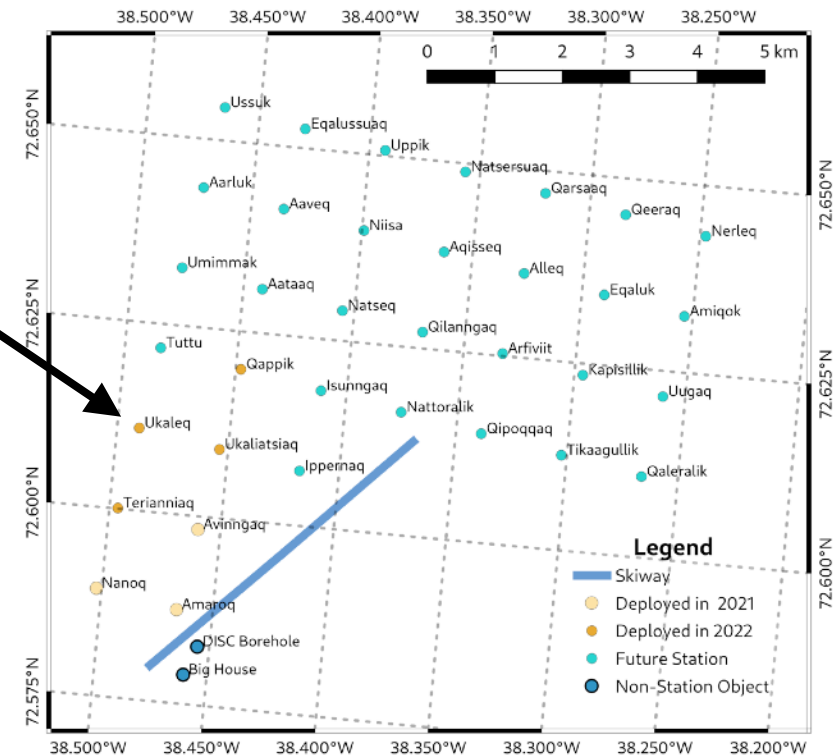
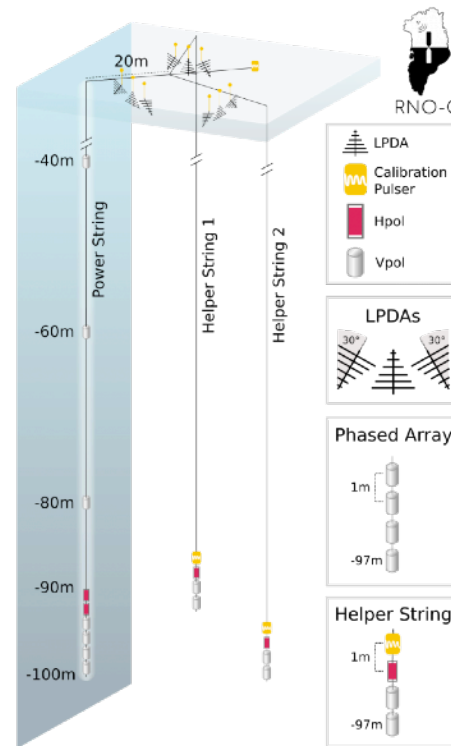
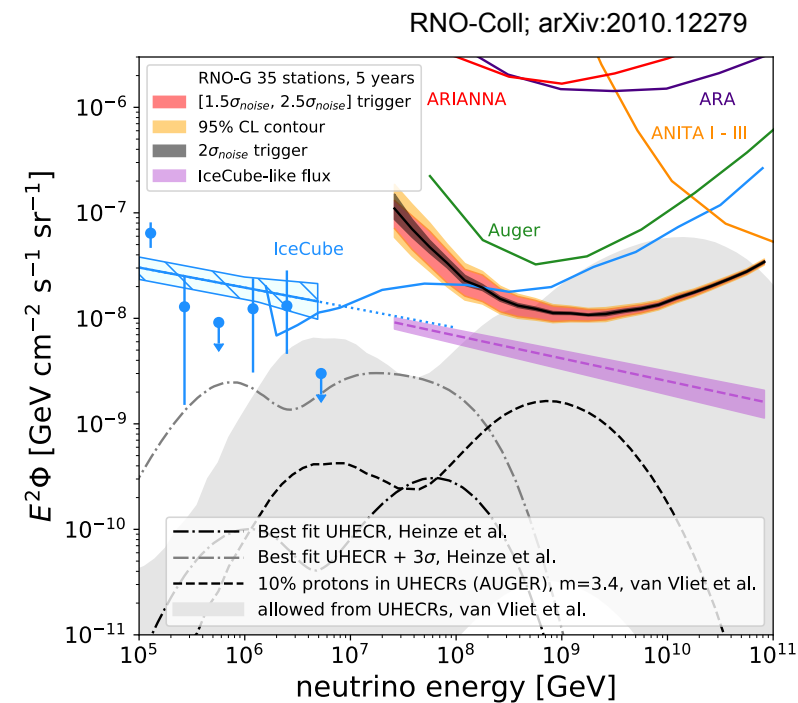


