



Credit M. Wolf - IceCube/NSF

IceCube-Gen2

towards the next generation high-energy neutrino observatory

Darren R Grant — May 2026



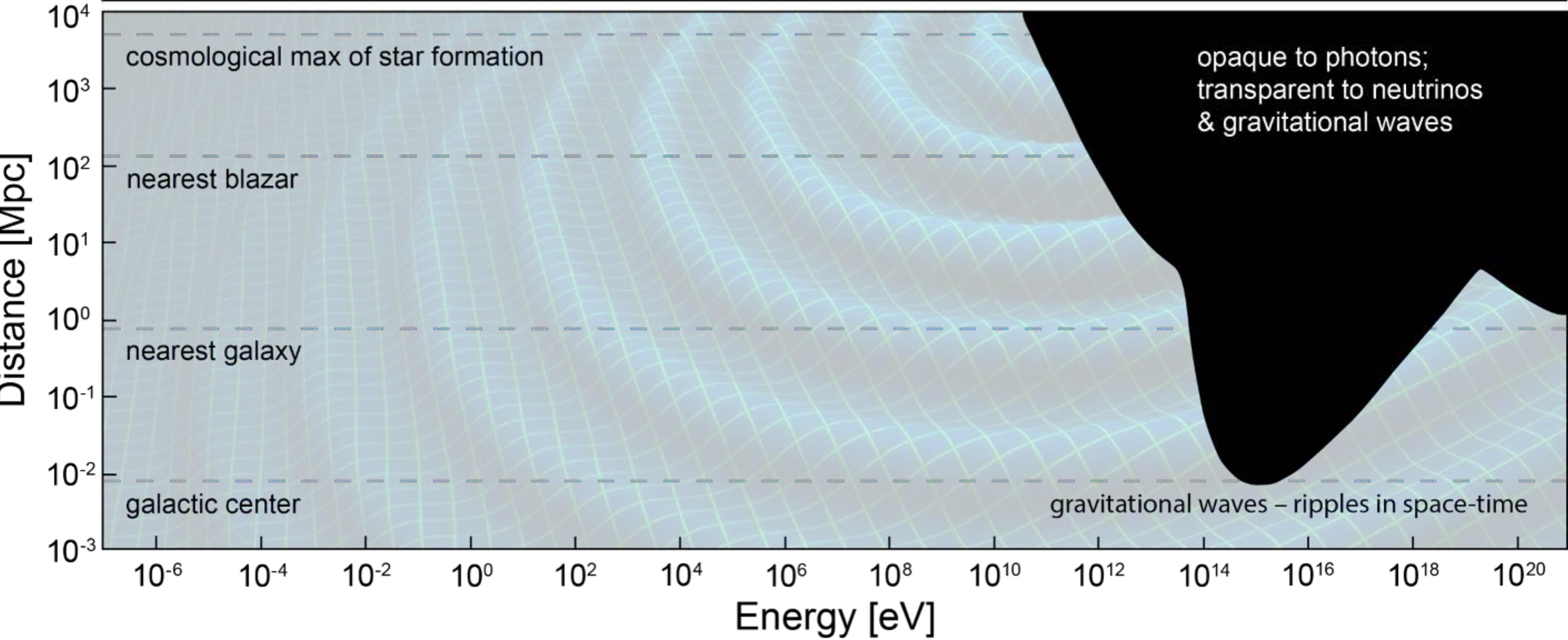
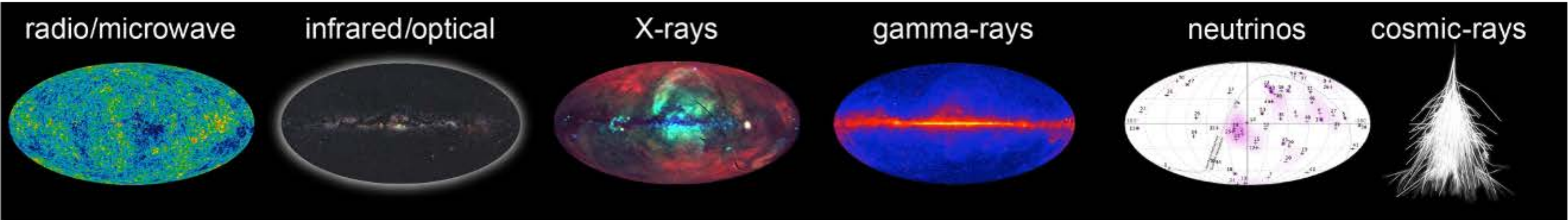
Canada Excellence
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SIMON FRASER
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Astronomical messengers

