve rack space. All server and data taking systems are performing well and provide adequate capacity for science runs.

An extended power outage on 3 February 2012 resulted in five hours of detector downtime as a consequence of fire panel testing in the IceCube Laboratory (ICL). The testing required a planned power outage of 10 minutes at power panel 21C; however, the circuit breakers in distribution panel 21B were tripped and power was not restored to the individual racks at the conclusion of the 10 minute test. This resulted in the UPS batteries running to depletion and power loss to all ICL server systems. Power was restored to the racks within two hours of the beginning of the tests; however, it took approximately three hours to complete a consistency check on the storage arrays used by the data taking systems before the server systems could fully recover.

Several changes were made as a result of the post-mortem analysis of this event. UPS settings were altered to begin an orderly shutdown of server systems within 10 minutes of power loss in order to avoid the need for consistency checks on the storage arrays. Procedures were updated to ensure that formal advanced notice of such testing is provided to IceCube personnel. IceCube personnel will also be physically present in the ICL during such tests to quickly detect and correct problems. In addition, the winterover training program will improve recognition of potential issues and reinforce detector recovery procedures.

***Data Movement –*** Data movement has performed nominally over the past five months. Figure 4 shows the daily satellite transfer rates in MB/day through February 2011. The IC86 filtered physics data, in dark cyan, dominates the total bandwidth. The dips in late December are related to the hardware upgrade of the data movement system. The spikes during early February are related to the data backlog accrued during the power outage associated with the ICL fire panel test. Data movement returned to a steady rate of transfer after maintenance activities subsided in mid-February.

The IceCube data are archived on two sets of duplicate LTO4 data tapes; however, writing the security copy was temporarily suspended due to problems with writing to Dell-branded LTO4 tape. The security tape writing resumed after an adequate supply of HP-branded LTO4 tapes were received at the South Pole.

Data movement goals were met despite some outages for maintenance. A total of 133.8 TB of data were written to LTO tapes averaging 880.5 GB/day. A total of 12.8 TB of data were sent over TDRSS averaging 84.5 GB/day.

