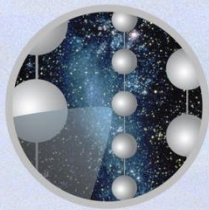


Madison – spring 2015

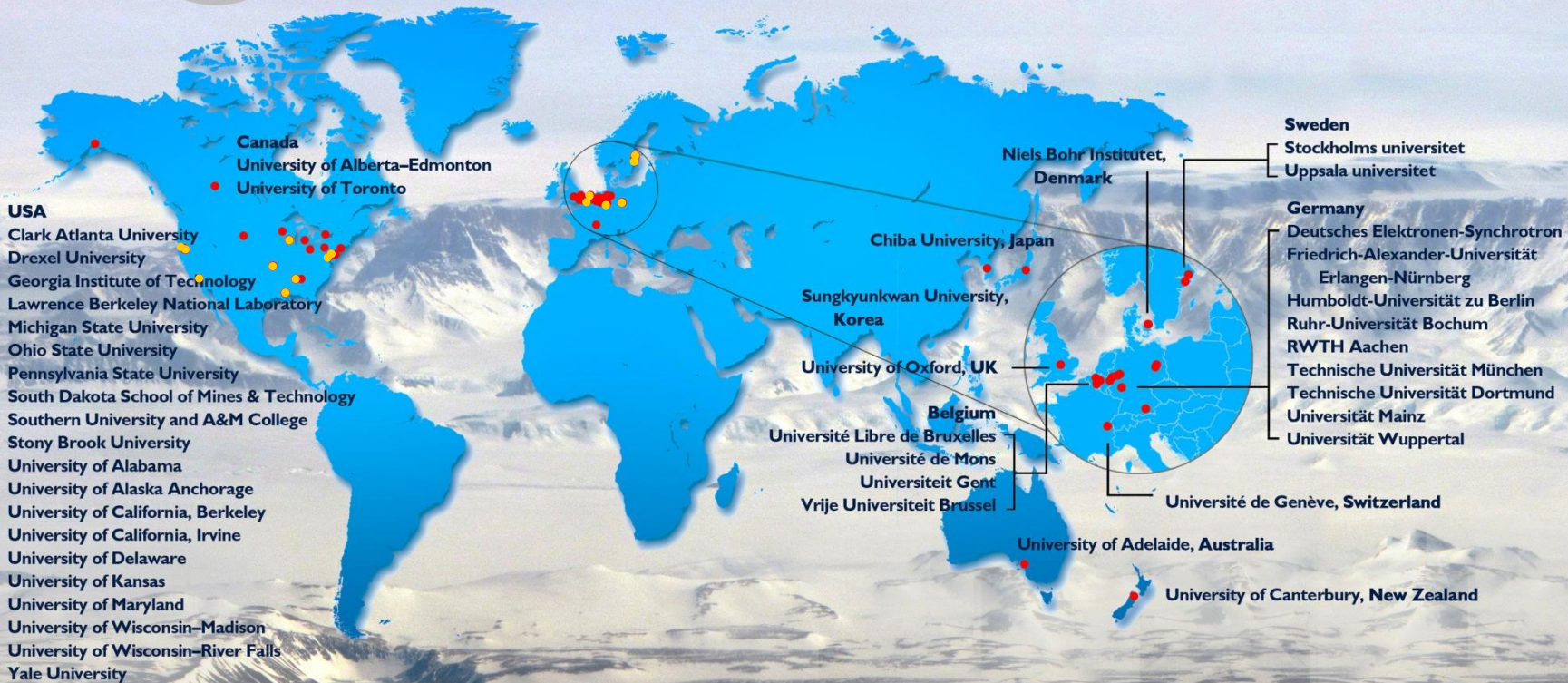


THE ICECUBE COLLABORATION (MAY 2015)

- scientists and engineers at 44 institutions world-wide (12 countries)
- ~ 315 people
- core: 15 institutions who worked out the original IceCube proposal in 1999



The IceCube Collaboration



Funding Agencies

Fonds de la Recherche Scientifique (FRS-FNRS)
 Fonds Wetenschappelijk Onderzoek-Vlaanderen (FWO-Vlaanderen)
 Federal Ministry of Education & Research (BMBF)
 German Research Foundation (DFG)

Deutsches Elektronen-Synchrotron (DESY)
 Japan Society for the Promotion of Science (JSPS)
 Knut and Alice Wallenberg Foundation
 Swedish Polar Research Secretariat
 The Swedish Research Council (VR)

University of Wisconsin Alumni Research Foundation (WARF)
 US National Science Foundation (NSF)

