IceCube Neutrino Observatory

The IceCube Neutrino Observatory is funded primarily by the U.S. National Science Foundation and is operated by a team headquartered at the University of Wisconsin–Madison.

IceCube construction and operations were also funded by significant contributions from the National Fund for Scientific Research (FNRS & FWO) in Belgium; the Federal Ministry of Education and Research (BMBF) and the German Research Foundation (DFG) in Germany; the Knut and Alice Wallenberg Foundation, the Swedish Polar Research Secretariat, and the Swedish Research Council in Sweden; and the Department of Energy and the Wisconsin Alumni Research Foundation in the U.S.

The IceCube Collaboration, made up of more than 450 people from 58 institutions in 14 countries, is responsible for the scientific program. Many of the collaborators also contributed to the design and construction of the detector.

icecube.wisc.edu

Original Illustrations by: Savannah Guthrie
Additional Illustrations & Layout by: Alexa Nelson
Story by: Alisa King-Klemperer & Jean DeMerit
Advisors: Jim Madsen, Dan Hooper, Francis Halzen & Albrecht Karle

Adventures with Rosie & Gibbs
the lost penguins

IceCube

Adventure 7: A Cool Celebration

December 2025

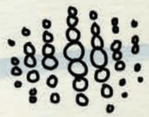
On their first (and long) trip from Antarctica's coast to the South Pole, the penguins Rosie and Gibbs had many adventures. But they were in for a big surprise on their return visit to the IceCube Neutrino Observatory...

Rosie's Discoveries

U.S. National Science Foundation:
The U.S. National Science Foundation (NSF) is an independent federal agency that supports science and engineering in all 50 states and U.S. territories. NSF was established in 1950 by Congress to promote the progress of science; advance national health, prosperity and welfare; and secure national defense.

Glashow Resonance:
Sheldon Glashow first proposed this resonance in 1960, when he was a postdoctoral researcher at what is today the Niels Bohr Institute in Copenhagen, Denmark. There, he wrote a paper in which he predicted that an antineutrino (a neutrino's antimatter twin) could interact with an electron to produce an as-yet undiscovered particle—if the antineutrino had just the right energy—through a process known as resonance.

When the proposed particle, the W boson, was finally discovered in 1983, it turned out to be much heavier than what Glashow and his colleagues had expected back in 1960.


The event detected by IceCube!

Active Galaxy:
An active galaxy emits up to thousands of times more energy than a normal galaxy. Most of this energy is released not in visible light but in other wavelengths, from radio waves to gamma rays. In addition, long jets of gas can spew forth from the galaxy at nearly the speed of light. This activity is driven by a supermassive black hole in the galaxy's nucleus.

Machine Learning:
Machine learning is a branch of artificial intelligence and computer science that focuses on using data and algorithms to enable artificial intelligence to imitate the way that humans learn, gradually improving its accuracy.

Happy Anniversary NSF!

Some Time Later...

WELL, WITH THE UPGRADE WE'LL BE DRILLING AGAIN! ICECUBE WILL DEPLOY MORE INSTRUMENTATION, LEADING TO NEW MEASUREMENTS OF NEUTRINO PROPERTIES.

SO, WHAT'S NEXT FOR ICECUBE?

HAPPY 75th NSF!

IceCube's scientific discoveries were all made possible by NSF—with 75 years focused on the endless frontier of science—and by the IceCube Collaboration. Here's to an even brighter future ahead!

HEY ROSIE AND GIBBS. YOU MADE IT!

75

HELP YOURSELVES TO SOME CAKE, ALTHOUGH I SEE ROSIE HAS ALREADY.

Rosie quickly led the way to the dessert table. There, they found winterovers Alex and Maeko.

HAPPY 75th NSF!

CAN YOU TELL US WHAT THE PARTY IS FOR? SOMETHING BIG MUST HAVE HAPPENED!

