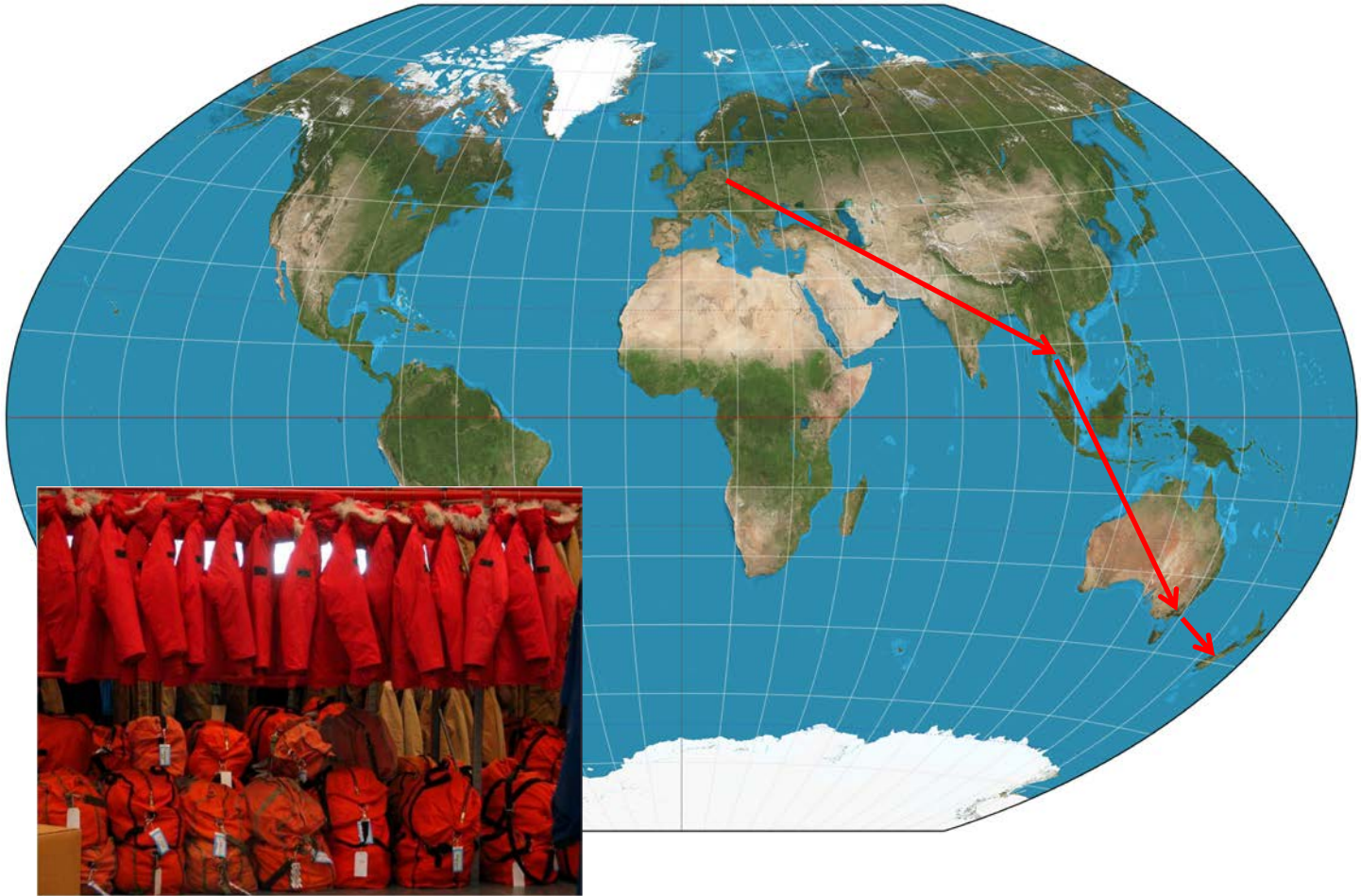
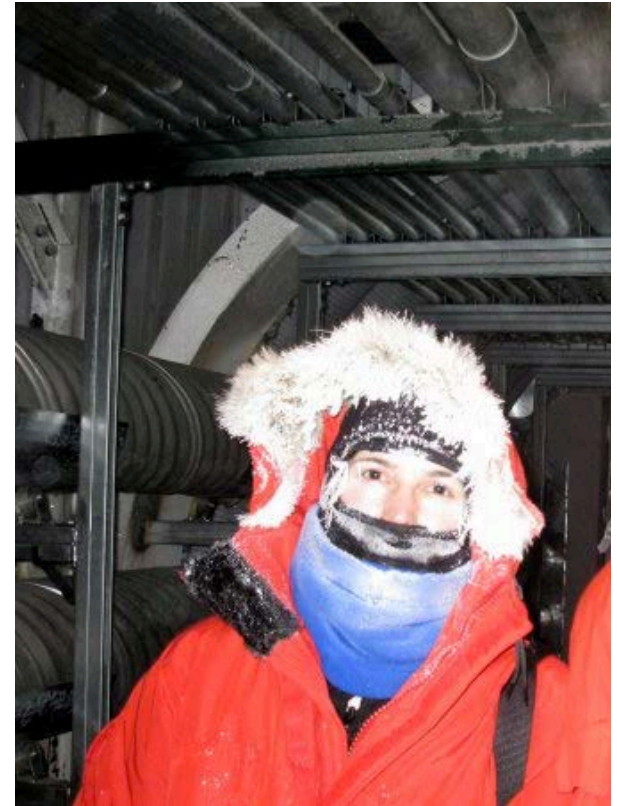


# The South Pole









# Weather at the South Pole

[Weather Today](#) [Weather Hourly](#) [14 Day Forecast](#) [Yesterday/Past Weather](#) [Climate \(Averages\)](#)

**Now**

-73 °F

Snow flurries. Sunny.

