

TeVPA 2023
(Naples, Italy)

TAMBO:
Searching for ν_τ
in the Peruvian Andes

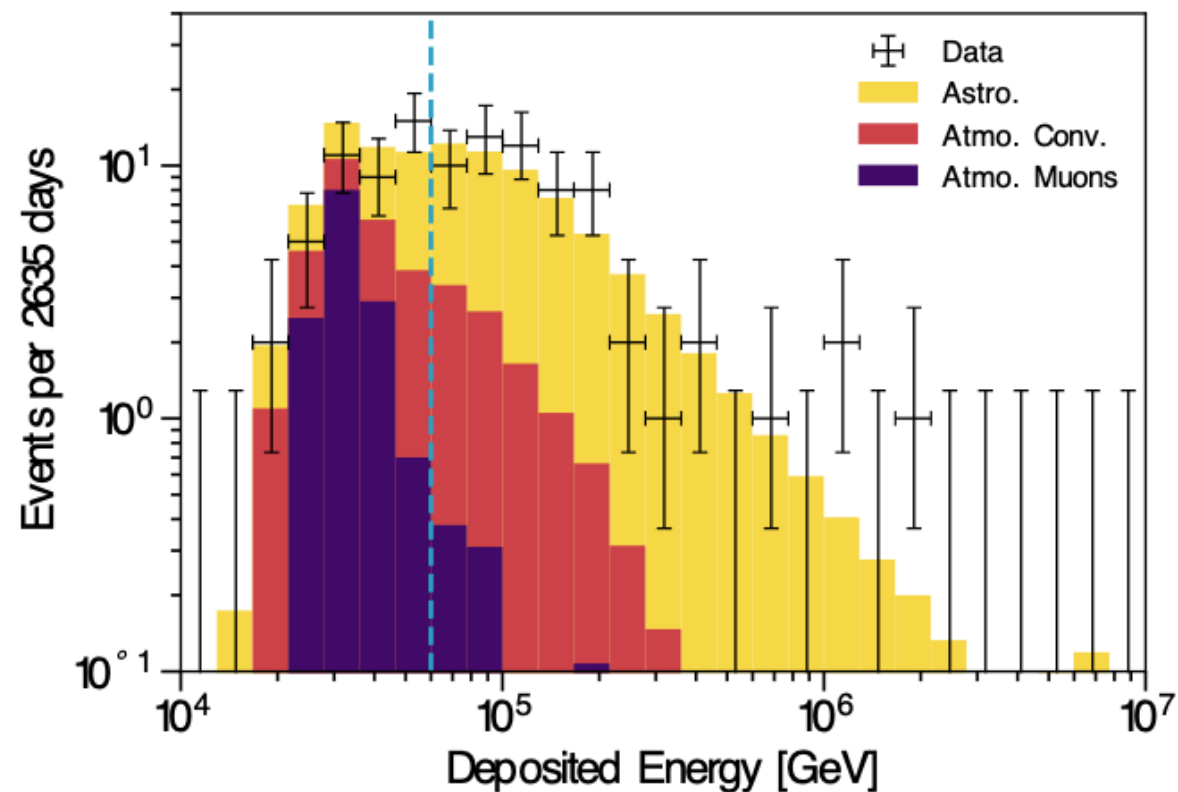
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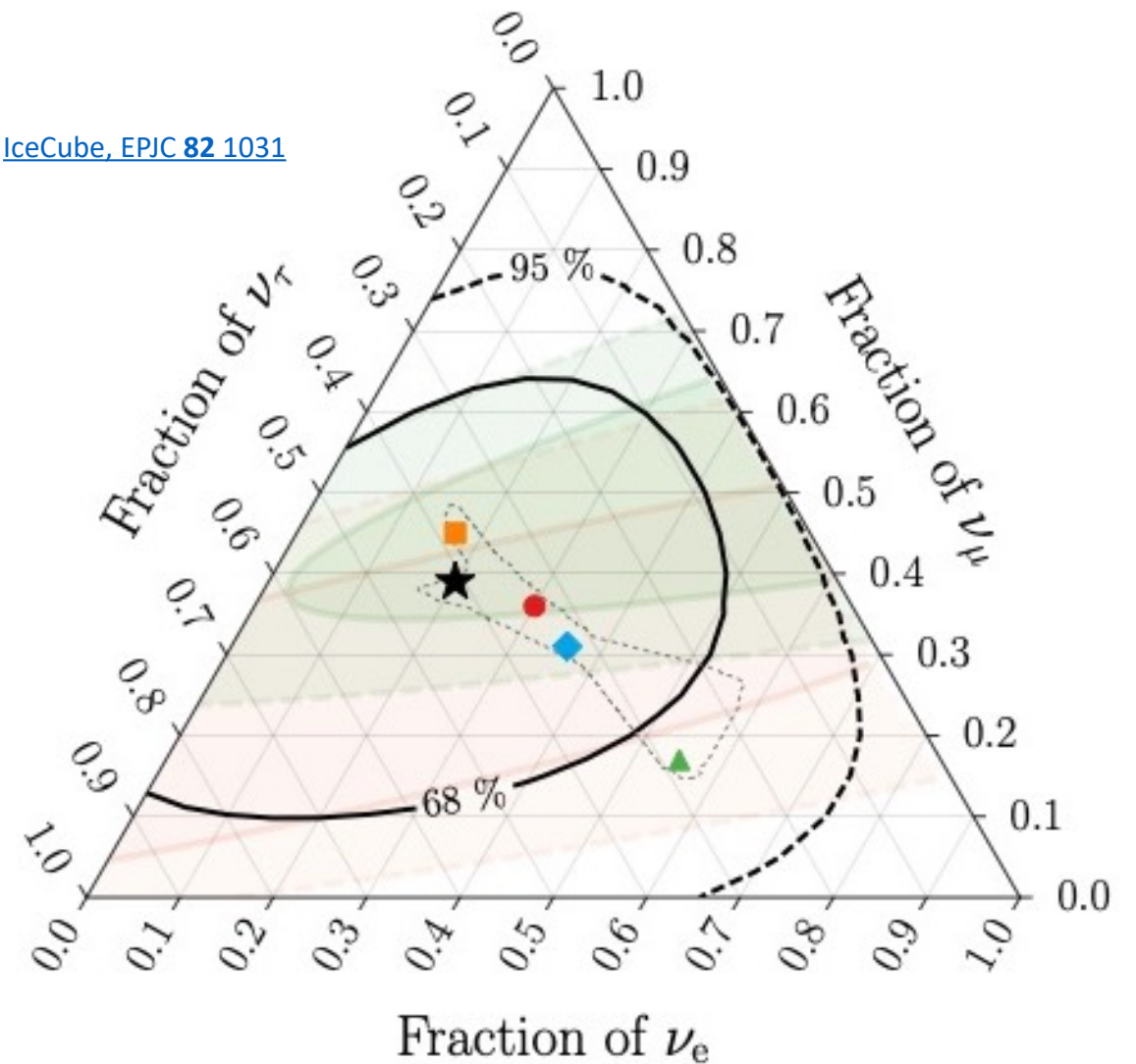
Open Questions in Neutrino Astronomy

