The first map of the Milky Way in neutrinos!

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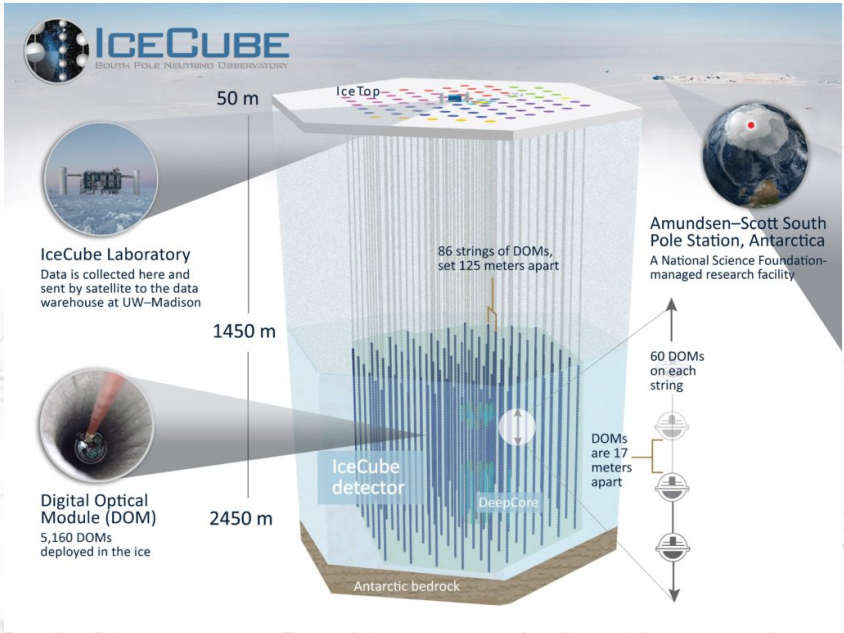
arXiv:2307.14842 and **arXiv:2211.09972**

Neutrino-physics


IceCube
South Pole Neutrino Observatory
50 m
IceTop
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
60 DOMs on each string
DOMs are 17 meters apart
IceCube detector
DeepCore
Digital Optical Module (DOM)
5,160 DOMs deployed in the ice
2450 m
Antarctic bedrock

IceCube


THE ICECUBE COLLABORATION
AUSTRALIA
University of Adelaide
BELGIUM
UCLouvain
Université libre de Bruxelles
Universiteit Gent
Vrije Universiteit Brussel
CANADA
Queen's University
University of Alberta–Edmonton
DENMARK
University of Copenhagen
GERMANY
Deutsches Elektronen-Synchrotron
ECAP, Universität Erlangen-Nürnberg
Humboldt–Universität zu Berlin
Karlsruhe Institute of Technology
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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)
IceCube Neutrino Observatory
icecube.wisc.edu

IceCube Upgrade (planned 2023-)

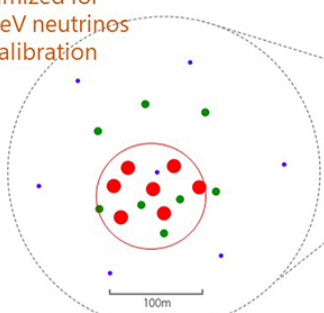
Optimized for
- GeV neutrinos
- Calibration

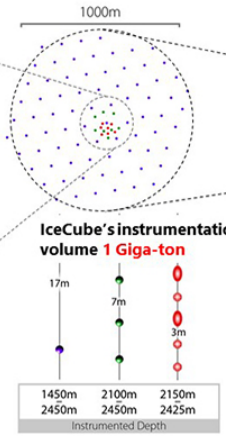
IceCube (2005-)

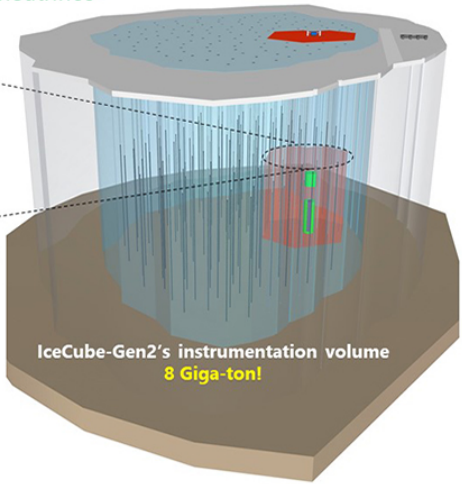
Optimized for
- Diffuse high energy cosmic neutrinos

