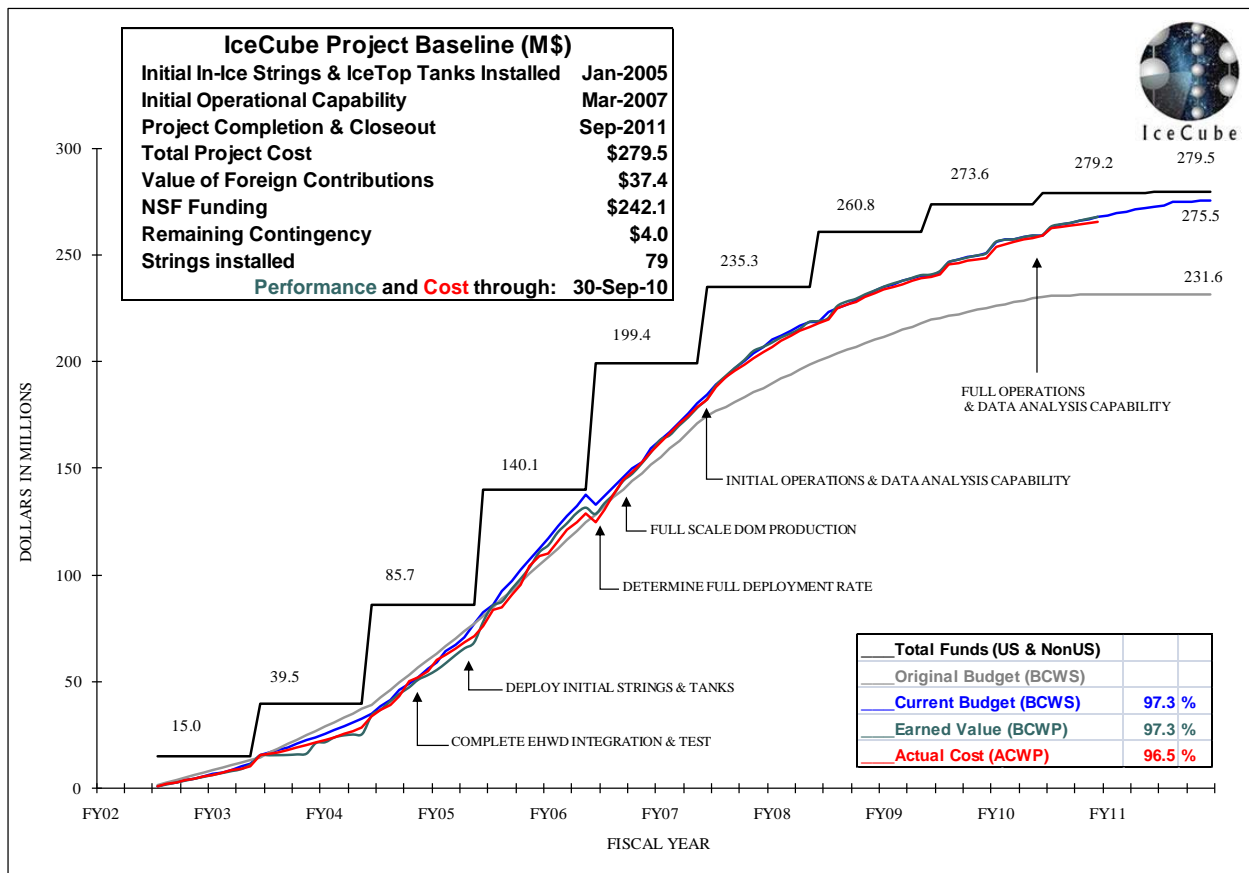


# IceCube Project Monthly Report - October 2010

## Accomplishments

- The first IceCube drillers departed for South Pole in late October to prepare the Seasonal Equipment Site for the upcoming drilling season.
- A readiness review was conducted in October for special devices that will be installed with the final Digital Optical Modules (DOMs) cables, e.g. the Swedish bubble camera.
- Data movement goals for the month of October were met.
- The project continues to conduct a series of reviews of the MREFC deliverables including the Data Acquisition, IceTop, Processing and Filtering, etc. The objective of these reviews is to ensure that the entire IceCube MREFC scope is complete.
- The final IceTop stations and IceCube strings will be installed in December 2010.



**Cost and Schedule Performance** – The project is 97.3% complete. Remaining contingency is \$3.997 million. The NSF IceCube MREFC funding of \$242.1 million remains unchanged since the project baseline was established in early 2004.

