COLLEGE OF ARTS AND SCIENCES | CENTER OF COSMOLOGY AND ASTROPARTICLE PHYSICS | DEPARTMENT OF PHYSICS

Astroparticle Experiments at OSU

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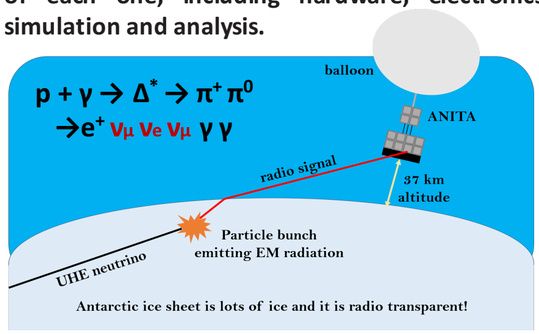
Welcome! Interested in Multi-Messenger Astroparticle Physics? At OSU we work on several Astroparticle Experiment projects including IceCube, AUGER, ANITA, ARA, ARIANNA and BuckArray! They all look for high-energy particles of astrophysical or cosmogenic origins. IceCube has observed the first astrophysical 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.

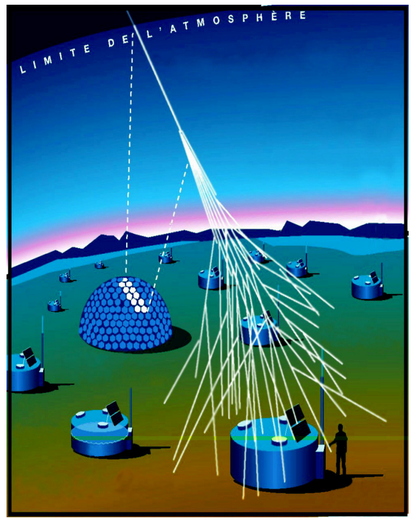


Above is a cartoon showing Askaryan radio detection of theorized ultra-high-energy (UHE) neutrinos

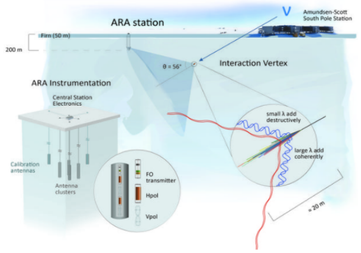
Why Antarctica?

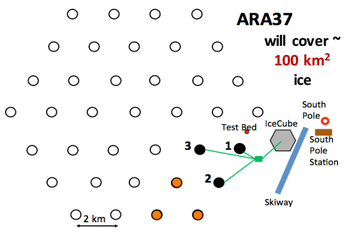
- **Has lots of ice (dielectric target medium) for neutrinos to interact in and produce optical Cherenkov (IceCube) and radio Cherenkov (ANITA, ARA, ARIANNA) light.**
- **It is radio-quiet compared to rest of the world so less noisy for radio experiments.**
- **Earth's magnetic field points straight 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 km^3 of Antarctic ice for UHE neutrinos.**

AUGER: Water Optical Cherenkov experiment in Argentina

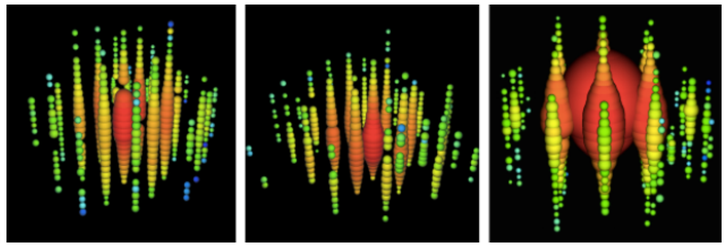


Askaryan Radio Array (ARA)



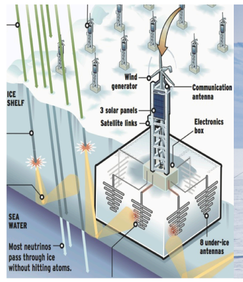


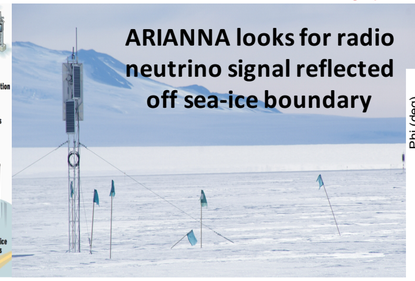
IceCube, 1 km^3 neutrino observatory at the South Pole, observes astrophysical neutrinos for the first time!