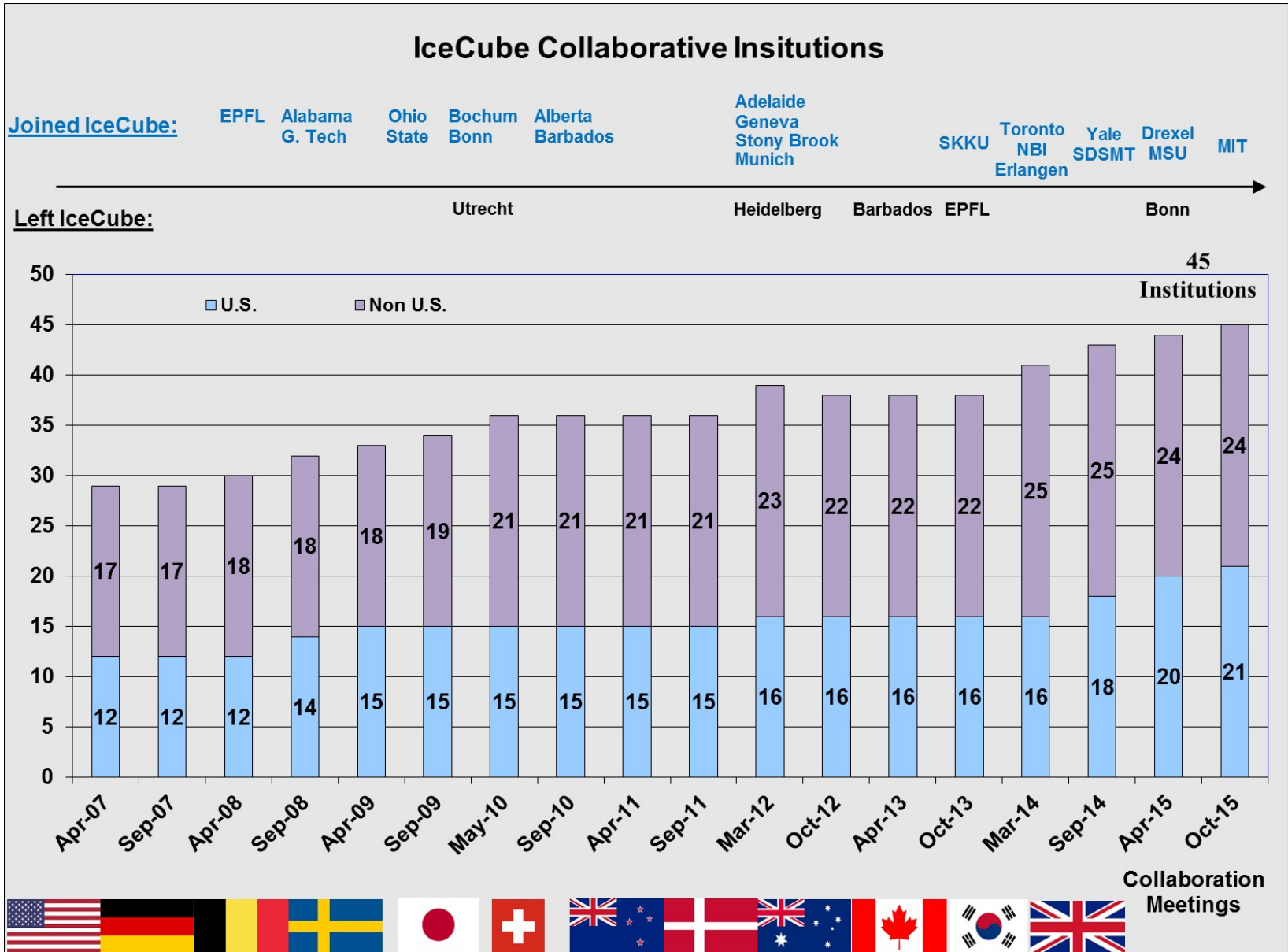


THE ICECUBE COLLABORATION (OCTOBER 2015)

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 - MIT accepted in May
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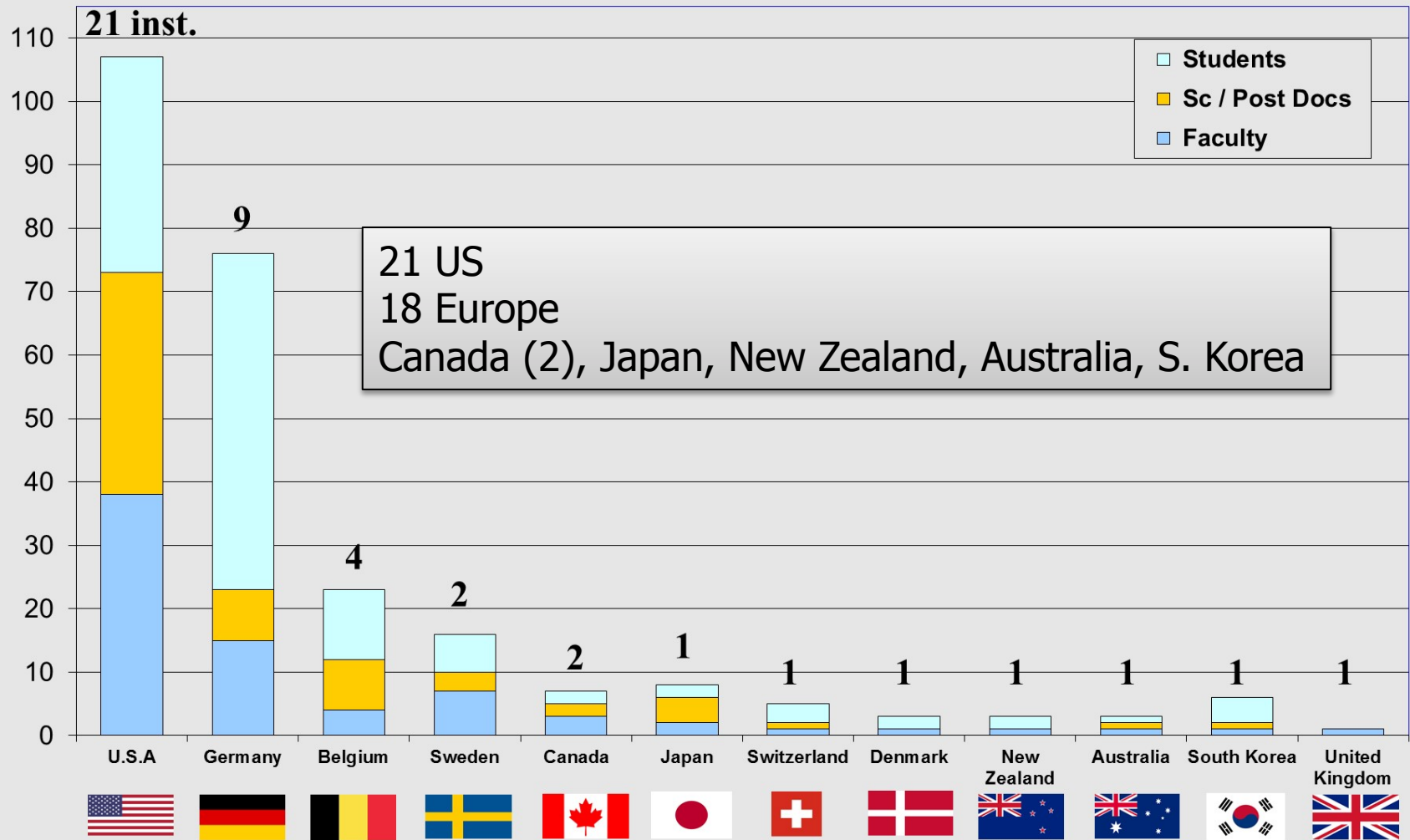