# The Radio Neutrino Observatory Greenland (RNO-G)

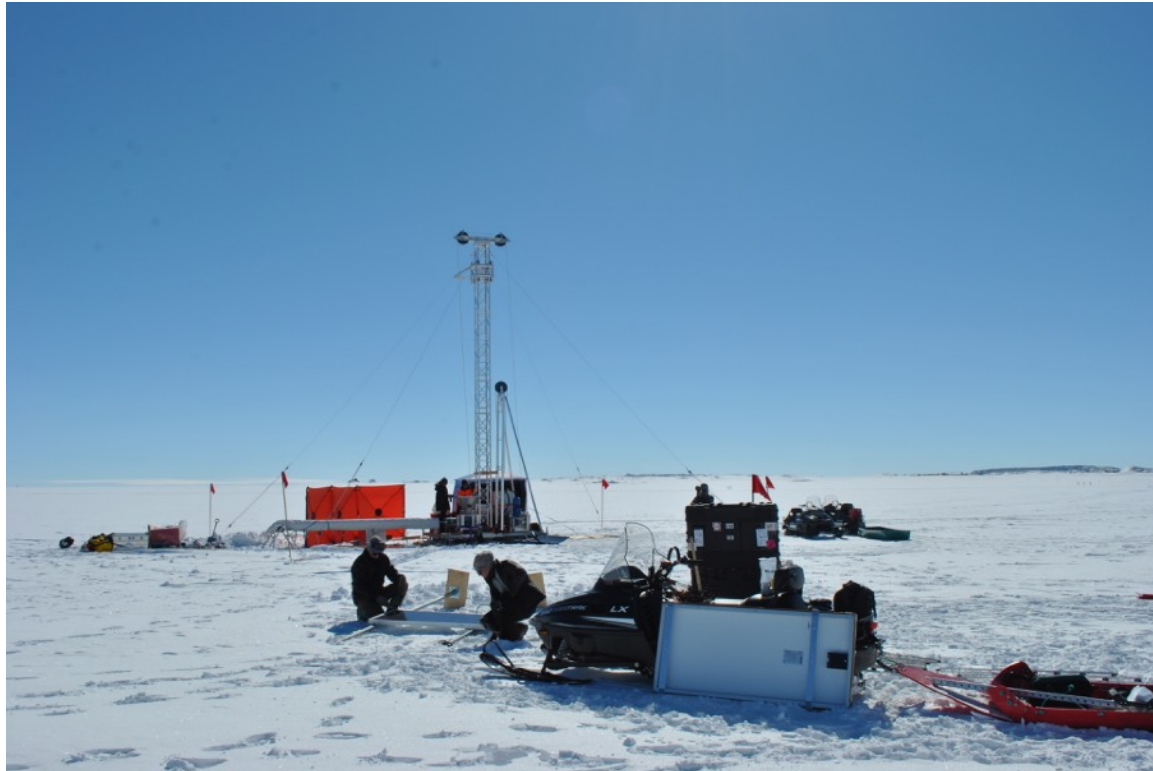
Construction of 35 stations: 2021 - 2026

- Targets the energy range in which neutrinos are expected from the interaction of ultra-high energy cosmic rays and the CMB (>10 PeV) : Discovery experiment
- Partners: Germany (FAU + DESY, Funding: Emmy-Noether, ERC), US, Belgium, Sweden
- Several proposed competitors in this energy range, RNO-G currently only one funded