Feels Like: -112 °F

Forecast: N/A

Wind: 22 km/h ← from East



**Location:** Amundsen-Scott South Pole Station

**Current Time:** 24 Jun 2021, 23:50:56

**Latest Report:** 24 Jun 2021, 18:00

**Visibility:** 1 km

**Pressure:** N/A

**Humidity:** N/A

**Dew Point:** N/A



## Upcoming 5 hours



**Now**



-73 °F

**00:00**



-67 °F

**01:00**



-67 °F

**02:00**



-67 °F

**03:00**

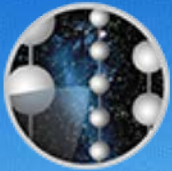


-67 °F

**04:00**

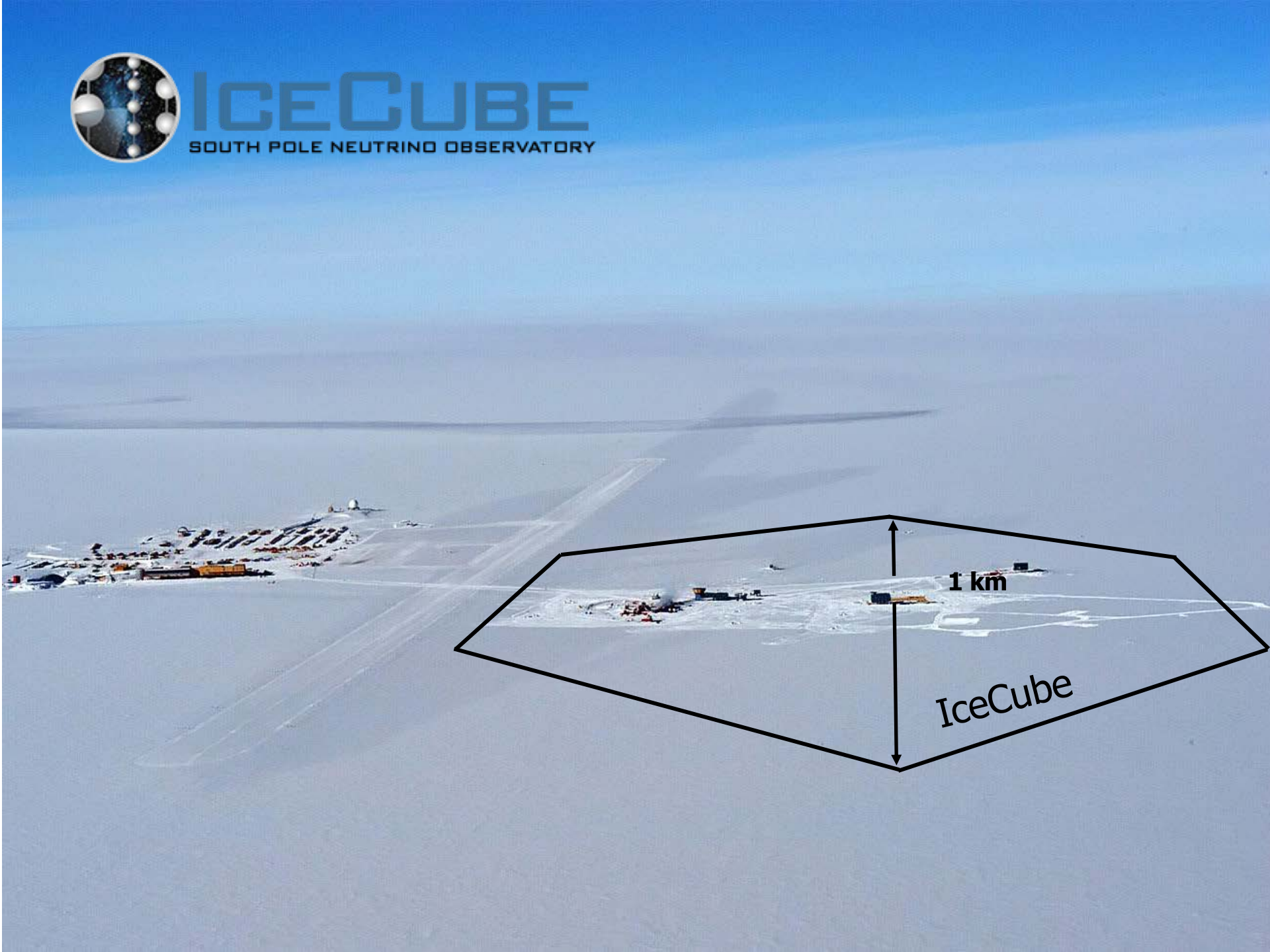


-67 °F



# ICECUBE

SOUTH POLE NEUTRINO OBSERVATORY



1 km

IceCube



# ICECUBE

SOUTH POLE NEUTRINO OBSERVATORY

50 m

Ice Top



## IceCube Laboratory

Data is collected here and sent by satellite to the data warehouse at UW-Madison

1450 m

86 strings of DOMs,  
set 125 meters apart



## Amundsen-Scott South Pole Station, Antarctica

A National Science Foundation-managed research facility



## Digital Optical Module (DOM)

5,160 DOMs  
deployed in the ice

2450 m

IceCube  
detector

DeepCore

DOMs  
are 17  
meters  
apart

60 DOMs  
on each  
string



Antarctic bedrock



# ICECUBE

SOUTH POLE NEUTRINO OBSERVATORY

x 400000

50 m



Amundsen-Scott South Pole Station, Antarctica  
A National Science Foundation-managed research facility



## IceCube Laboratory

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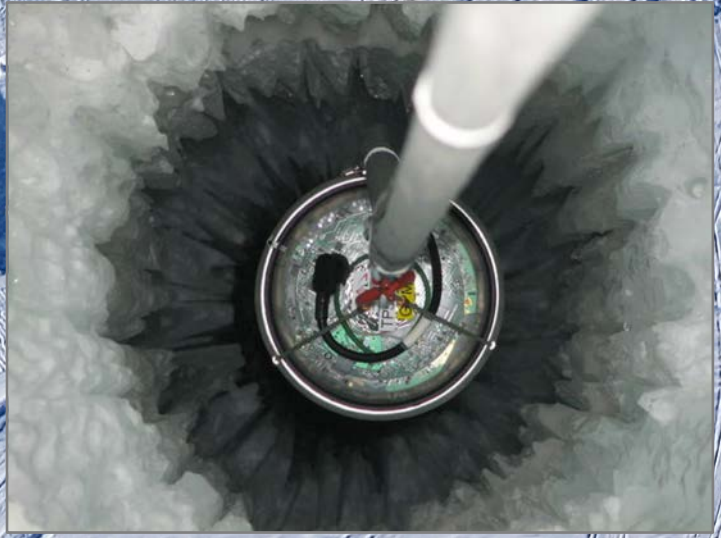
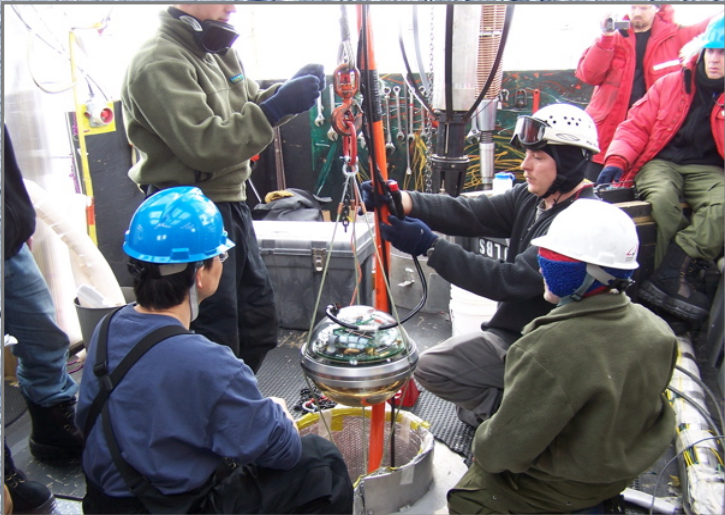
60 DOMs  
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apart