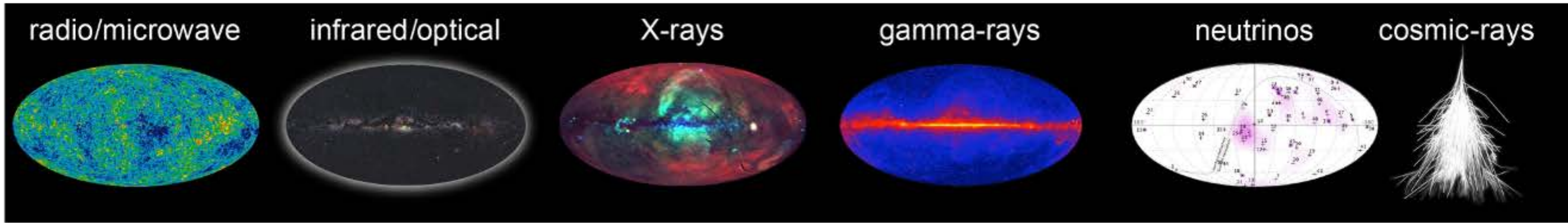
Bartos & Kowalski, IOP 2018



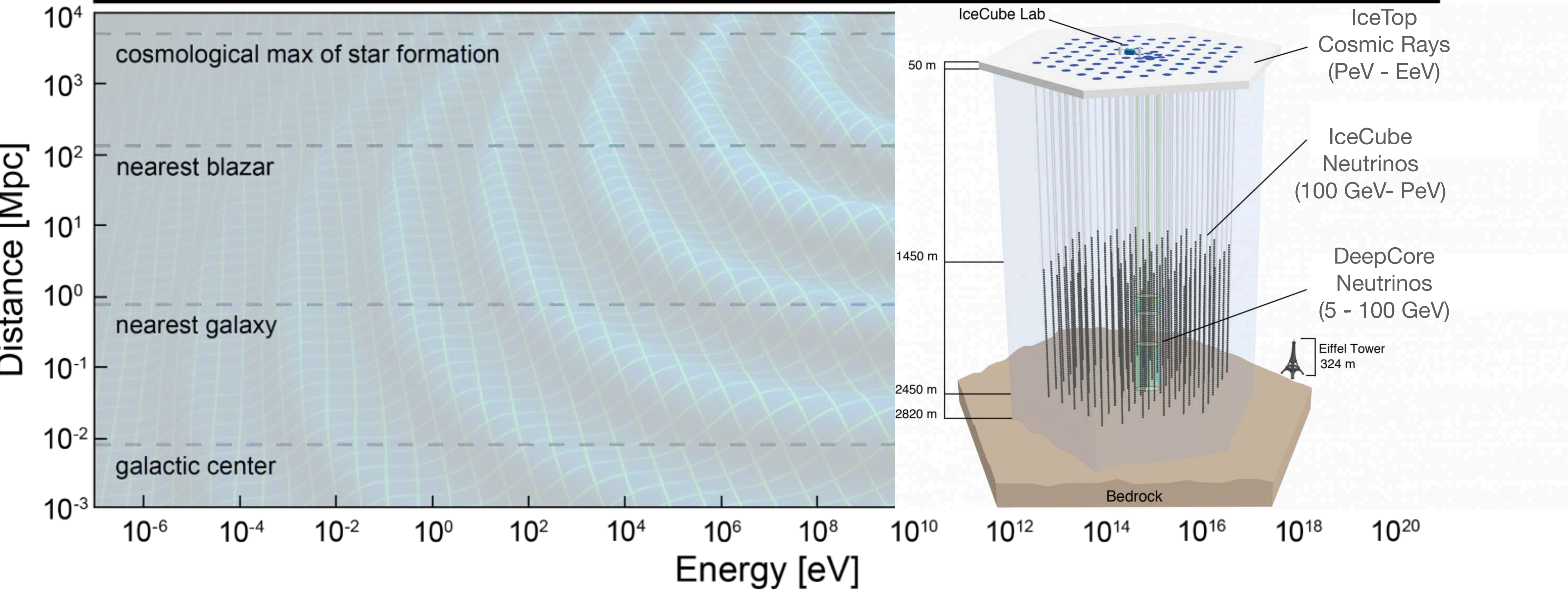
Astronomical messengers



Bartos & Kowalski, IOP 2018



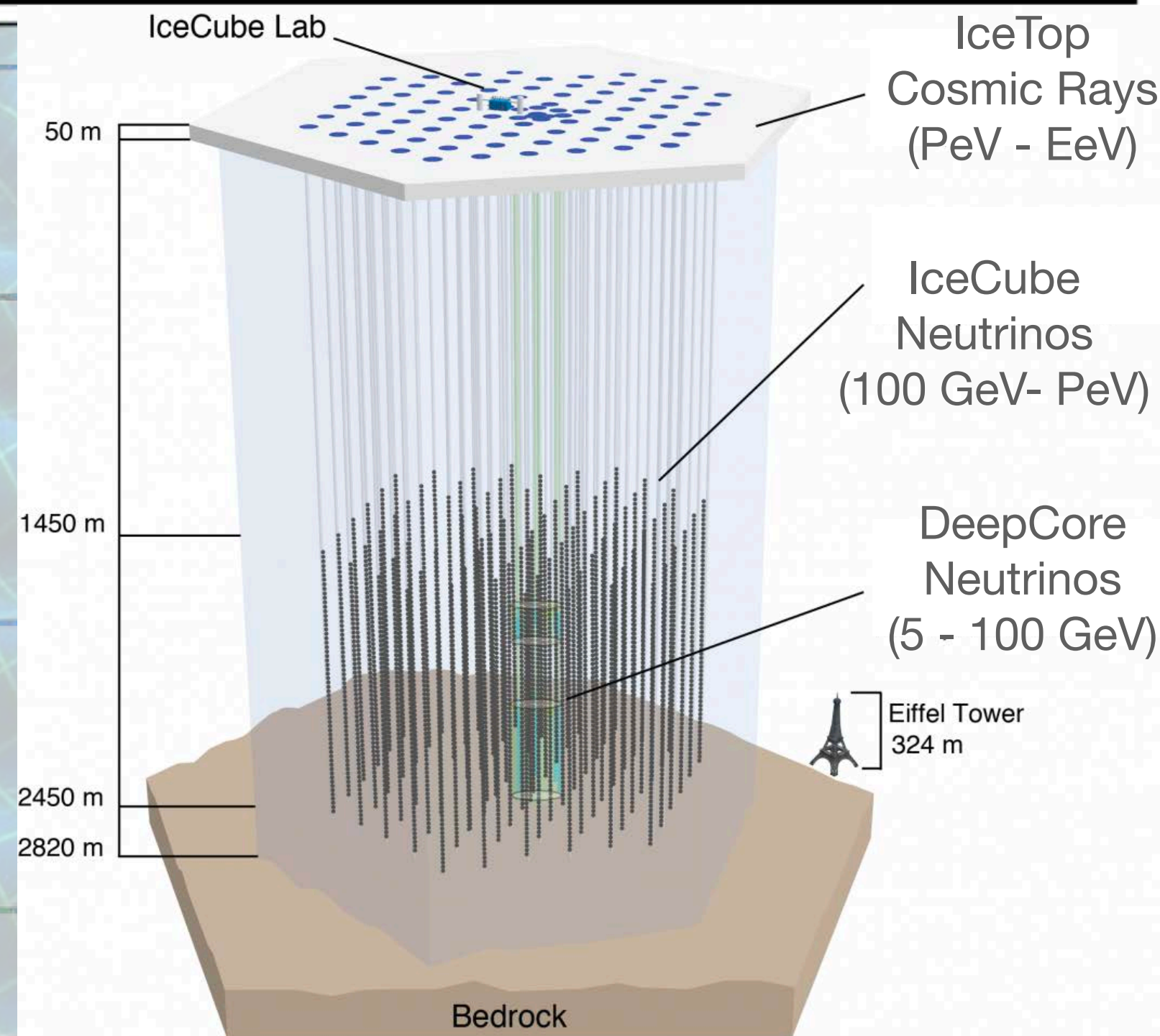
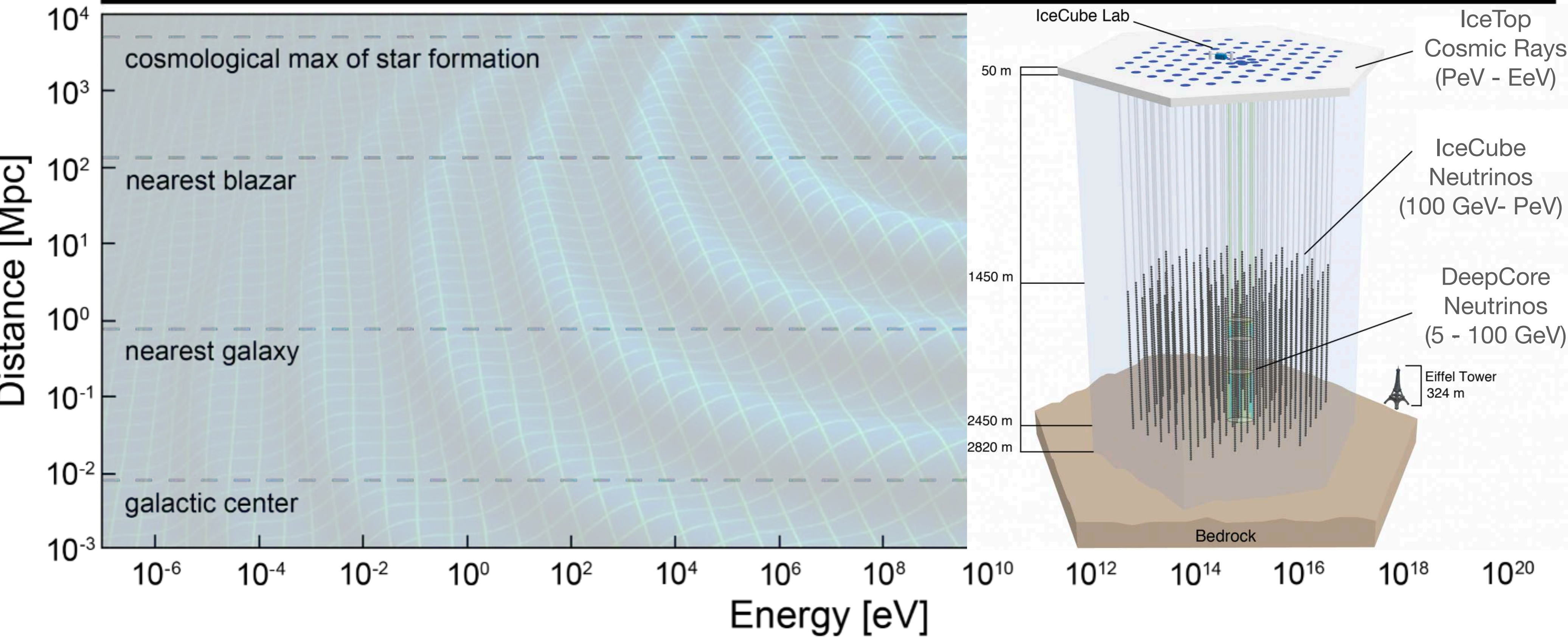
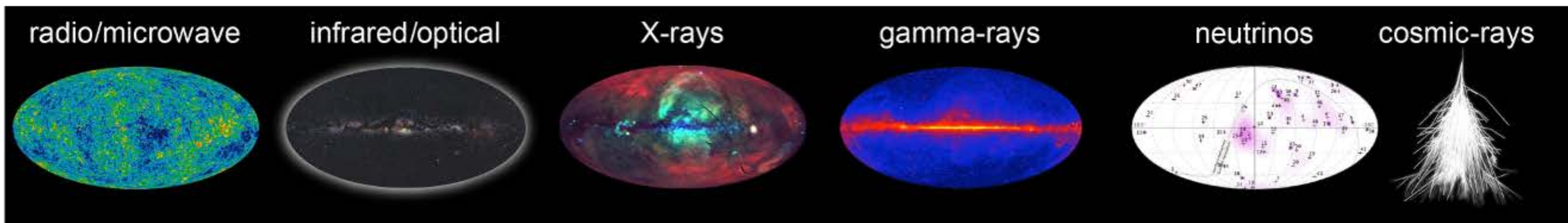
2010 - Cubic-km observatory completed



