

# Interim Presentation

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February 15, 2023

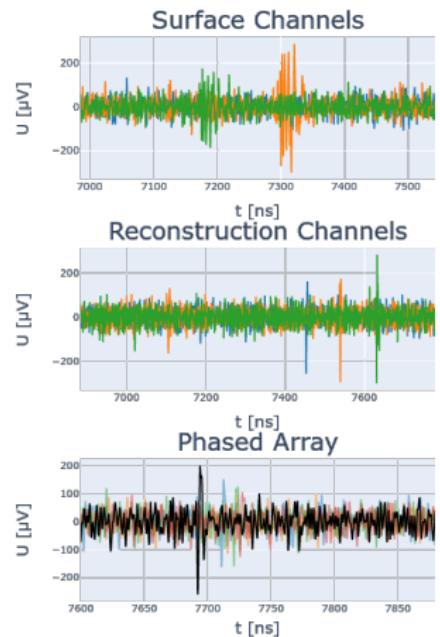
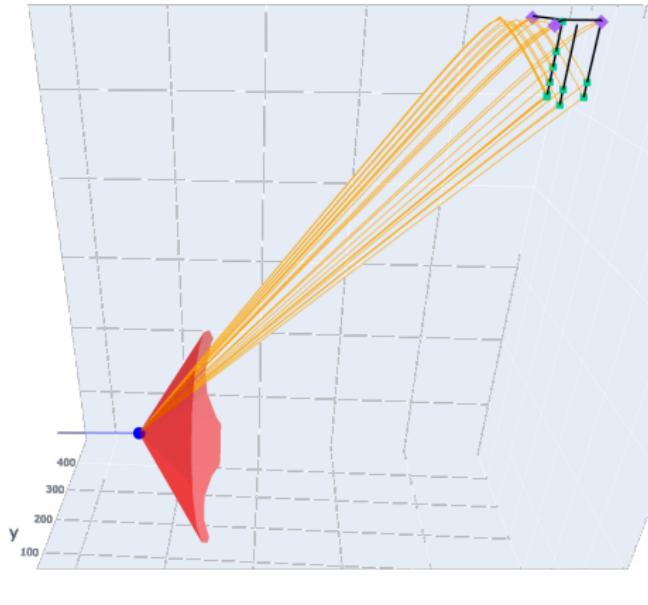
# Setup

- principle
- The need for RNO-G
- RNO-G
- Ice Models
- Iterative Ray Tracer
- Hybrid Ray Tracer