# Hardware status as of now

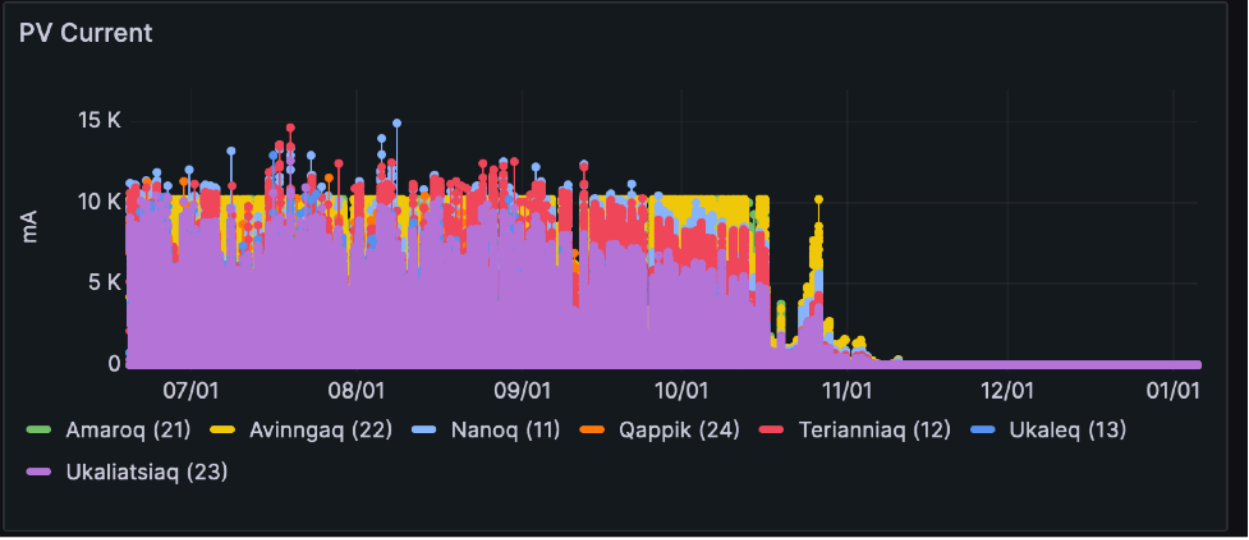
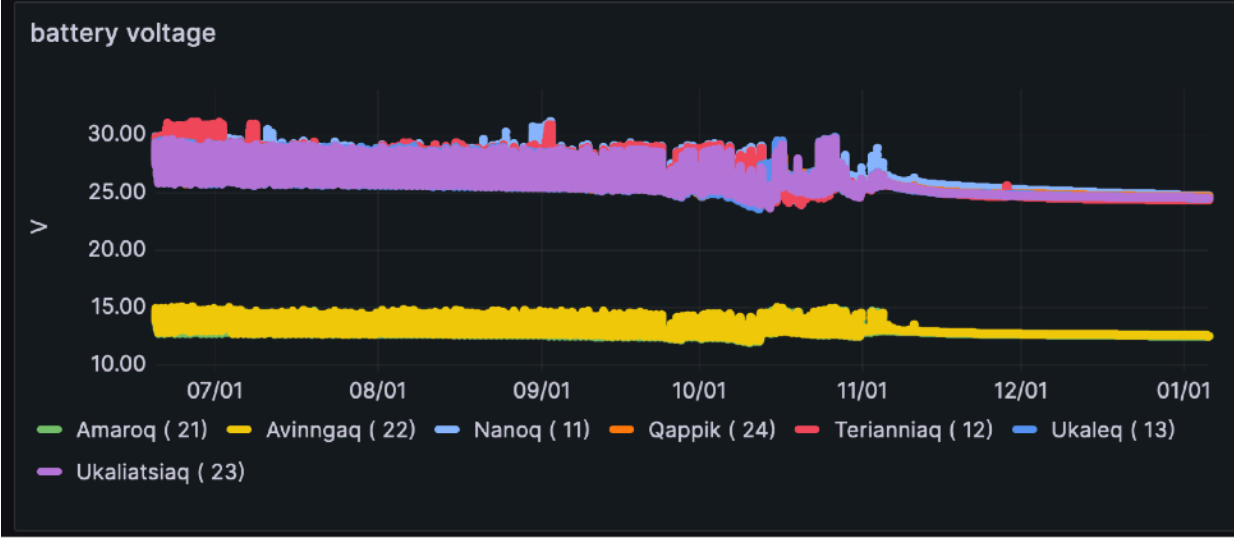
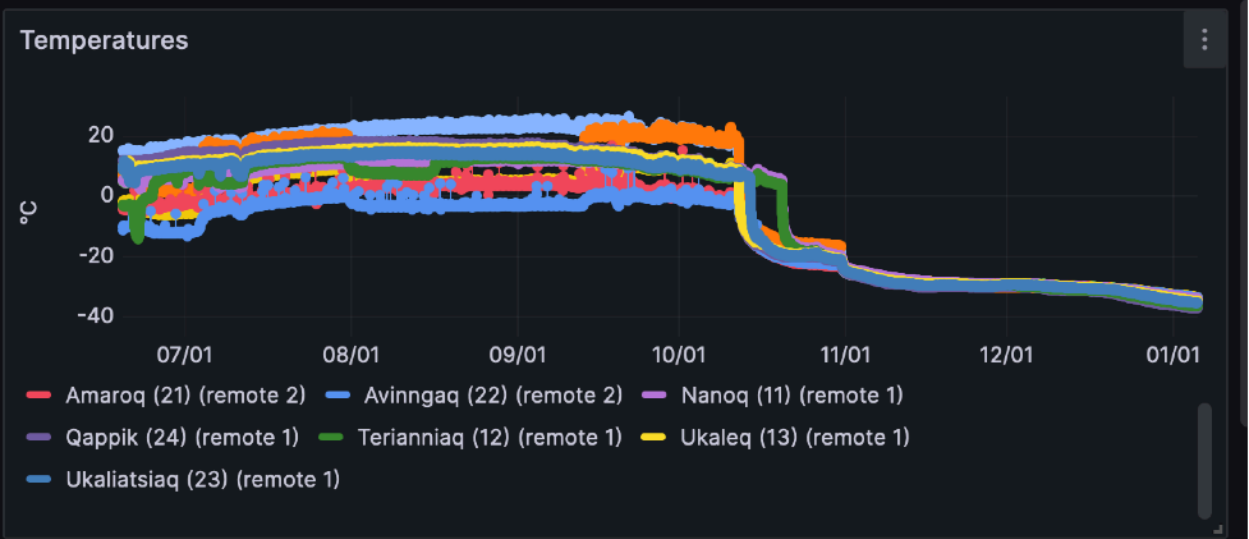
7 stations installed and running