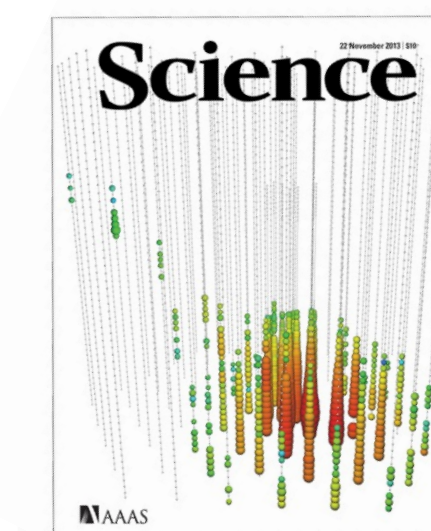
Astronomical messengers



Bartos & Kowalski, IOP 2018



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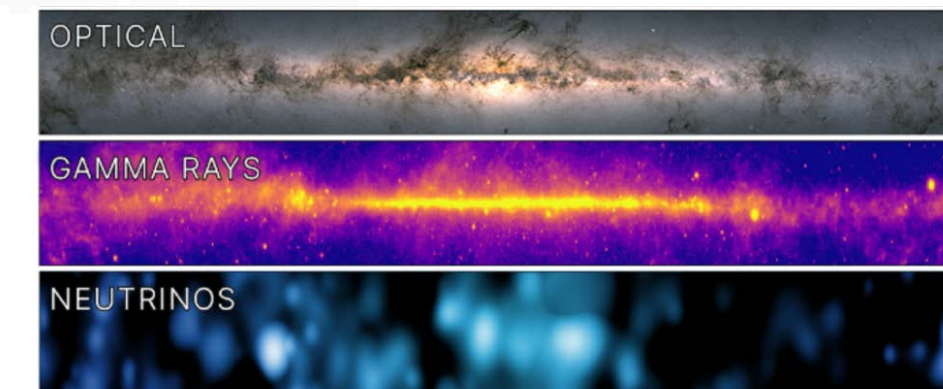


2013 - Discovery of high-energy astrophysical neutrino flux



2017 - First high-energy neutrino transient multimessenger follow-up

2022 - First evidence of high-energy neutrino sources (NGC 1068)

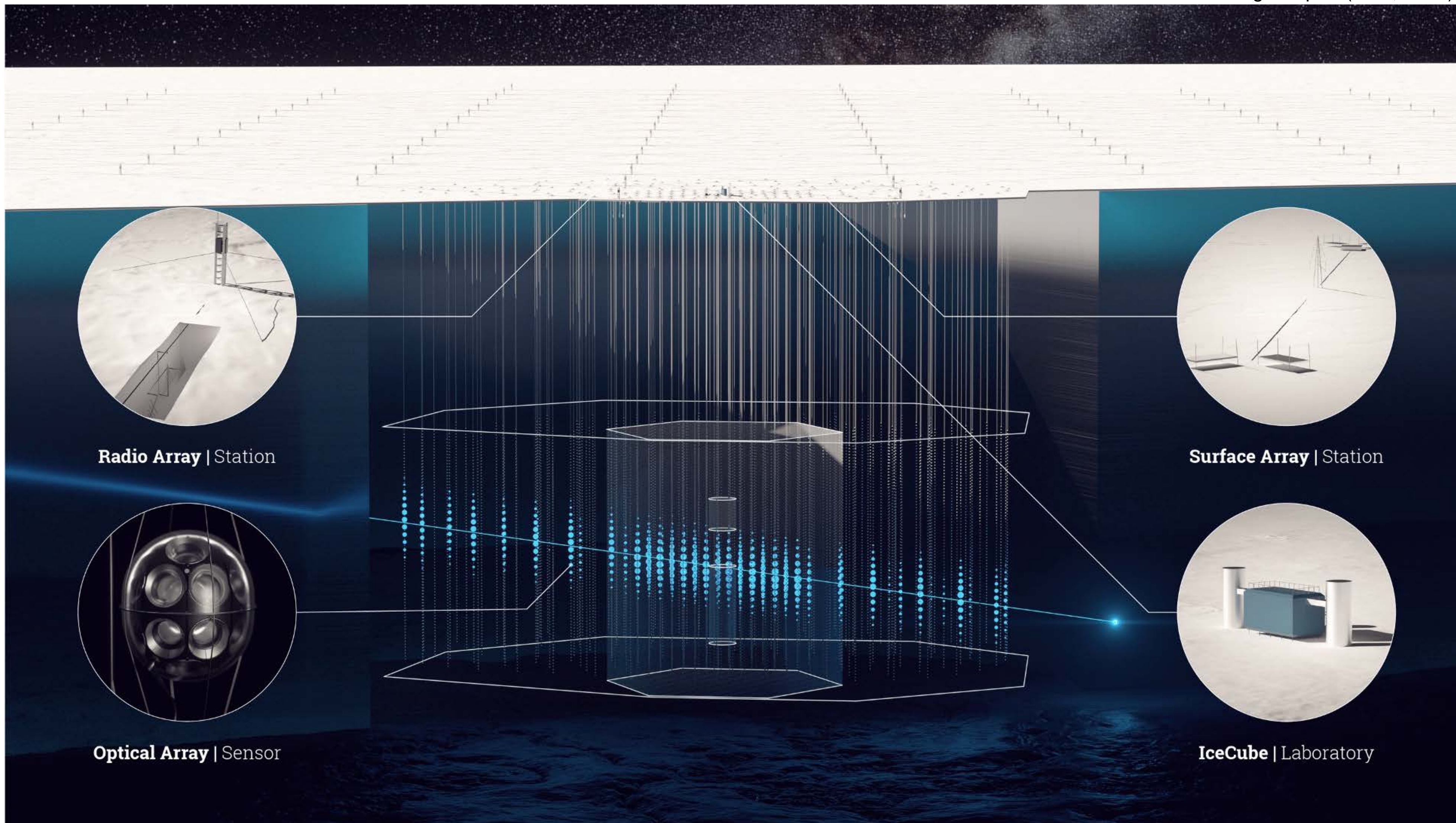


2024 - High-energy neutrinos observed from the Milky Way

More than 15 years of greater than 99% uptime and less than 1% instrumentation failure

IceCube-Gen2 (envisaged) — beyond the global cubic-km-year scale

IceCube-Gen2 [Technical Design Report \(TDR, 2024\)](#)



- 8x increased instrumented volume
- 5x increased sensitivity to neutrino sources compared to current IceCube
- 500 square-km array designed for radio detection of > 100 PeV neutrinos
- Surface array above optical array footprint designed for cosmic ray science