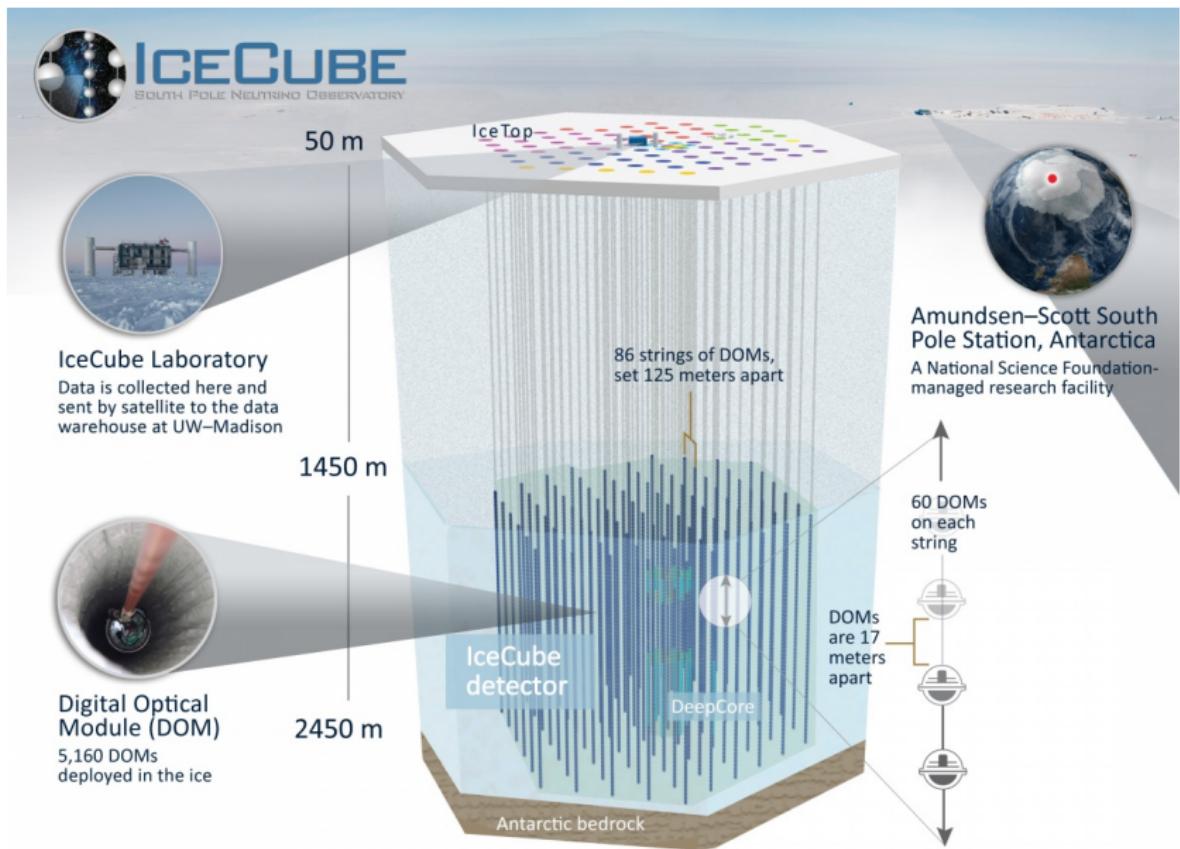
# Principle

- vertex
- ray path
- dipoles
- LPDAs

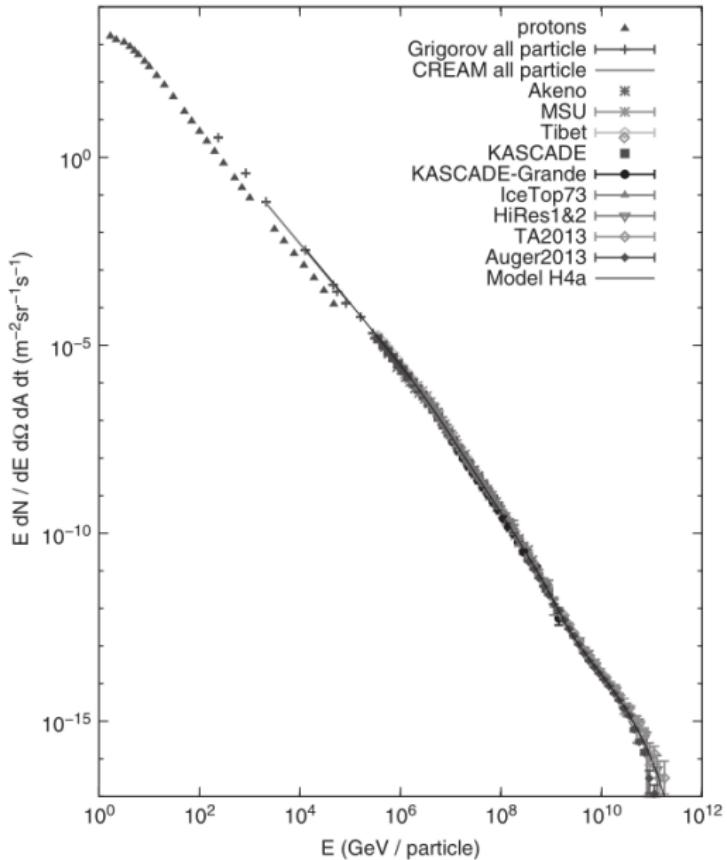
$E=2e+18\text{eV}$   
 $\theta=93.3^\circ$   
 $\varphi=178.8^\circ$