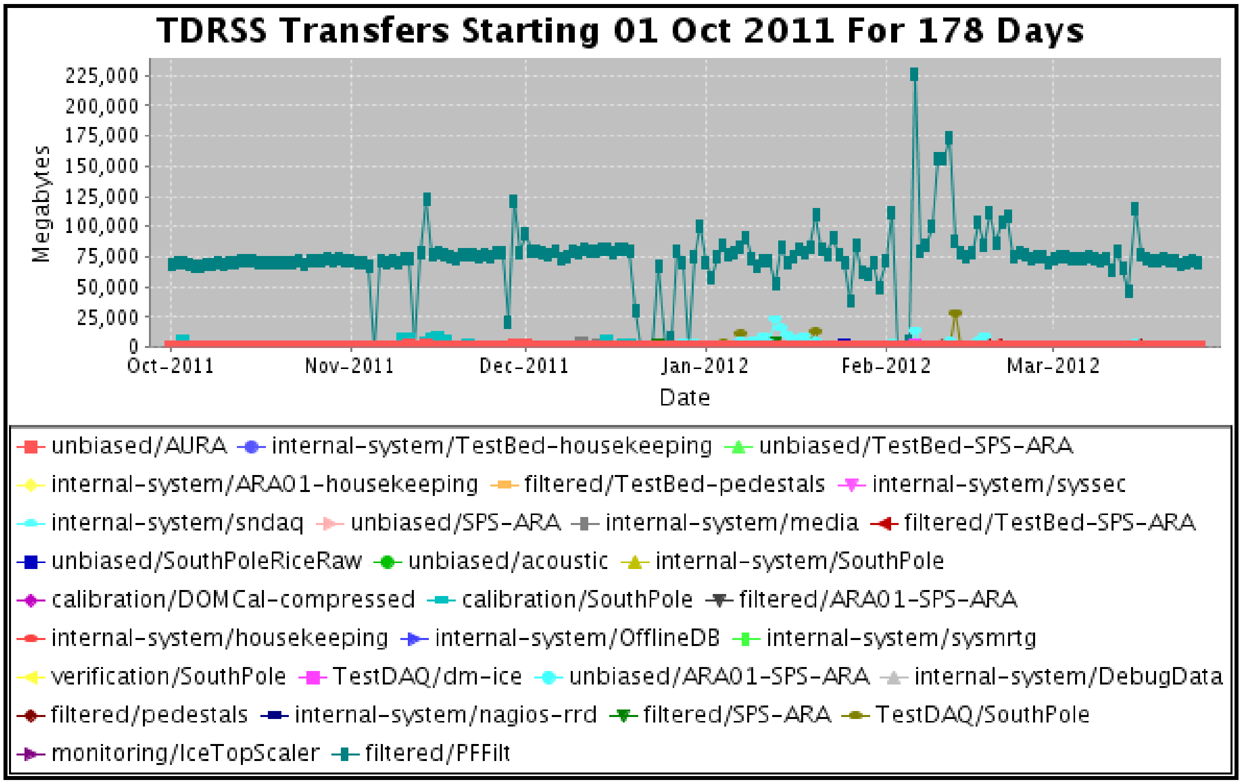


**Figure 4: TDRSS Daily Data Transfer Rates (dark cyan represents IceCube filtered data)**

***Offline Data Filtering*** **–** Preparation and testing of the offline filtering processing scripts for the 2011 IC86 data has been completed. Production of the level 2 filtered data has commenced on the NPX3 cluster. Recent upgrades to this cluster will enable faster production. Based on benchmark results, it is estimated that the processing will be completed in nine weeks using 50% of the NPX3 cluster (500 CPU cores). Accurate predictions of the production completion date can only be made after data acquisition for the 2011 IC86 season has ended. The transition from gzip to bzip2 compression for both input pole-filtered and ouput level 2 files has resulted in more efficient use of the data storage facility at UW–Madison. Daily storage requirements are 72GB and 220GB for pole-filtered and level 2 data, respectively. This results in an annual requirement of 105TB of disk storage. The collaboration is making plans to begin offline production as close as possible to the start of data collection at Pole in an effort to reduce the delay of physics analysis.

***Simulation*** **–** Production of IC79 Monte Carlo began in September 2011 and is complete with the exception of a few datasets needed for studies of systematic uncertainties. Producing simulations of direct photon propagation using Graphics Processing Units, or GPUs, began with a dedicated pool of computers built for this purpose in addition to the standard CPU-based production. The GPU-base production will be expanded during the coming year. The production sites are: Dortmund; EGEE – German Grid; SWEGRID – Swedish Grid; LONI – Louisiana Optical Network Infrastructure; GLOW – Grid Laboratory of Wisconsin; UMD – University of Maryland; NPX3 – UW IceCube; and CHTC – UW Campus.

***Personnel*** – A software professional was added at 1.0 FTE in shared support of DAQ and IceCube Live. A current 0.5 FTE system administrator's time was increased to 1.0 FTE in the area of data management and disaster recovery. A second 1.0 FTE system administrator position responsible for virtualization was vacated and the position will be filled. A job search is underway for a 1.0 FTE software professional in the areas of data analysis and detector simulation. The computing and data manager position held by Martin Merck was vacated and an international job search is underway. Steve Barnet is serving as the acting manager.

## Section II – Financial/Administrative Performance

The University of Wisconsin–Madison is maintaining three separate accounts with supporting charge numbers for collecting IceCube M&O funding and reporting related costs: 1) NSF M&O Core Account; 2) U.S. Common Funds Account; and, 3) Non-U.S. Common Funds Account.

A total of $6,900,000 was released to UW–Madison to cover the costs of Maintenance and Operations in FY2012. Of this amount, funds totaling $941,850 were directed to the IceCube M&O U.S. Common Fund account and the remaining $5,958,150 were directed to the IceCube M&O Core account (Figure 8).

| FY2012 | Funds Awarded to UW |
|---|---:|
| IceCube M&O Core account | $5,958,150 |
| U.S. Common Fund account | $941,850 |
| **TOTAL NSF Funds** | **$6,900,000** |

**Figure 8: NSF IceCube M&O funds - Federal Fiscal Year 2012**

A total amount of $1,736,000 of the IceCube M&O FY2012 Core funds was committed to six U.S. sub-awardee institutions during the first half of FY2012. Sub-awardees submit invoices to receive reimbursement against their actual IceCube M&O costs. Deliverable commitments made by each sub-awardee institution are monitored throughout the year. Figure 9 summarizes M&O responsibilities and total FY2012 funds for the six sub-awardees.

| Institution | Major Responsibilities | FY2012 M&O Funds |
|---|---|---:|
| Lawrence Berkeley National Laboratory | Detector verification, detector calibration | $63k |
| Pennsylvania State University | Detector verification, high-level monitoring and calibration. | $36k |
| University of California at Berkeley | Calibration, monitoring | $83k |
| University of Delaware, Bartol Institute | IceTop surface array calibration, monitoring and simulation | $170k |
| University of Maryland at College Park | Support IceTray software framework, online filter, simulation production, spokesperson | $1,185k |
| University of Wisconsin at River Falls | Education and outreach support | $199k |
| **Total** | | **$1,736k** |

**Figure 9: IceCube M&O sub-awardee institutions - FY2012 major responsibilities and funds**

### *IceCube M&O Common Fund Contributions*

The IceCube M&O Common Fund was established 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 contributed to the Common Fund based on the total number of the institution's Ph.D. authors at the established rate of $13,650 per Ph.D. author. The Collaboration updated the

Ph.D. author count twice a year before each collaboration meeting in conjunction with the update to the IceCube Memorandum of Understanding for M&O.