# Hardware status as of now

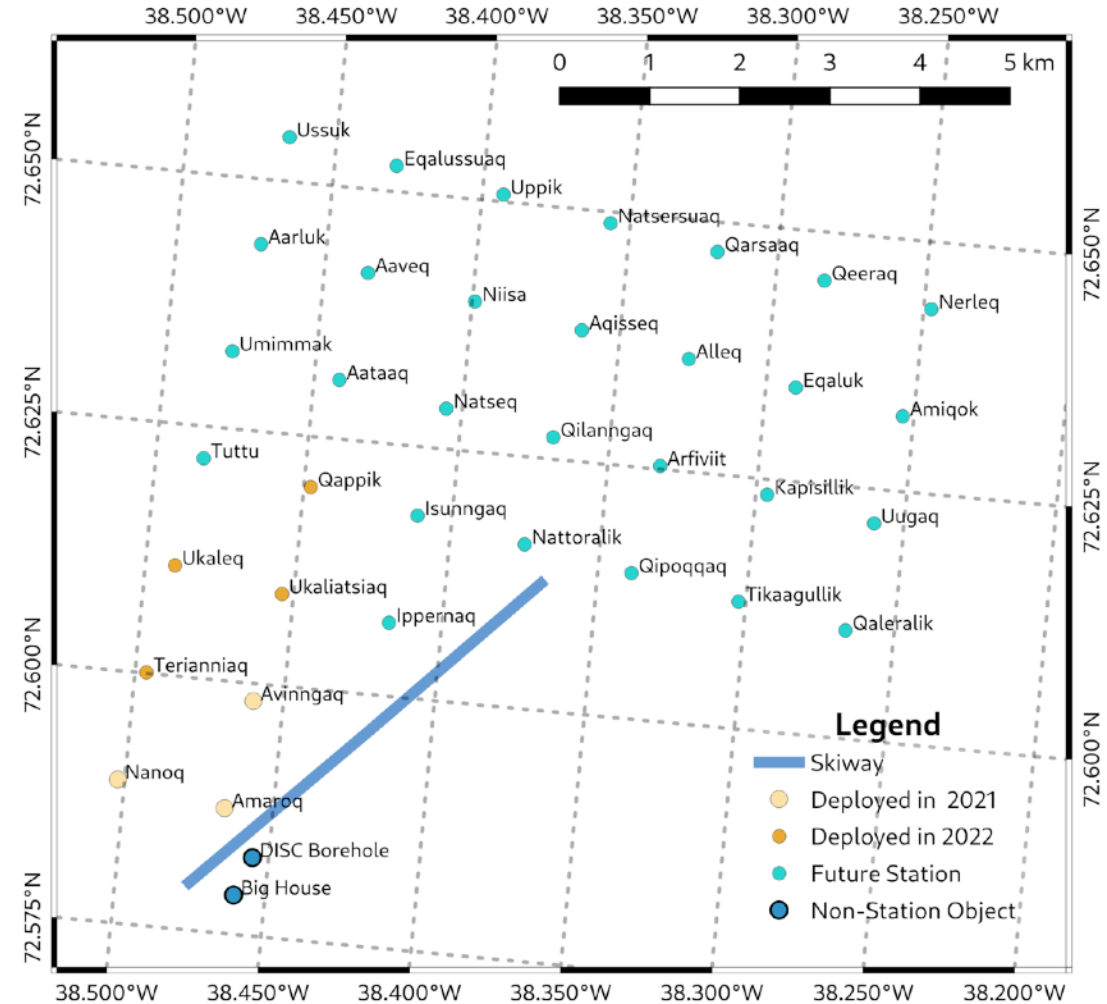
7 stations installed and running (Monitoring Screenshot, January 5th 2024)



# Hardware status as of now and known issues

## 7 stations installed and running

- 2024: strings at 8 stations
- 2025: strings at 10 stations
- 2026: strings 10 stations
- Bottleneck: Drilling performance
  - Longer drill shift than originally planned
  - Madison is now lead on drilling, no longer the team of British Antarctic Survey (BAS)
- Operation ok but not 100% ideal yet
  - New DAQ board in 2025 (no new boards in 2024), current board requires too much babysitting
  - Autonomous power system not ideal for winter, better wind turbines needed