IceCube Collaborative Institutions

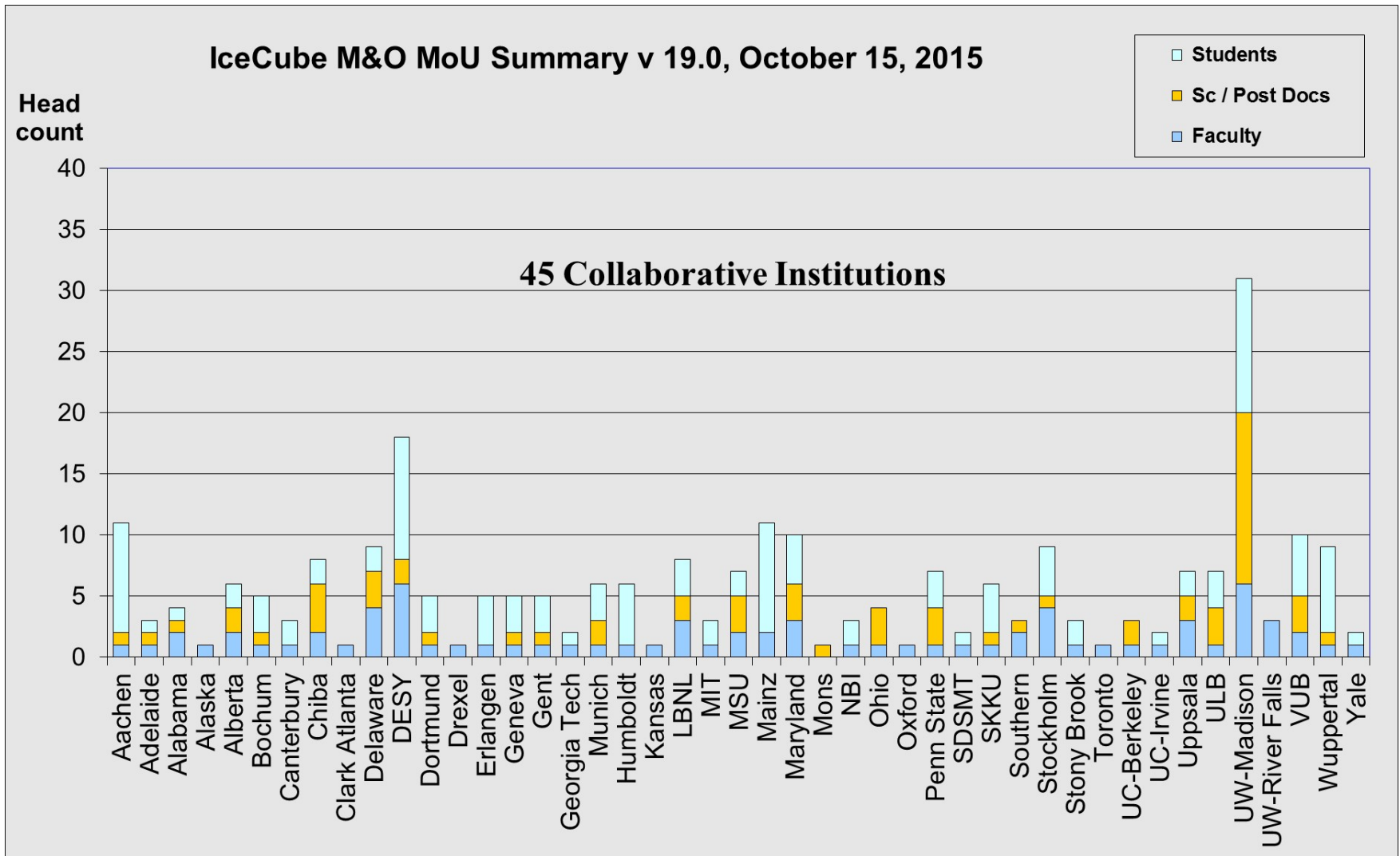


Collaborative Countries – Physics Group

IceCube M&O MoU Summary v 19.0, October 15, 2015



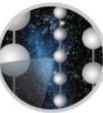
Collaborative Institutions – Physics Group





THE ICECUBE COLLABORATION (OCTOBER 2015)

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THE ICECUBE COLLABORATION (OCTOBER 2015)

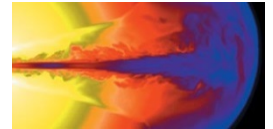
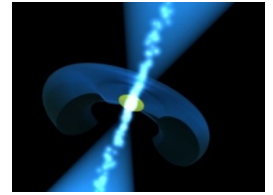
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GOAL