IceCube Neutrino Observatory Cost Schedule Status Report Reporting Period Ending: 9/30/2010										Note 1
Cumulative (AY K\$)							At Complete Note 4	Complete (%)		
OBS Structure L2	Budgeted Cost <sup>2</sup>		Actual Cost of Work Performed	Cost Variance	Risk Contingency <sup>Note5</sup>		Budgeted AY \$s	Scheduled	Performed	Actual Cost
	Work Scheduled	Work Performed			Assigned	% Remain Work				
Project Support	26,528	26,528	26,440	88.0	125	13.3%	27,471	96.6%	96.6%	96.2%
Implementation	43,998	43,998	43,665	333.0	560	20.2%	46,767	94.1%	94.1%	93.4%
Instrumentation	76,753	76,753	76,583	169.7	30	21.2%	76,895	99.8%	99.8%	99.6%
Data Acquisition	33,855	33,855	33,855	0.6	0	0.0%	33,855	100.0%	100.0%	100.0%
Data Systems	26,495	26,495	26,518	-23.4	50	10.1%	26,989	98.2%	98.2%	98.3%
Commissioning & Verification	20,562	20,562	20,544	18.2	25	28.9%	20,649	99.6%	99.6%	99.5%
Pre Operations	4,772	4,772	4,637	134.5	50	10.2%	5,263	90.7%	90.7%	88.1%
Subtotal	232,963	232,963	232,242	720.6	840	17.1%	237,889	97.9%	97.9%	97.6%
RPSC SUPPORT	33,809	33,809	32,434	1,375.4	300	11.9%	36,323	93.1%	93.1%	89.3%
NSF	1,188	1,188	1,188	0.0	15	20.0%	1,263	94.1%	94.1%	94.1%
Total	267,960	267,960	265,864	2,096.0	1,155	15.4%	275,475	97.3%	97.3%	96.5%
CONTINGENCY <sup>Note 3</sup>							3,997			
IceCube Total <sup>Note 2</sup>	267,960	267,960	265,864	2,096.0	1,155		279,472	97.3%	97.3%	96.5%

Notes: 1 Incorporates approved baseline changes.  
2 Total Budget at Completion includes \$37.4 M  
3 Remaining Contingency is \$4.0 M  
4 The BAC (Budget At Completion), reflects PY9-10 detailed Baseline Review.  
5 Contingency is assigned based on the remaining Technical, Cost & Schedule risks associated with the approved scope of work.

The cost variance at the end of September 2010 was a favorable \$2,096M, primarily due to Raytheon and NY Air National Guard FY10 on-ice fuel and labor cost savings.

**Contingency Status and Plans** – One change request on the amount of \$596k was implemented this month to support Pre-Operations effort during the 2<sup>nd</sup> half of Project Year 9 and slightly increases Project Support effort.

9/30/2010

**Change Log - IceCube Total Project Budget Baseline (\$K)**

No.	Description	Approval Date	Total Baseline	Allocated Budget	Allocated Budget Change	Contingency Budget
CR166	Pre-Operations Budget Plan through Sep.2010-2nd phase	07/12/10	279,472	274,880	367	4,593
NA	Status as of July 2010		279,472	274,880	0	4,593
NA	Status as of August 2010		279,472	274,880	0	4,593
CR167	Pre-Operations Plan through March 2011 and Project Support Budget Replan	10/07/10	279,472	275,475	596	3,997
NA	Status as of September 2010		279,472	275,475	0	3,997

Reviews of MREFC subsystems continue and any additional resources necessary to ensure success are considered in the risk assessment process and can be addressed within available contingency. Remaining contingency will be adequate to complete the approved scope. A no-cost extension was submitted to NSF requesting an extension of the project end date from March 31, 2011 to March 31, 2012 to accommodate activities associated with the final disposition of the IceCube Enhanced Hot Water Drill (EHWD); the orderly termination of construction activities; and the preparation of a comprehensive completion report on construction.

## Risk Assessment & Potential Contingency Adjustments

Item	Estimate (\$K)
1. Potential cost exposure for the approved scope of work based on Level 3 technical, cost and schedule risk assessment.	\$1,155K
2. Computing infrastructure and software development.	\$1,260K
3. Estimated cost to retro IceCube equipment/materials from the South Pole at the end of the project.	\$1,050K
4. Potential labor cost to retain experienced personnel in the final year of construction to ensure that the final season will be a success.	\$150K
Total	<b>\$3,615K</b>
<b>Available Contingency as of Sep 30, 2010</b>	<b>\$3,997K</b>

***Drill Operation and Installation*** – All readiness reviews were completed and equipment was shipped South. The South Pole Station opened in mid-October. In early November the first IceCube staff reached the South Pole.