# Data status as of now

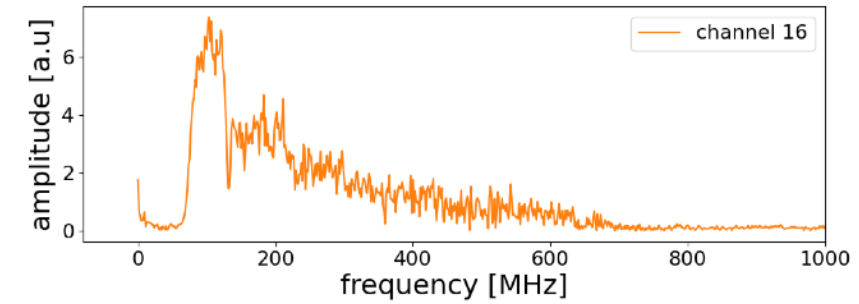
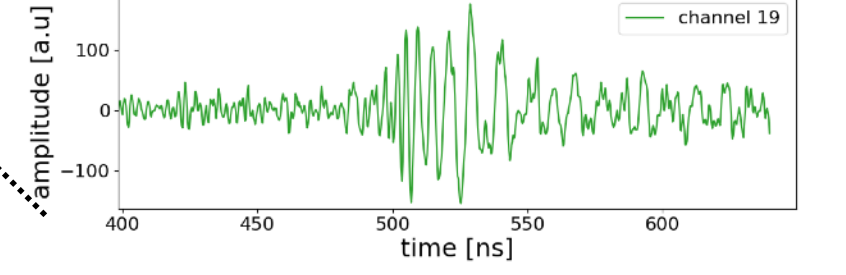
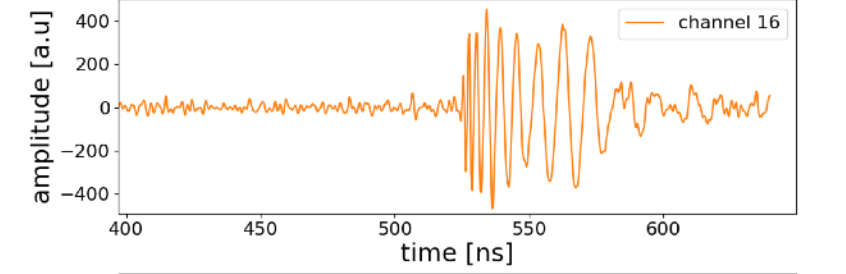
