The IceCube-Gen2 Neutrino Observatory

A Window to the High Energy Universe

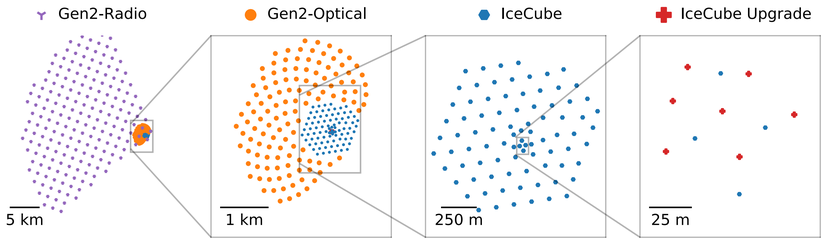
Brian Clark for the IceCube-Gen2 Collaboration

MICHIGAN STATE UNIVERSITY

ICECUBE GEN2

The Gen2 Instrument

IceCube-Gen2 will be a wide-band neutrino observatory with sensitivity from GeV to beyond EeV energies. The array will augment the existing IceCube detector and planned Upgrade with an enlarged in-ice optical array, a radio array, and surface cosmic ray detector.



IceCube: 1 km^3, 86 strings, most with 125 m lateral spacing
60 DOMs/string with 17 m spacing, completed 2011

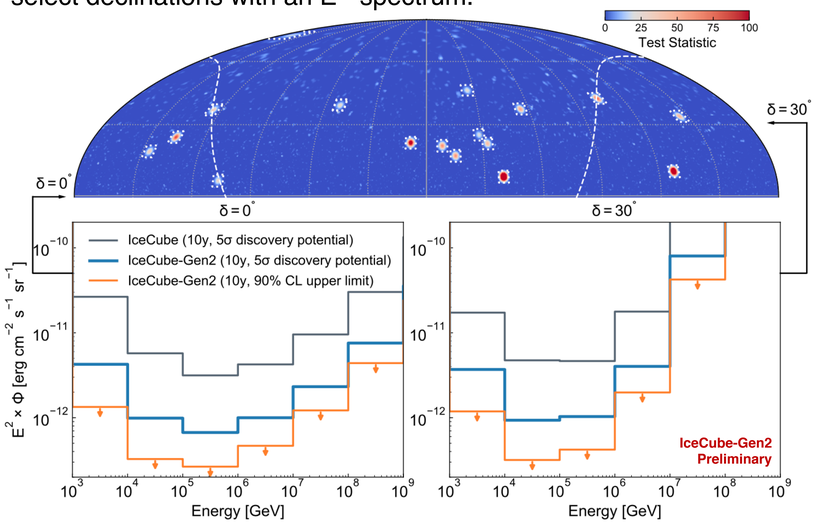
Upgrade: 7 strings, $\mathcal{O}(100)$ DOMs/string with 3 m spacing
In production, to be deployed Dec 2022

Gen2-Optical: 8 km^3, 120 strings with 240 m lateral spacing
80 DOMs/string with 17 m spacing

Gen2-Radio: 500 km^2, with $\mathcal{O}(200)$ stations

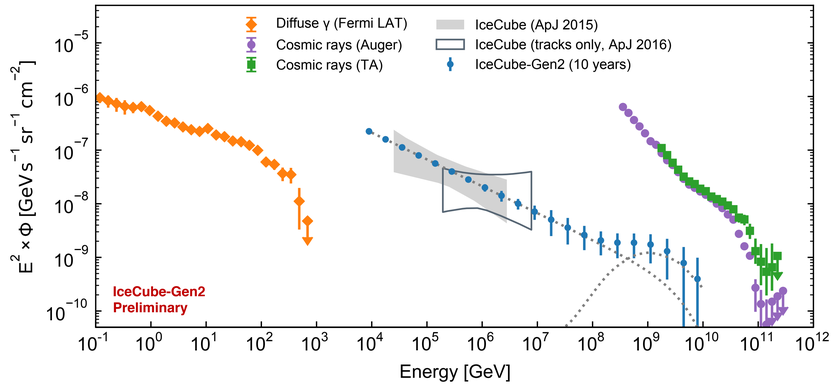
Resolving the TeV-EeV Neutrino Sky

Gen2 enables the identification of sources five times fainter than is possible with IceCube, accelerating the rate of discovery of sources and probing the neutrino sky with unprecedented sensitivity. Shown is a mock Test Statistic map of the neutrino sky as might observed with Gen2, and the quasi-differential sensitivity to a steady source for two select declinations with an E^{-2} spectrum.