The Seasonal Equipment Site excavation plans were reviewed in October and the plan is for actual excavation to begin in early November. The Drill Control Center and Tower Operations housing essential “do-not-freeze” equipment remain powered and heated.

The Northern Hemisphere Support Group (located in UW-Madison) was re-started to provide technical/logistical support to the on-ice team. The group provides dedicated contact points available 24/7 to respond to all support requests from the ice.

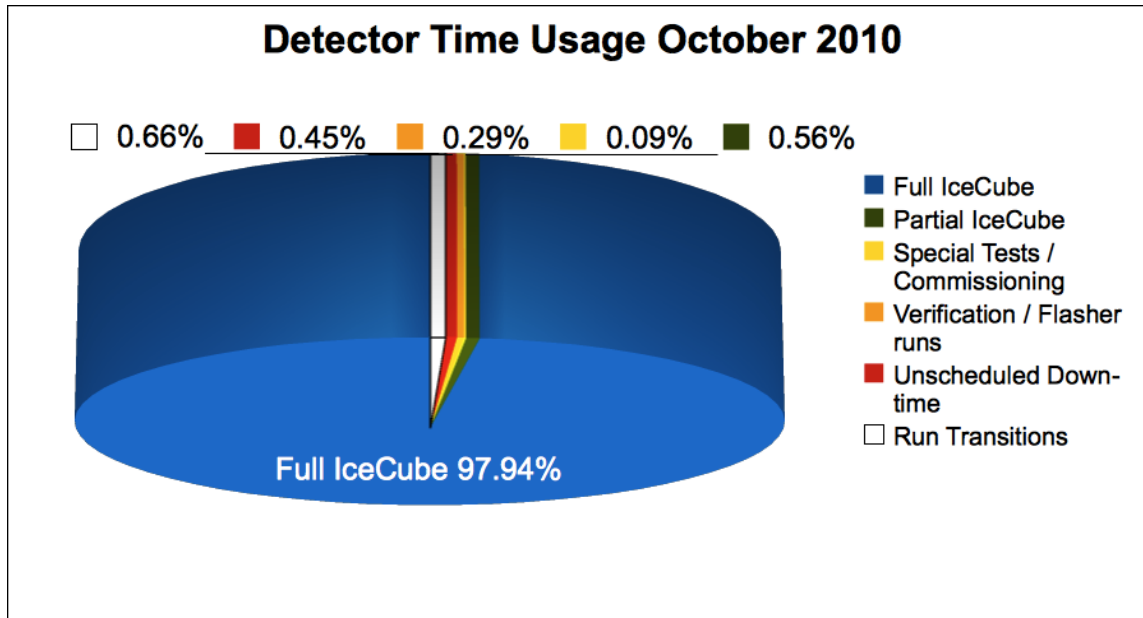
The following off-ice activities were completed in October:

- A Special Devices Readiness Review was conducted for approved equipment.
- Drillers completed final preparations, procurements, and shipments, including repaired equipment and the Enhanced Hot Water Trencher.
- Hazard Analysis reviews were completed in October and Operating Procedure revisions finalized.
- EHWD Capital Equipment disposition was coordinated with NSF and Raytheon Polar Services Company (RPSC) for turnover of custodianship at end of construction.
- Plans for drill-hole water samples/testing was coordinated through RPSC and a New Zealand laboratory.

This month the EHWD Test Bed/Training Facility at the Physical Sciences Laboratory was winterized and closed.

## Detector Operations and Maintenance

**Detector Performance** - Austral summer work began at the South Pole is underway. Two brief power outages at the ICL were observed since the South Pole station opened. The detector recovered well following both instances. A high detector up-time of 98.44% was achieved in October. The clean run up-time was 96.12%. Unscheduled downtime in October was caused by a routine DOM hub failure and an unusual DAQ issue that required the DOMs to be rebooted.



**Detector Up-Time: 98.44%**

**Clean run Up-Time: 96.12%**

**Unscheduled Downtime: 0.72%**

### Definition of terms:

**Detector Up-Time** is the percentage of time that data are acquired and delivered at an event rate of at least 500Hz. The up-time measurement includes periods in which the detector was taking data in a partial detector configuration or with light contamination from calibration sources.