- ORIGINAL: design and build the IceCube Neutrino Observatory
- PRESENT: exploit it for science
 - primarily study of high-energy ν 's from cosmic sources



- **ASTROPHYSICS**
 - point sources of ν 's (SNR, AGN ...), extended sources
 - transients (GRB, AGN flares ...)
 - diffuse fluxes of ν 's (all sky, cosmogenic, galactic plane ...)
- **COSMIC RAY PHYSICS**
 - energy spectrum around "knee", composition, anisotropy
- **DARK MATTER**
 - indirect searches (Earth, Sun, galactic center/halo)
- **EXOTIC SOURCES OF ν 'S**
 - magnetic monopoles
- **PARTICLE PHYSICS**
 - ν oscillations, sterile ν 's
 - charm in CR interactions
 - violation of Lorentz invariance
- **SNe** (galactic/LMC)
- **GLACIOLOGY**





THE ICECUBE COLLABORATION (OCTOBER 2015)

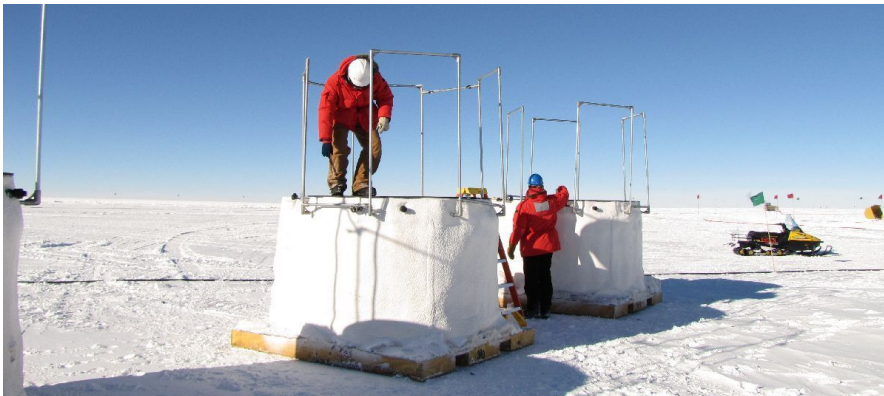
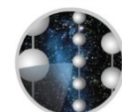
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GOAL

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- ★ many individuals and institutions across the collaboration contributed to the development and construction of IceCube

– and contribute to the science output



IceTop tanks & freeze control units



DOM mainboards

– designed and delivered by



5160 DOMs assembled & verified at three production sites



PSL at Stoughton, WI



DESY

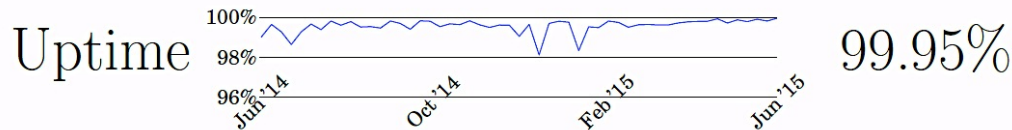


Stockholm/Uppsala



- ★ IceCube was completed in December 2010
- ★ continuously producing high quality science data

livedtime > 99.5%
– thanks to the winter-overs
AND the DAQ s/w team



Erik Beiser, Stephan Richter, Dag Larsen, Ian Rees

- ★ detector operations is a collaborative effort
 - organized via IceCube Coordination Committee
 - all main functions represented
 - most positions filled by collaboration experts
- detector M&O
- computing & data management
- triggering & filtering
- data quality, simulation & reconstruction tools

University of Wisconsin – Madison

R. Blank, Chancellor
M. Mailick, Vice Chancellor for Research and Graduate Education (VCRGE)

National Science Foundation

International Oversight and Finance Group

Science Advisory Committee

B. Barish, Caltech, Chair

Software & Computing Advisory Panel

M. Ernst, Brookhaven, Chair

WIPAC Education & Outreach Advisory Panel

Wisconsin IceCube Particle Astrophysics Center (WIPAC)

K. Hanson, Executive Director
A. Herrick, HR, Business, & Admin
S. Bravo Gallart / M. Madsen, Communications
N. Irland, Business IT Support

IceCube Neutrino Observatory

F. Halzen, Principal Investigator
K. Hanson, Director of Operations
A. Karle, Associate Director for Science & Instrumentation
J. Madsen, Associate Director for Education & Outreach

Collaboration Board

Spokesperson & Executive Committee Chair,
O. Botner (Uppsala)
Deputy Spokesperson, T. DeYoung (MSU)
Publication Com. Chair, D. Grant (Alberta)
Speakers Com. Chair, J. Madsen (UW River Falls)
Beyond Deep Core Upgrades Coordinators,
D. Grant (Alberta) & D. Cowen (Penn State)

Maintenance & Operations

Coordination Committee Chair, P. Desiati
Resource Coordination, V. Vankina & A. Peles
Software Coordination, A. Olivas

Detector M&O –

Run Coordination, J. Kelley, UW Manager
DAQ, M. Kauer (UW)
Supernova DAQ, D. Glowacki (UW)
Processing & Filtering, V. Baum / B. Eberhardt (Mainz)
IceTop Operations, E. Blaufuss (Maryland)
IceCube Live, S. Tilav (Delaware)
Calibration, M. Frère (UW)
D. Williams (Alabama)