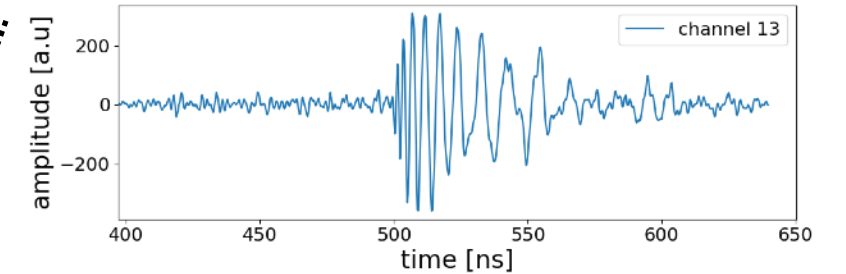
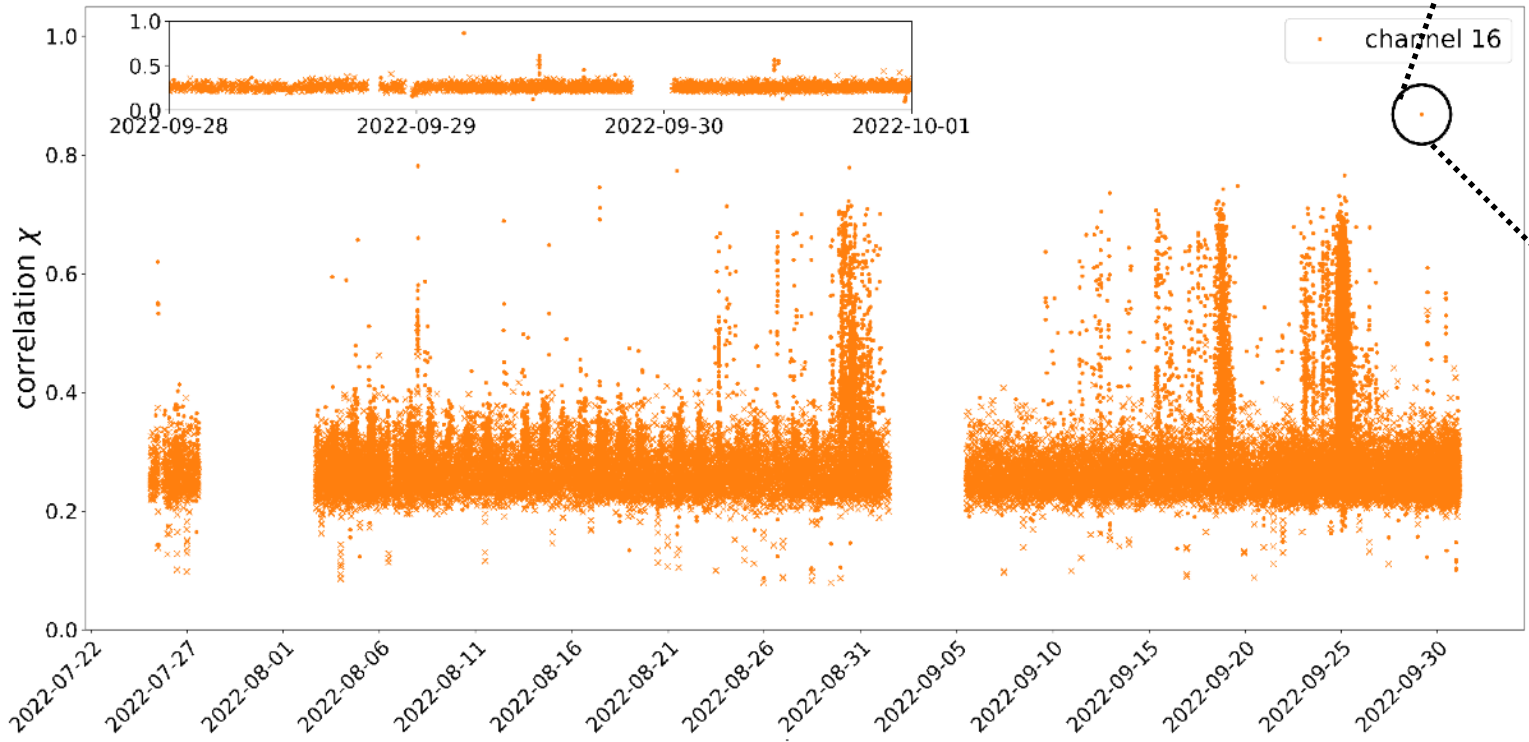
## First neutrino the earliest in 2027 (if not violating IceCube limits)