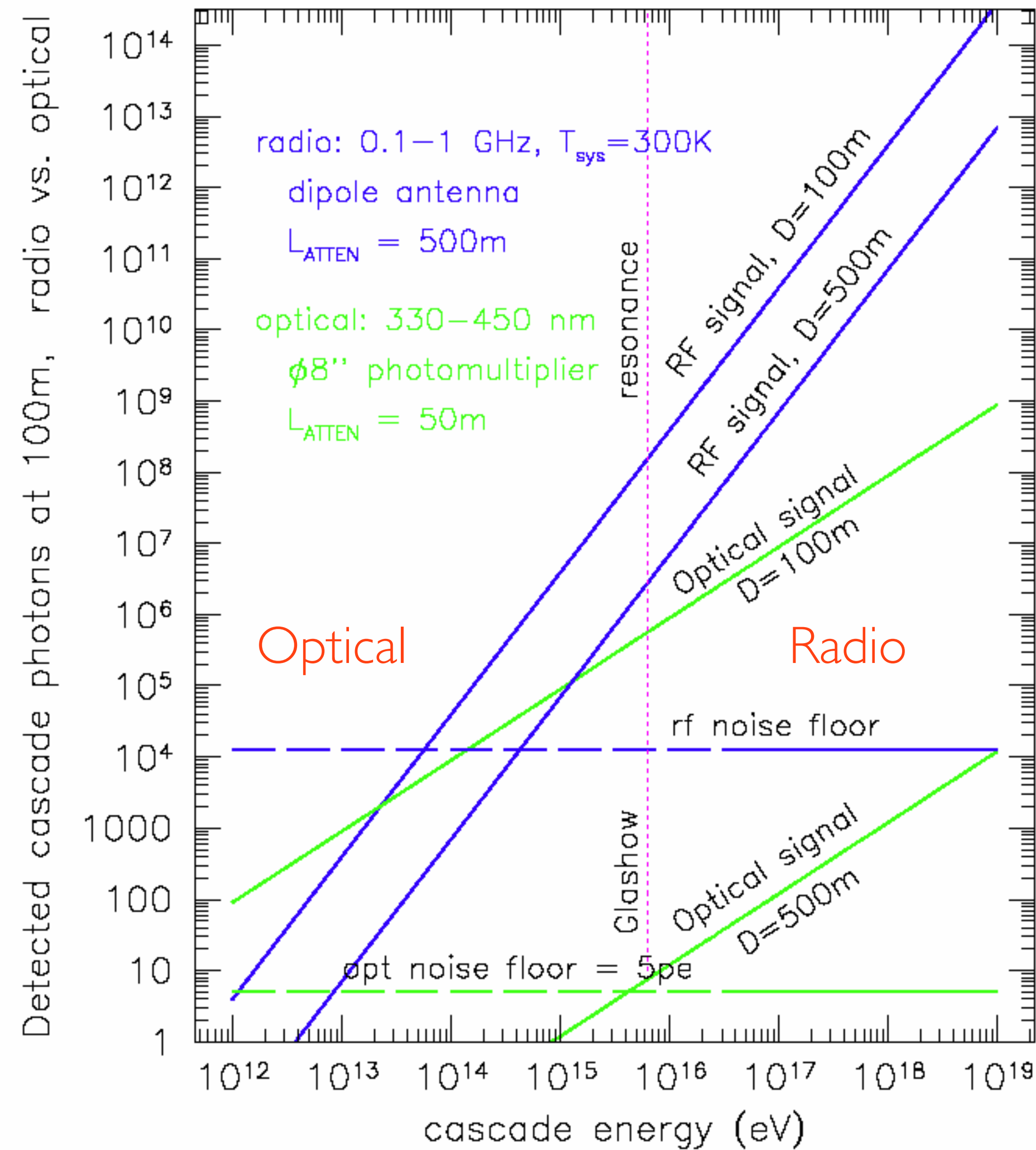
Radio Array | Station

Surface Array | Station

Optical Array | Sensor

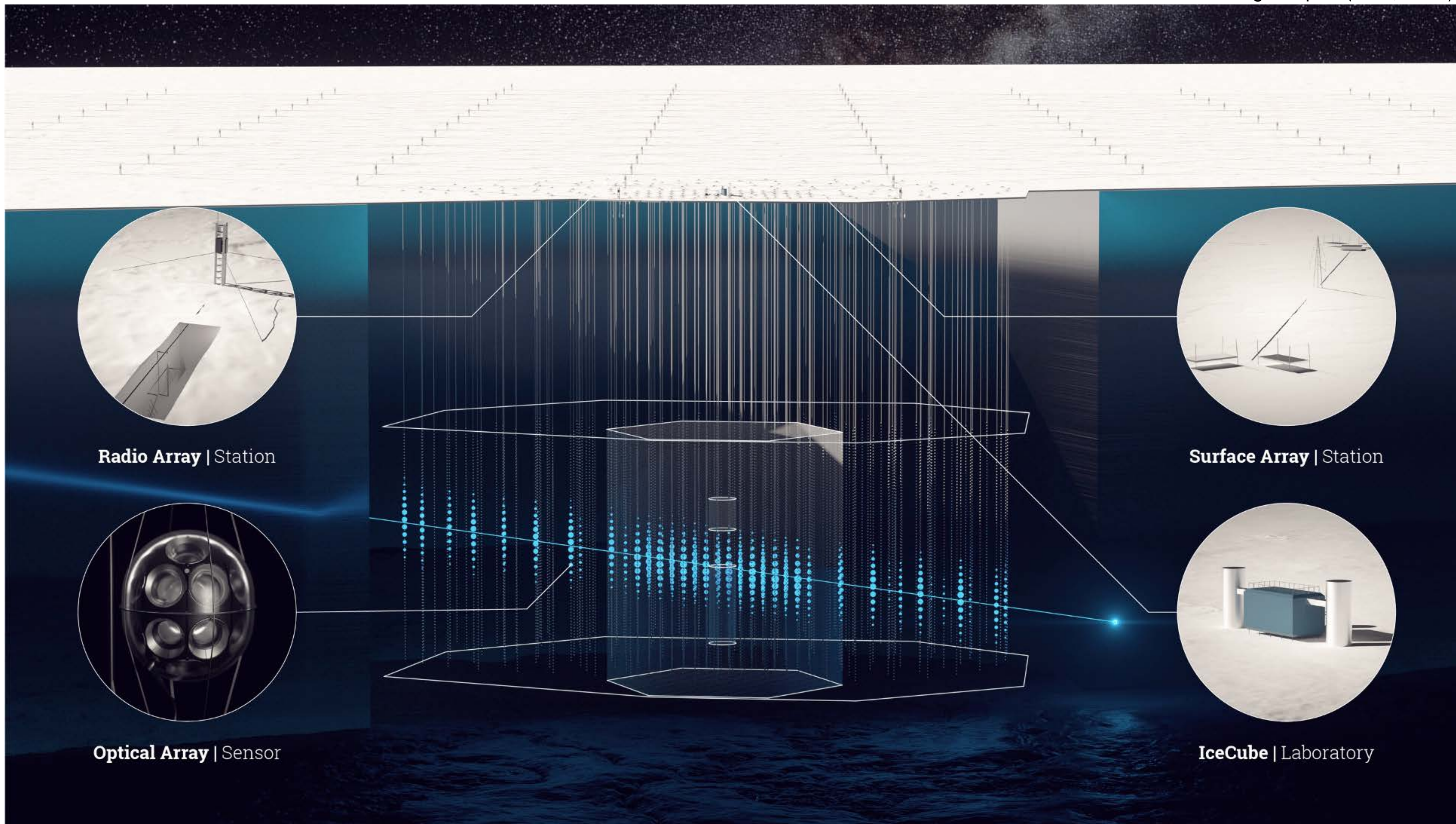
IceCube | Laboratory

Principles of high-energy ν detection aside

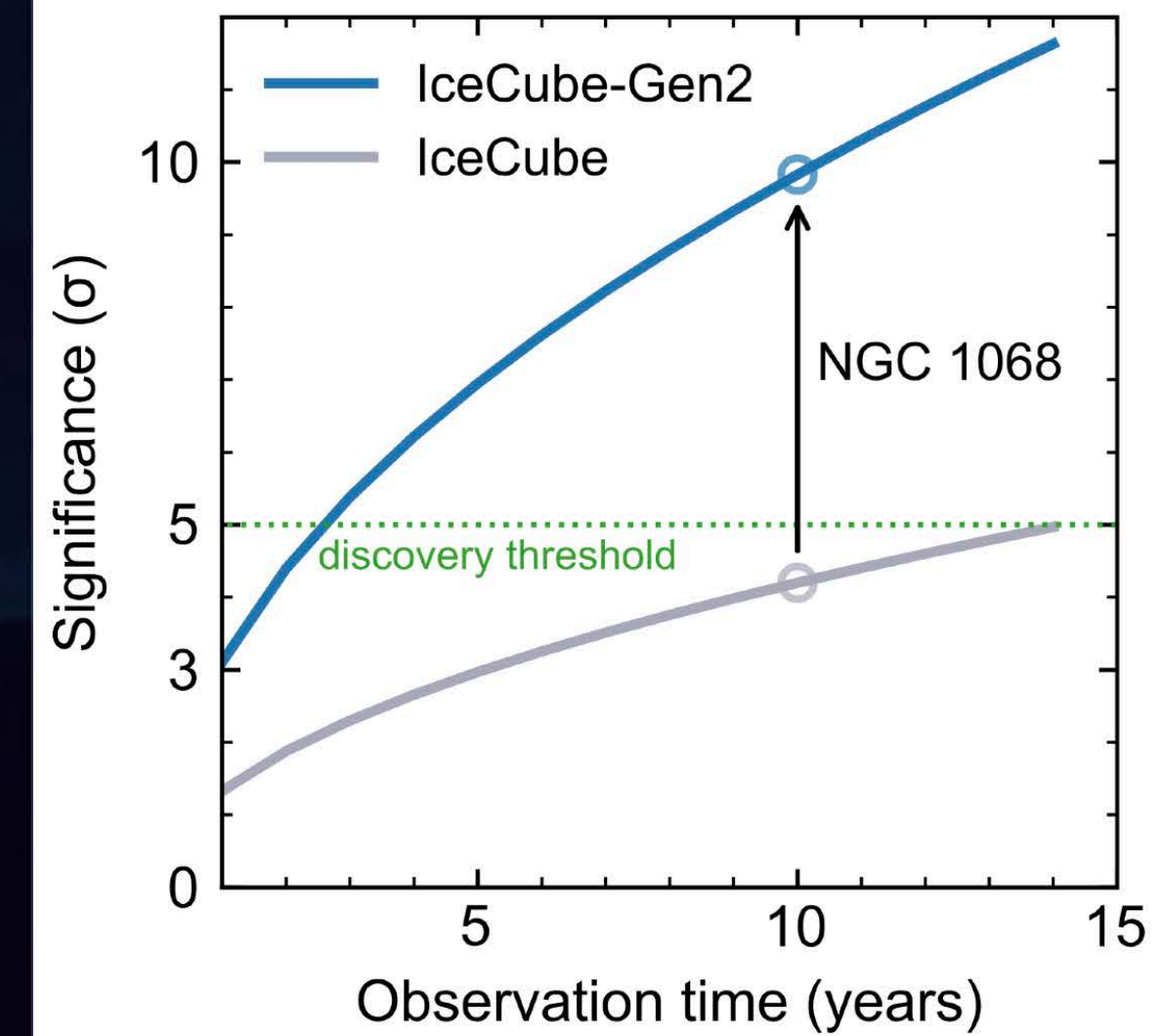