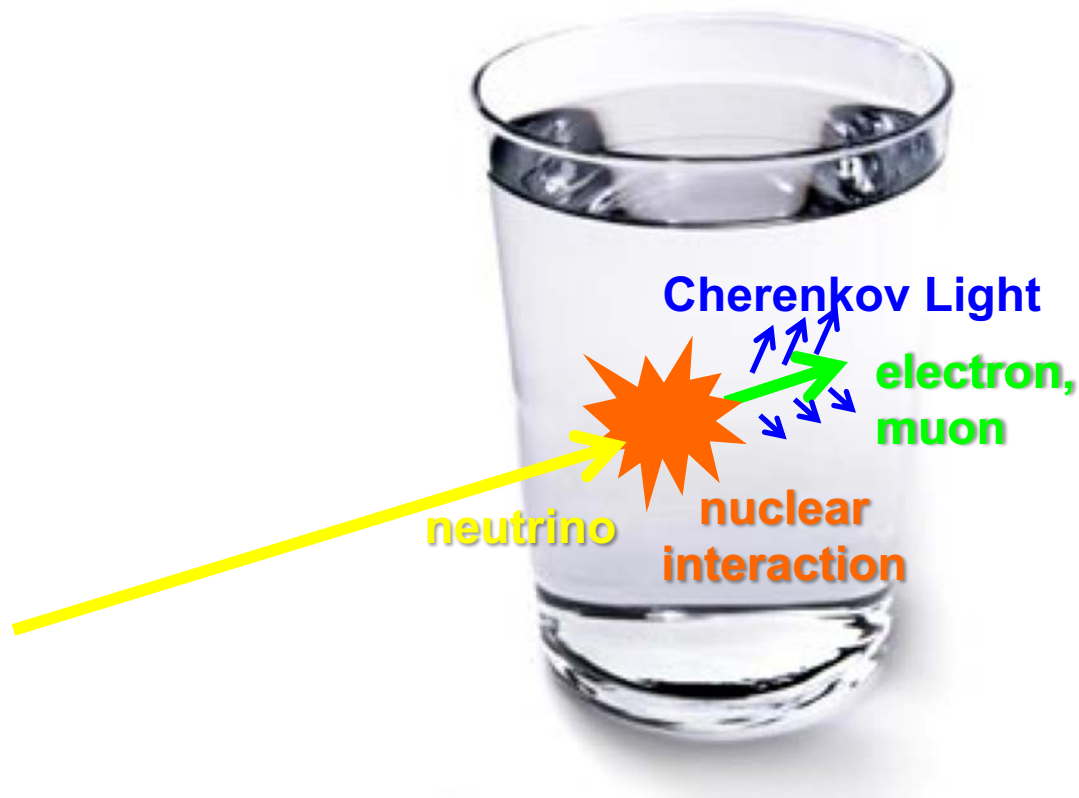
Antarctic bedrock



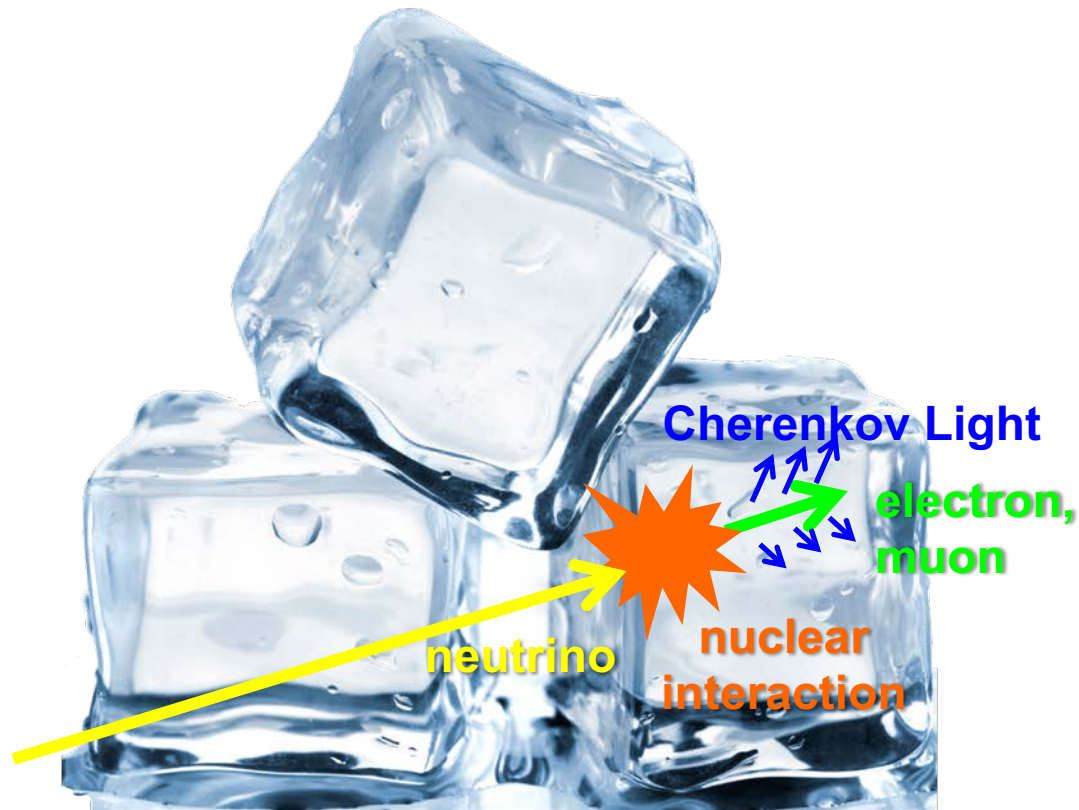