**Clean run Up-Time** is the percentage of time determined to have pristine data in the standard hardware and software configuration, with the full nominal detector enabled, no contamination from light sources, and for which no serious alerts were generated by the monitoring, verification or other systems. The criteria applied are not algorithmic but represent the Run Coordinator's overall impression of the data quality, including run uniformity.

Fire suppression testing, a new power drop in the ICL, an extensive server upgrade, and numerous special test runs will impact detector up-time and clean up-time throughout the summer. Preventive planning to limit the impacts is in place and frequent communication among staff in the North and the South Pole is already underway to help mitigate issues as they arise.

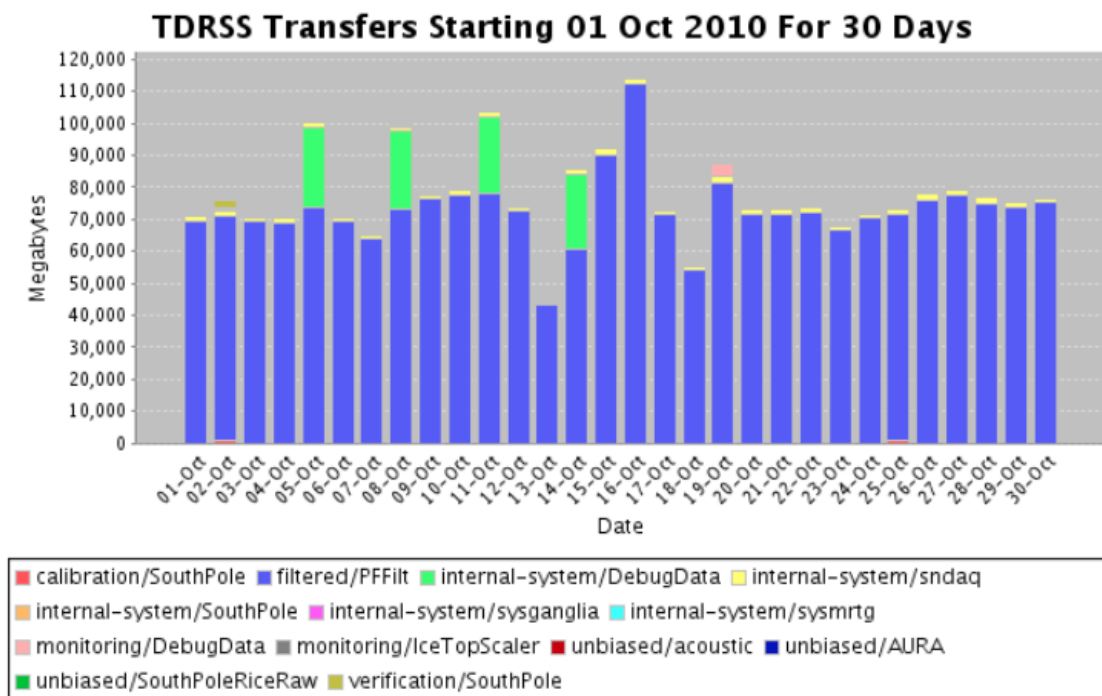
The IceCube Live (<https://live.icecube.wisc.edu>, access information available upon request) monitoring page was upgraded to allow for a more comprehensive annotation of the detector history for operators and physicists. The Crab flare analysis recently highlighted the integration of additional run quality information into IceCube Live, which looked at a transient event in IC79. Collaborators analyzing transient events now have a quick way to assess a run before the formal good run list is compiled.

A problem with a four-month-old flasher run was resolved, enabling the collection of verification data to reliably resume. Data acquisition will realize a significant change by the end of the year when the roughly three minutes of down-time between runs will be eliminated. The continual running of the detector will increase detector up-time by nearly 0.6%.

The online filtering system is running smoothly with daily satellite transmission of filtered data to the northern data warehouse at the University of Wisconsin. We have made significant progress on the feasibility of writing a short data summary record (called a DST) for every event triggered by the DAQ in addition to the raw data for the selected filter events. This will aid in some analysis using down-going events (i.e., galactic center and moon shadow) as well as provide a possible source of data for eventual public availability.

Data movement goals for the month of October were met, despite minor technical problems in the middle of the month. In two instances, the bandwidth provided by the satellite link fell to practically zero. IceCube was provided with additional bandwidth to resolve the backlog.