- Survey of radio backgrounds on-going
  - Air planes, Wind generated events, Diffuse Galactic Emission, Station activity, ... (many theses in progress)
- Cosmic ray detector verification on-going
  - First anticipated science publication (see next slide)
- Instrument paper for first 7 station (draft in progress)
- Many glaciology studies on-going (or already published)
  - In situ, broadband measurement of the radio frequency attenuation length at Summit Station, Greenland, Journal of Glaciology, 68 (272), 1234–1242 ArXiv:2201.07846, <https://doi.org/10.1017/jog.2022.40>
  - Radiofrequency Ice Dielectric Measurements at Summit Station, Greenland, Journal of Glaciology, Oct 2023, Arxiv:2212.10285, <https://doi.org/10.1017/jog.2023.72>
  - Precision measurement of the index of refraction of deep glacial ice at radio frequencies at Summit Station, Greenland, Submitted to The Cryosphere, Arxiv:2304.06181
  - ...

# Data status as of now

The detector is working and we are learning to understand it

- Cosmic ray searches as shown at ICRC
  - With more data still blind, already > 40 cosmic rays identified



# The RNO-G funding scheme

In contrast to South Pole Funding and what you may know from IceCube



10 Mio EUR infrastructure funds



HELMHOLTZ



ParticleAstro + EPSCOR



2 Starting Grants



35 + calibration stations funded

Hardware (Stations, Drill), People, Travel Funds,...

one NSF-funded grant is enough to guarantee support (for grant duration)



