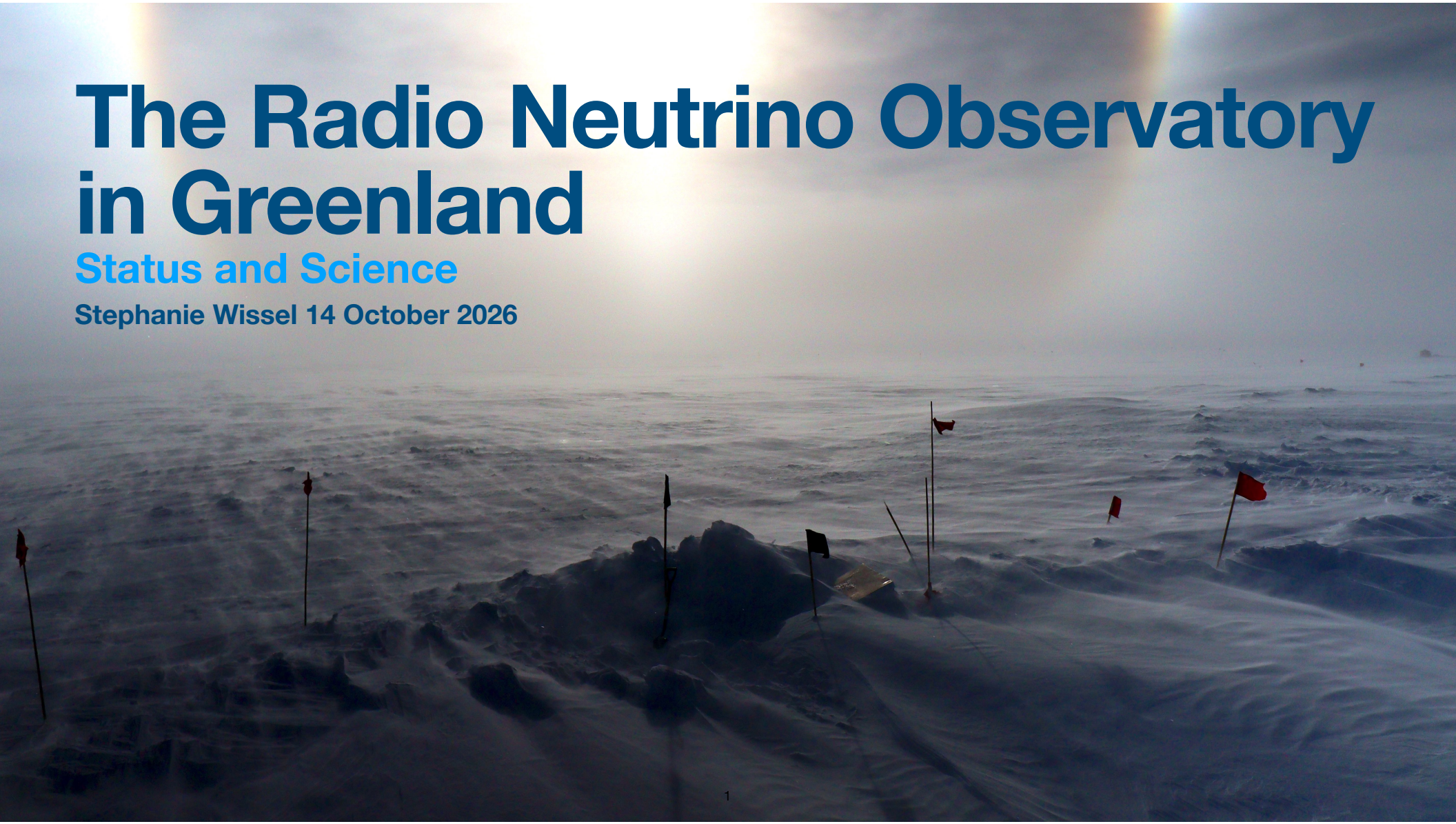


The Radio Neutrino Observatory in Greenland

Status and Science

Stephanie Wissel 14 October 2026

18 Institutes in 5 countries
~80 scientists

Whittier College
University of Nebraska-Lincoln
University of Kansas
University of Wisconsin-Madison
University of Chicago
The Ohio State University
Pennsylvania State University
University of Alabama
University of Delaware
Summit Station
Uppsala University
DESY-Zeuthen
TU Dortmund
FAU-Erlangen
Radboud University
Wuppertal University
Université Libre de Bruxelles
Vrije Universiteit Brussels
Ghent University

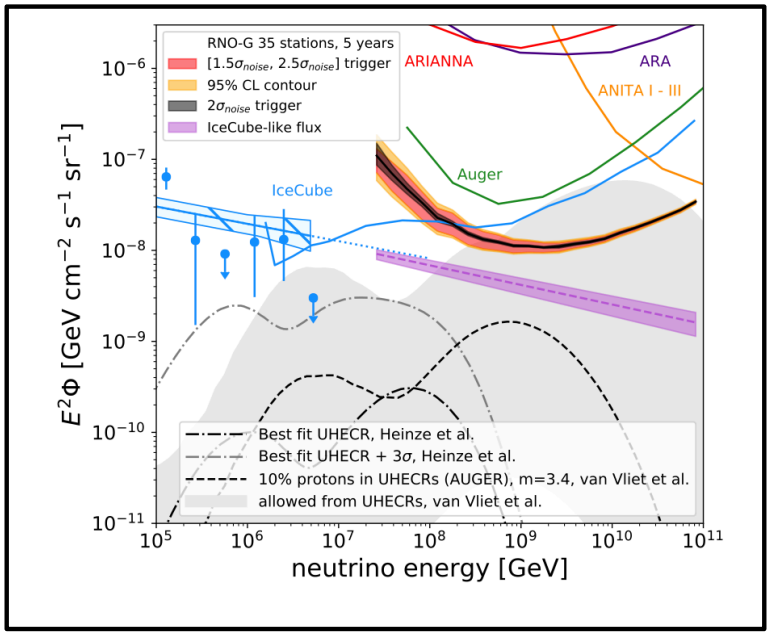


RNO-G
Collaboration
April 2024

UHE Neutrino Science Goals with RNO-G

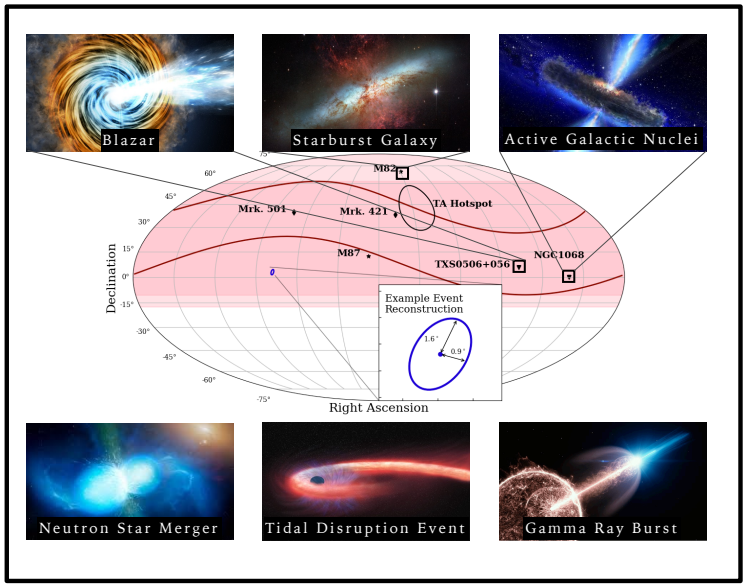
- Measure **ultra high energy neutrino flux** or place limits on the diffuse flux that constrain production models.