# The need for RNO-G



# The need for RNO-G



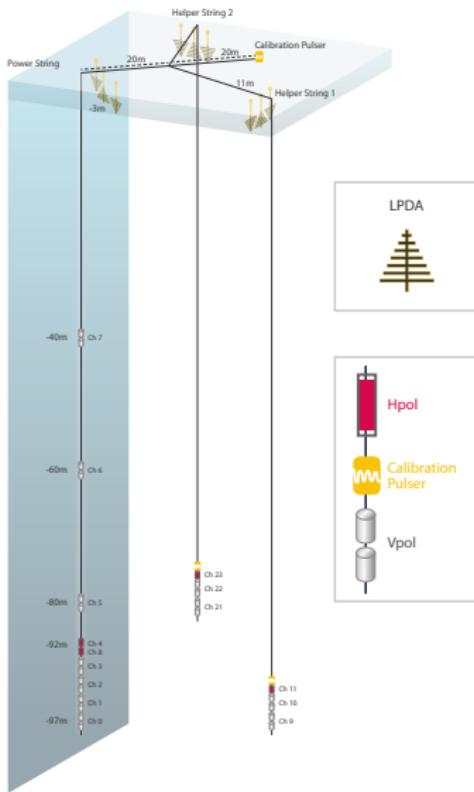
# The need for RNO-G

- IceCube finds no events for energies  $> 3\text{PeV}$  (*IceCube study of down-going neutrinos for the spectral cutoff determination by Palczewski and Tomasz*)

