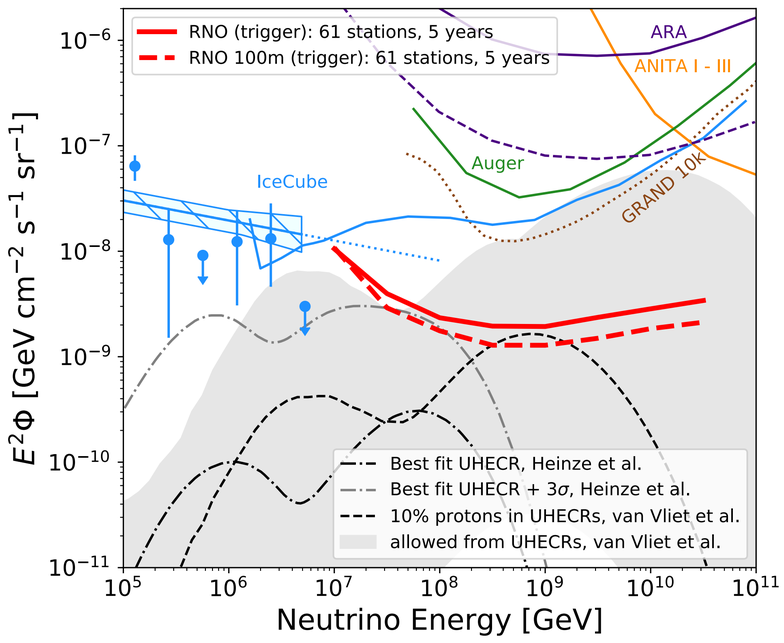
The Radio Neutrino Observatory

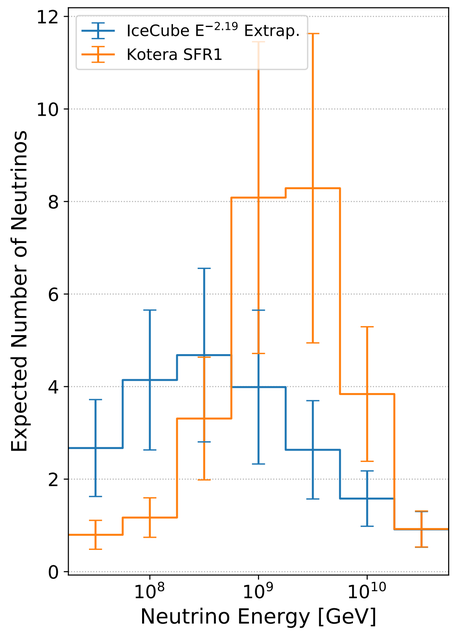
Targeting the radio emission of neutrinos above 10 PeV at South Pole

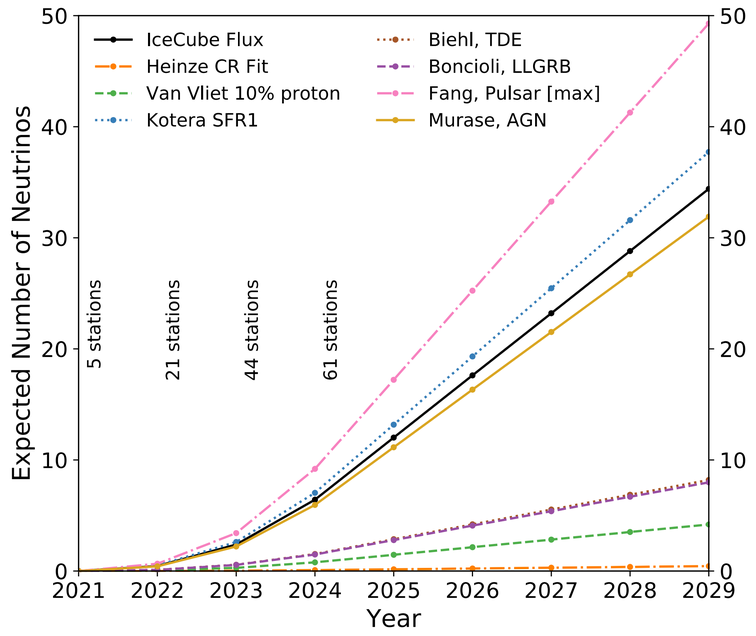
Albrecht Karle and Anna Nelles for the RNO Collaboration

The science case

> A neutrino flux is expected from the interaction of ultra-high energy cosmic rays with the CMB.
> Flux predictions of neutrino production in sources extend to energies beyond 10 PeV.
> IceCube measured astrophysical neutrinos. The continuation of the flux to higher energies is to be investigated.