[IceCube, PRD 104 022002](#)



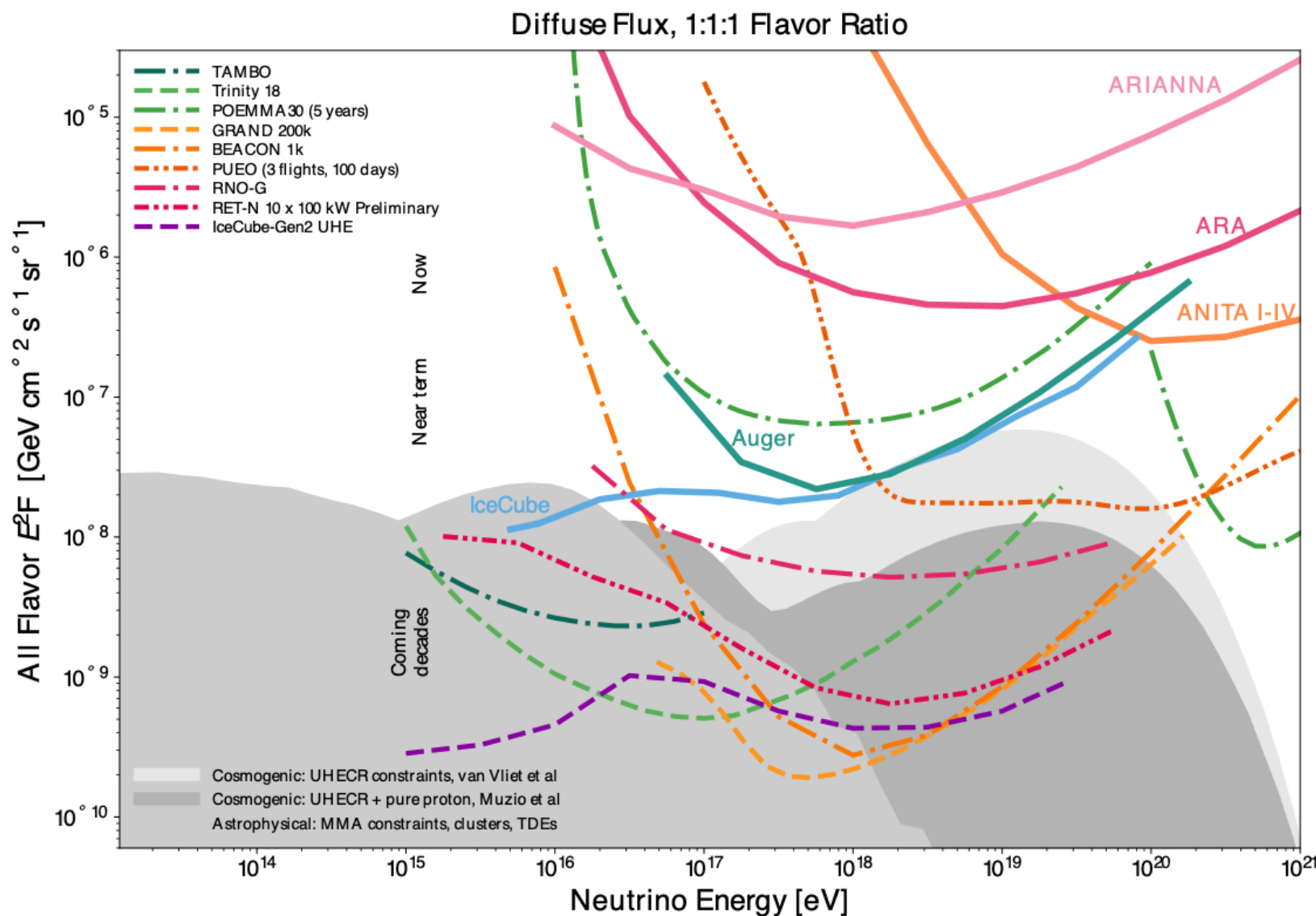
- Diffuse astrophysical flux discovered by IceCube
- Is there a high energy cutoff?