All Flavor Sensitivity targeting EeV-scale neutrinos

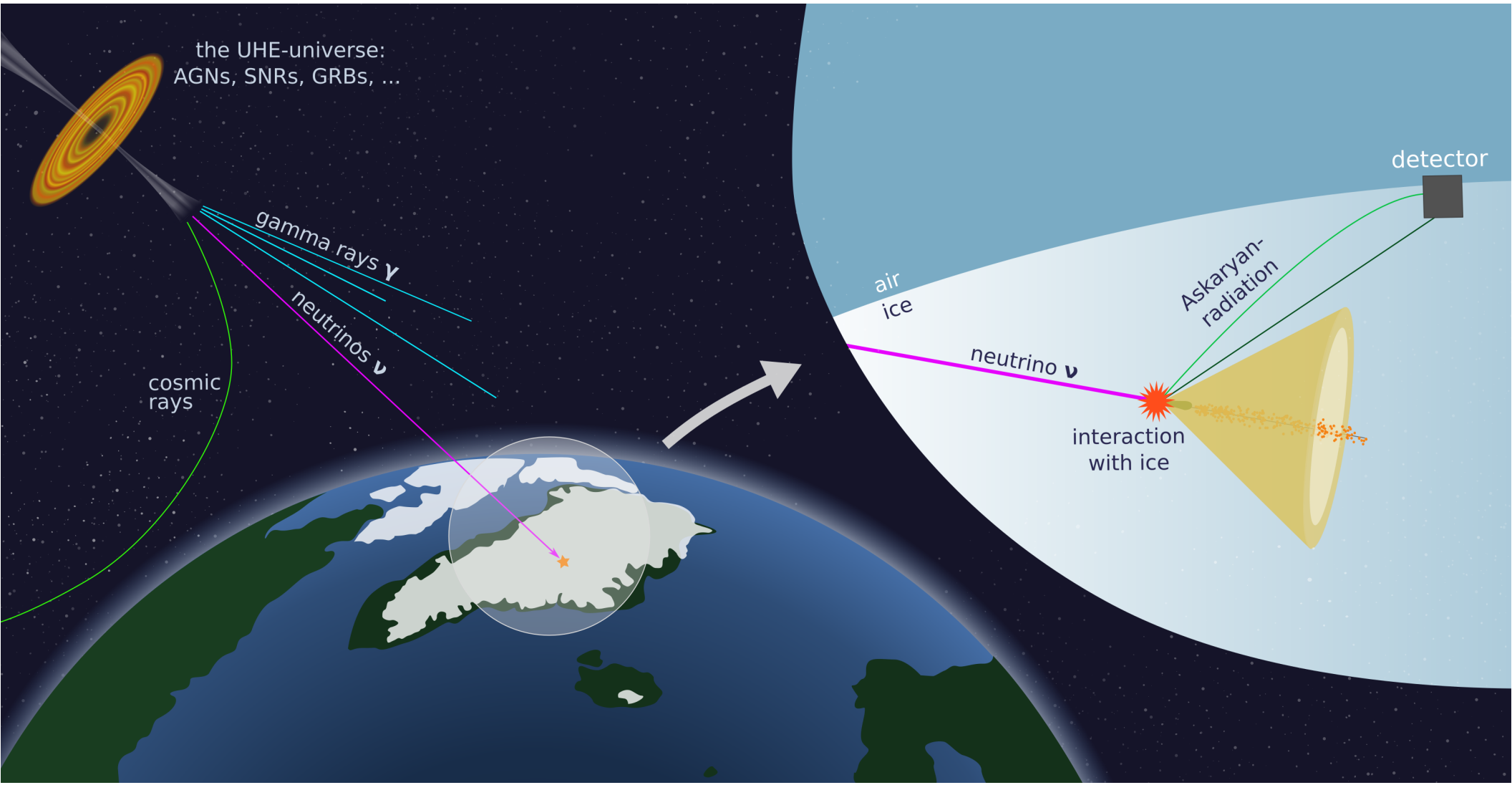


J. A. Aguilar et al (RNO-G Coll.) JINST 16 P03025 2021

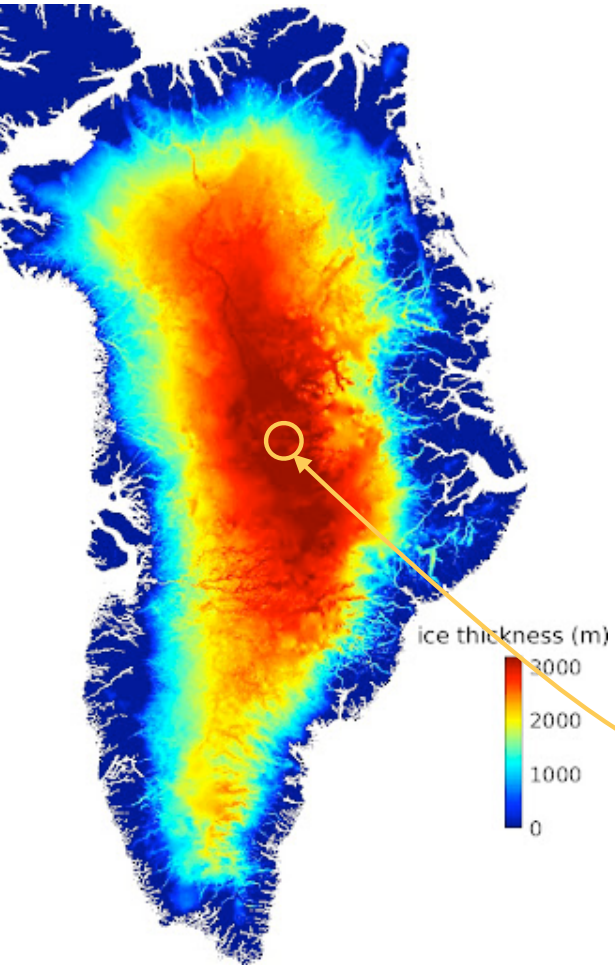
Greenland Site is Unique for Multi-Messenger Astrophysics



- Northern Neutrinos at UHE
- Overlapping sky coverage with TeV-scale IceCube neutrinos
- 24/7 satellite coverage (+72.6° N lat.)

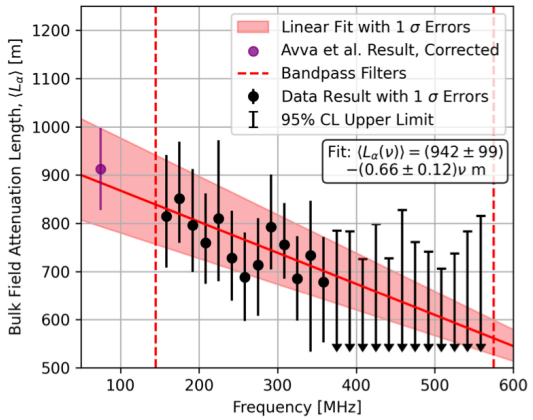

the UHE-universe:
AGNs, SNRs, GRBs, ...
gamma rays γ
neutrinos ν
cosmic
rays
air
ice
detector
Askaryan-
radiation
neutrino ν
interaction
with ice

RNO-G Site: Summit Station in Greenland



- One of the biggest volume of radio transparent medium on Earth
  - 3 km thick ice at Summit Station.
  - Attenuation length
- Good infrastructure
  - Summit Station NSF-operated.
- Sunlight 10 months/year
  - Solar power