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 and were listed in the Maintenance & Operations Plan.

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

The current IceCube NSF M&O 5-year award was established at the beginning of Federal Fiscal Year 2011, on October 1, 2010. The following table presents the financial status half way into FY2012 which is Year 2 of the award, and shows an estimated balance at the end of FY2012.

Total awarded funds to the University of Wisconsin (UW) for supporting Year 1 and Year 2 of IceCube M&O, are $13,800K. With a total actual cost to date of $7,939K and $1,803K open commitments, the current remaining unobligated funds at UW on March 31, 2012 are $4,058K. Based on a spending plan of $1,413K in quarter 3 of Year 2 and $1,566K in quarter 4 of Year 2, the estimated unspent funds at the end of Year 2 are $1,079K which is 15.6% of Year 2 budget.

| **(a)** | **(b)** | **(c)** | **(d)= a - b - c** | **(e1)** | **(e2)** | **(f) = d – e** |
|---|---|---|---|---|---|---|
| **YEARS 1+2 Budget** (Oct.'10-Sep.'12) | **Actual Cost To Date** through 03/31/12 | **Open Commitments** 03/31/12 | **Current Balance** 03/31/12 | **YEAR2 Q3 Expenses Forecast** Apr12-Jun'12 | **YEAR2 Q4 Expenses Forecast** Jul'12-Sep'12 | **YEARS 1+2 Forecast Balance** 09/30/12 |
| **$13,800K** | **$7,939K** | **$1,803K** | **$4,058K** | **$1,413K** | **$1,566K** | **$1,079K** |

**Figure 10: IceCube NSF M&O Award Budget, Actual Cost and Forecast**

The balance at the end of Year 2 is currently expected to exceed 10% of the funding available and therefore UW-Madison must formally notify the NSF Program Managers. The current forecasted balance at the end of Year 3 is expected to be about 5% of the funding available and within the 10% reporting threshold requirement in the M&O Cooperative Agreement.

## Section III – Project Governance and Upcoming Events

The detailed M&O institutional responsibilities and Ph.D. authors head count are revised twice a year for the IceCube collaboration meetings as part of the institutional Memorandum of Understanding (MoU) documents. The MoU was last revised in March 2012 for the Spring collaboration meeting in Berkeley, CA and the next revision will be posted in October 2012 at the Fall collaboration meeting in Aachen, Germany.

### *IceCube Collaborating Institutions*

In September 2011 at the 2011 Fall collaboration meeting in Uppsala, three new institutions joined the IceCube Collaboration:

- Université de Genève (DPNC), Institutional Lead is Dr. Teresa Montaruli
- Stony Brook University (SBU), Institutional Lead is Dr. Joanna Kiryluk
- University of Adelaide, Institutional Lead is Dr. Gary Hill

In February 2012, Technische Universität München (TUM) joined the IceCube Collaboration and Max Planck Institute (MPI) at Heidelberg left IceCube, after the institutional lead Dr. Elisa Resconi officially moved from MPI to TUM.

The list of current IceCube collaborating institutions was updated accordingly in Appendix A of the IceCube Collaboration Governance Document (Rev 6.4, last revised on February 23, 2011).

### *IceCube Major Meetings and Events*

| | |
|---|---|
| IceCube Spring Collaboration Meeting - University of California, Berkeley | March 19-23, 2012 |
| NSF Off-site M&O Review | May 2012 |
| IceCube Fall Collaboration Meeting - Aachen, Germany | October 2012 |

### *Acronym List*

| | |
|---|---|
| DAQ | Data Acquisition System |
| DOM | Digital Optical Module |
| ERM | Extended Runtime Module |
| IceCube Live | The system that integrates control of all of the detector's critical subsystems |
| IceTray | IceCube Core Analysis software framework is part of the IceCube core software library |
| ICL | IceCube Laboratory (South Pole) |
| IRC | IceCube Research Center |
| M&OP | Maintenance & Operations Plan |
| MoU | Memorandum of Understanding between UW-Madison and all collaborating institutions |
| NSTA | National Science Teachers Association |
| SPS | South Pole System |
| TDRSS | The Tracking and Data Relay Satellite System is a network of communications satellites |
| TFT Board | Trigger Filter and Transmit Board |
| UPS | Uninterruptable Power Supply |