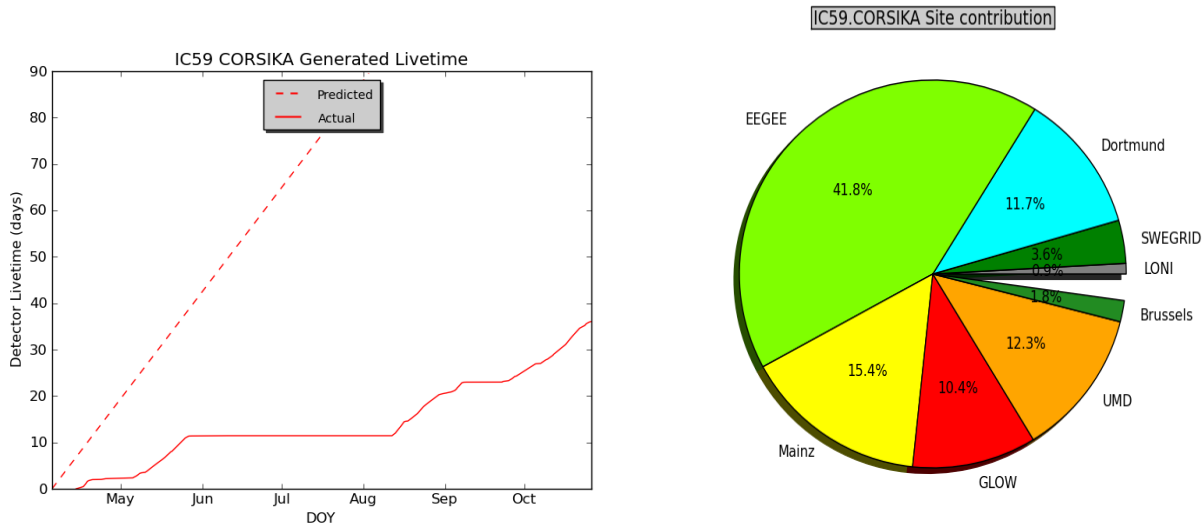
A total of 2.34 TB of data were sent over the satellite, averaging 77.3 GB/day. A total of 21 TB of data were written to LTO tapes in October, averaging 696.3 GB/day. The figure below shows the daily satellite data transfer rates in MB/day for October. The steady IC79 filtered physics data, in blue, dominates the total bandwidth.



**Offline Filtering** - Work continues on L3 data offline processing at the data warehouse. IC59 is the first run with a planned L3, which will reduce dataset sizes and split the sets out for the different working groups. The muon group successfully ran the data through L3 and other groups are in the process of getting it implemented.

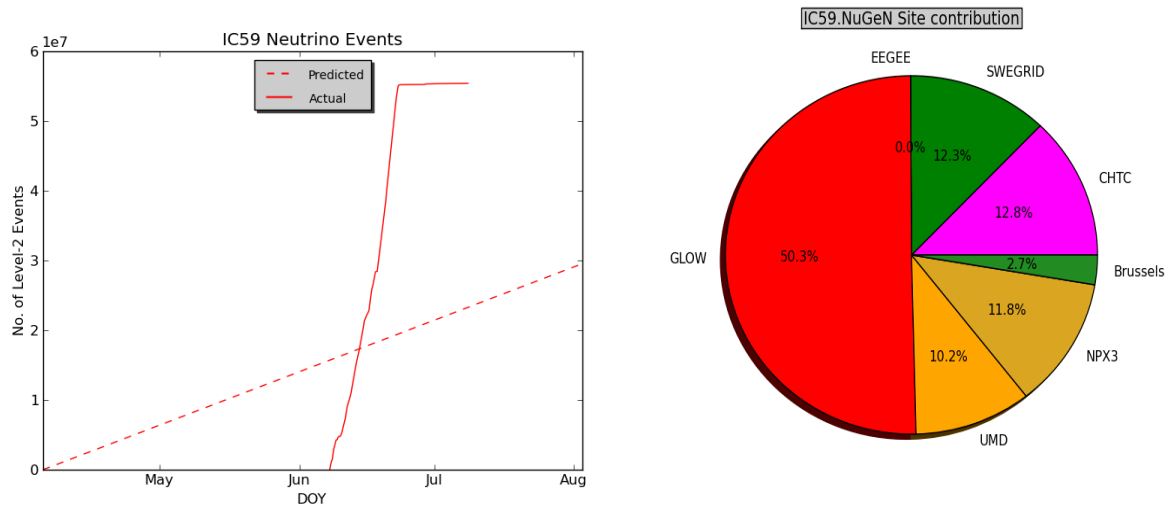
Work continues in preparing the L2 offline processing for IC79 run including investigating the possibility of a new Super DST.