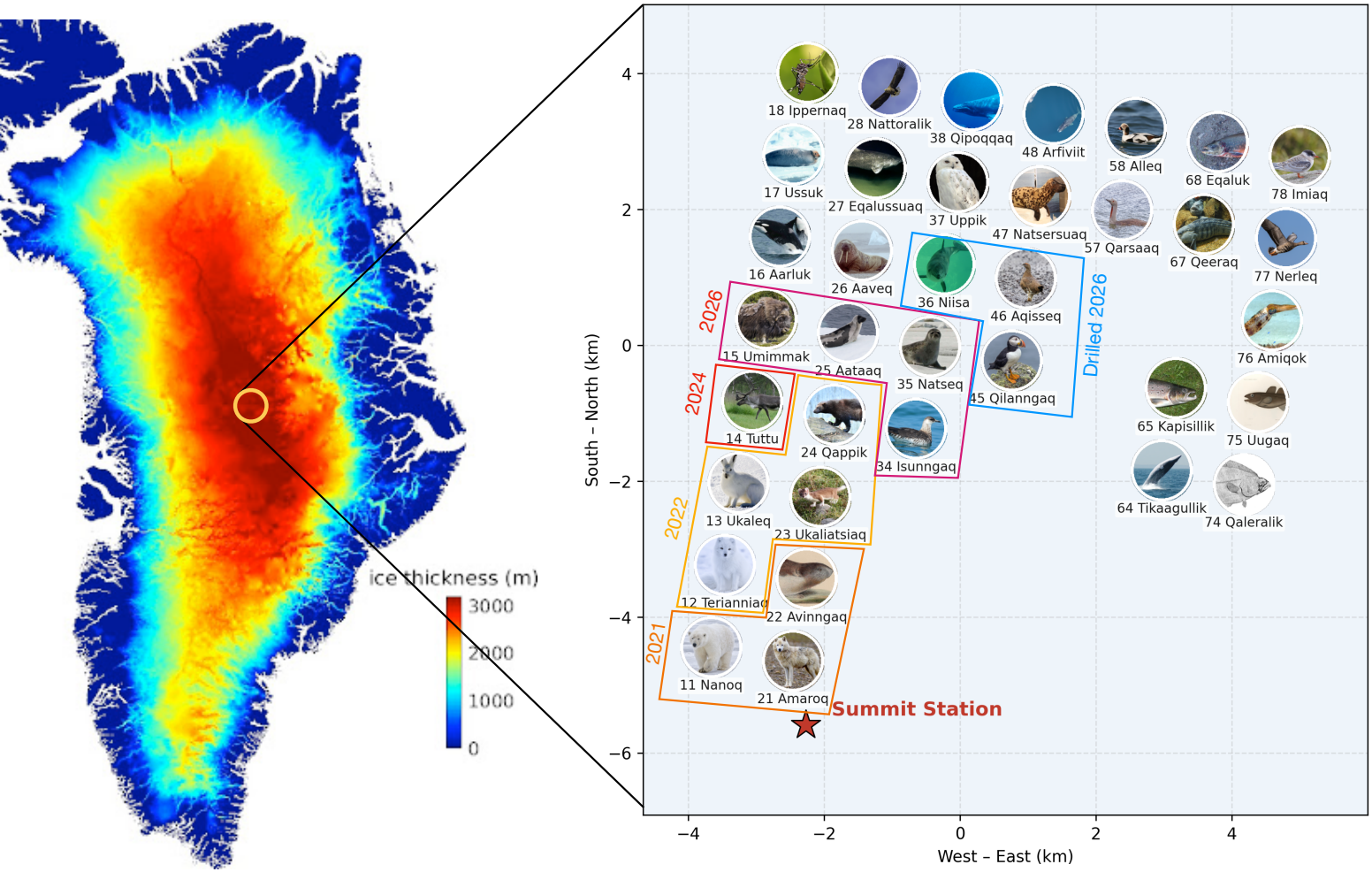
J. Aguilar, JINST 29 09 P09029 2026





IGC PennState Eberly College of Science

RNO-G Array



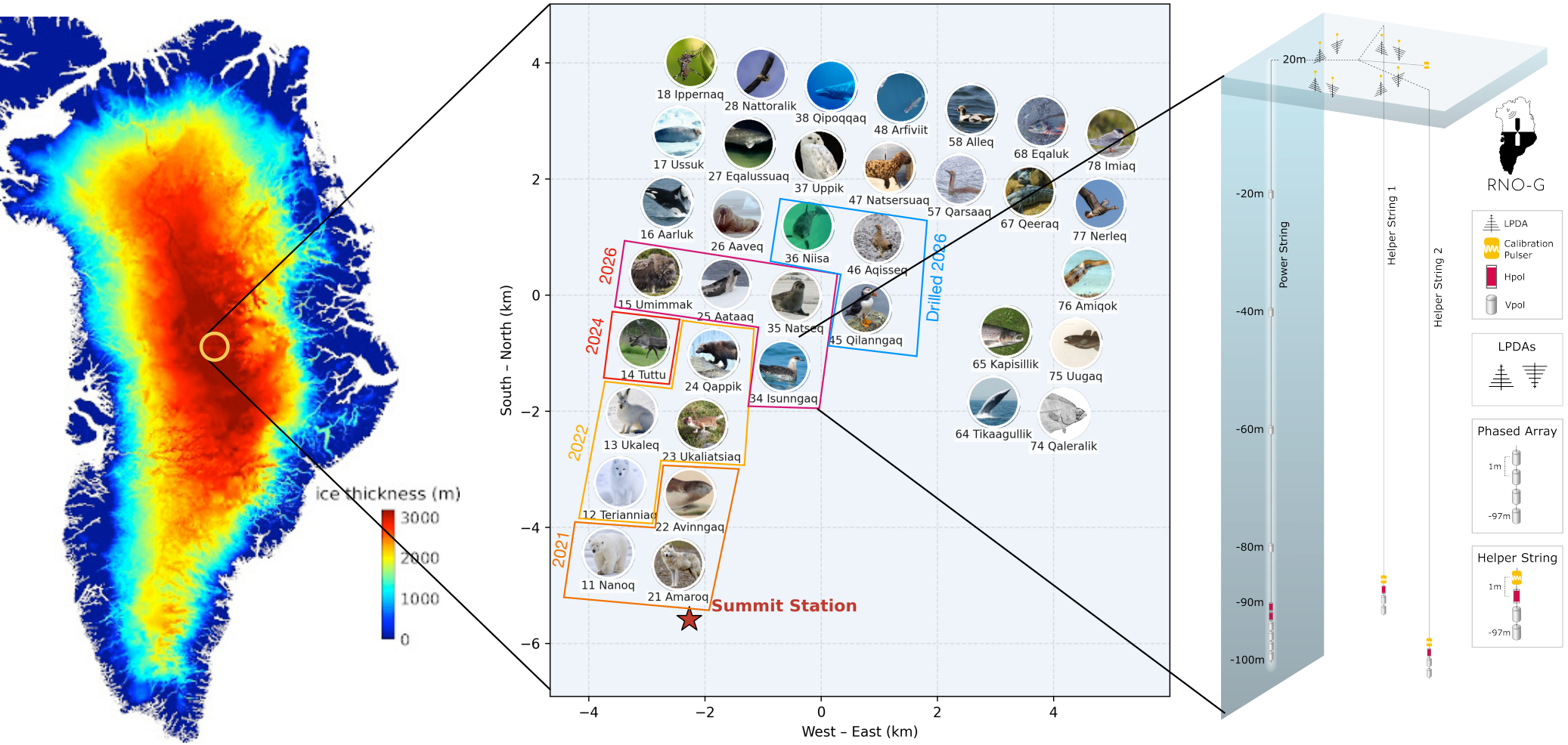
Progress

- Planned 35 stations on 1.25 km grid
- 12/35 stations operating
- Hardware for full array is fully funded
- Autonomous operation with solar power and LTE network

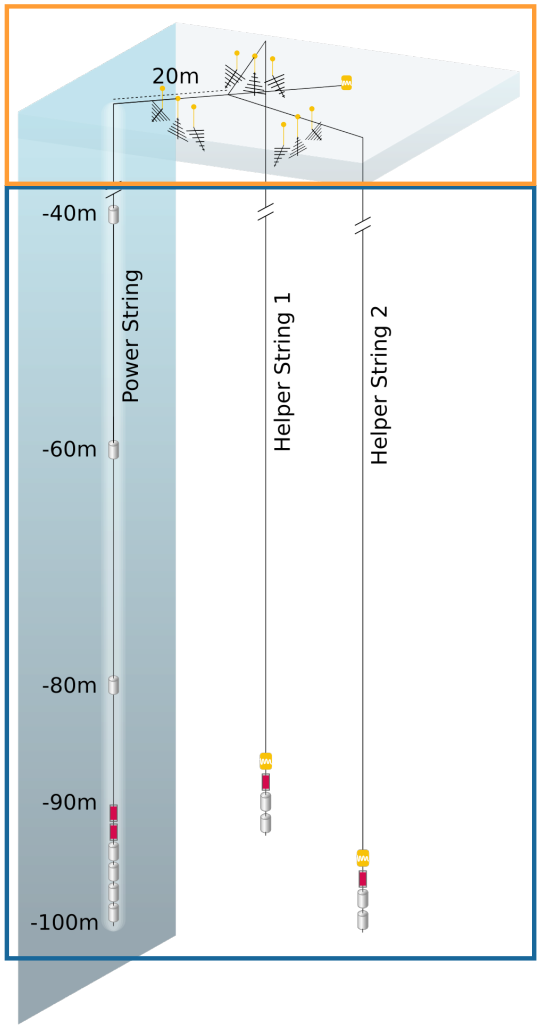
IGC

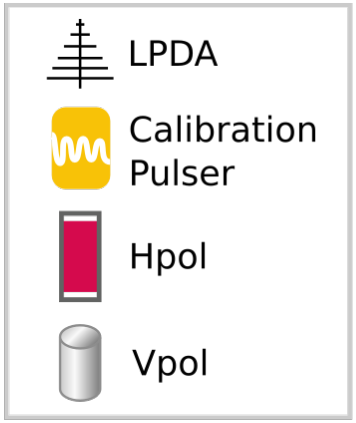
PennState
Eberly College of Science

RNO-G Array & Station



RNO-G Stations: Hybrid Design





Three different antenna types:

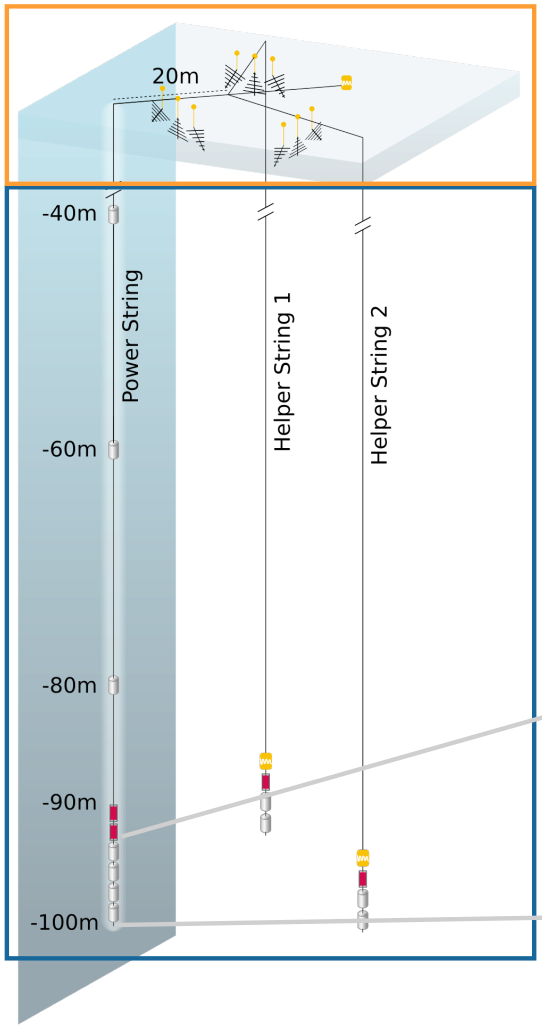
- Log-Periodic Dipole Antenna (LPDA)
- Vertically-polarized (Vpol)
- Horizontally-Polarized (Hpol)