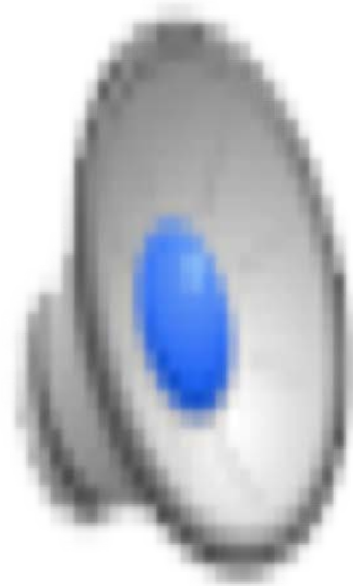


# Cherenkov Light

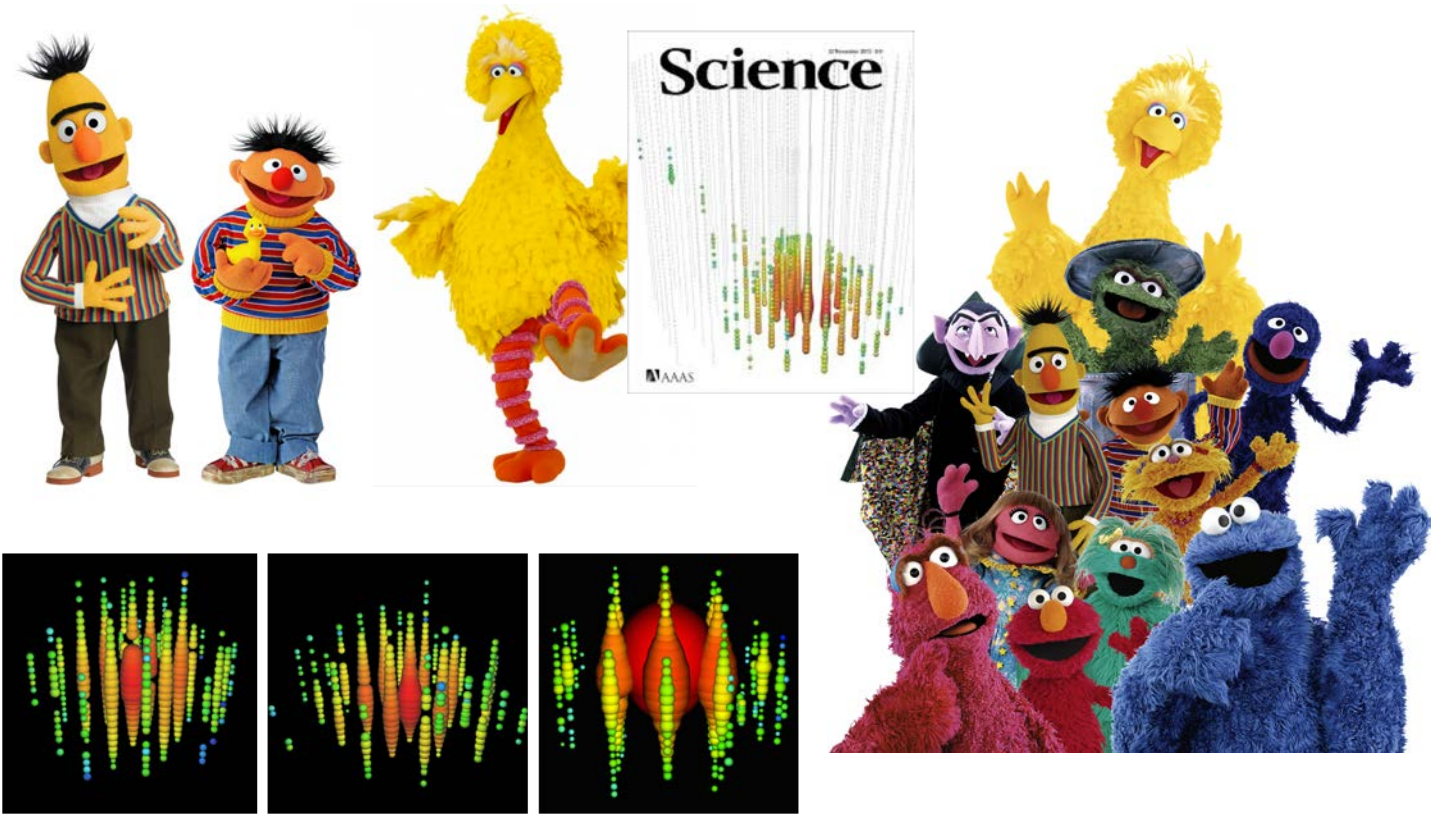


# Cherenkov Light

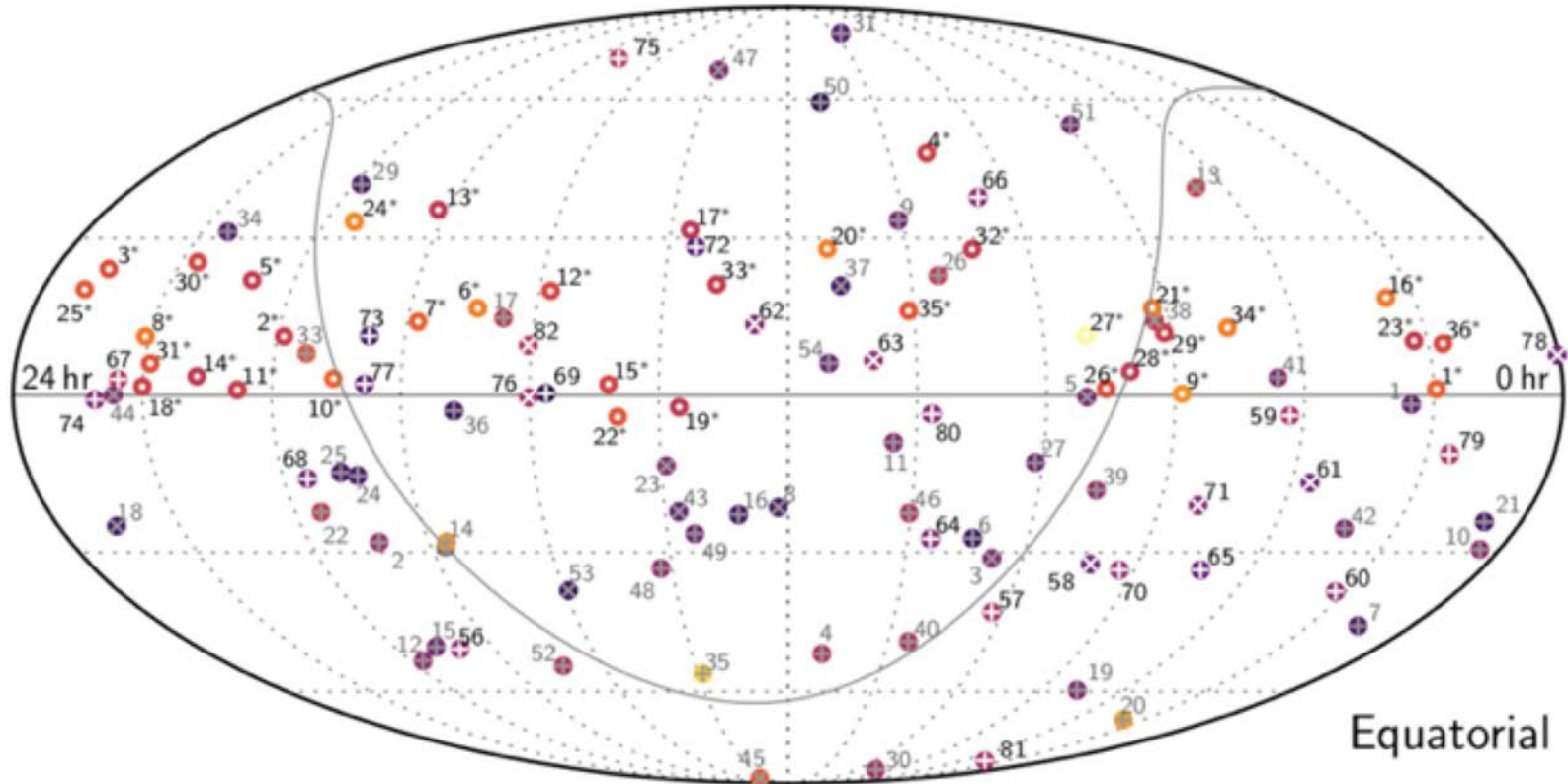