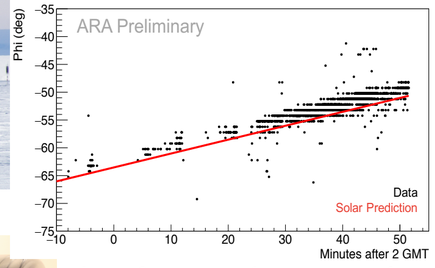
From left to right, Bert, Ernie and Big Bird, with energies of 1.0, 1.1 and 2.2PeV.

Antarctic Ross Ice-Shelf ANtenna Neutrino Array (ARIANNA)

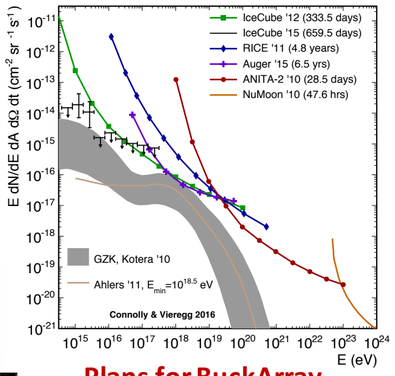




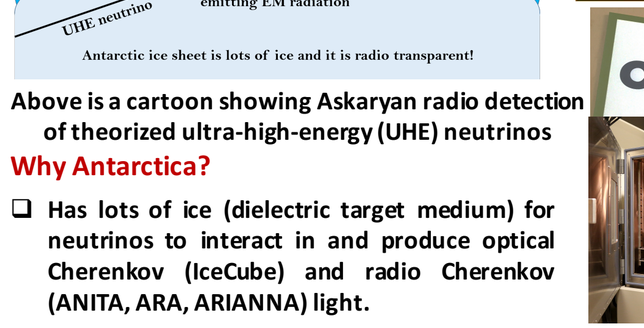
ARA observes Solar Flares!



ANITA dominates Neutrino Astronomy at energies > 10^{19} eV



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



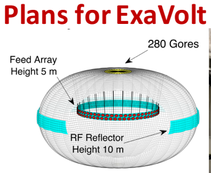
Large thermal chamber for rapid thermal testing

Pick & Place Machine for rapid mass assembly

Radio (to be Anechoic) Chamber

Mill machine for Radio circuit boards

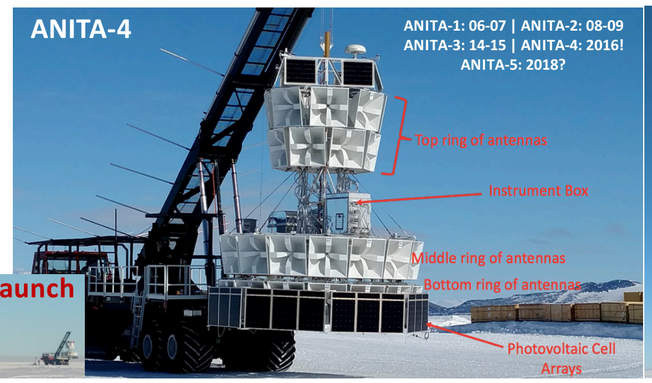
Plans for ExaVolt Antenna (EVA)

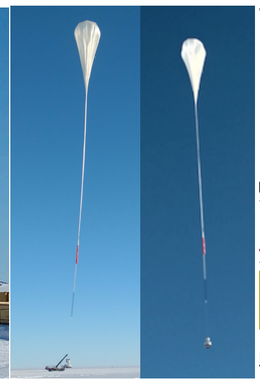


Plans for BuckArray

Array of 143 smartphones + 200-400 MHz Radio Antennas

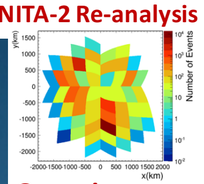
ANtarctic Impulsive Transient Antenna (ANITA)



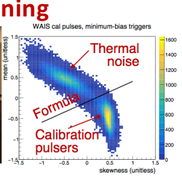


ANITA-4 before launch

ANITA-2 Re-analysis



Exploring Machine Learning



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

DEPARTMENT OF PHYSICS
ASPIRE
http://u.osu.edu/aspire/

Oscilloscopes: perform radio interferometry

Arduino microcontroller: build and program radios

Mathematica: Learn ANITA analysis techniques

THE OHIO STATE UNIVERSITY

CURRENT GRAD STUDENTS

CONNOLLY GROUP: Brian Clark, Oindree Banerjee, Jorge Torres Espinosa

BEATTY GROUP: Sam Stafford, Jacob Gordon, Keith McBride, Alex Klepinger, Andres Medina

CURRENT POSTDOCS/STAFF

Carl Pfendner, Jordan Hansen, Brian Dailey

Michael Sutherland, Patrick Allison