IceCube-Gen2 (envisaged) — beyond the global cubic-km-year scale

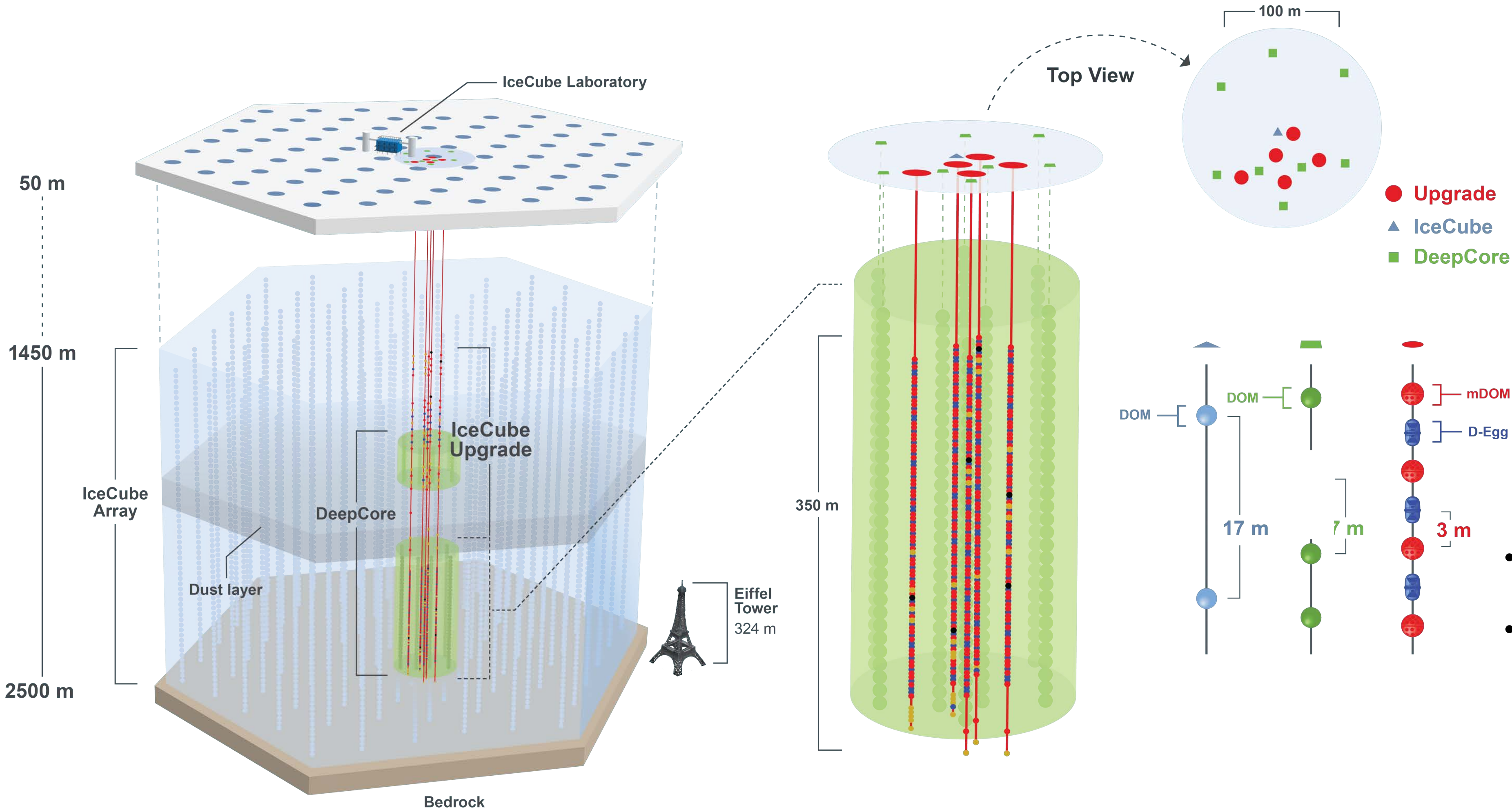
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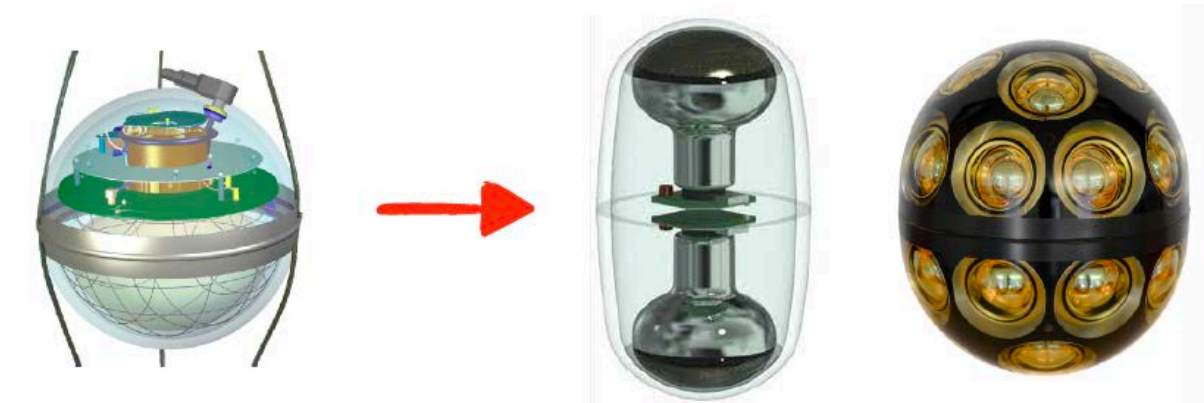
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Path to IceCube-Gen2 science