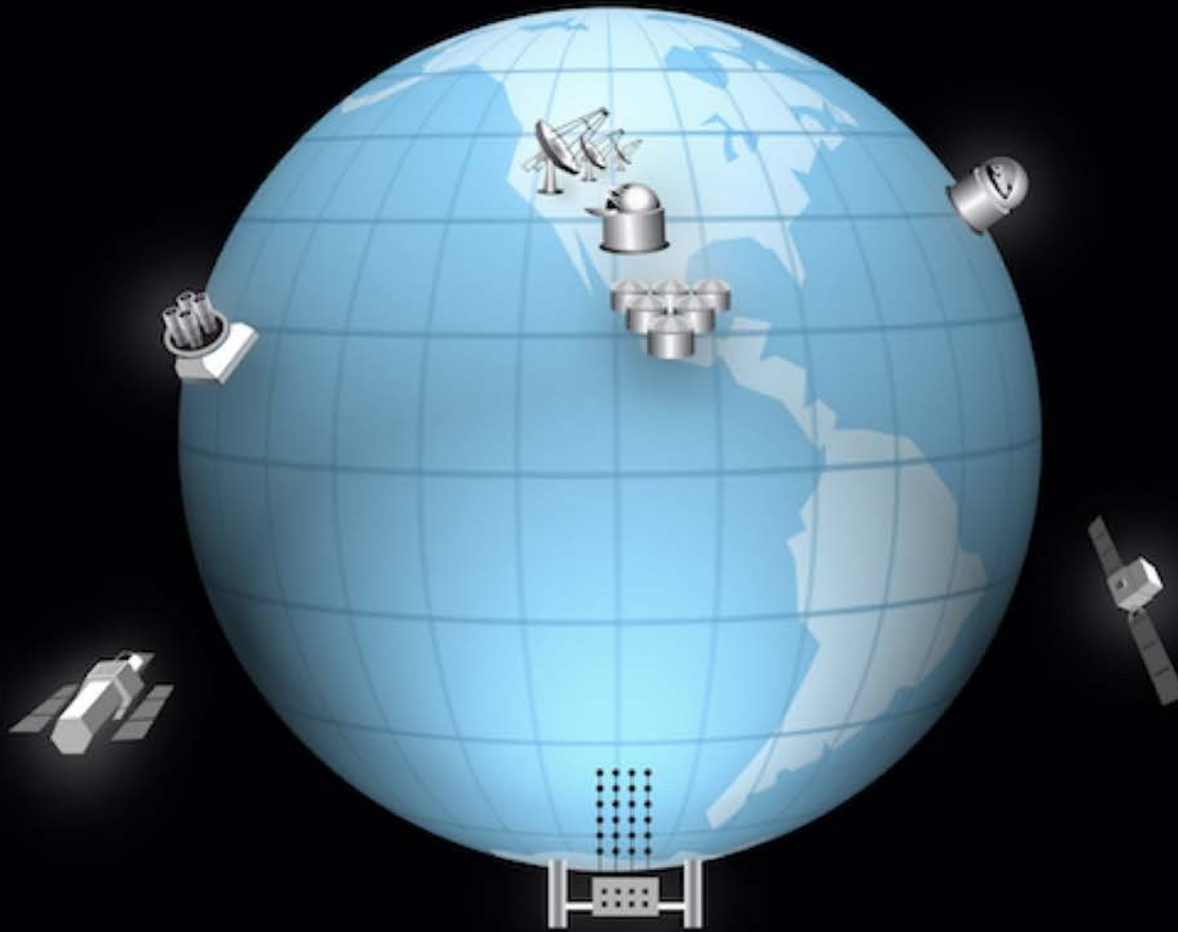
# First detection of high-energy extragalactic neutrinos