TFT Coordination –

A. Hallgren (Uppsala)

Data Processing Coordination

Data Processing, D. Schultz, acting (UW)
Offline Processing Software (2013), C. Kopper (Alberta) & N. Wandkowsky (UW)
IceTray Framework/Development, D. LaDieu (Maryland)
Database Development Systems, G. Kohlen (Mons)

South Pole Logistics/R&D Support – J. Haugen (UW)

Computing & Data Management – G. Merino, UW Manager

Operations Coord. & Cybersecurity, S. Barnett (UW)
South Pole System & Test System, R. Auer (UW)
Data Transfer Systems, P. Meade (UW)
Data Storage Systems, S. Barnett, acting (UW)
Data Management, J. Bellinger (UW)
High Throughput Computing, V. Brik (UW)
Networking and Facilities, P. Wisniewski (UW)
Support Infrastructure, B. Stock (UW)
Data Archive at DESY, K. Leffhalm (DESY)

Simulation Production –

P. Desiati, UW Manager
Production Coordinator, J.C. Diaz-Velez (UW)
Simulation Programs, A. Olivas (Maryland)

Collaboration Simulation Production Centers:

Belgium: IIHE-Brussels, UGent-Ghent; **Canada:** WestGrid (Alberta)
Germany: DESY, Aachen, Dortmund, Wuppertal, Mainz, Bochum
Sweden: SWEGRID; **US:** UW (npx3, GLOW, CHTC, GZK), UMD, UDEL, LBNL/NERSC, UCI, PSU, SUBR(LONI)

Research & Physics Analysis

Analysis Coordinator –

E. Blaufuss (Maryland)

Working Groups:

Muons
Cascades & Taus
Cosmic-Ray
Point Source
EHE and Diffuse Neutrinos
Gamma-ray Burst
Beyond the Standard Model
Supernova
Low-Energy / Neutrino Osc.



- ★ physics analysis organized in working groups
 - diverse science topics
- teleconferences on a weekly / bi-weekly basis
- in person twice a year at collaboration meetings
 - tricky logistics – nevertheless 1-2 meetings/day
- ★ weekly analysis calls chaired by the analysis coordinator
 - all mature analyses & results presented
 - decisions to show at conferences / publish



current analysis coordinator
Erik Blaufuss, UMD



GOVERNANCE DOCUMENT

- developed at the very outset
- amended regularly, as needed

★ the main decision making body is the **Collaboration Board**

authority over

- science policy and goals
- membership
- data access
- publication
- conference presentations
- analysis working groups
- education and outreach

- ★ each IceCube inst. Represented on CB - # votes depends on # PhDs
- ★ Early Career scientists (< 7y after PhD) – 2 repr. / 1 vote



- ★ ICB is chaired by the **Spokesperson**
- ★ elected by the majority vote of all PhD scientists in the collaboration

represents the collaboration

- the scientific community
- general public

communicates with

- host institution
- IOFG

Advisory to the Spokesperson:

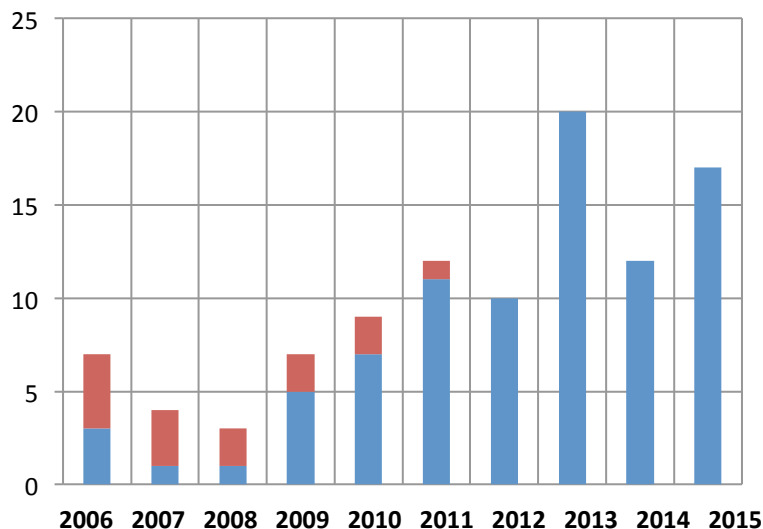
- ★ **Deputy spokesperson**
- ★ **EXEC committee** – advisory to the spokesperson
 - EC includes major groups, functions

ICB meets in person twice a year at collaboration meetings – telecon's as needed



★ The Governance Document establishes procedures for

- publication of science results → pub. comm. (chair + 9)
- presentation at conferences → speakers comm. (chair + 3)
- education & outreach efforts



■ AMANDA

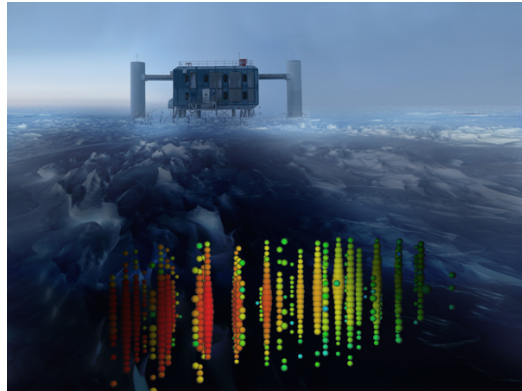
■ IceCube

★ alphabetic authorlists

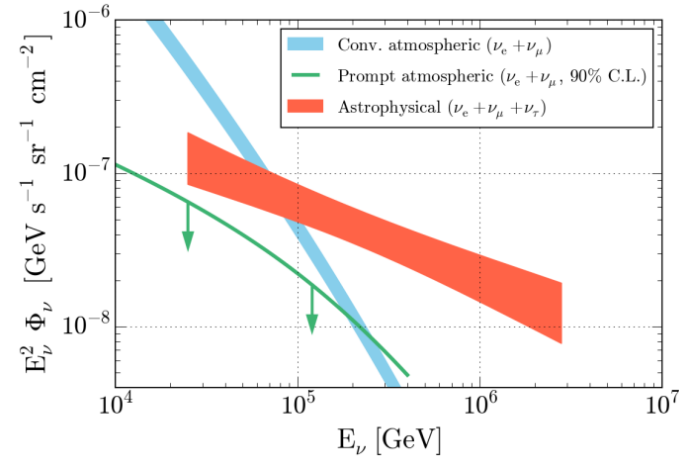
In 2015

- 17 papers subm. or published
- 5 papers since May
- 3 under journal review
- 14 at various stages of collaboration review

