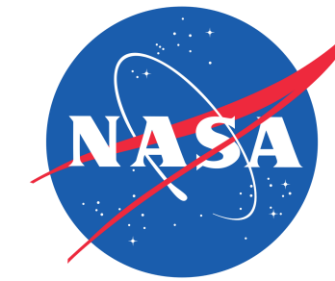


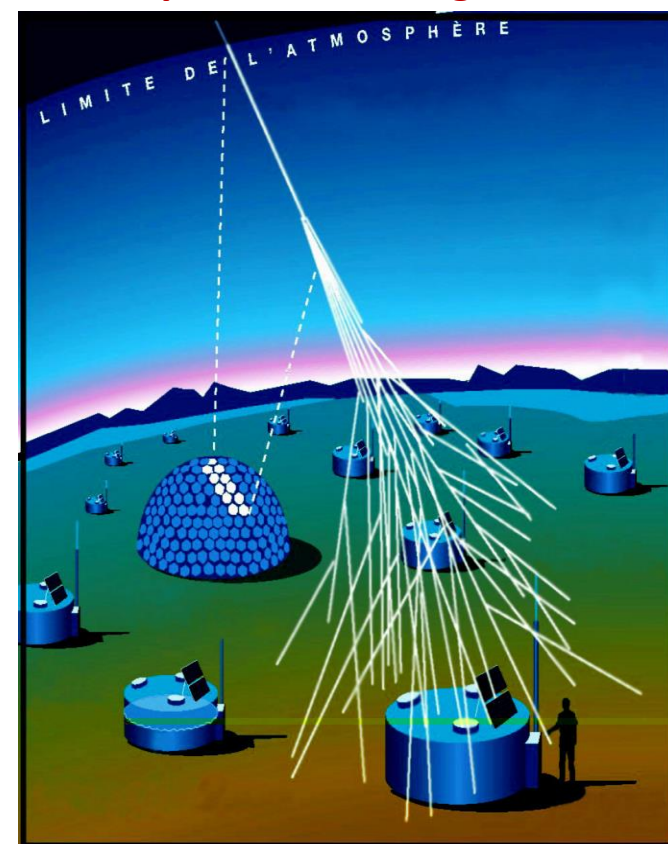
# Astroparticle Experiments at OSU

Prof. Amy Connolly ([connolly@physics.osu.edu](mailto:connolly@physics.osu.edu)) and Prof. Jim Beatty ([beatty.85@osu.edu](mailto:beatty.85@osu.edu))

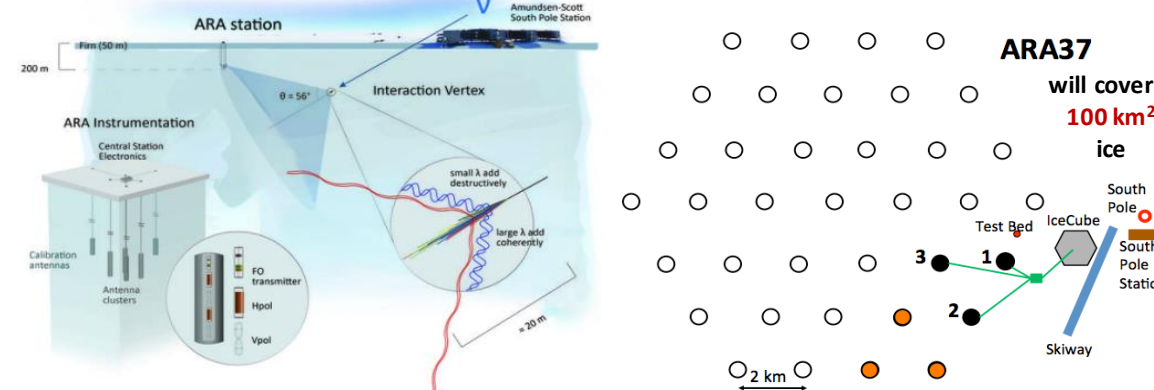


Welcome! Interested in Multi-Messenger Astroparticle Physics? At OSU we work on several Astroparticle Experiment projects including **IceCube**, **AUGER**, **ANITA**, **ARA**! They all look for high-energy particles of astrophysical or cosmogenic origins. IceCube has observed the first astrophysical neutrinos! Others have observed cosmic-rays (CR). All of these projects are highly collaborative efforts. Here at OSU, we are involved in multiple aspects of each one, including hardware, electronics, simulation and analysis.