# Where do the neutrinos come from?



# IceCube Target of Opportunity Program



**Goal: Find electromagnetic counterpart**

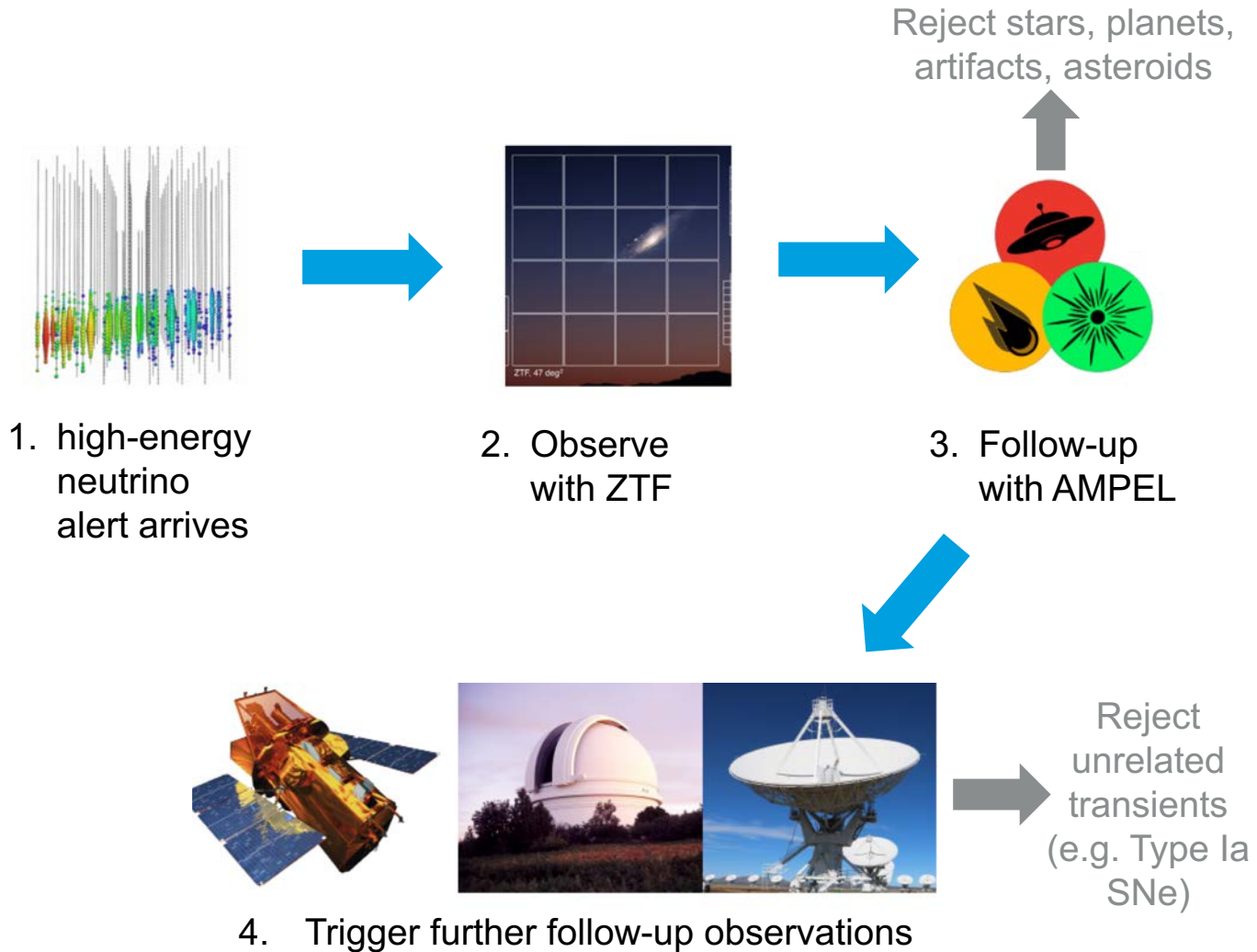
# Optical Follow-up of Neutrino Events

Zwicky Transient Facility, 1.2 m  
telescope, Mt Palomar

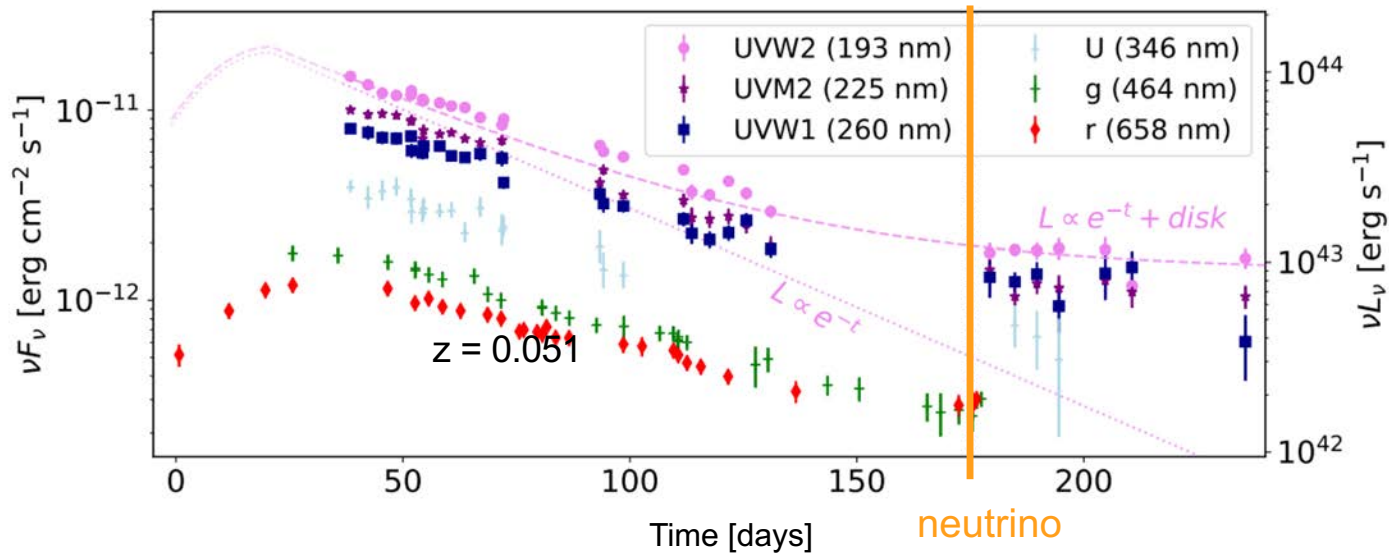




# ZTF Follow-up Pipeline



# AT2019dsg / “Bran Stark” coincident with 200 TeV Neutrino IC191001A

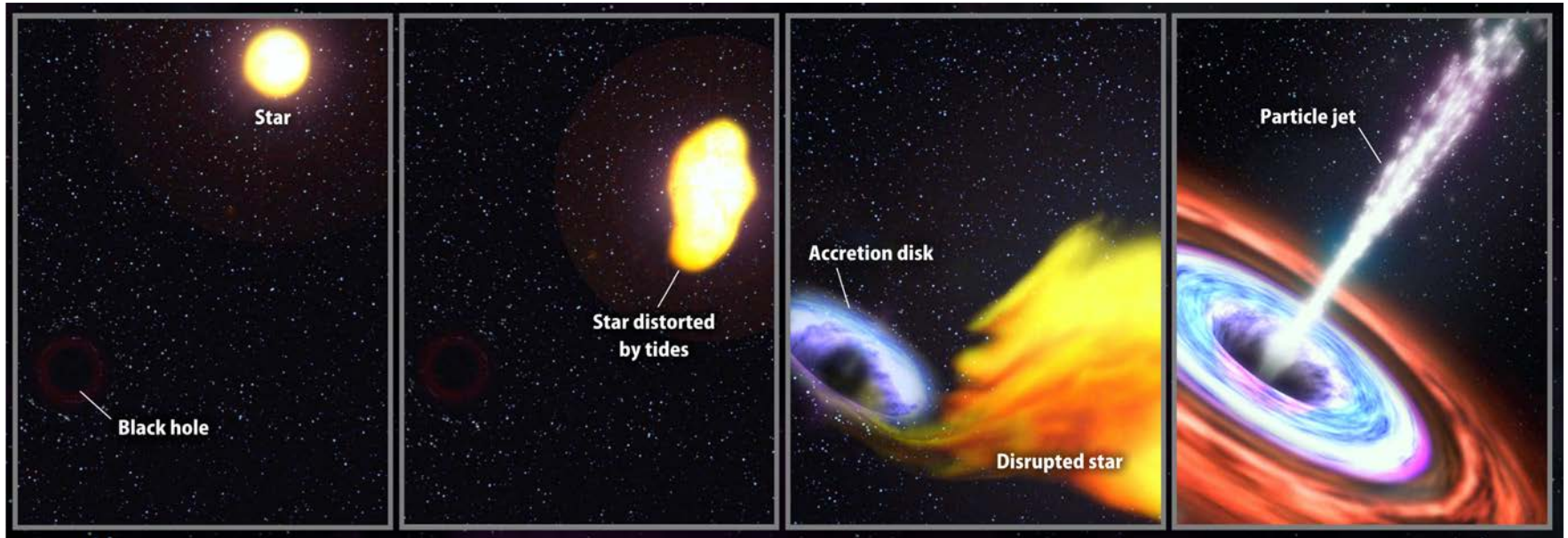