IGC

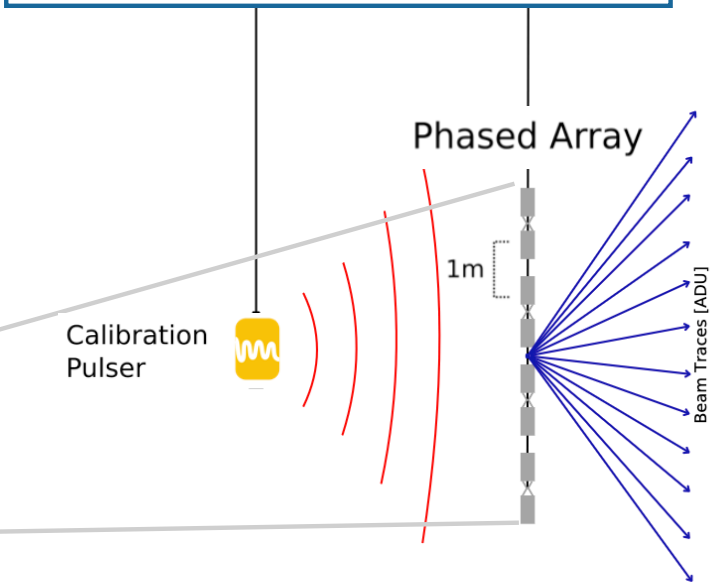
PennState
Eberly College of Science

Trigger from Deep Phased Array

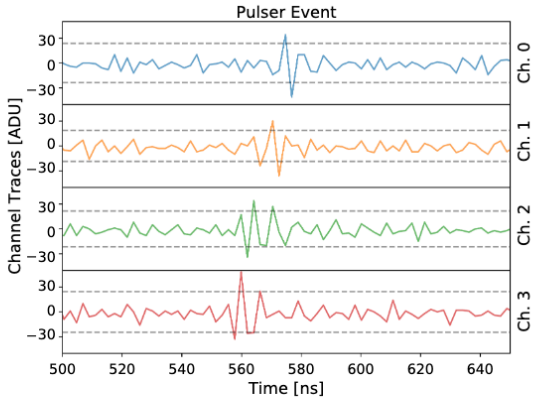


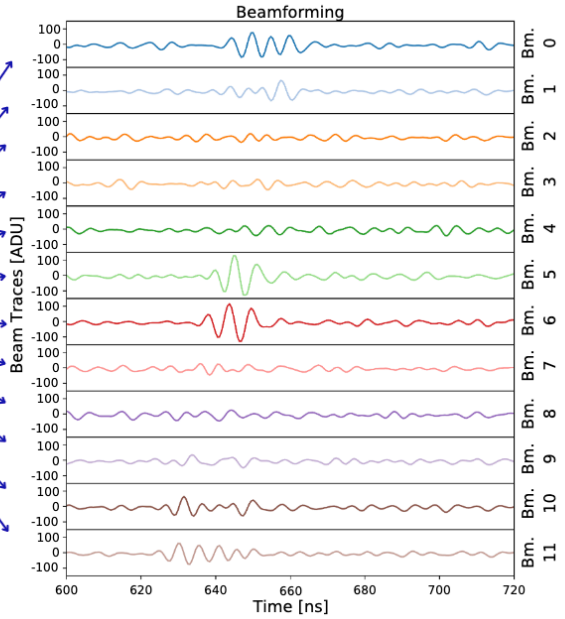
Low threshold trigger:
Densely packed Phased-Array of Vpols

- digital interferometer forms 12 beams over the full volume
- trigger runs on each beamformed trace



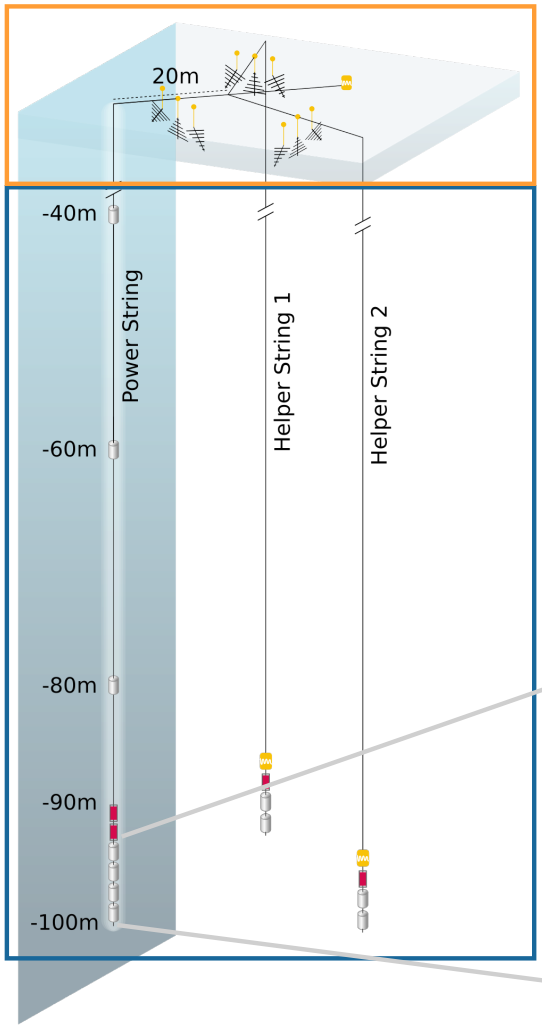
JINST 29 09 P09029 2026 (R. Krebs, PSU)





cience

Trigger from Deep Phased Array

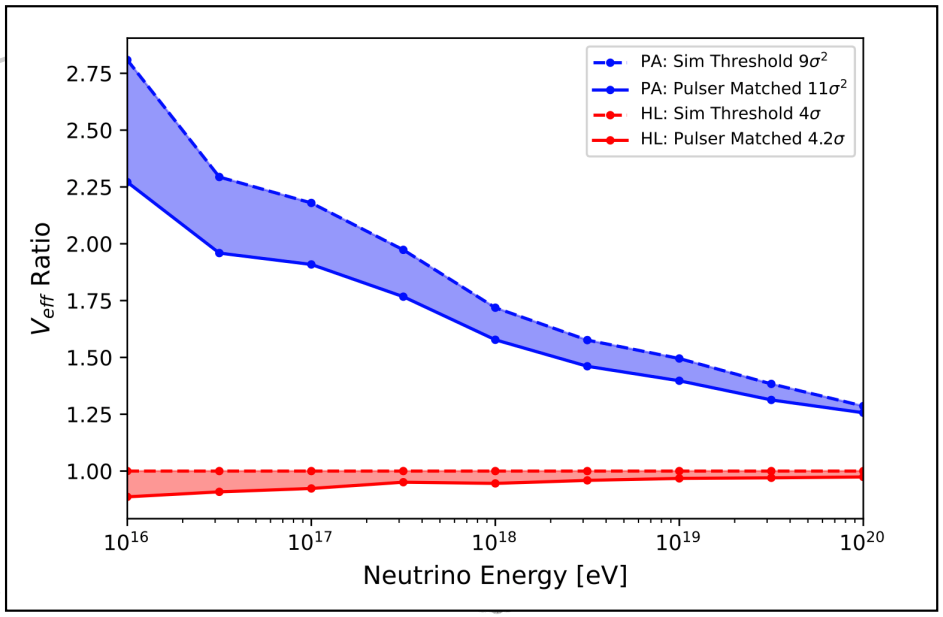


Low threshold trigger:
Densely packed Phased-Array of Vpols

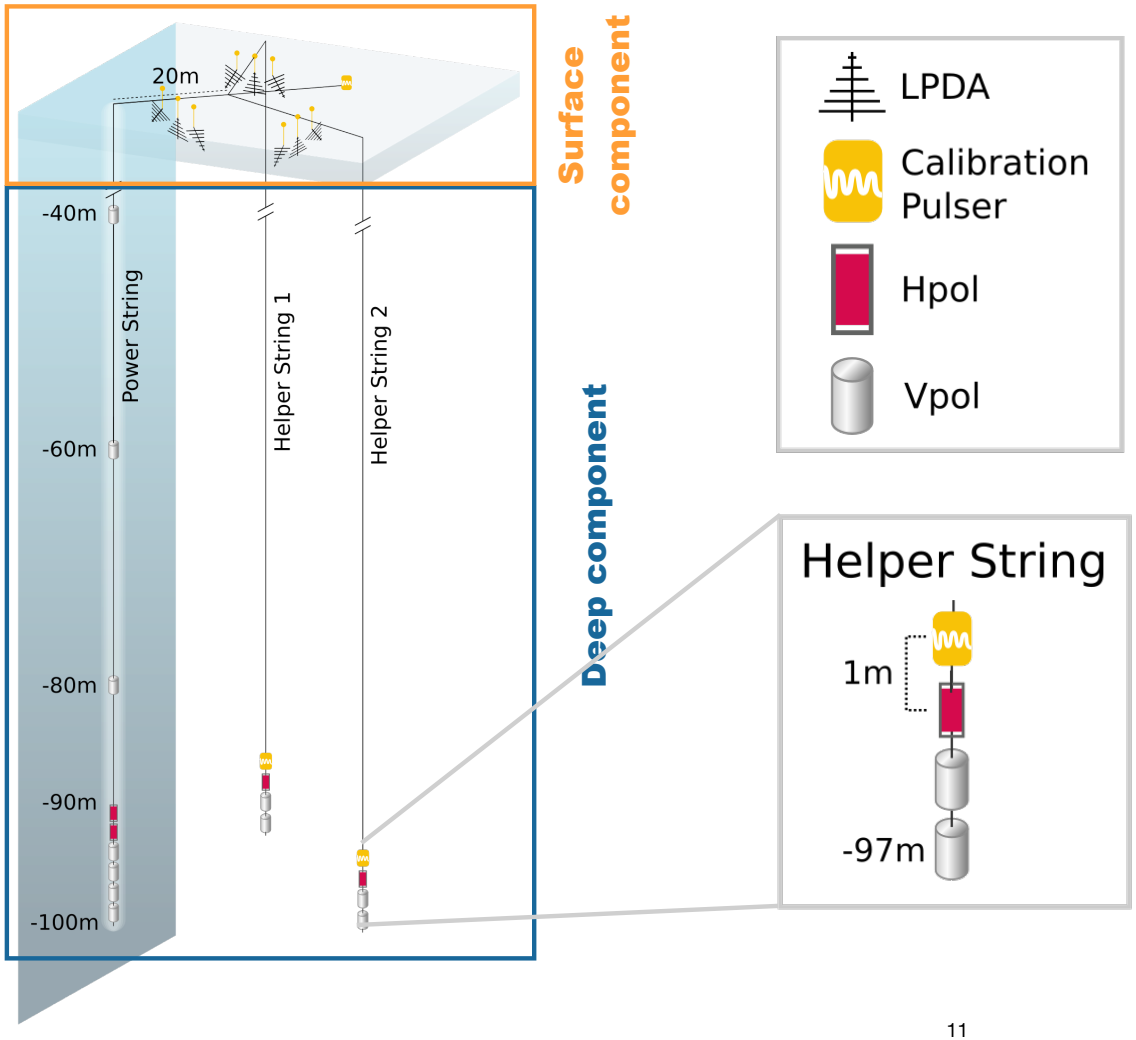
- digital interferometer forms 12 beams over the full volume
- trigger runs on each beamformed trace

2024 Trigger upgrades lead to up improved neutrino volume

JINST 29 09 P09029 2026 (R. Krebs, PSU)