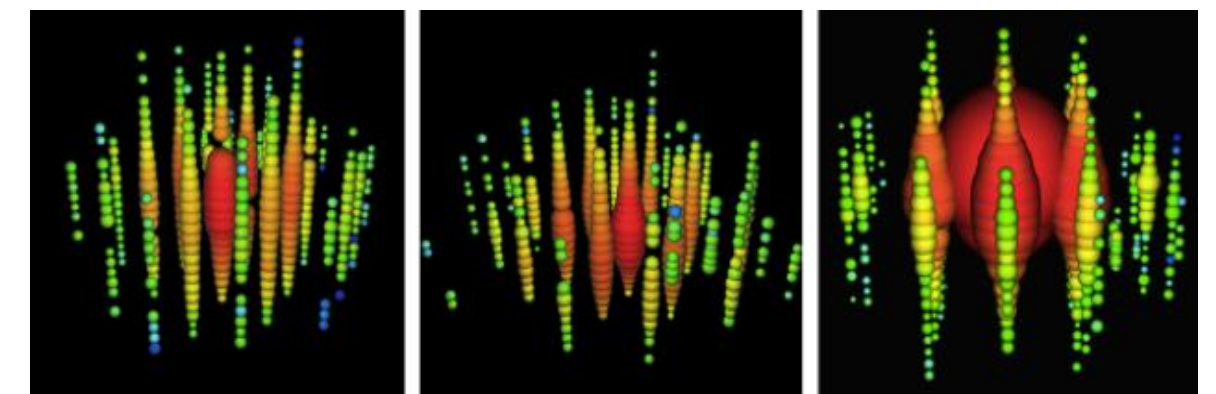
## AUGER: Water Optical Cherenkov experiment in Argentina



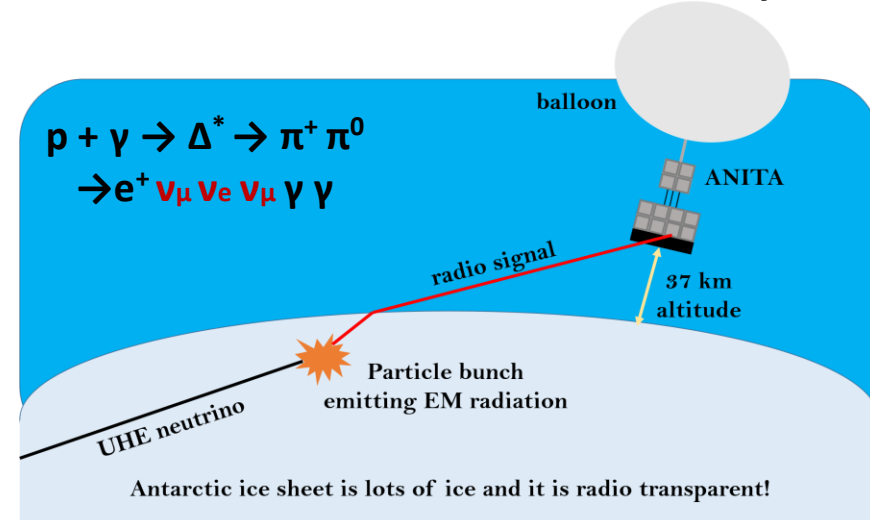
## Askaryan Radio Array (ARA)



## IceCube, 1 km³ neutrino observatory at the South Pole, observes astrophysical neutrinos for the first time!



From left to right, Bert, Ernie and Big Bird, with energies of 1.0, 1.1 and 2.2 PeV.