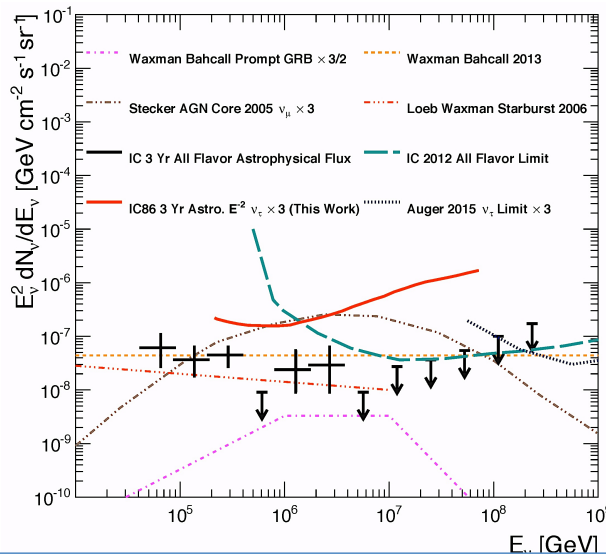
- ★ over 50 talks at conferences per year, mostly international
- ★ IceCube Master Class



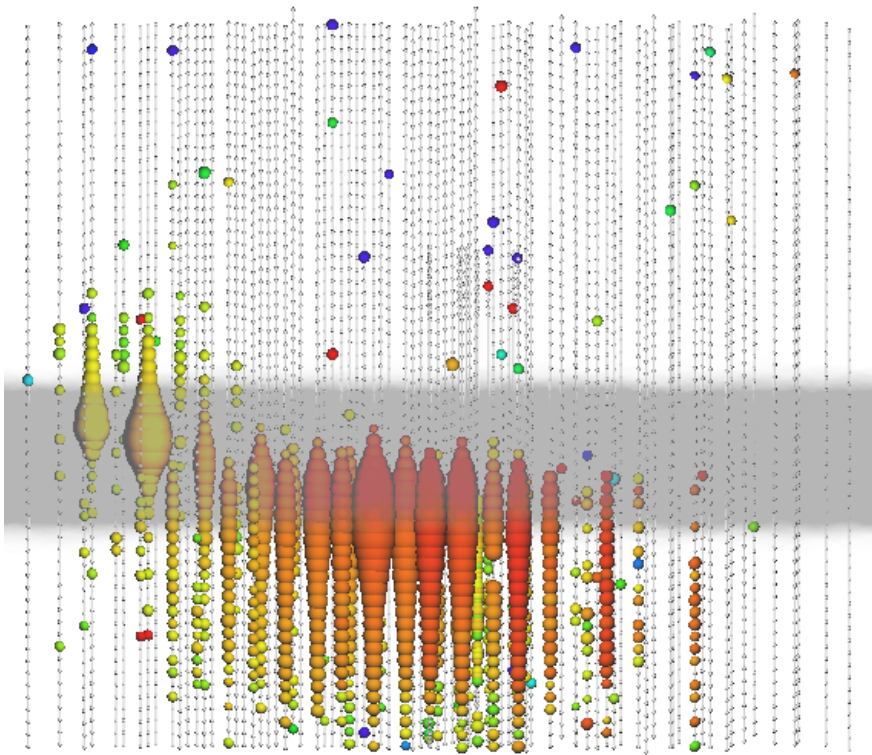
"Evidence for Astrophysical Muon Neutrinos from the Northern Sky with IceCube"
PRL 115, 081102 (2015)



"A combined maximum-likelihood analysis of the high energy astrophysical neutrino flux measured with IceCube"
ApJ 809, 98 (2015)



"Search for astrophysical tau neutrinos in three years of IceCube data"
Submitted to PRD



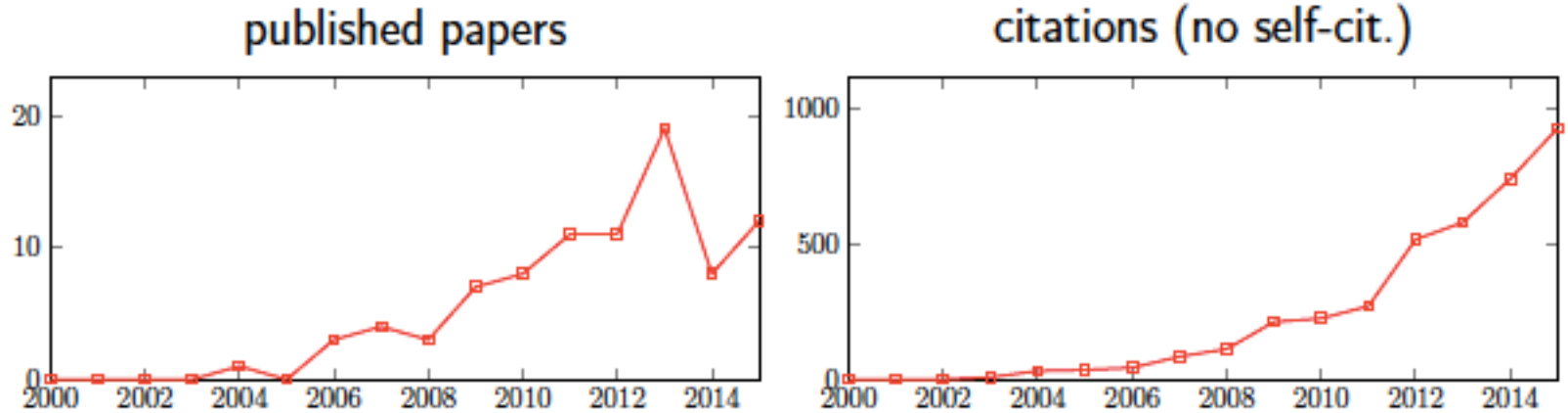
the highest energy neutrino ever
observed in IceCube.