Reconstruction from Helper Strings



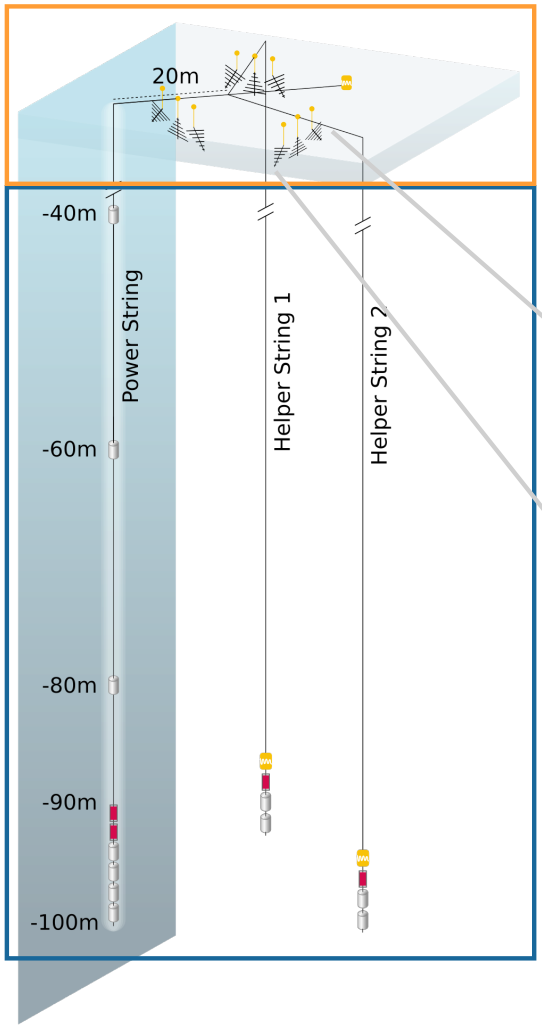
Three different antenna type:

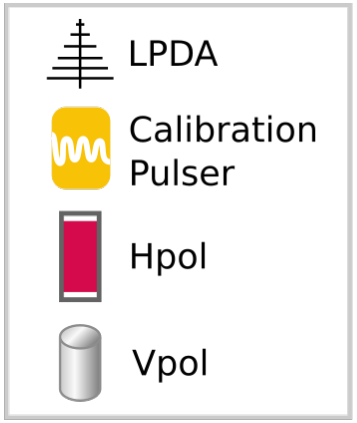
- Log-Periodic Dipole Antenna (LPDA)
- Vertically-polarized (Vpol)
- Horizontally-Polarized (Hpol)

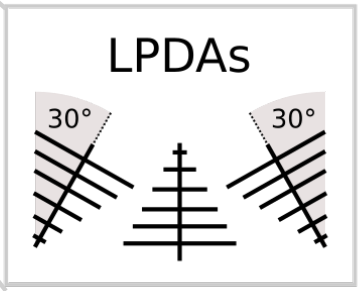
Helper strings include Vpol and Hpol antennas for signal reconstruction, as well as calibration pulsers that transmit signals as needed.

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Surface LPDAs







Three different antenna type:

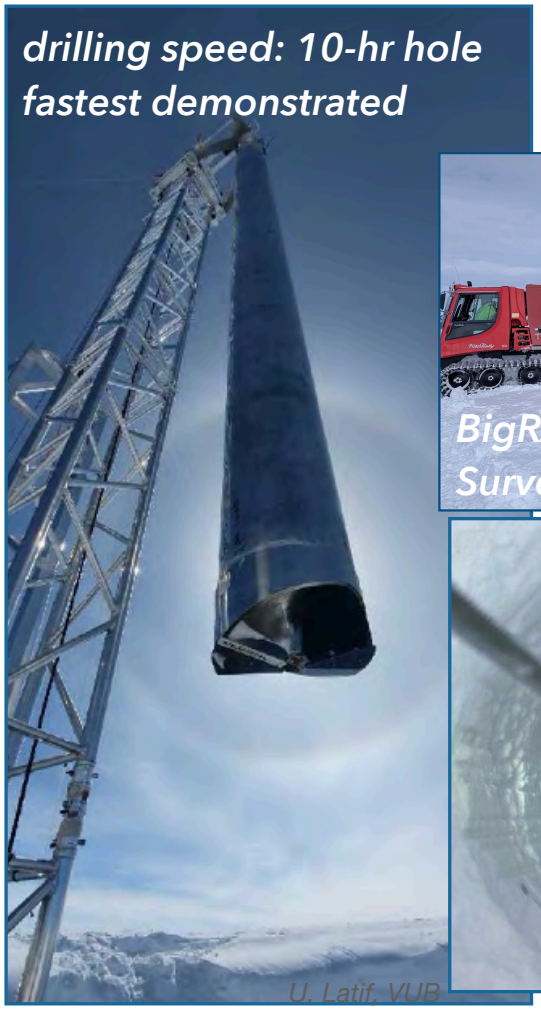
- Log-Periodic Dipole Antenna (LPDA)
- Vertically-polarized (Vpol)
- Horizontally-Polarized (Hpol)

LPDAs at the surface help with signal reconstruction and act as a surface veto.

They also contribute a small amount to neutrino effective volume.

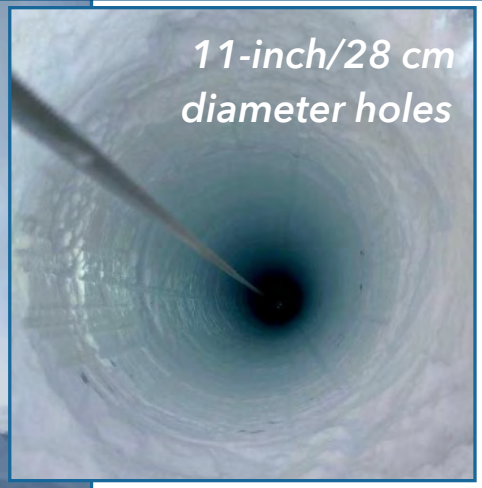
IGC PennState Eberly College of Science

Drilling



J. Tutt, PSU



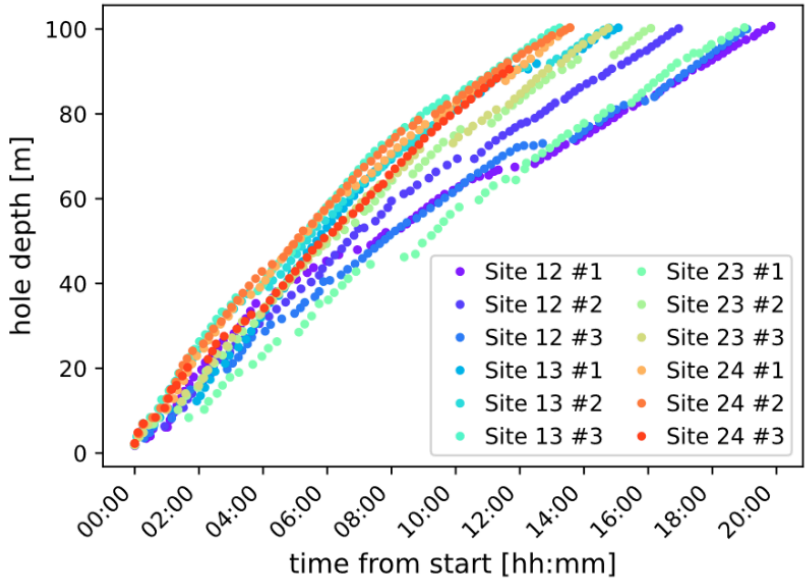


D. Tosi, PSU

Station design relies on **3 holes of a depth of 100m** per stations

- World's largest mechanical drill designed by British Arctic Survey and managed by WIPAC
- Significant effort to enhance speed & de-icing from 2023-2025
- Drill performance much improved in 2025 and fastest holes ever in 2026