Yearly: discussion scope, bills

Airplanes, Housing, Comms

Office of Polar Programs ARCTIC

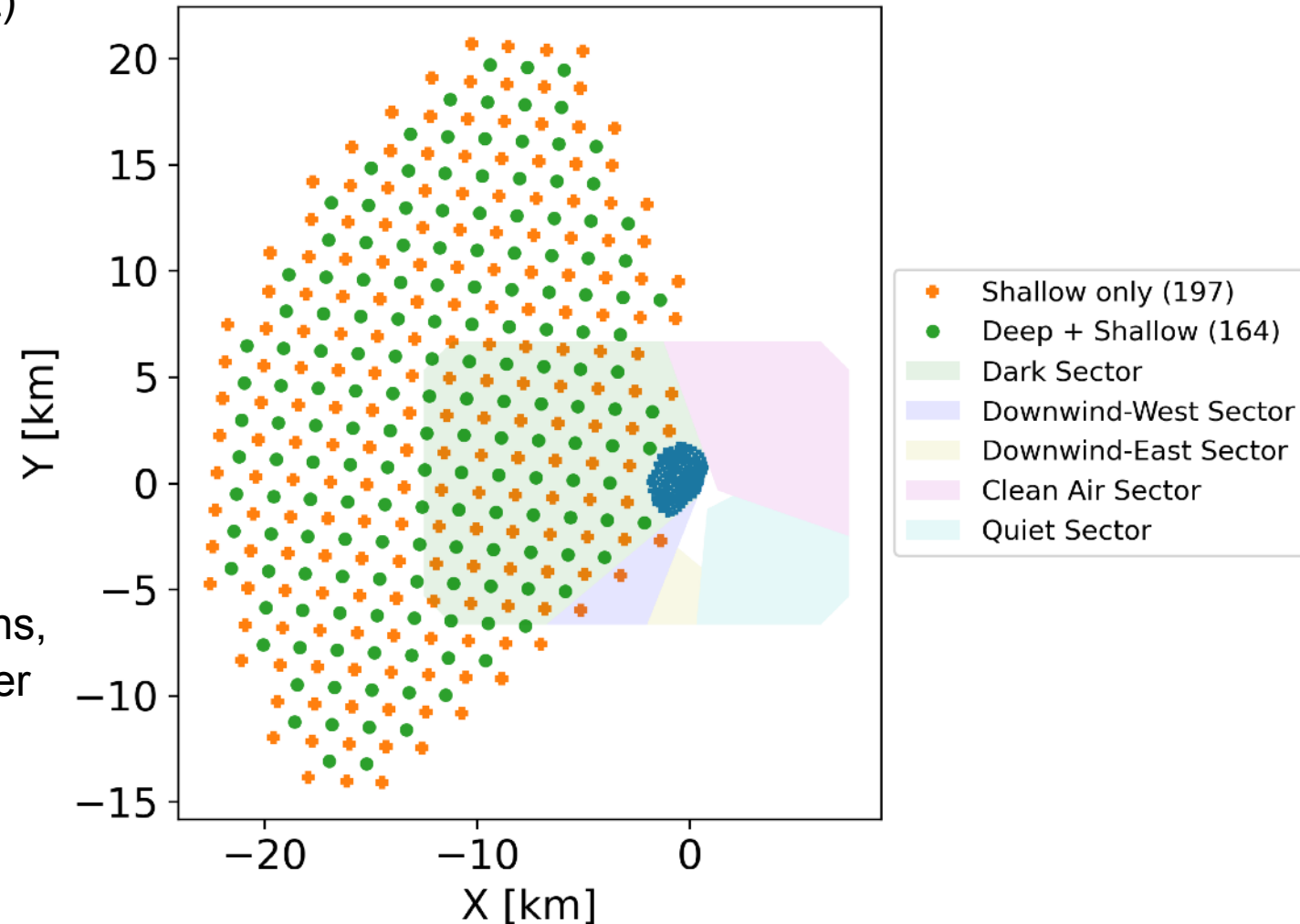


RNO-G

# Relation of RNO-G to the radio array of IceCube-Gen2

## Baseline plan

- A hybrid station of IceCube-Gen2 will (almost) look like an RNO-G station
- New DAQ board for RNO-G (currently in development) is needed/planned for Gen2
- Drilling improvements also needed for Gen2
- Difference:
  - Power system (cabled)
  - Comms system (cabled)
  - RNO-G has (currently) no shallow stations, — may end up being added for air shower studies in a small region





# Relation of RNO-G to the radio array of IceCube-Gen2

(not necessarily politically correct slide)

- RNO-G collaboration and the one would be building the radio array of IceCube-Gen2 is almost identical
  - Not members of RNO-G: Barwick, Connolly, Hofmann, Chiba, NTU
  - RNO-G collaboration could absorb one or two additional groups, but more work needed for Gen2
- **If IceCube-Gen2 happens: RNO-G construction will need to end**
  - Operation can continue, M&O costs are something like 50k a year (cost driver is flying to Greenland for maintenance)
- **If the radio array of Gen2 is not at South Pole, there is no critical obstacle to build in Greenland**
  - Design of power and comms system needs to be different (no cables, different sun vs. wind ratio)
  - Operation needs to scaled up carefully — it will never be as fast/large as at Pole
  - Relation of RNO-G to IceCube-Gen2 needs to refined
    - Financing and organizational scheme cannot remain like RNO-G
    - RNO-G to merge with IceCube-Gen2?