Distance:  $z = 0.05$  ( $d=230\text{Mpc}$ )

# Tidal Disruption Events

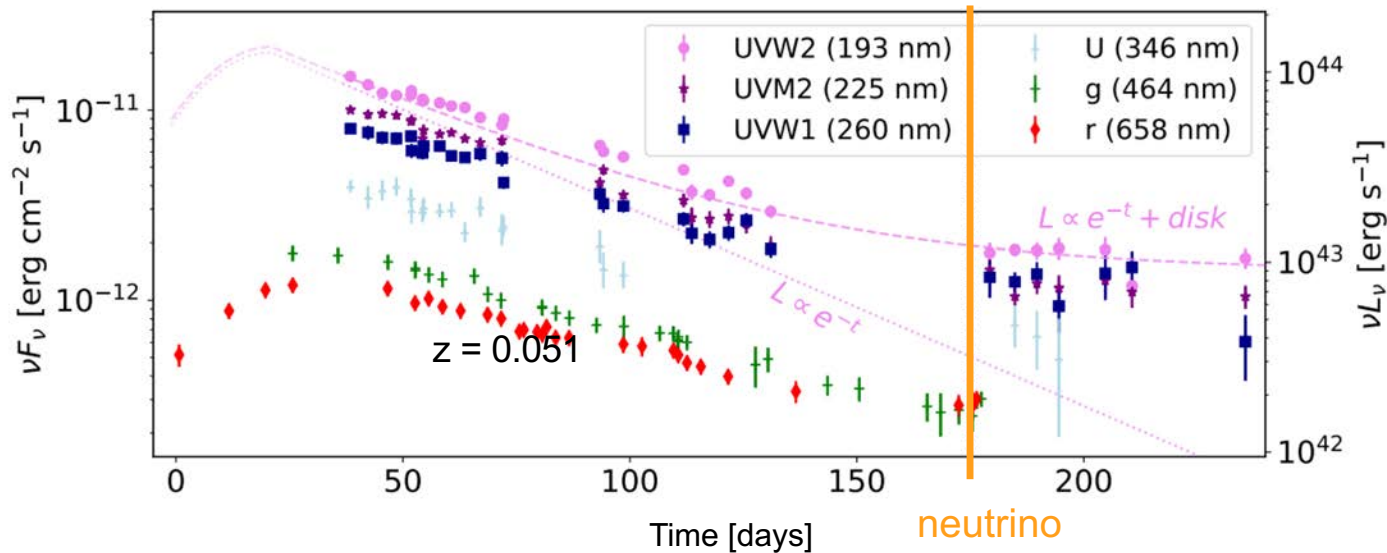


# Tidal Disruption Events



~50 TDEs identified, 3 jetted TDEs

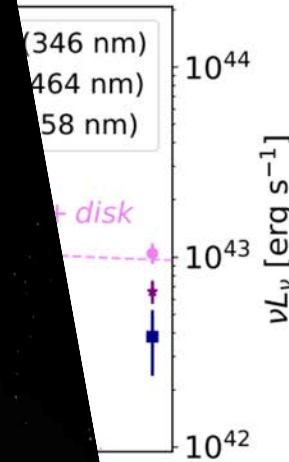
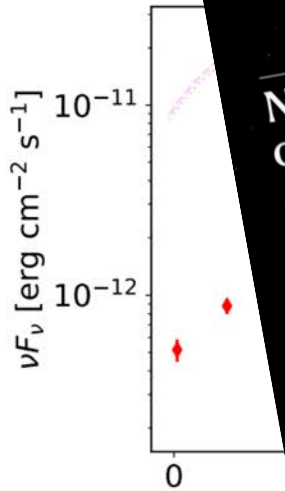
# AT2019dsg / “Bran Stark” coincident with 200 TeV Neutrino IC191001A



Distance:  $z = 0.05$  ( $d=230\text{Mpc}$ )