S. Agarwal et al (RNO-G Coll.) 2025 JINST 20 P04015



Installation



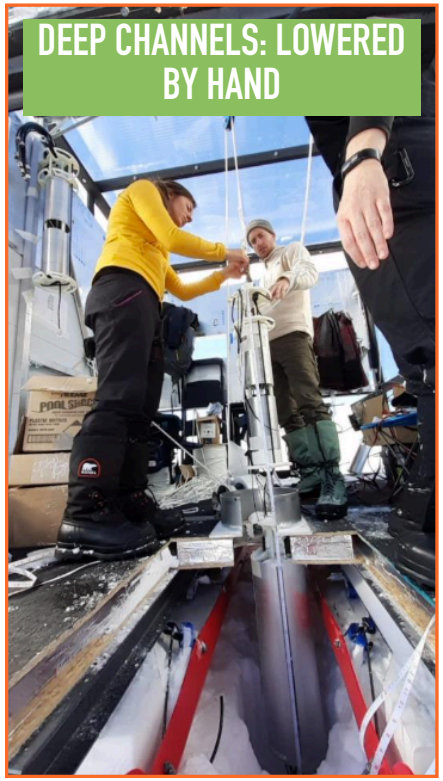




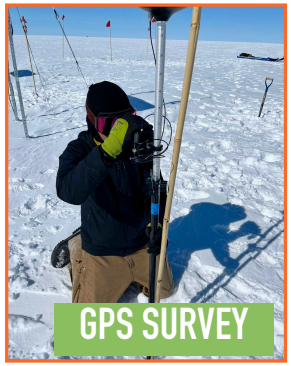




SURFACE LPDA IN TRENCHES



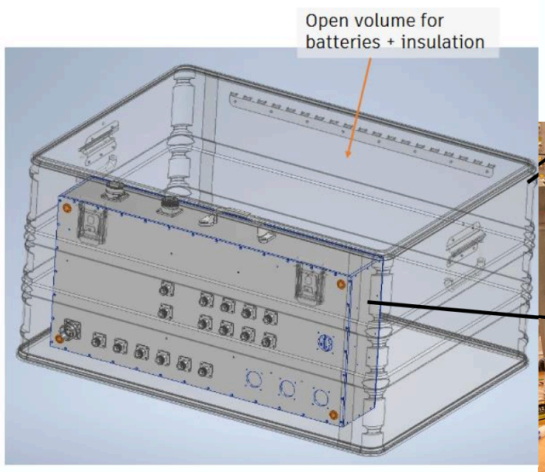


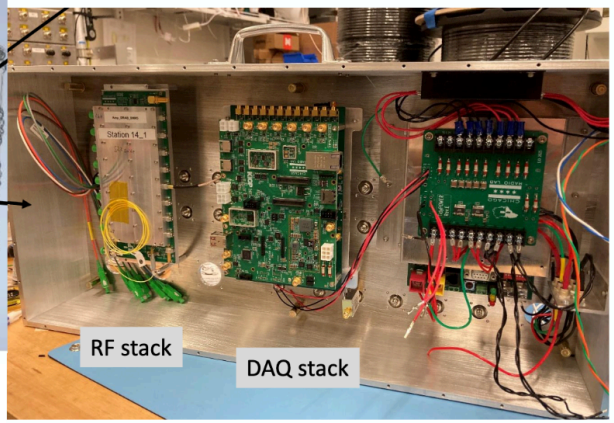


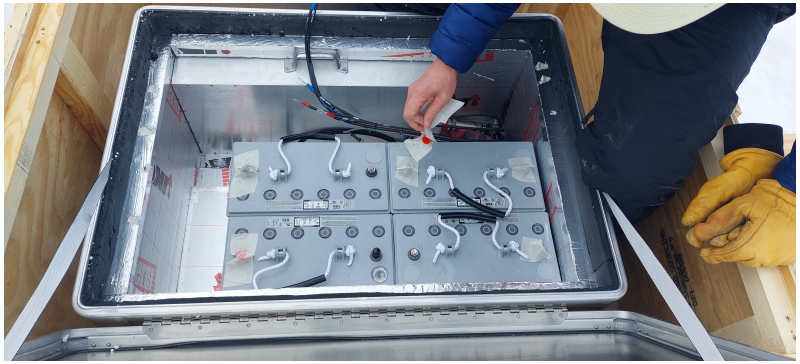


State
Eberly College of Science

Season 2026 - Major upgrade with new DAQ



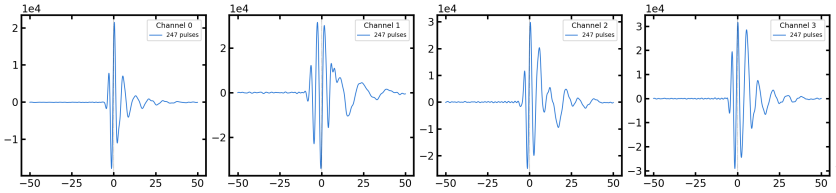




E. Oberla (Chicago), M. Schust (DESY)

- DiDAQ: All digital 24-channel system
- Robust (lower maintenance), modest power increase compared with prior design

All-Digital DiDAQ during commissioning



Calpulser run on Phased Array channels

IGC

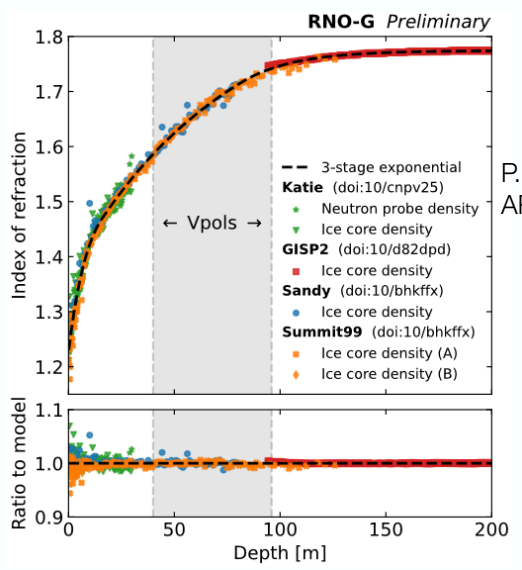
PennState
Eberly College of Science

Detector Commissioning

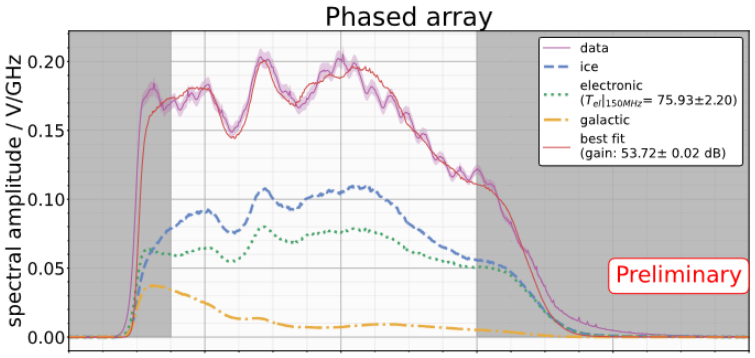
Calibration

- **Signal amplitude calibration**: for event energy estimation
- **Absolute positioning of antennas**: for direction estimation
- **Antenna alignment and relative calibration**: for signal polarization, needed for neutrino identification and reconstruction
- **In-situ ice properties**: for accurate description of signal propagation.

Refractive index: via dedicated measurements in-situ



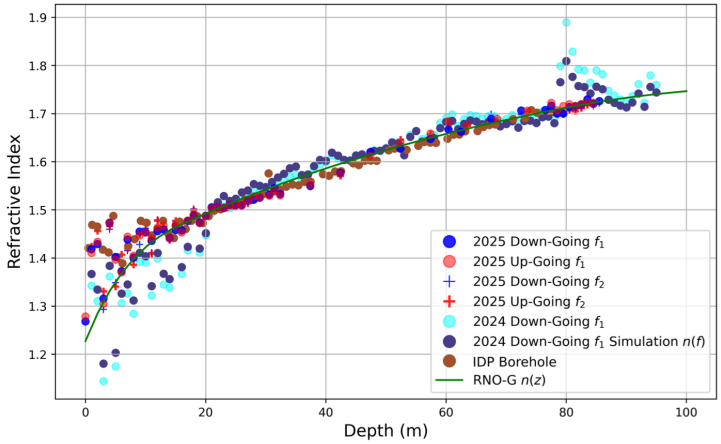
P. Windischoffer ARENA 2024



Full simulation chain for prediction of absolute signal amplitude

R. Camphyn ARENA 2026

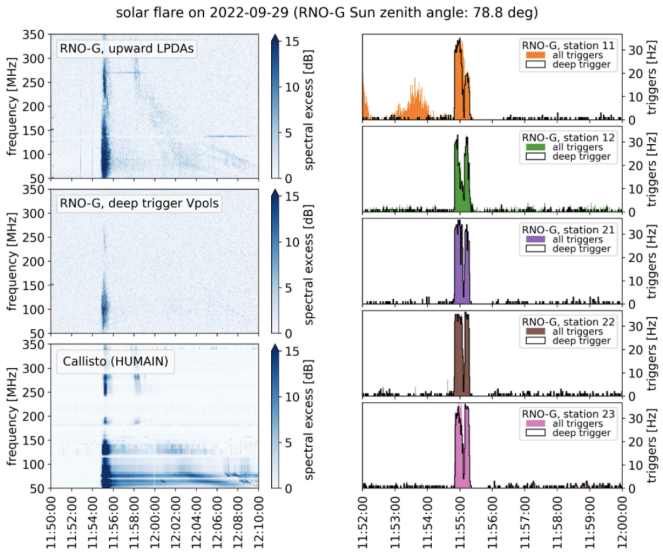
S. Agarwal J. Glaciology 2026



Natural Sources of Radio

Calibration or Backgrounds?

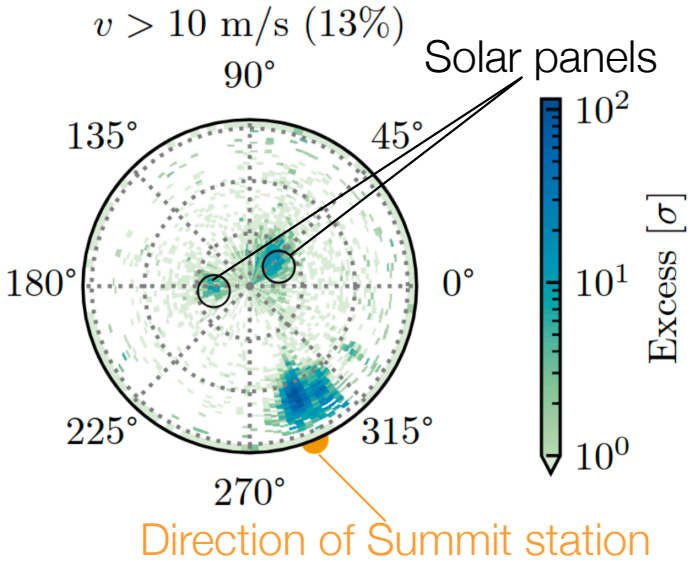
- RNO-G detects solar flares in the 100-500 MHz range
- Distant source for **absolute pointing calibration** and solar science