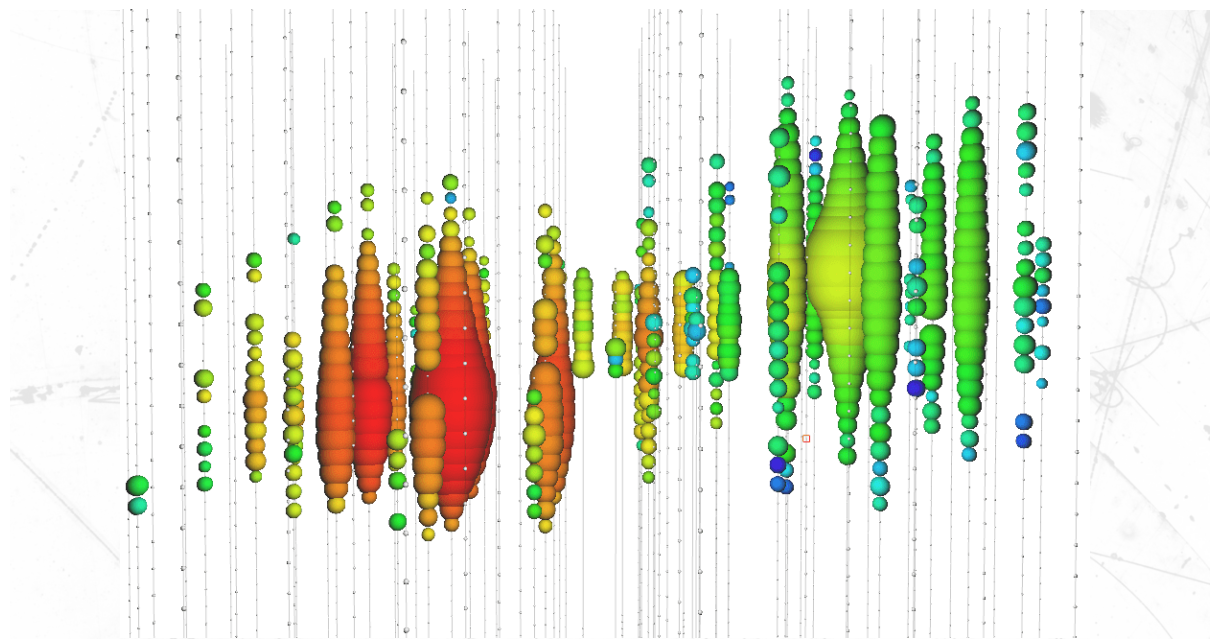
IceCube-Gen2 (planned 2026-)