HI GIBBS! WE ARE CELEBRATING THE U.S. NATIONAL SCIENCE FOUNDATION'S 75TH ANNIVERSARY.

U.S. National Science Foundation

HAPPY 75th NSF!

WOW, THAT'S SO COOL!

75 YEARS?!

I WASN'T EVEN BORN YET...

HI ROSIE AND GIBBS! MY NAME IS PETER, AND I WORK AT THE NSF. NICE TO MEET YOU TWO!

NICE TO MEET YOU!

HI!

Rosie and Gibbs made a new friend at the Pole.

ICECUBE HAS BEEN PRETTY BUSY SINCE NSF FUNDED THE ICECUBE UPGRADE. THERE IS A LOT TO CELEBRATE TODAY.

THOSE SPECIAL GOGGLES WERE SO COOL!

OH YES, I REMEMBER LEARNING ABOUT THAT!

ROSIE WAS BUSY LOOKING AT THESE COOL ICE SCULPTURES NEARBY. SHE GUESSED THEY WERE SHOWING DIFFERENT THINGS ABOUT ICECUBE!

YES, ICECUBE HAS HAD TWO SUCCESSFUL FIELD SEASONS FOR THE UPGRADE, WITH ONE MORE TO GO.

THAT'S SO EXCITING!

HAVEN'T YOU BEEN KEEPING UP WITH ICECUBE NEWS?

WHAT COOL STUFF HAS ICECUBE BEEN DOING?

NO, I WAS TOO BUSY LOOKING FOR WATER...

ROSIE WASN'T AS UP-TO-DATE AS GIBBS...

HA HA! WELL, WHERE DO WE START...

OH, HOW ABOUT THE ICECUBE DETECTION OF A GLASHOW RESONANCE EVENT?

Glashow Resonance

THAT RESULT PROVED CORRECT A 60-YEAR-OLD THEORY PREDICTED BY NOBEL LAUREATE PHYSICIST SHELDON GLASHOW IN 1960.

THE PENGUINS LEARNED ABOUT THE DISCOVERY REPRESENTED BY THE FIRST ICE SCULPTURE.

AND DIDN'T ICECUBE FIND ANOTHER SOURCE OF HIGH-ENERGY NEUTRINOS?

THAT'S RIGHT! WE DETECTED 80 HIGH-ENERGY NEUTRINOS FROM THE DIRECTION OF AN ACTIVE GALAXY 47 MILLION LIGHT-YEARS AWAY!

80

Active Galaxy

ROSIE REMEMBERED THE BLAZAR THAT ICECUBERS IDENTIFIED AS A SOURCE OF NEUTRINOS. THAT WAS THE LAST PARTY THEY WENT TO!

SO NOW WE KNOW THAT NEUTRINOS COME FROM TWO SOURCES, THE BLAZAR AND THEN THIS NEW GALAXY, RIGHT?

WE ACTUALLY HAVE THREE SOURCES NOW. MOST RECENTLY, ICECUBE FOUND HIGH-ENERGY NEUTRINOS COMING FROM OUR OWN BACKYARD!

YES, OUR OWN GALAXY, THE MILKY WAY!

BUT HOW DID THEY DO IT?

PETER POINTED TO THE LAST SCULPTURE IN LINE.

THEY FOLLOWED PETER OVER TO WHERE ALEX WAS STANDING WITH A LARGE POSTER. IT SHOWED WHAT THE MILKY WAY LOOKED LIKE USING DIFFERENT TYPES OF LIGHT, AND NOW NEUTRINOS, TOO! PETER TOLD THEM ABOUT HOW THE IMAGE WAS CREATED.

SCIENTISTS USED MACHINE LEARNING TO CREATE A CLEAR PICTURE OF OUR GALAXY, WHICH WAS PREVIOUSLY ONLY SEEN USING LIGHT.

RADIO

OPTICAL

GAMMA RAYS

NEUTRINOS

WOW, I WILL NEVER LOOK AT OUR GALAXY THE SAME!

Machine Learning