Problem: visible light doesn't travel far in ice

→ Solution: radio waves

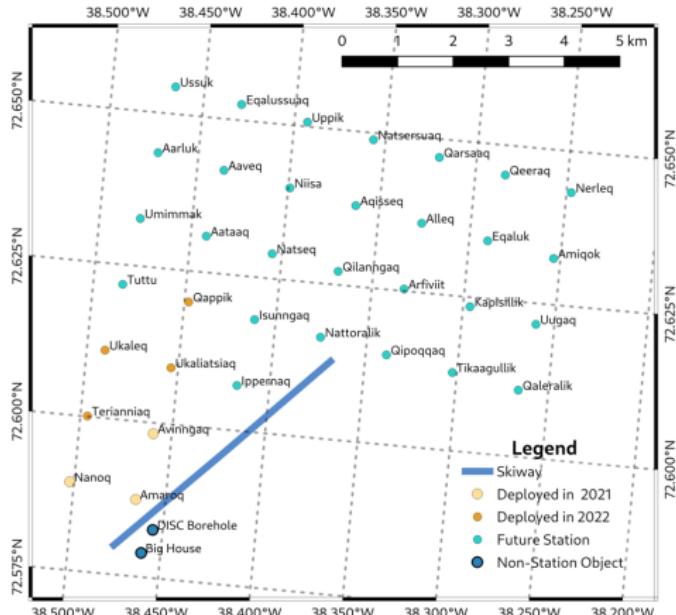
# RNO-G



# RNO-G



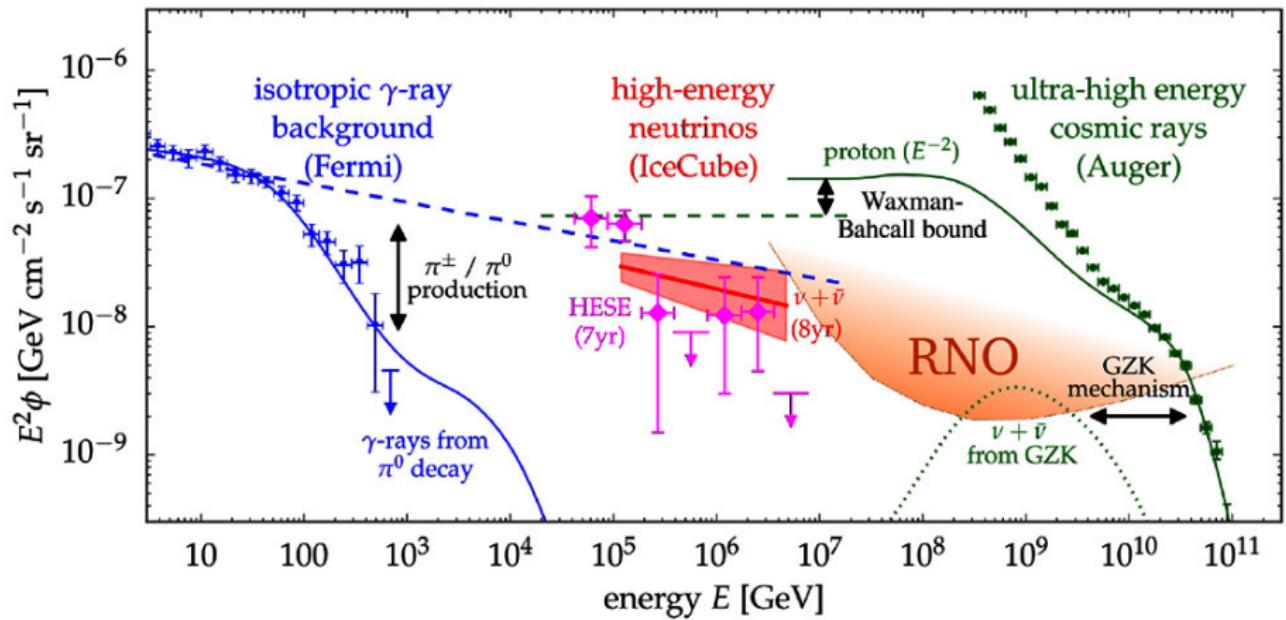
## RNO-G Planned Layout



## Notes:

- Station numbering follows a grid, where the first numeral is in increasing W-E and the second numeral is in increasing S-N, skipping non-existent stations (the Seckel method).
- Station spacing is 1.25 km in map coordinates (but really 1.23 km due to projection, which creates a 2% scale difference.)
- Projection is Greenland Polar Stereographic (EPSG:5938). True north indicated by Rose, offset from grid north by 5.37°.
- Magnetic Declination, for August 1 2022, is -25.2° according to the WMM.
- In list below, all future stations labeled as 2023.



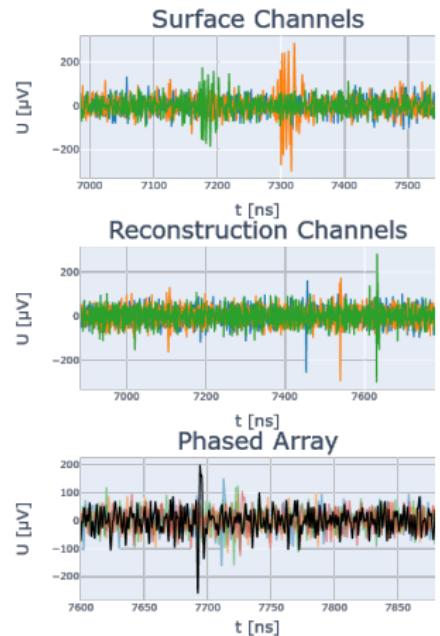
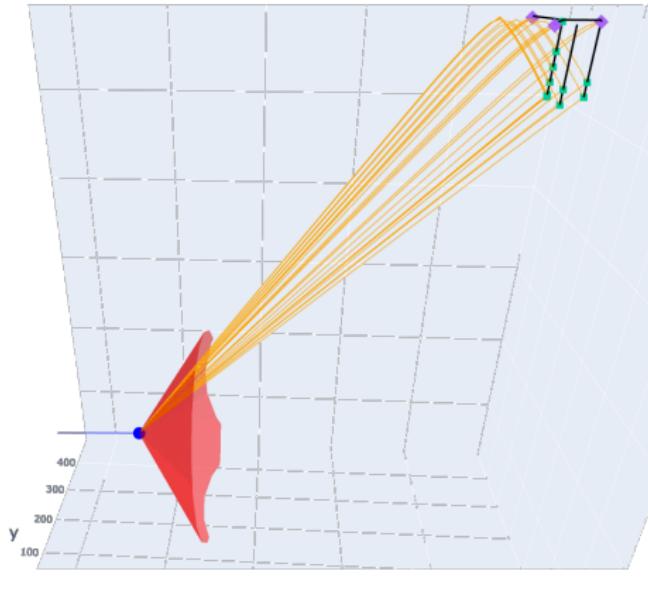


## "A Pathfinder for IceCube-Gen2 Radio"

# Ice Models

- vertex
- ray path
- dipoles
- LPDAs

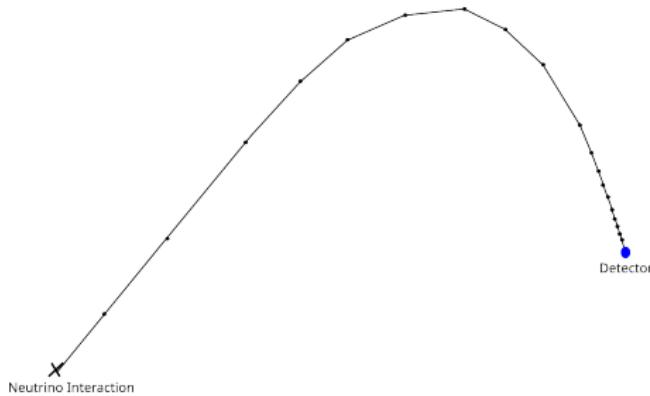
$E=2e+18\text{eV}$   
 $\theta=93.3^\circ$   
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# Ice Models