Optimized for
- Cosmic neutrino point sources

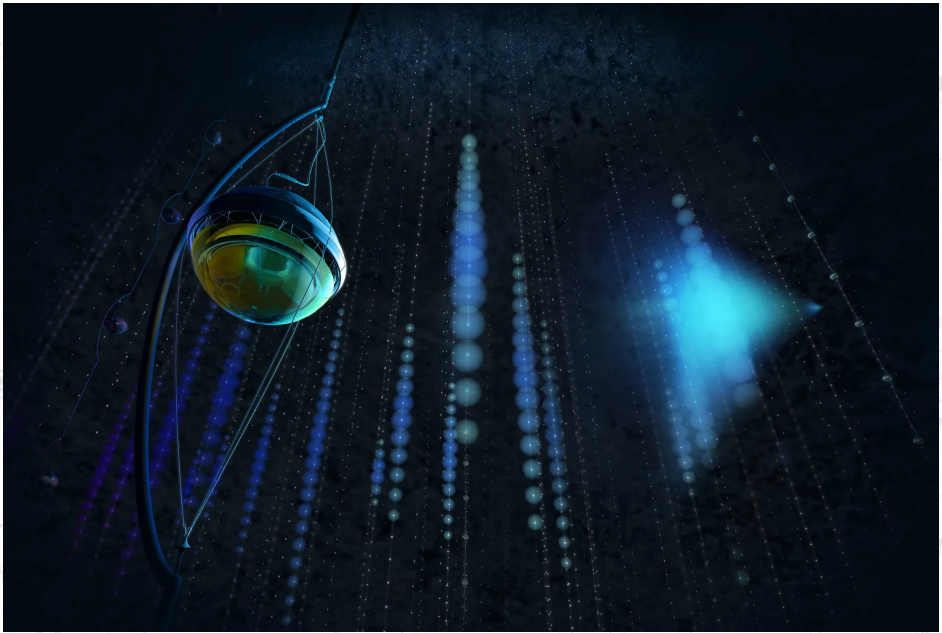




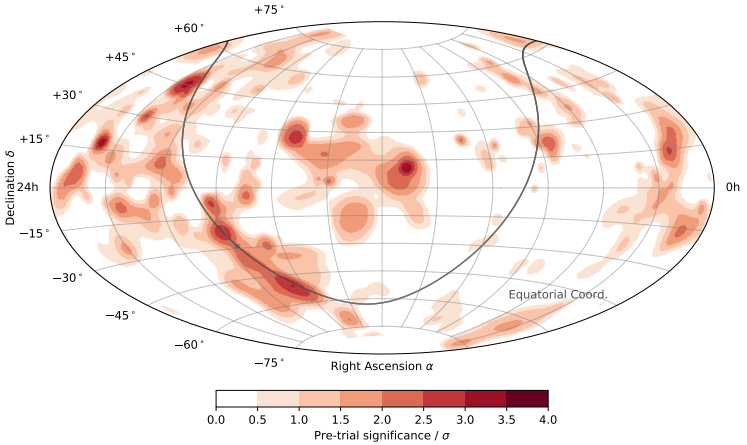




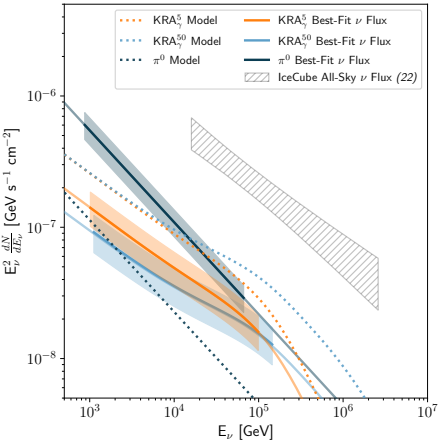
IceCube



IceCube

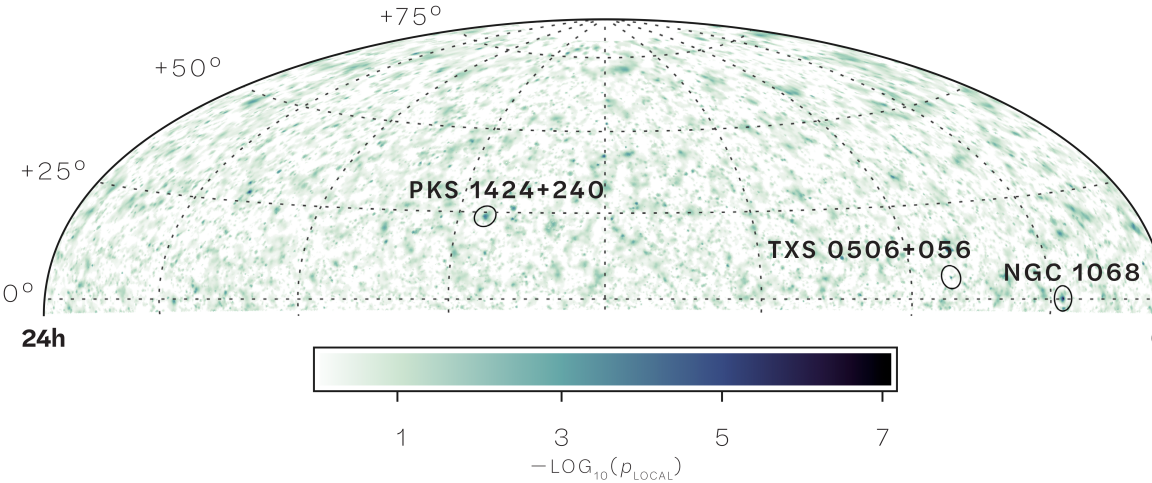


The best-fitting pre-trial significance for the all-sky search is shown as a function of direction in an Aitoff projection of the celestial sphere, in equatorial coordinates (J2000 equinox). The Galactic plane is indicated by a grey curve, and the Galactic Center as a dot. Although some locations appear to have significant emission, the trial factor for the number of points searched means these points are all individually statistically consistent with background fluctuations. The clustering of larger significances along the galactic plane reflects the significant excess that is observed in the template searches for the Galactic plane.