S. Agarwal et al (RNO-G Coll.) Astroparticle Physics 164 (2025) 103024

- Triboelectric charging due to wind

Wind events reconstruct to large metal structures

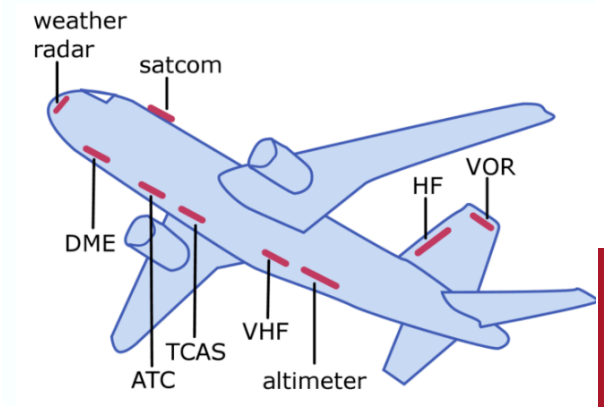


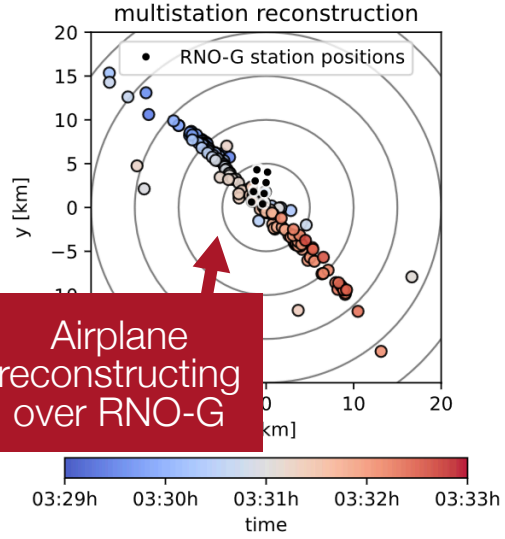
Work presented at ARENA 2026 (P. Schriefer, ECAP)

IGC PennState Eberly College of Science

Humanmade Backgrounds? Calibration Sources?

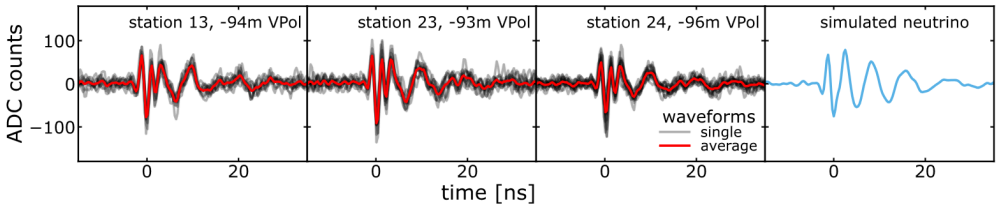
Airplanes





Airplane reconstructing over RNO-G

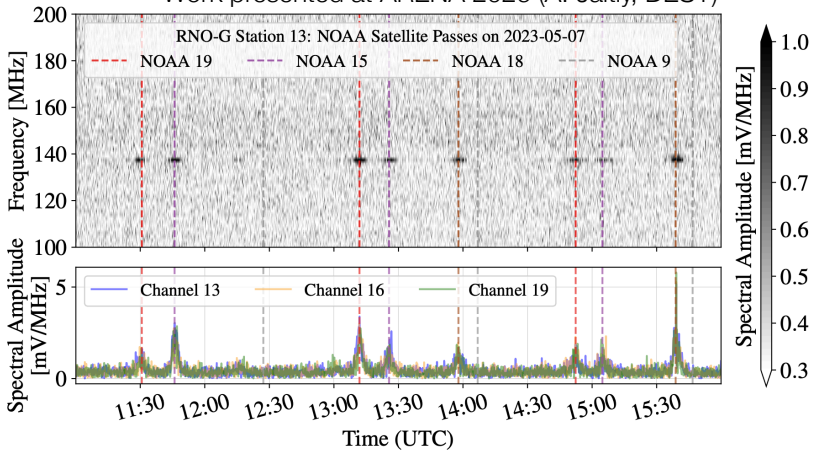
Signal from airplane similar to neutrino



S. Agarwal et al (RNO-G Coll.) 2025 JINST 20 P11015

Continuous wave signals from satellites in a few hours of data

Work presented at ARENA 2026 (A. Jaitly, DESY)



NOAA satellites passes

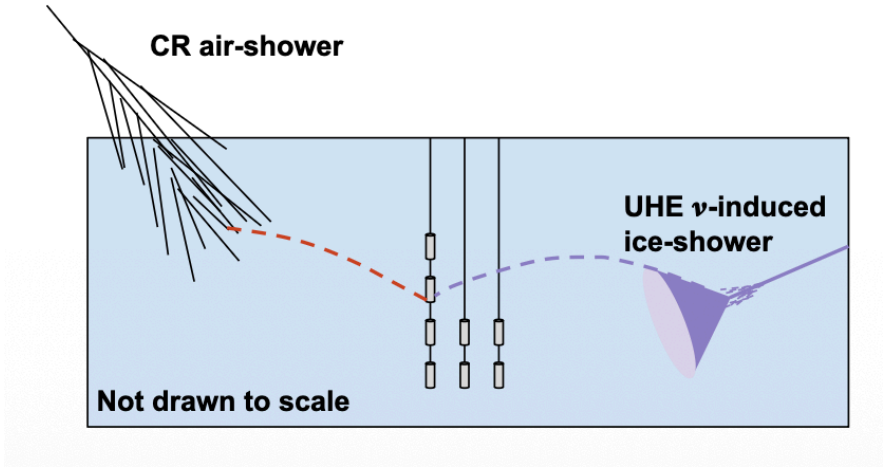
IGC PennState Eberly College of Science

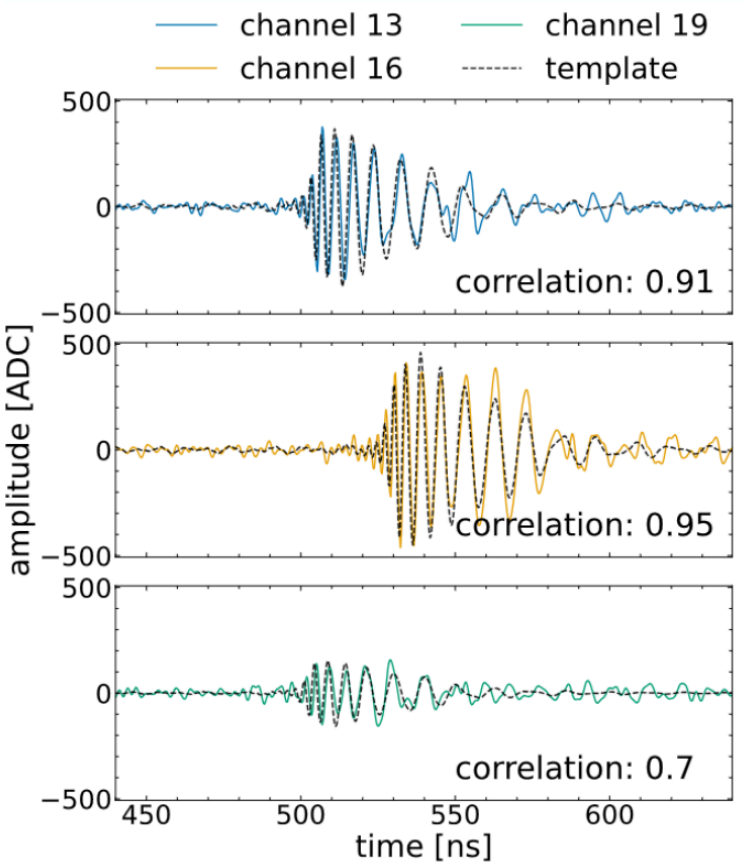
Cosmic Rays – first astroparticle channel

in surface channels

Work submitted to EPJ-C (J. Henrichs, DESY)

- Cosmic ray air showers generate radio emission in air (geomagnetic) and in ice (Askaryan)
- Several CR candidates identified in two years of data in upward facing surface channels
- Important to understand detector response and systematics
- Number and reconstructed properties consistent with expectation.

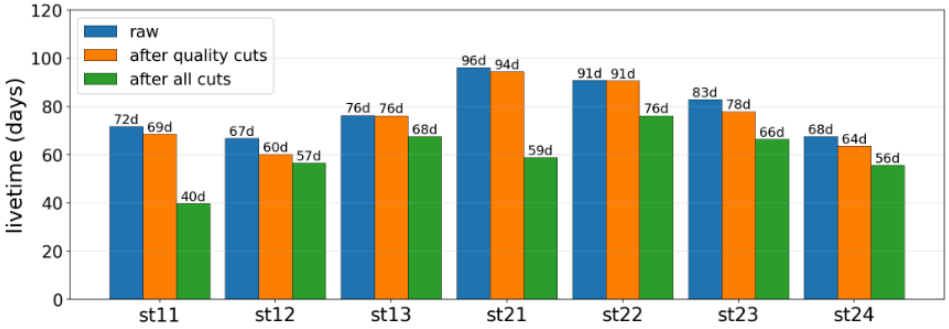




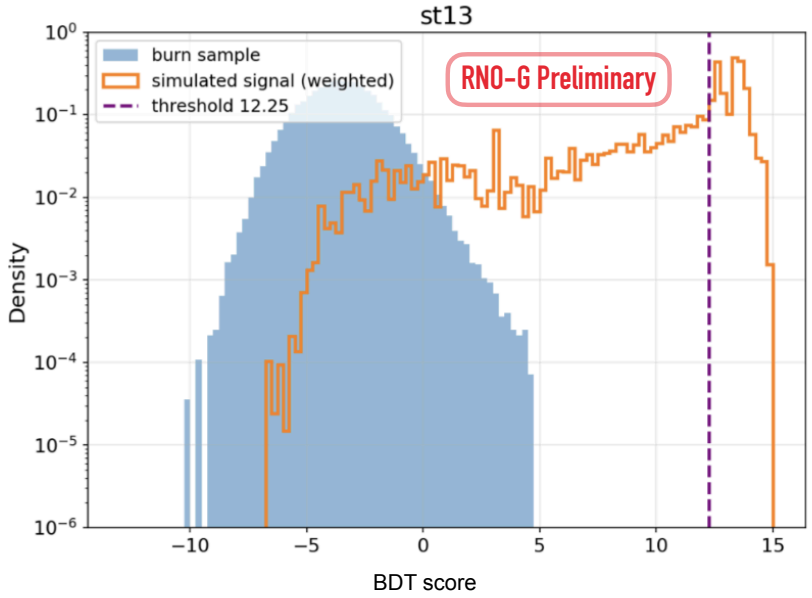
Cosmic Rays – first astroparticle channel