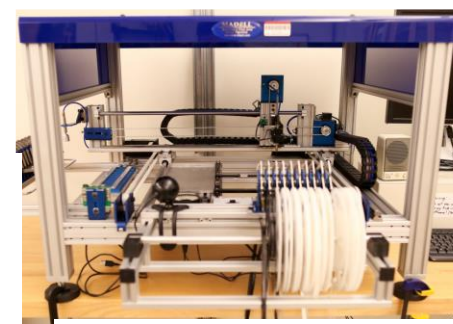
Above is a cartoon showing Askaryan radio detection of theorized ultra-high-energy (UHE) neutrinos. **Why Antarctica?**

- Has lots of ice (dielectric target medium) for neutrinos to interact in and produce optical Cherenkov (IceCube) and radio Cherenkov (ANITA, ARA) light.
- It is radio-quiet compared to rest of the world so less noisy for radio experiments.
- Earth's magnetic field points straight down giving cosmic-ray signals a distinctive polarization.
- Summer polar vortex allows balloon-borne ANITA to fly in circles over the continent observing ~ 1 million km³ of Antarctic ice for UHE neutrinos.



Large thermal chamber for rapid thermal testing

We are well-equipped to build, test and deploy!



Pick & Place Machine for rapid mass assembly

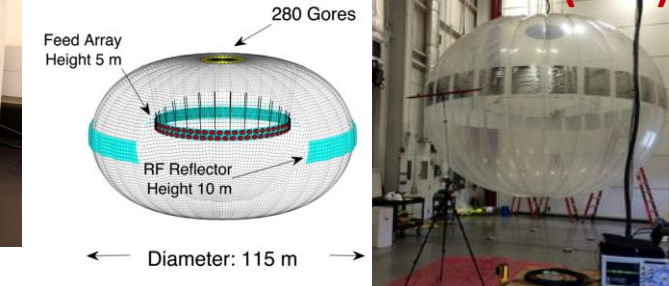


Radio (to be Anechoic) Chamber

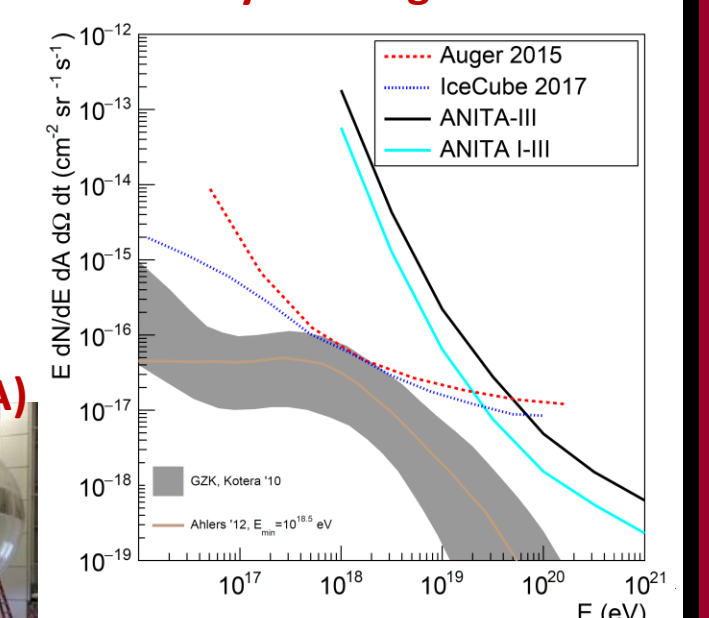