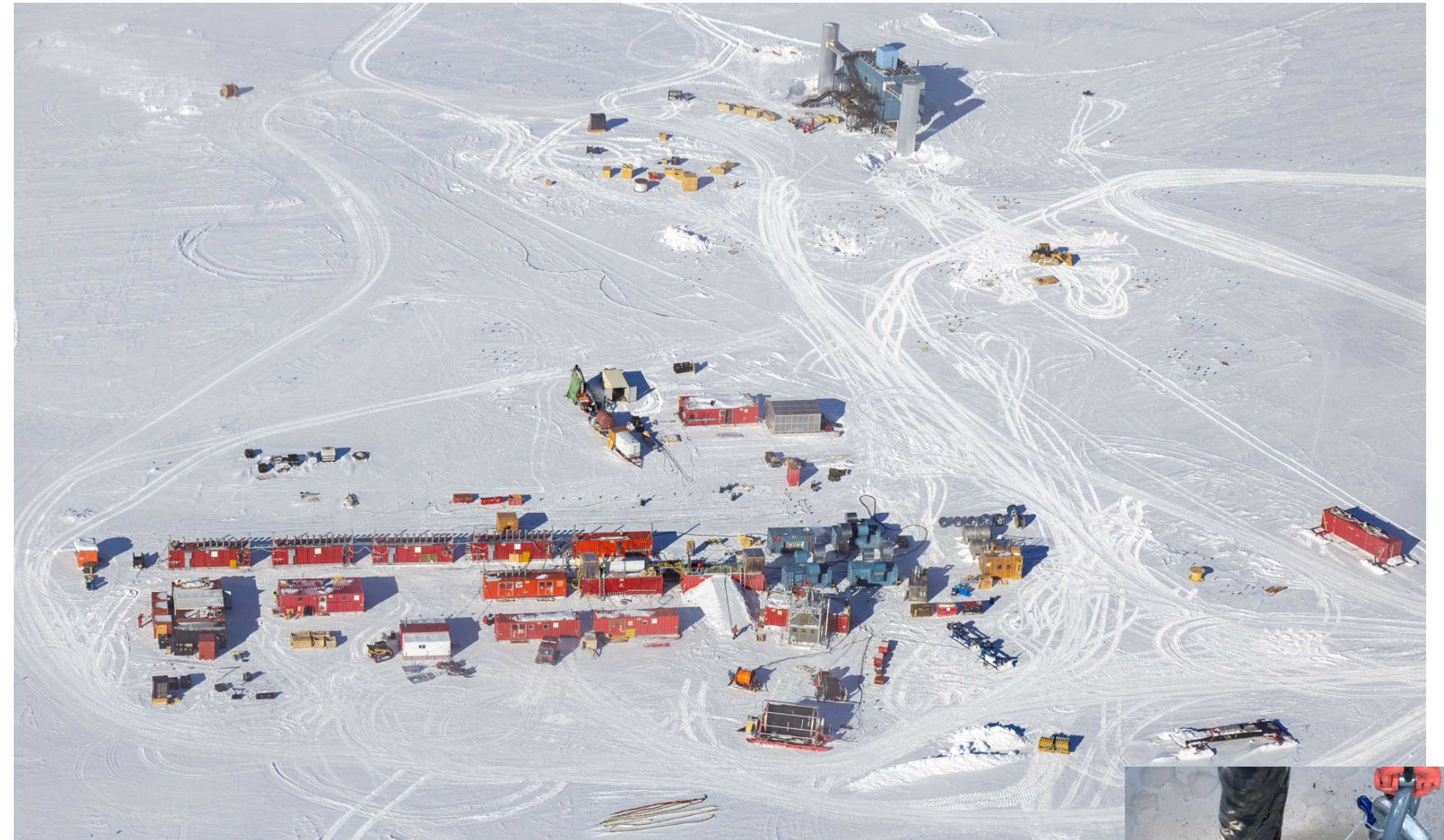
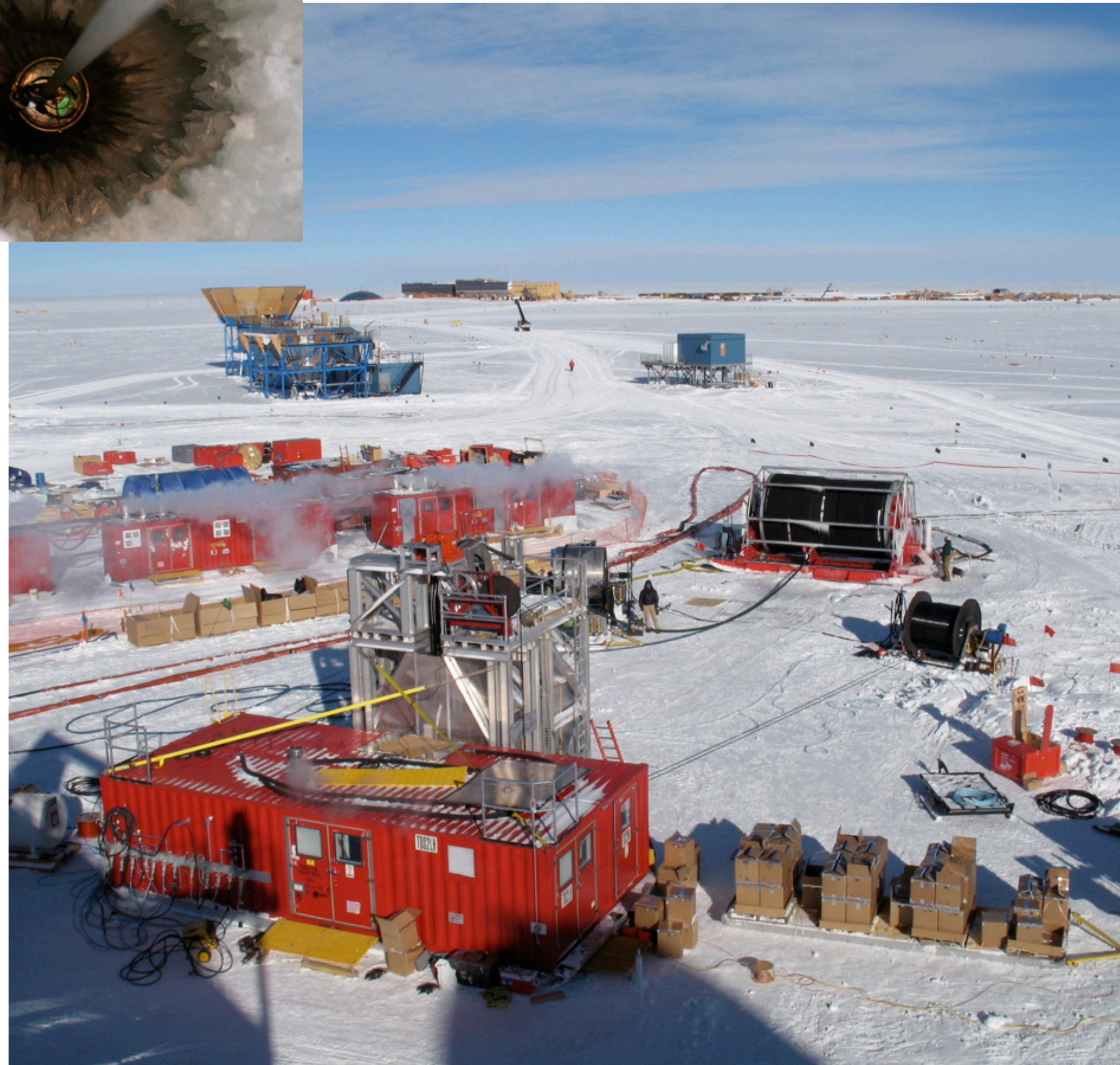
- Construction completed January 2026
- Scientific reach:
 - Precision oscillation measurements
 - Recalibration of the complete IceCube dataset (including high-energy regime); improved angular and energy resolutions and ice model.
- More than 600 next generation modules (3X sensitivity) and precision calibration devices deployed to depths up to 2600 m