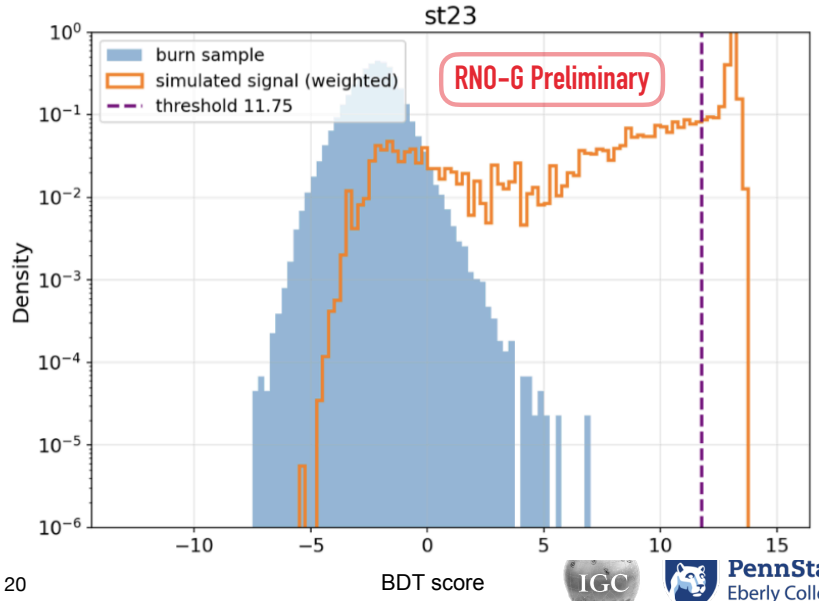
in deep channels

Work presented at ARENA 2026 (B. Hendricks, PSU)



- Search in **deep channels** of early data for in-ice Askaryan emission ARA PRL 2026
- Represents first detailed study of backgrounds (dominant thermal and more rare non-thermal backgrounds)





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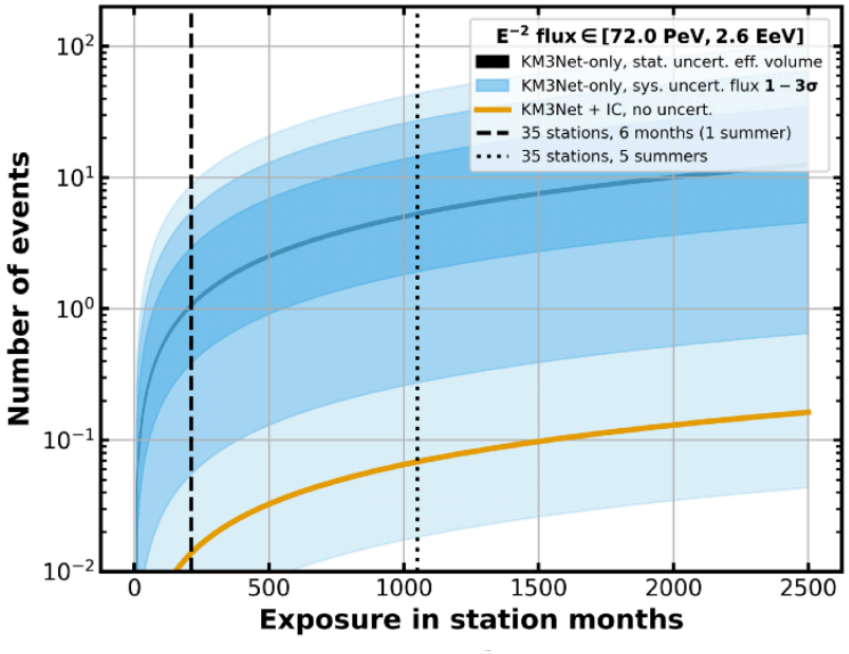
Conclusions

RNO-G targets neutrinos >10 PeV

- Expect to complete 35-station array in early 2030s (hardware fully funded)
- 1/3 of the array currently operating, several drilling and instrument upgrades in progress.
- Cosmic ray searches in progress: first astroparticle signatures which are crucial for detector validation
- First diffuse neutrino search coming soon
- RNO-G well-positioned (Northern sky, UHE sensitivity) for following up KM3NeT event.



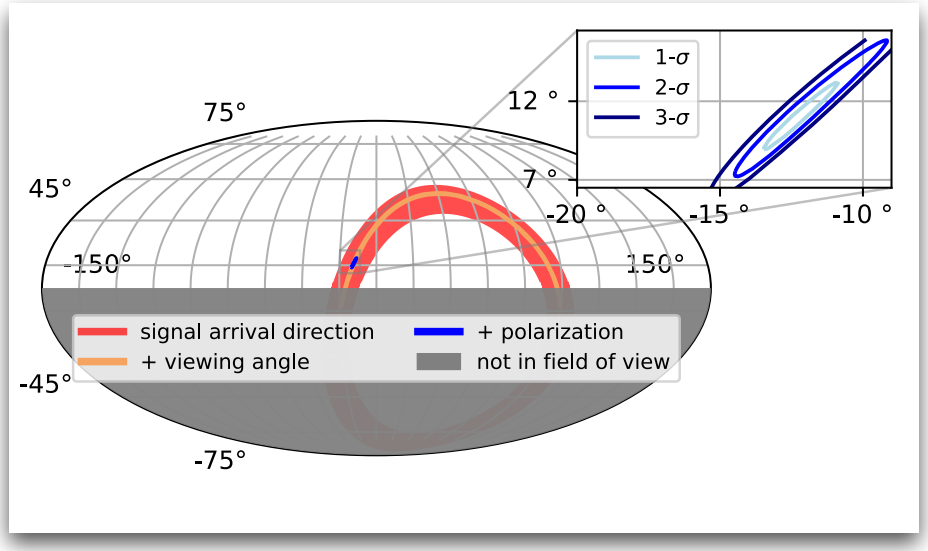
Sensitivity to KM3NeT event. Expect O(1) event in one summer with RNO-G-35

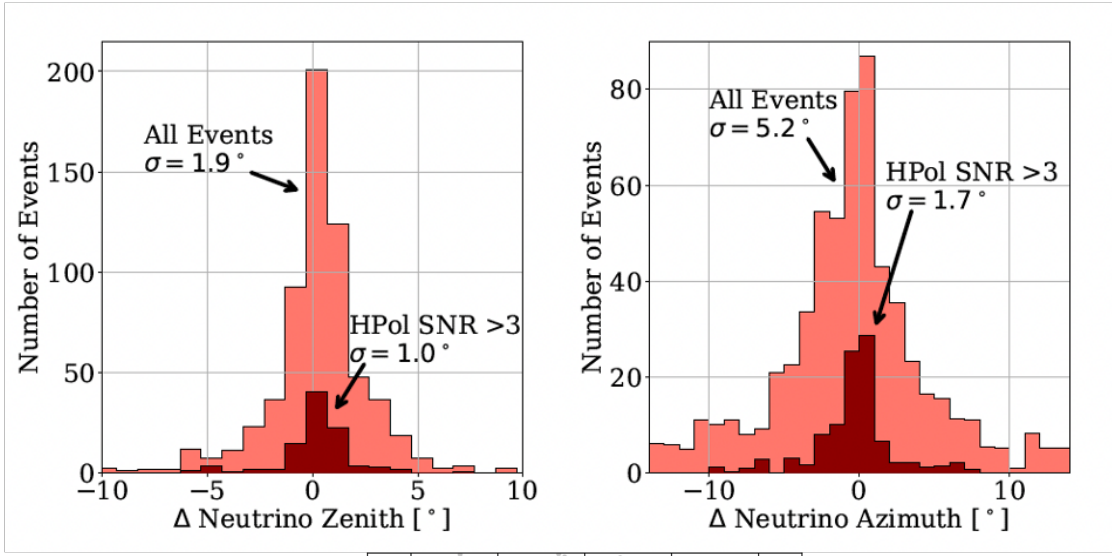


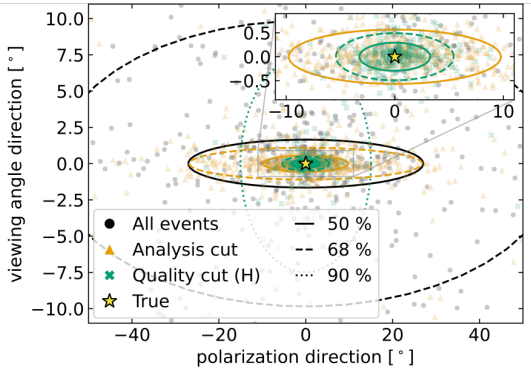
Backup

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Expected Direction Reconstruction







[S. Bouma for IceCube-Gen2, Pos (ICRC23) 1045](#) [I. Plaisier et.al., EPJC 83 (2023) 5](#)