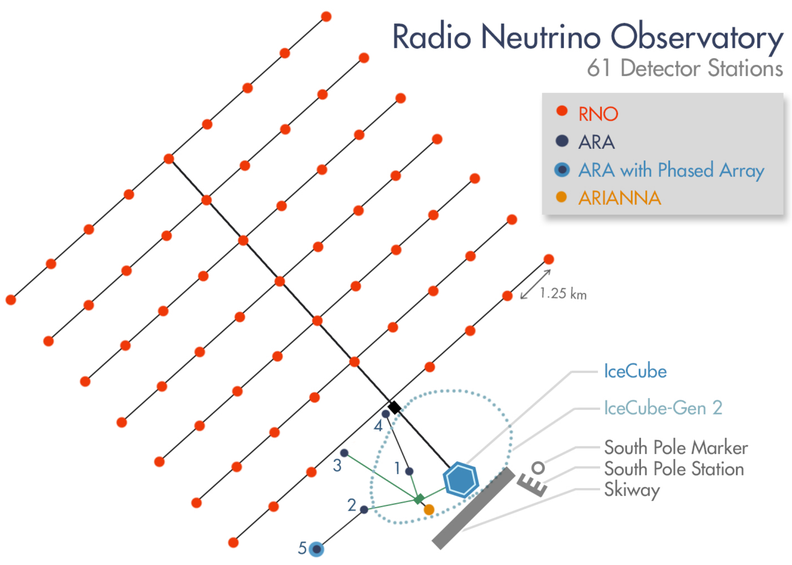




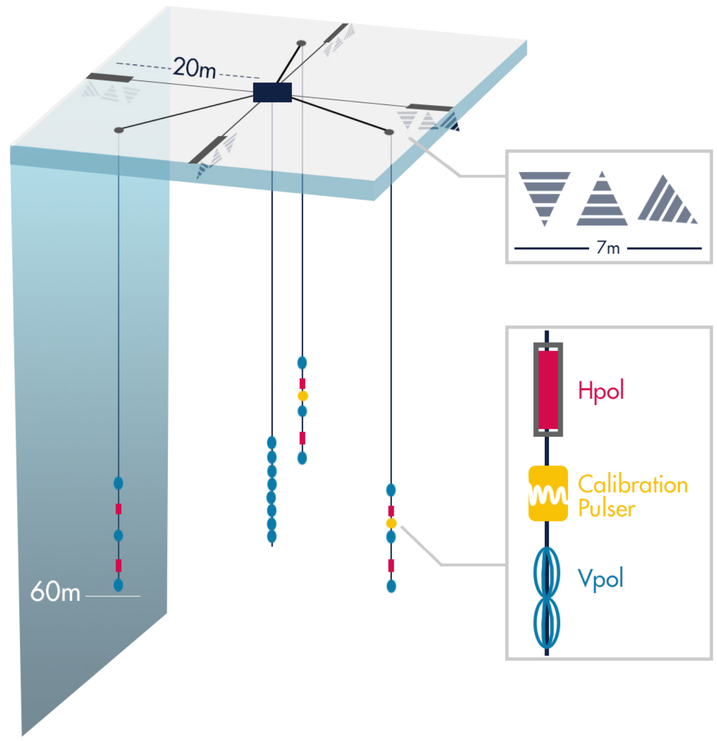


> No existing detector with promising sensitivity beyond 10 PeV.
> Radio emission can travel large distances in the ice, therefore a sparse instrumentation can cover large effective volumes.
> Covering a large fraction of the neutrino parameter space will help to pin-point the sources of ultra-high energy cosmic rays.

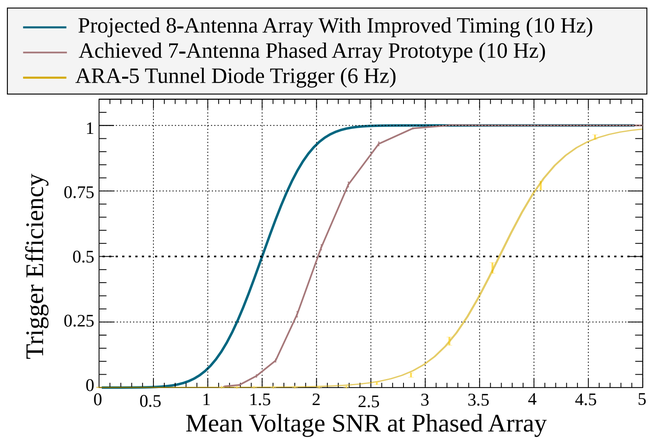
The design of RNO



RNO at South Pole
> 61 stations deployed with a power grid.
> Station distances of 1.25 km.
> Each station acts independently.



Design of a single RNO station
> Deep antennas make use of large effective volume at depth.
> Surface antennas provide large gain and polarization sensitivity.
> Coincidence (deep + surface) provide excellent reconstruction.



Technical features
> Central phased array string.
> Phased array trigger lowers threshold.
> Lower threshold increases effective volume at all energies.

Project Timeline

Installation of an antenna in ARA station 5.
Students and Postdocs are vital to construction.

> Funding for RNO has been requested from the National Science Foundation.
> International collaboration from 18 institutions with already secured non-US funding.
> Build on experience from ALL previous radio neutrino detectors (ANITA, ARA, ARIANNA, RICE, …)
> Extensive field experience with ARA critical for construction planning.
> RNO at South Pole will be deployed at the same time as the IceCube Upgrade.
> IceCube Gen2 will also contain a large radio component building on the experiences with RNO.

Calendar Year	2019	2020	2021	2022	2023	2024
Project year		PY 1	PY 2	PY 3	PY 4	PY 5
Design work						
Preliminary Design Review						
Final Design Review						
Production Readiness Review						
Production		Long lead, test systems				
Production (# of stations)		6	16	26	18	
Deployment preparation		Review	Readiness			
Deployment (# of stations)		5	16	23	17	