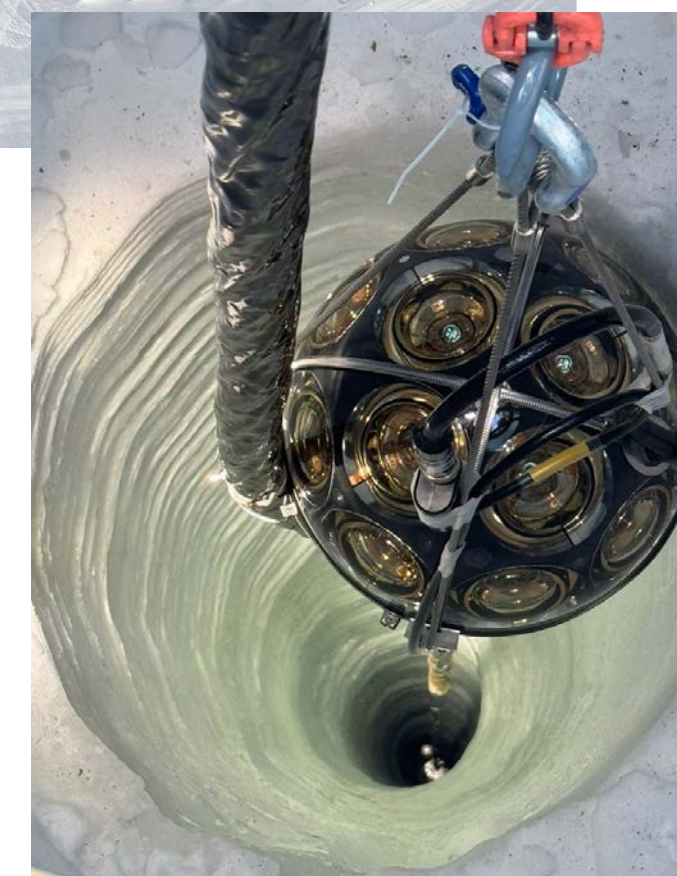
Path to IceCube-Gen2 science



IceCube — 2004-2010



IceCube Upgrade — 2025/6

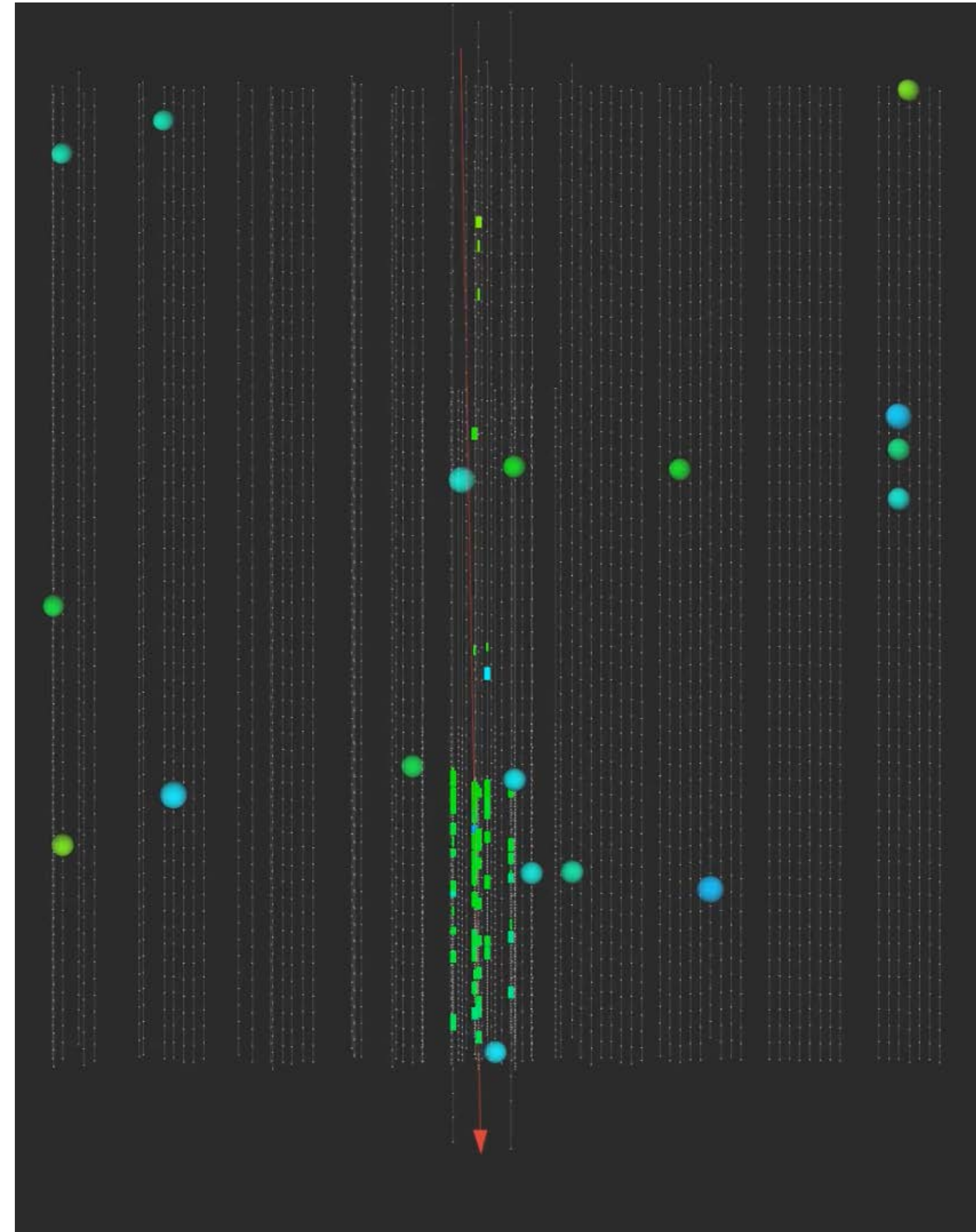


Path to IceCube-Gen2 science

Commissioning of new strings well underway

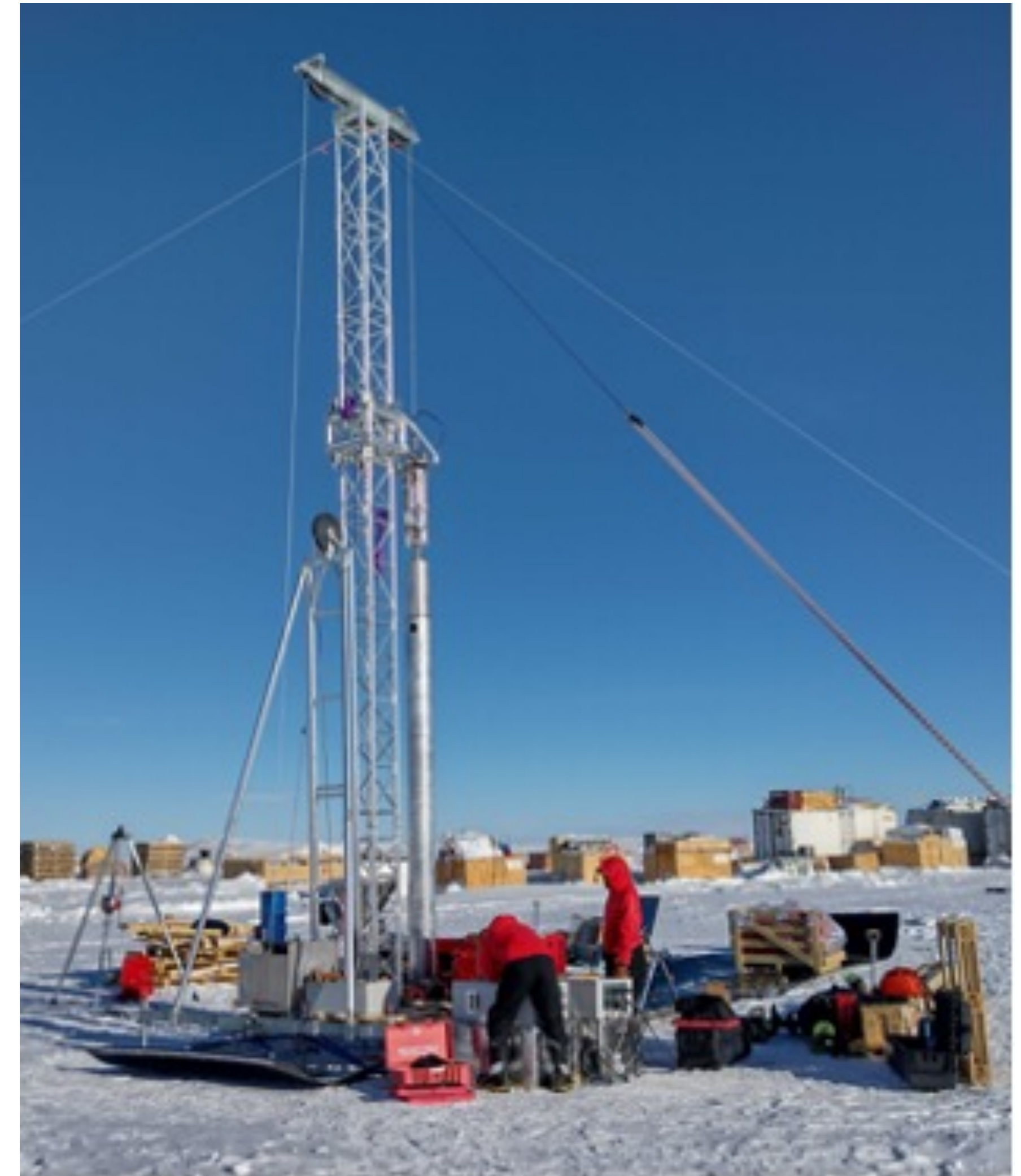


Upgrade deployed Gen2 optical module



Path to IceCube-Gen2 science





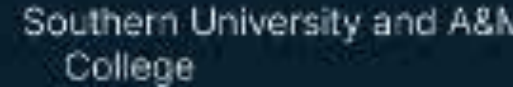
First surface stations in operation at South Pole