**Simulation** - The IC59 simulation data are produced and processed with the latest software release. Production of the background physics datasets using CORSIKA resumed in mid-August after an increase in available storage capacity for the data. A dramatic increase in the production of neutrino signal simulation data and special simulation data compensated for the reduced background data production. Production sites: 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.



**Figure 1:** Left: Cumulative production of IceCube-59 background events with CORSIKA generator (continuous line) compared with 2010 plan (dashed line). Right: Relative contribution of production sites to the background production.

Between June and August, the target of neutrino signal event generation, for all the types, exceeded the plan by more than a factor of two (see Figure 2) with a total of 18 CPU-years used.



**Figure 2:** Left: Cumulative production of IceCube-59 neutrino events (continuous line) compared with 2010 plan (dashed line). The graph includes the generator of electron neutrinos, muon neutrinos and tau neutrinos. Right: Relative contribution of production sites to the neutrino signal production.

The summer pause was very active in the production of several benchmark datasets essentially aimed at systematic checks as noted below. The IC79 detector configuration for simulation purposes is finalized and the corresponding data production will start shortly.

1. Production of IC86 benchmark datasets for background and neutrino signal (all types) has exceeded the plan. These data serve multiple purposes, from testing a newly developed reconstruction algorithm for the newly deployed Deep Core detector, to the intensive study of offline processing of IC79. We will also use these data to study online data filtering strategies for 2011 science runs.
2. Benchmark datasets were produced with the newly developed direct photon propagation as an alternative to the current use of the bulky lookup photon tables. The simulation of Cherenkov light detected by IceCube requires the knowledge of ice optical properties. A new ice properties profile is under study and the generation of benchmark simulation datasets with direct photon propagation is necessary to perform high statistical comparisons with experimental data.
3. Dedicated physics datasets for IC40 were generated in DESY and in the Swedish Grid to address specific data analyses.

***Education and Outreach*** – Seven IceCube scientists participated in a lab-wide open house at Lawrence Berkeley National Lab on October 2. Approximately 3,000 visitors attended the event. IceCube researchers interacted with visitors and provided hands-on displays for them.

Engineer and driller Matt Newcomb educated groups of third grade and fifth grade classes in Cross Plains, WI. He talked about life in Antarctica, ice drilling with hot water, and some of the physics behind the project. Grad student Laura Gladstone and researcher Reina Maruyama presented to the Madison Area Women's Philanthropy Group about women in science.

Francis Halzen, IceCube Principal Investigator, was profiled in an October 25<sup>th</sup> video by *Science Nation*, a series commissioned by the NSF Office of Legislative and Public Affairs. The story received great feedback and continues to be picked up by a number of media outlets. The video is available at the following site:

[http://www.nsf.gov/news/special\\_reports/science\\_nation/icecube.jsp](http://www.nsf.gov/news/special_reports/science_nation/icecube.jsp)

Albrecht Karle gave the plenary address at the Wisconsin Association of Physics Teachers annual meeting on October 29<sup>th</sup>. This meeting was held in conjunction with the Minnesota Association of Physics Teachers and the Wisconsin Society of Physics Students. Prof. Karle brought the audience up-to-date on the IceCube construction project and recent analysis results.

On November 1<sup>st</sup>, collaborator Kirill Filimonov gave a talk at Sonoma State University in California as part of the public lecture series/undergraduate colloquium “What Physicists Do.” His talk, titled “Extreme astronomy: Eyeing the cosmos through a cubic kilometer of ice” was attended by over 100 people.

***2011 Detector Completion Planning*** – The next IceCube collaboration meeting will be held in Madison from April 26 – May 2. An event commemorating the completion of the detector is planned for the afternoon of Thursday, April 28<sup>th</sup>.

### *Upcoming IceCube Meetings and Events*

DAQ Subsystems and Test DAQ Review	November 17-18, 2010
Monitoring & Verification Review	November 30 – December 2, 2010
On-line Processing & Filtering Review	December 6-7, 2010
IceCube Collaboration Meeting, Madison	April 25 – May 2, 2011
IceCube Detector Completion Event	April 28, 2011

### *Acronym List*

DAQ	Data Acquisition
EHWD	Enhanced Hot Water Drill
ICL	IceCube Laboratory
MREFC	Major Research Equipment and Facilities Construction
RPSC	Raytheon Polar Services Company