**Chance coincidence: 0.2% to find a TDE that bright**

# AT2019dsg / “Bran Stark” Incident with 200 TeV Neutrino IC101



Distance

Ch... and a TDE that bright

# Young Investigator Group at DESY



# How did I get here?





# How did I get here?





# How did I get here?





# THE ICECUBE COLLABORATION

 **AUSTRALIA**  
University of Adelaide

 **BELGIUM**  
Université libre de Bruxelles  
Universiteit Gent  
Vrije Universiteit Brussel

 **CANADA**  
SNOLAB  
University of Alberta-Edmonton


 **DENMARK**  
University of Copenhagen

 **GERMANY**  
Deutsches Elektronen-Synchrotron  
ECAP, Universität Erlangen-Nürnberg  
Humboldt-Universität zu Berlin  
Karlsruhe Institute of Technology  
Ruhr-Universität Bochum  
RWTH Aachen University  
Technische Universität Dortmund  
Technische Universität München  
Universität Mainz  
Universität Wuppertal  
Westfälische Wilhelms-Universität  
Münster

 **JAPAN**  
Chiba University

 **NEW ZEALAND**  
University of Canterbury

 **REPUBLIC OF KOREA**  
Sungkyunkwan University

 **SWEDEN**  
Stockholms universitet  
Uppsala universitet

 **SWITZERLAND**  
Université de Genève

 **UNITED KINGDOM**  
University of Oxford

 **UNITED STATES**  
Clark Atlanta University  
Drexel University  
Georgia Institute of Technology  
Harvard University  
Lawrence Berkeley National Lab  
Loyola University Chicago  
Marquette University  
Massachusetts Institute of Technology  
Mercer University  
Michigan State University  
Ohio State University  
Pennsylvania State University

South Dakota School of Mines  
and Technology  
Southern University  
and A&M College  
Stony Brook University  
University of Alabama  
University of Alaska Anchorage  
University of California, Berkeley  
University of California, Irvine  
University of Delaware  
University of Kansas  
University of Maryland

University of Rochester  
University of Texas at Arlington  
University of Utah  
University of Wisconsin-Madison  
University of Wisconsin-River Falls  
Yale University

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(FWO-Vlaanderen)

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German Research Foundation (DFG)  
Deutsches Elektronen-Synchrotron (DESY)

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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)



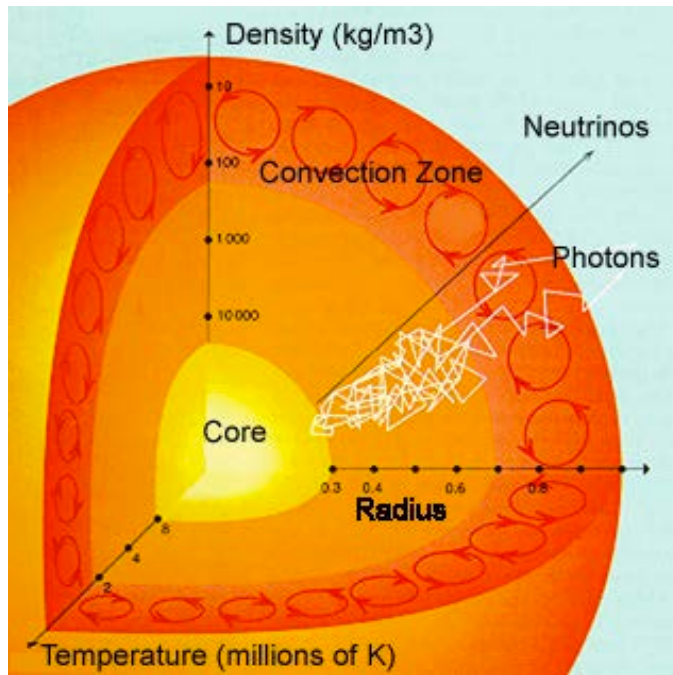
icecube.wisc.edu



# backup



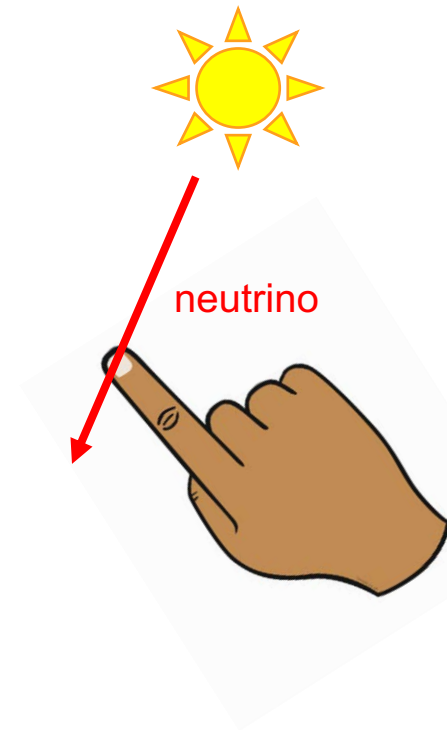
# Neutrinos can escape the densest environments!



For example the  
**center of the Sun**

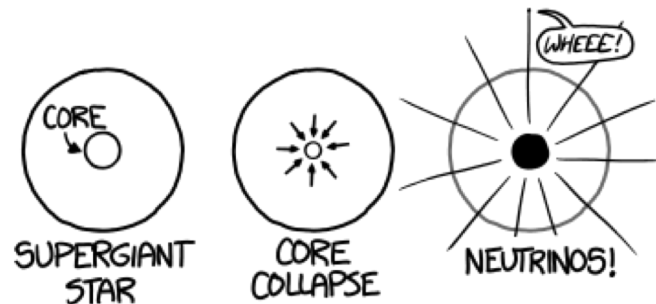
**70 billion neutrinos  
per second through  
your fingernail**

**Neutrinos helped us  
to understand how  
the Sun work!**





# Neutrinos are produced when Stars die



Heavy stars die in a powerful explosion called *Supernova*

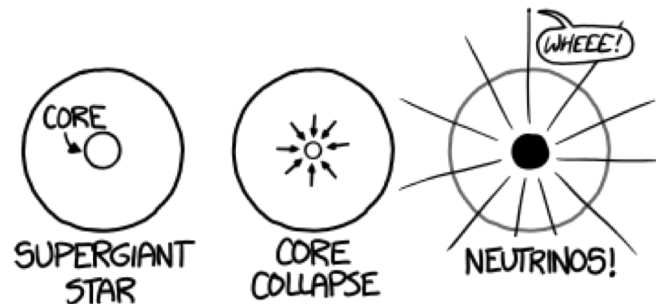
The supernova outshines the entire galaxy with 100 billion stars

SN1987A: Neutrinos arrived 3h **before** optical light

$10^{58}$  neutrinos emitted  
11 detected



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11 detected

**99% of energy release in neutrinos**