deposited energy 2.6 ± 0.3 PeV

detected on June 11, 2014

ATel including: energy, direction, ang. uncertainty, prob. atmospheric

Papers published in peer-reviewed journals: > 80 (since 2000)



Title	Journal	# cit.
Evidence for High-Energy Extraterrestrial Neutrinos at the IceCube Detector	Science (2013)	219
Observation of High-Energy Astrophysical Neutrinos in Three Years of IceCube Data	Phys.Rev.Lett. (2014)	211
First observation of PeV-energy neutrinos with IceCube	Phys.Rev.Lett. (2013)	180

...

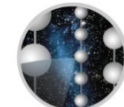


- ★ All results are published
 - on the arXiv – Open Access
 - AND in highly regarded international journals
- Science, Nature, Phys. Rev. Lett., Phys. Rev. D
- Astroph. Journal, Astropart. Phys. Journal etc.

- ★ strategy in place for public sharing IceCube data
 - NOT trivial
 - data from the detector NOT immediately usable to the general scientist

- ✓ several data sets on the web
- ✓ accessible over IceCube public web pages

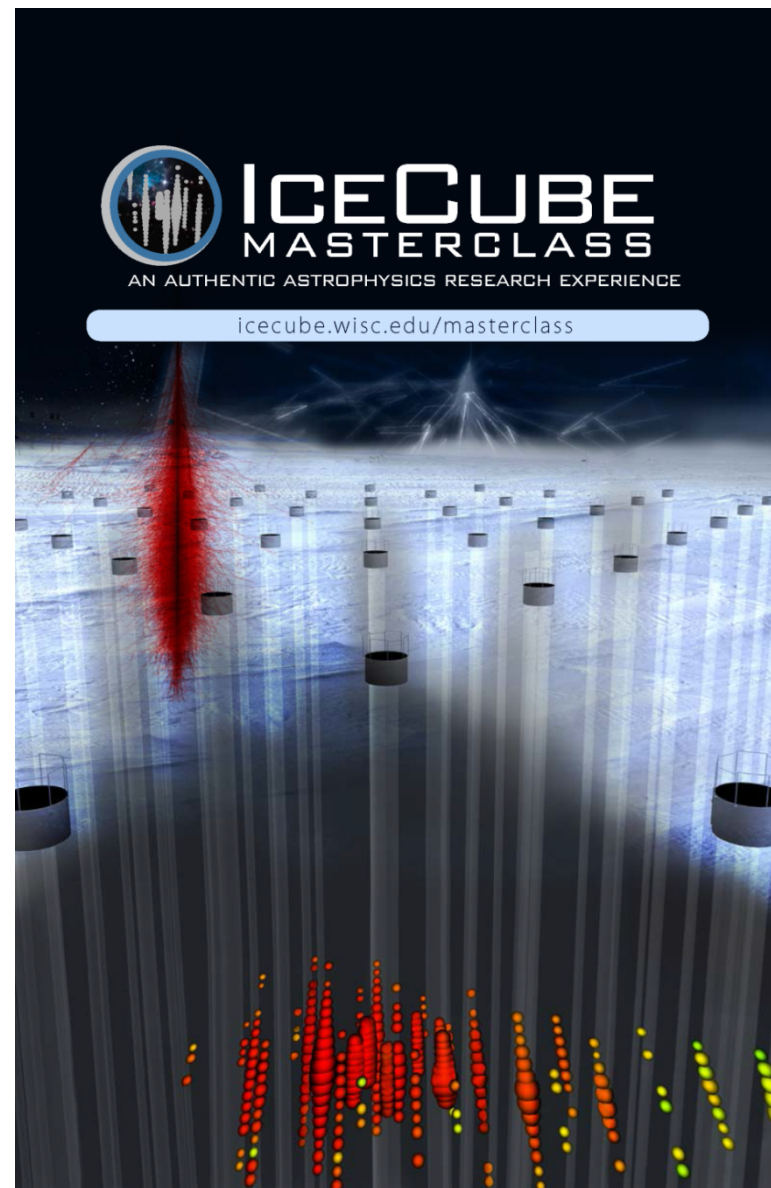




high school student interested in science

- meet IceCube researchers
- work with international partners
- **analyze actual IceCube data**

- Deutsches Elektronen-Synchrotron (DESY) in Zeuthen, Germany
- Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany
- Niels Bohr Institutet in Copenhagen, Denmark
- RWTH Aachen University, Germany
- Universiteit Gent, Belgium
- Universität Mainz, Germany
- University of Delaware in Newark, US
- Université Libre de Bruxelles, Belgium
- Vrije Universiteit Brussel, Belgium
- WIPAC at University of Wisconsin–Madison, US