Eikonal:

$$\nabla n \approx n(\mathbf{r}) \frac{d^2 \mathbf{r}}{ds^2} \quad (1)$$

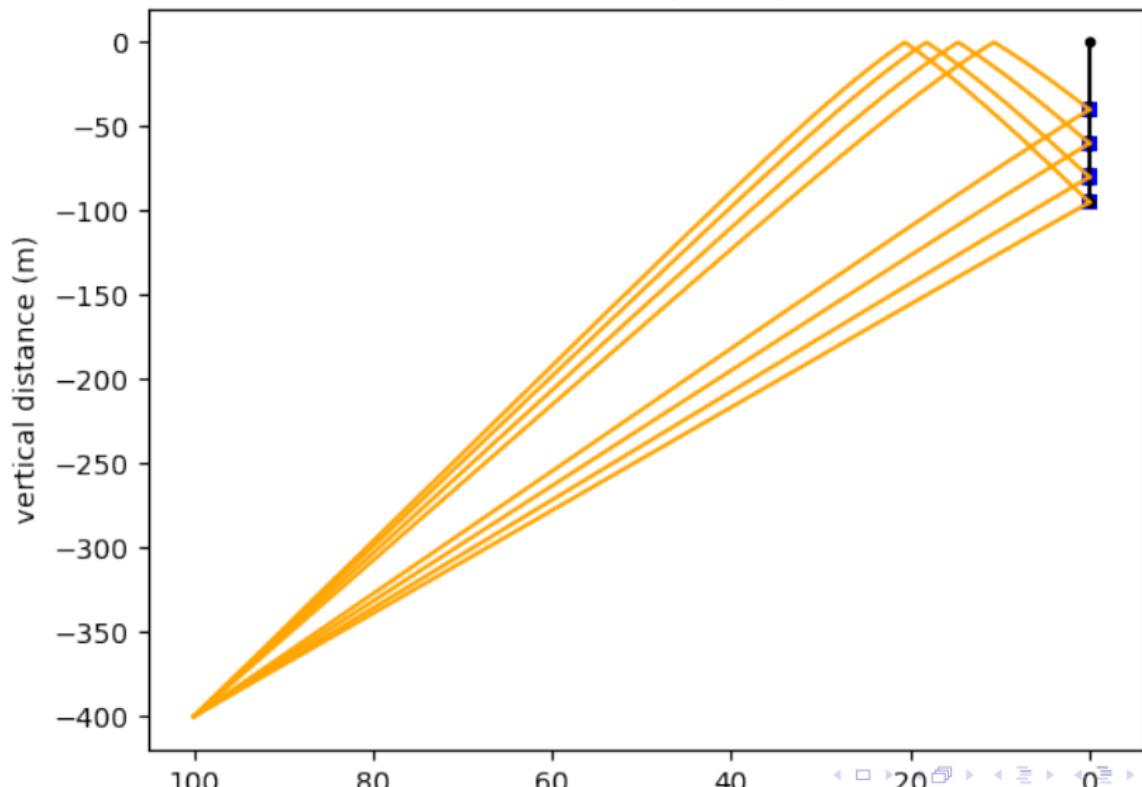


Exponential model:

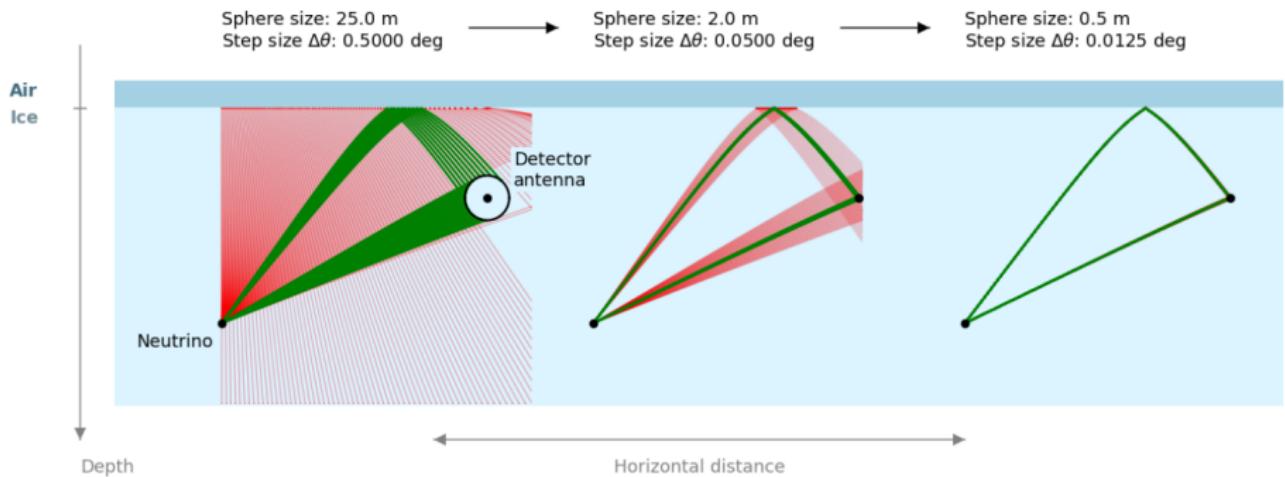
$$n(z) = n_0 - \Delta n e^{-z/z_0} \quad (2)$$

# Ice Models

Greenland simple trajectory with GL1 attenuation  
solved with analytic ray tracer



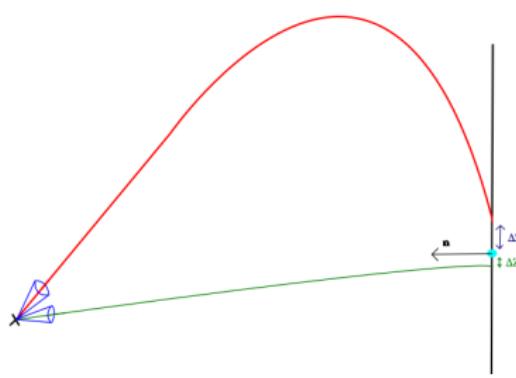
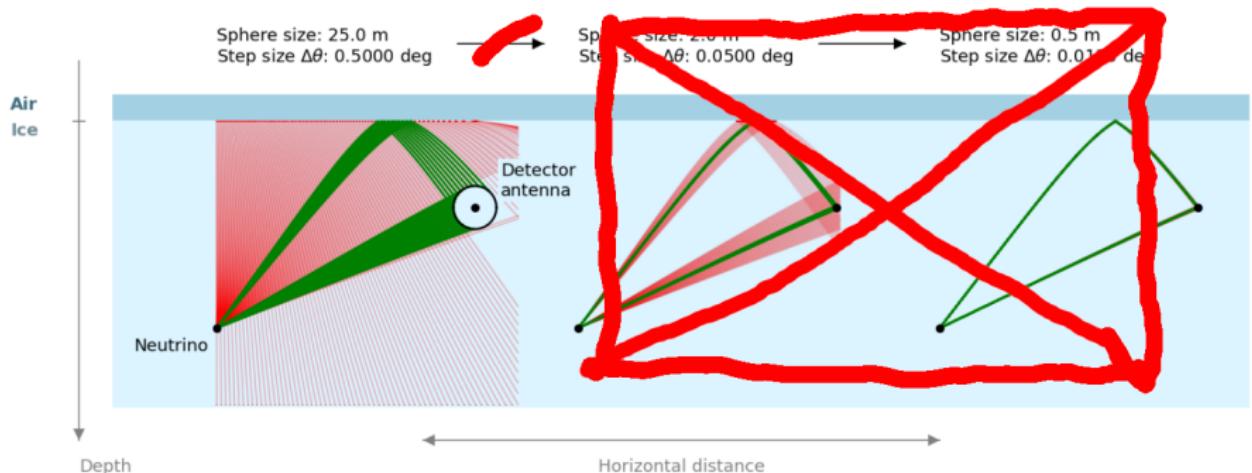
# Iterative Ray tracer