Mill machine for Radio circuit boards

## Plans for ExaVolt Antenna (EVA)



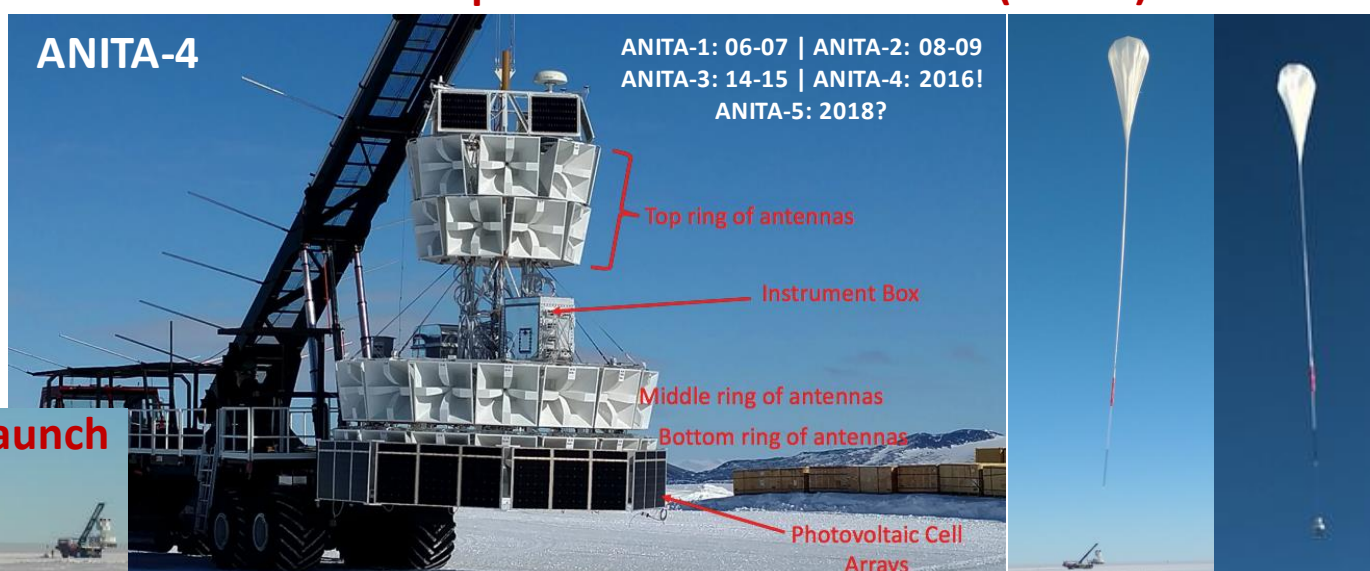
## ANITA dominates Neutrino Astronomy at energies > 10¹⁹ eV



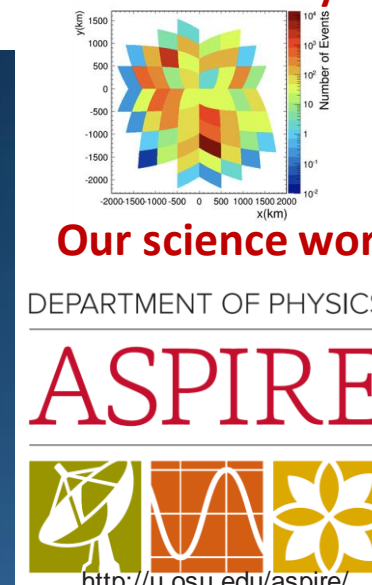
## Genetic Programming



## ANTarctic Impulsive Transient Antenna (ANITA)



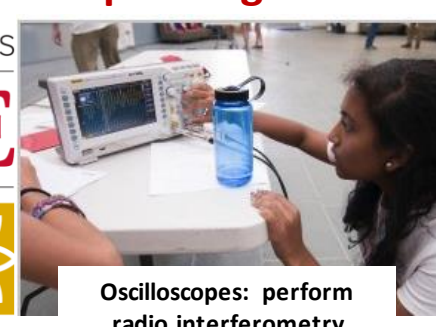
## ANITA-2 Re-analysis



## Exploring Machine Learning



Our science workshop for high school women funded by NSF | Hands on projects!



Oscilloscopes: perform radio interferometry



Arduino microcontroller: build and program radios



Mathematica: Learn ANITA analysis techniques

## CURRENT GRAD STUDENTS

**CONNOLLY GROUP:** Oindree Banerjee, Brian Clark, Lauren Ennesser, Jorge Torres Espinosa, Julie Rolla  
**BEATTY GROUP:** Keith McBride, Andres Medina

## CURRENT POSTDOCS/STAFF

Patrick Allison, Carl Pfendner, Steven Prohira, Michael Sutherland,