RNO-G radio array (pathfinder) underway in Greenland



THE ICECUBE-GEN2 COLLABORATION

 AUSTRALIA University of Adelaide	 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 Münster Universität Wuppertal	 INDIA Tata Institute of Fundamental Research	 SWEDEN Stockholms universitet Uppsala universitet	 UNITED STATES Columbia 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	 BELGIUM UCLouvain Université libre de Bruxelles Universiteit Gent Vrije Universiteit Brussel	 ITALY University of Padova	 SWITZERLAND Université de Genève	 CANADA Queen's University Simon Fraser University University of Alberta-Edmonton	 JAPAN Chiba University Osaka Metropolitan University	 TAIWAN Academia Sinica	 NEW ZEALAND University of Canterbury	 THAILAND Chiang Mai University	 DENMARK University of Copenhagen	 REPUBLIC OF KOREA Chung-Ang University Sungkyunkwan University	 UNITED KINGDOM University of Oxford	 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 Chicago University of Delaware University of Kansas University of Maryland University of Nevada, Las Vegas University of Notre Dame University of Rochester University of Utah University of Wisconsin-Madison	 University of Wisconsin-River Falls Whittier College Yale University
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ICECUBE-GEN2.WISC.EDU

Summary

A remarkable journey from discovery to astronomy

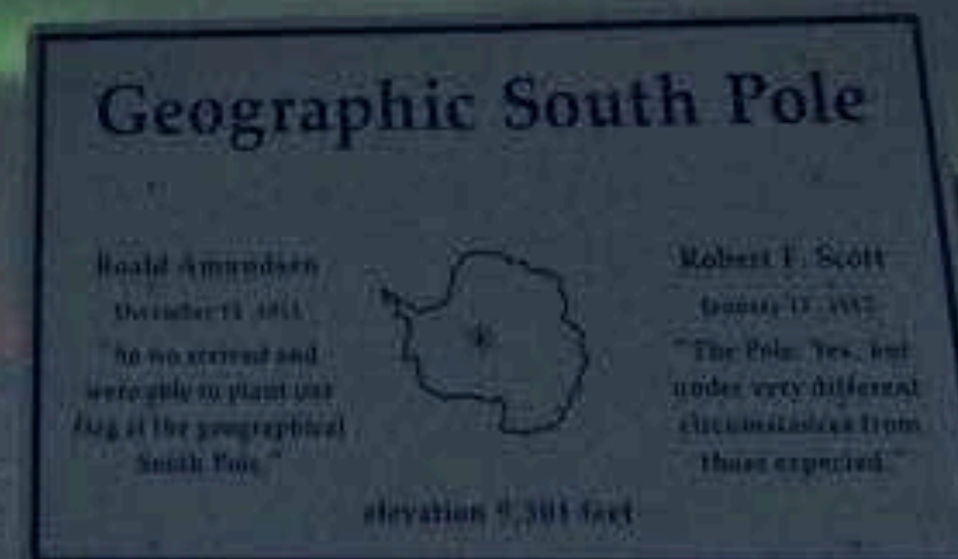
IceCube has been a discovery engine, opening new windows to view and understand our extreme Universe

A global program is rapidly emerging to realize the next generation observatories

IceCube Upgrade construction is completed and delivering first data, setting the stage for an exciting next scientific phase of the leading international program

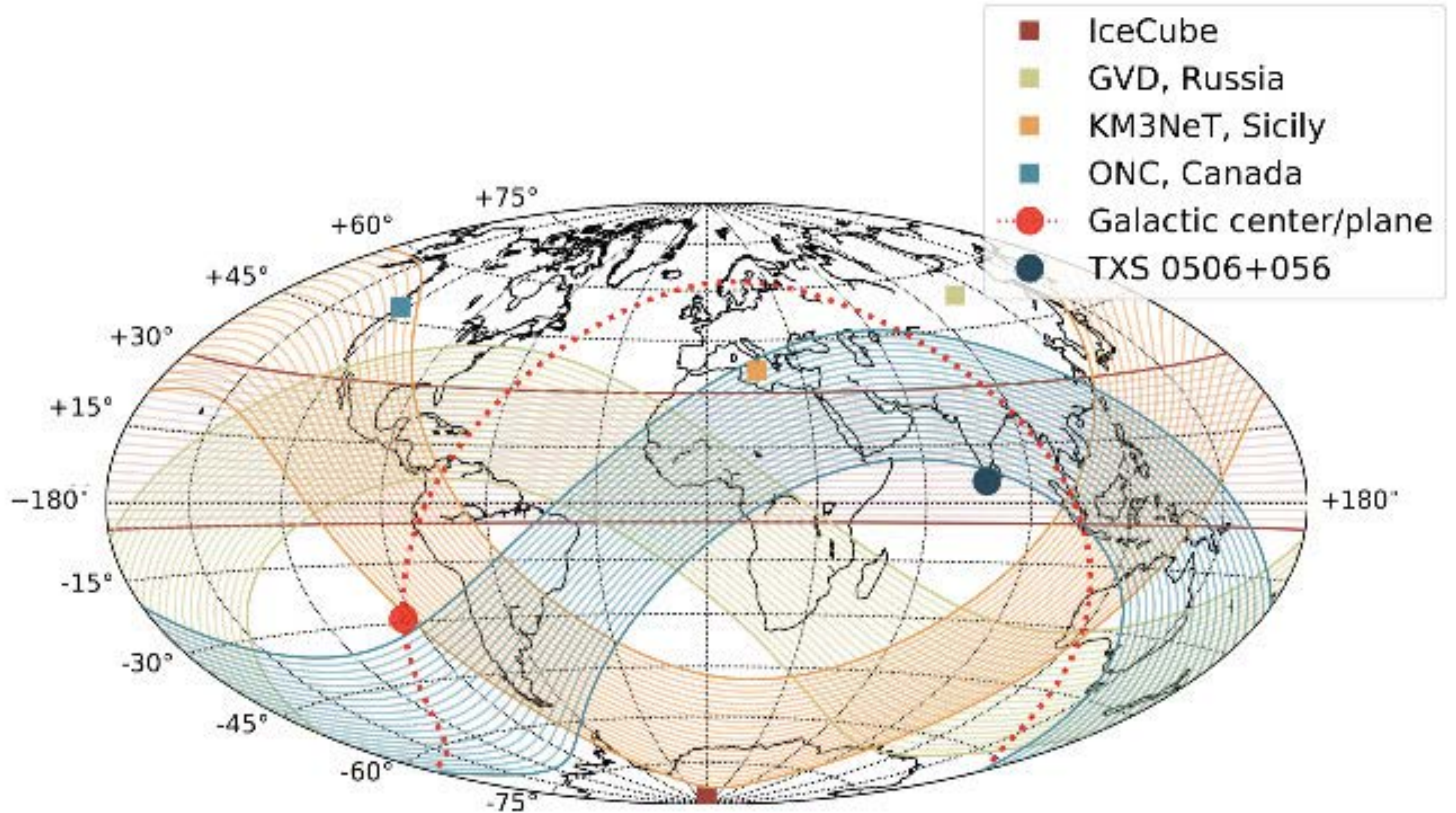
IceCube-Gen2 primary elements are well understood

Upgrade lessons-learned are incredibly timely as early preparations move towards commencing detector developments.



Backup slides

A concerted path toward neutrino astronomy



IceCube Upgrade Atmospheric Neutrinos

- 3-year sensitivity estimates
 - Improved sensitivity to the atmospheric mixing angle, including octant, and mass splitting
 - 5% uncertainty on the normalization of the tau neutrino normalization and test of PMNS unitarity
 - 3σ determination of the mass ordering (5σ with JUNO)