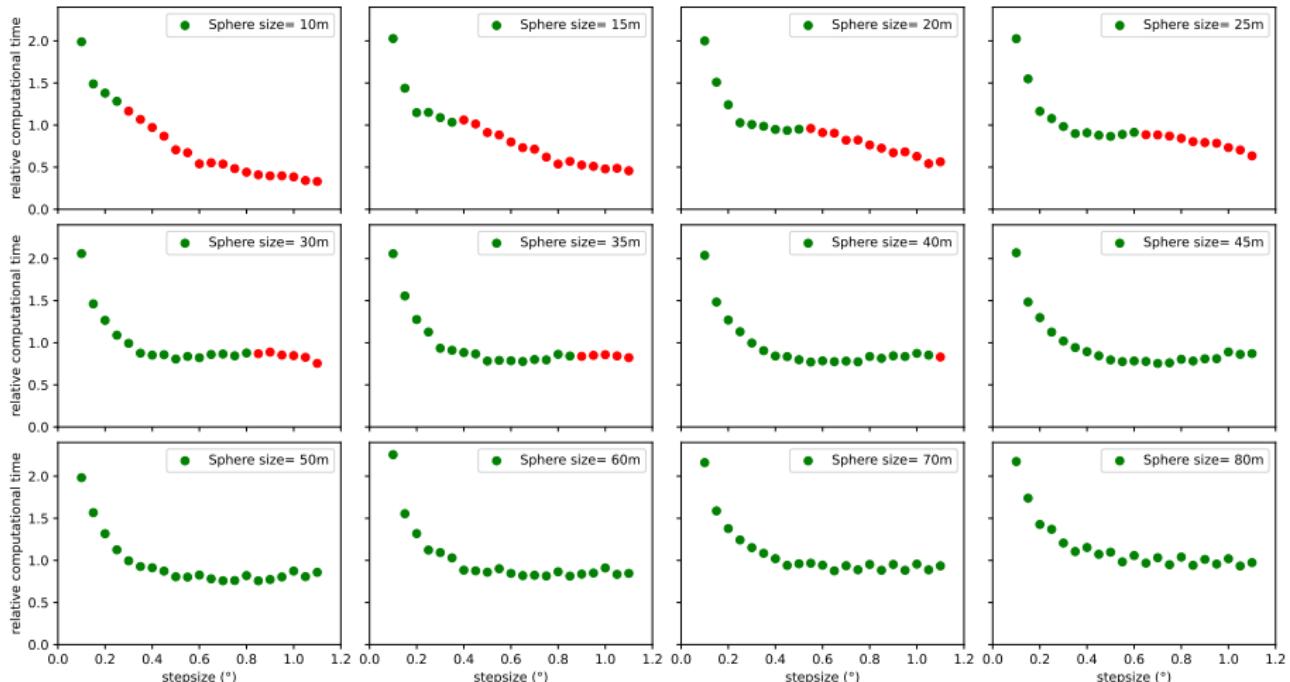
# Hybrid Ray tracer

What we want?: Scipy

# Hybrid Ray tracer



# Hybrid Ray tracer: Optimization



# Hybrid Ray tracer: Optimization

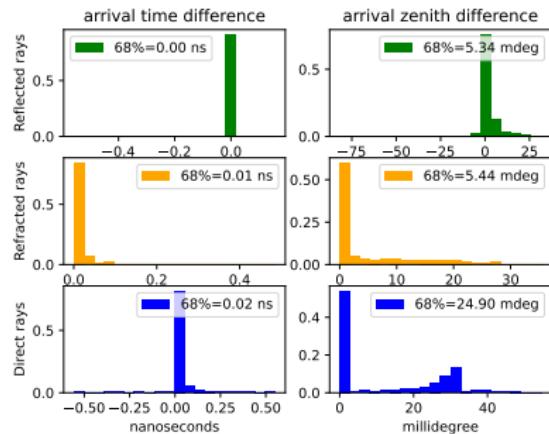


Figure: Hybrid

i.e more accurate whilst being  $\approx 30\%$  faster (30% more computations per second) than the iterative ray tracer

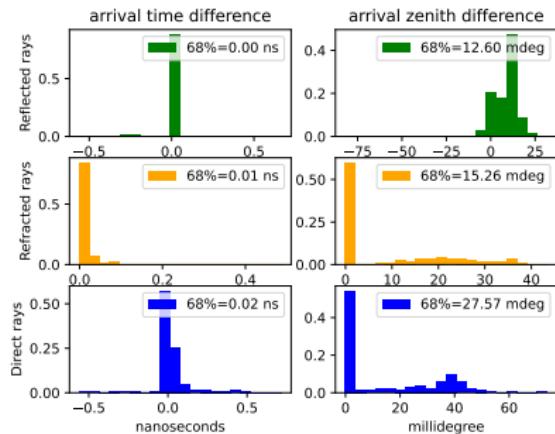


Figure: Iterative