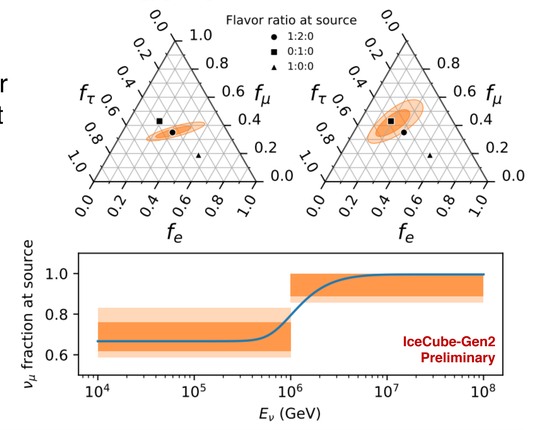


Cosmic Particle Acceleration

The optical and radio arrays span 6 orders of magnitude in energy, probing the extension, or cutoff, of the astrophysical neutrino spectrum. Shown in blue is the median flux as would be measured assuming an unbroken E$^{-2.5}$ astrophysical flux and a cosmogenic flux with a mixed composition of cosmic ray primaries (Ahlers et. al.).

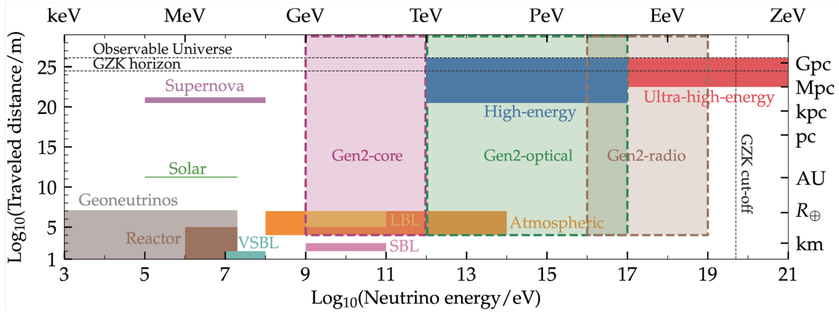


Gen2 will constrain flavor composition scenarios at neutrino sources, and their energy dependence. Shown is an example of Gen2 sensitivity to the muon fraction and flavor ratio of a source with muon cooling above 2 PeV.



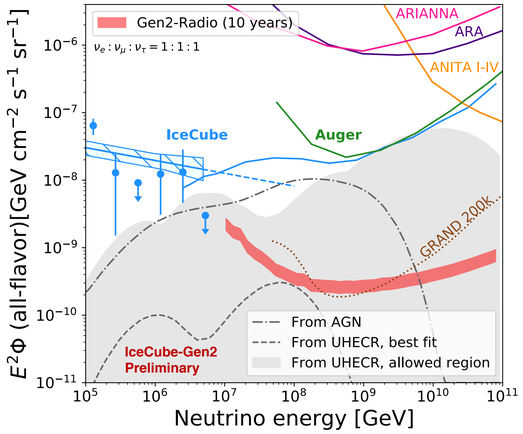
Fundamental Physics on Cosmic Baselines

Gen2 will probe fundamental physics on cosmic baselines and across a broad energy range. Shown as shaded boxes are the regions in distance-energy space where Gen2 will probe for new physics.

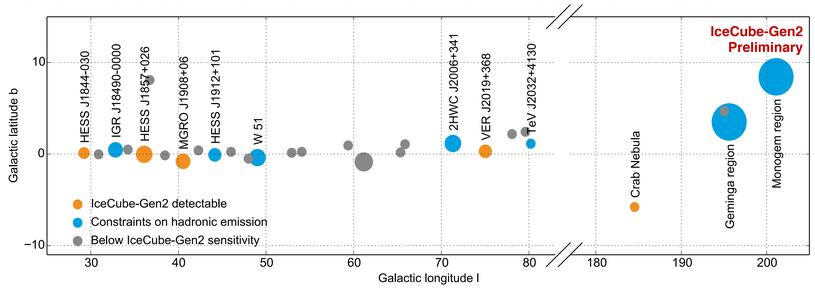


Sources and Propagation of Cosmic Rays

A radio array will test models for astrophysical and cosmogenic neutrino production and constrain the nature of CR accelerators. Shown is the differential sensitivity of the Gen2 radio detector in the context of present and future experiments and two models for high-energy neutrino production.



Gen2 will have sensitivity to neutrinos produced in Galactic sources, constraining CR acceleration processes. Shown are TeV HAWC sources near the galactic plane, color coded to indicate possible detections (if γ-ray emission arises solely from hadronic processes) and where Gen2 can constrain the level of hadronic emission.



Technology Development

Gen2 will leverage technology developments from the Upgrade, with the goal of having 3x the photocathode area per DOM compared to IceCube. Shown are two pixelated DOMs under development for the Upgrade: the mDOM and D-Egg.

NEUTRINO 2020

We are grateful to the NSF for support through award 1903885.