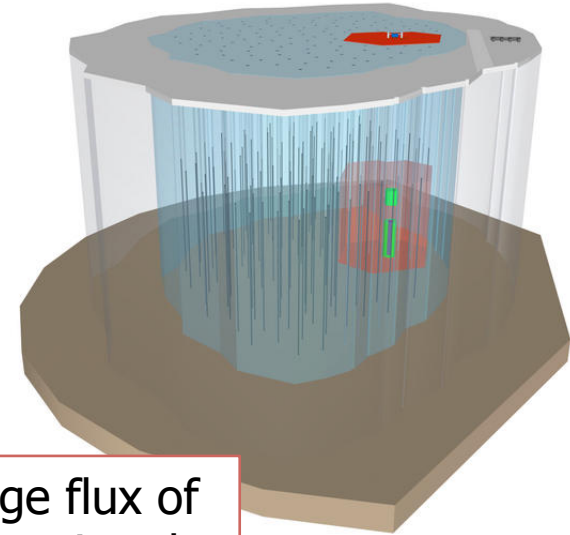


- seeking to build on IceCube's success
- propose to enhance IceCube's science reach

in the high energy domain / low energy domain

1 Gt \rightarrow $O(10$ Gt) detector
to resolve the question of
cosmic ν 's

exploit the huge flux of
atm. ν 's to determine the
neutrino mass ordering

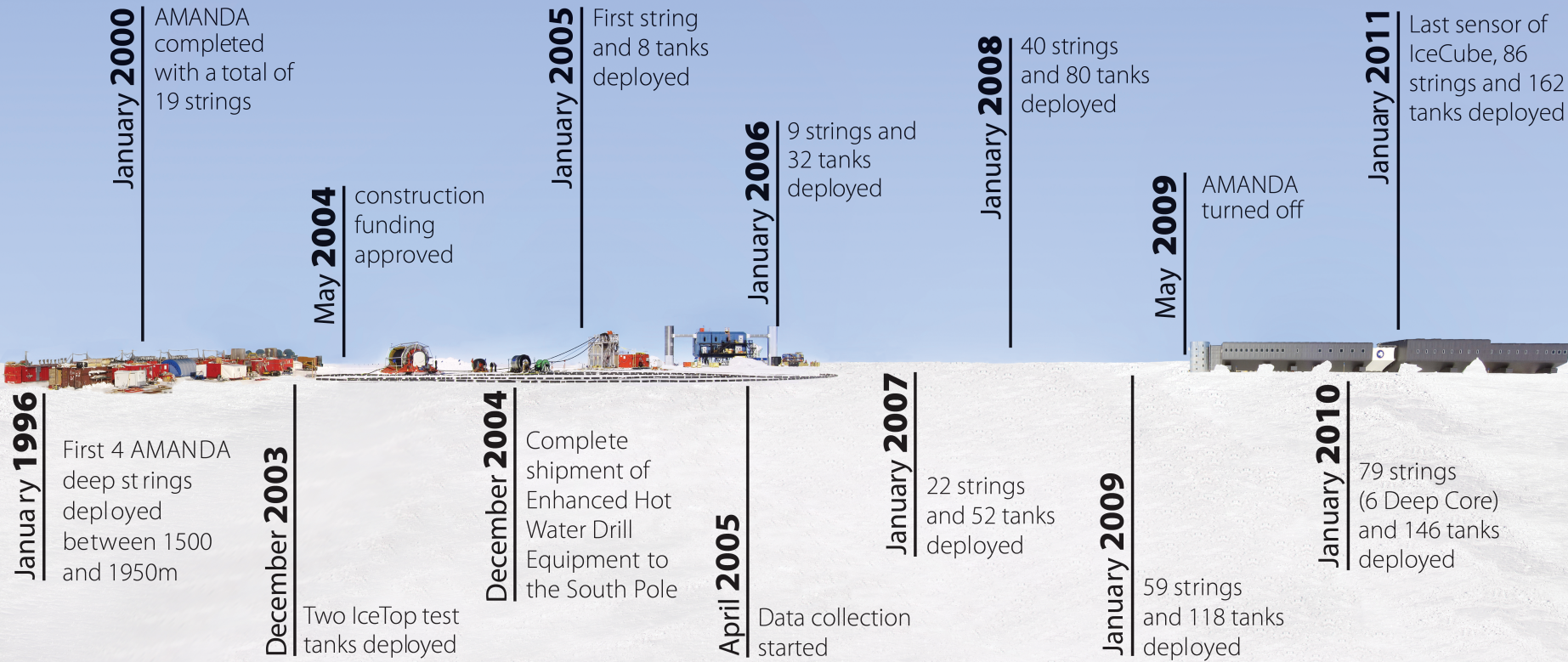


- new collaborating institutions \rightarrow IceCube-Gen2 proto-collaboration
- founding meeting on April 27
 - IceCube institutions
 - PINGU institutions – Manchester, Queen Mary, Tokyo
 - new institutions – MIT, Columbia, Notre Dame
 - interest from MPI Munich Astro-particle physics Dept.
 - Interest from Karlsruhe Institute of Technology

Goal: work out a successful proposal to ensure US and international funding



- ★ IceCube is the world-leading observatory for high-energy neutrinos
- ★ it produces unique results
- ★ this has only been possible due to outstanding efforts of the IceCube collaborators and the continuing support of the funding agencies in the member states
- ★ transitioning towards a rapid announcement/response phase



ICECUBE COLLABORATION REPORT



Olga Botner

SAC Meeting, October 2015