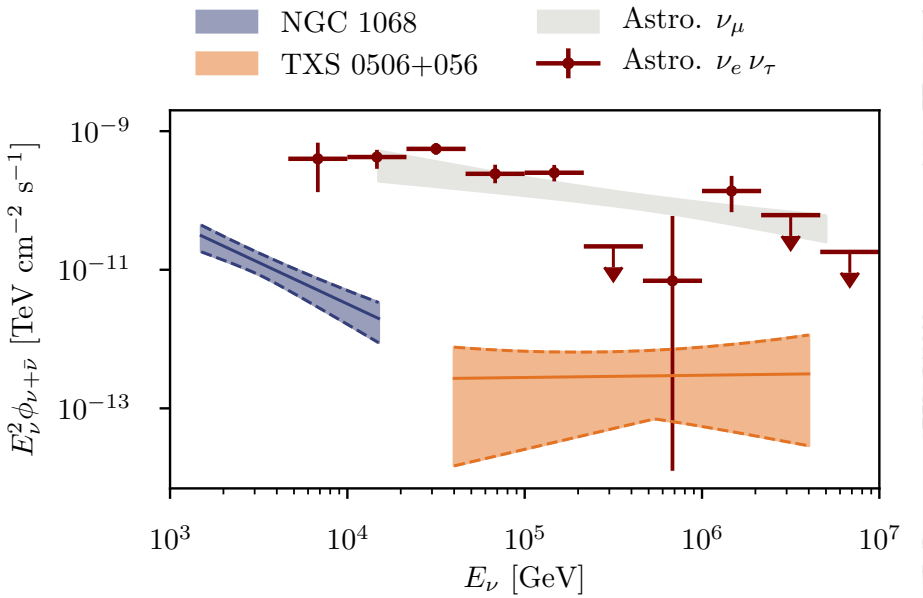


Energy-scaled, sky-integrated, per-flavor neutrino flux as a function of neutrino energy (E_ν) for each of the Galactic plane models. Dotted lines are the predicted values for the π^0 (dark blue), KRA$_\gamma^5$ (orange) and KRA$_\gamma^{50}$ (light blue) models while solid lines are our best-fitting flux normalizations from the IceCube data. Shaded regions indicate the 1σ uncertainties, extending over the energy range that contributes to 90% of the significance. These results are based on the all-sky (4π sr) template and are presented as an all-sky flux. For comparison, the grey hatching shows the flux of the IceCube all-sky neutrino flux, scaled to an all-sky flux by multiplying by 4π, with its 1σ uncertainty.

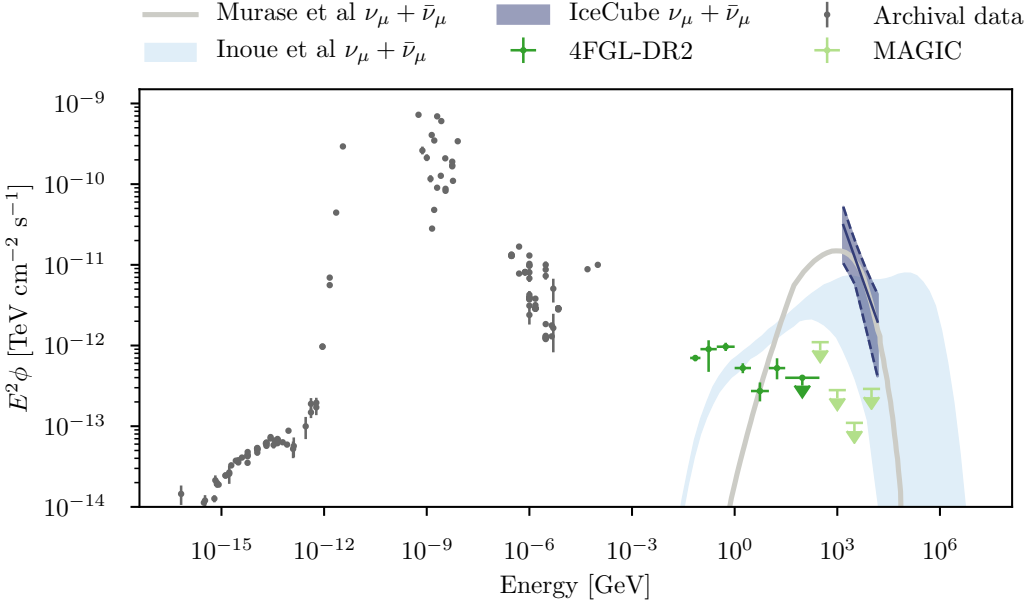
Numerous neutrinos from NGC 1068, better known as Messier 77, a dynamic galaxy 47 million light-years away, have been found by IceCube. With wide binoculars, it is possible to see the well-studied galaxy that the Hubble Space Telescope captured in this photograph.



Skymap of the scan for point sources in the Northern Hemisphere. The color scale represents the local p-value obtained from the maximum likelihood analysis evaluated (with the spectral index as free fit parameter) at each location in the sky, shown in Equatorial coordinates with Hammer-Aitoff projection. The black circles indicate the three most significant objects in the source list search. The circle of NGC 1068 also coincides with the overall hottest spot in the Northern Sky.



Comparison of point-source fluxes for NGC 1068 and TXS 0506+056 from this analysis with the total diffuse astrophysical neutrino flux.



Spectral energy distribution of NGC 1068.