[IceCube, EPJC 82 1031](#)

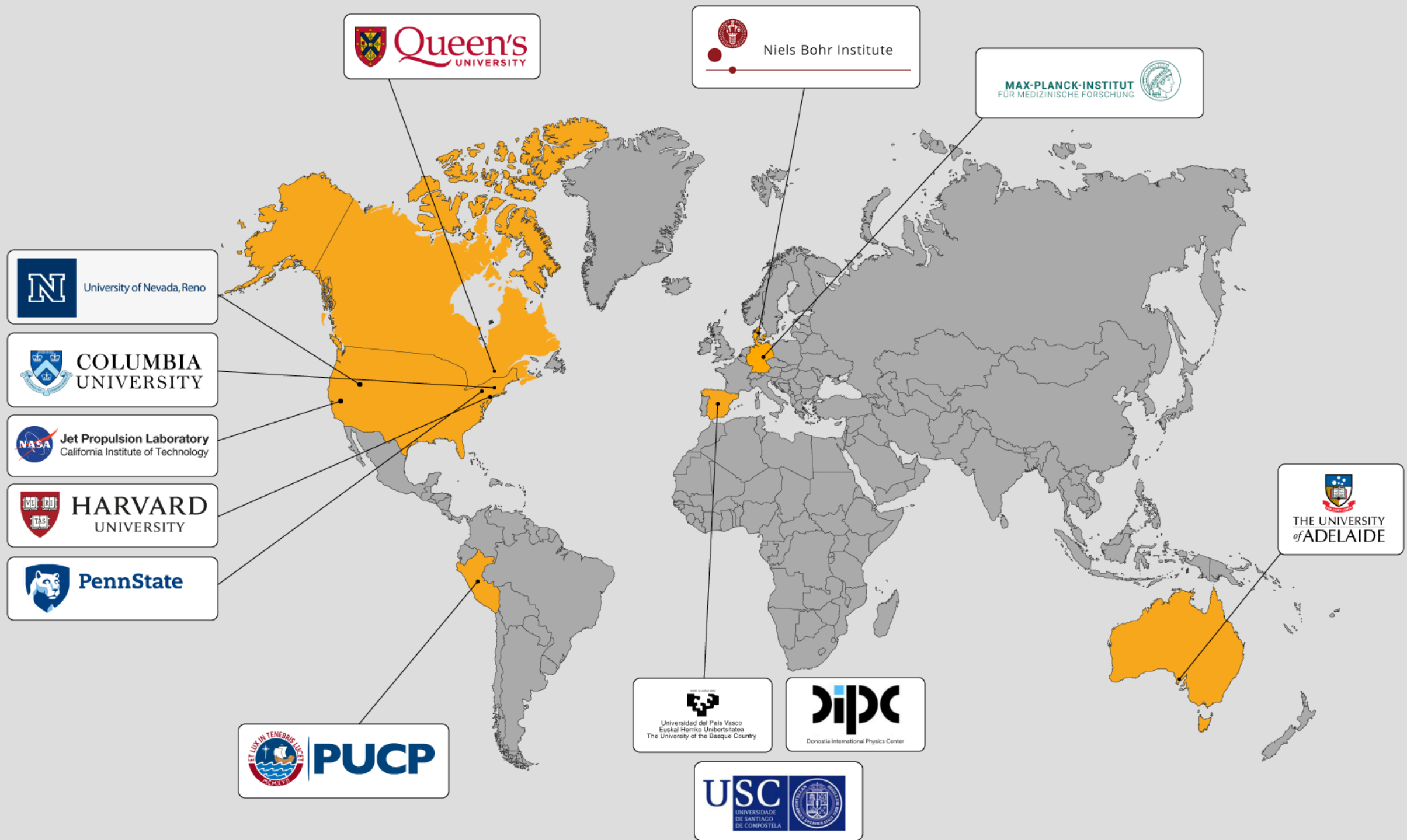


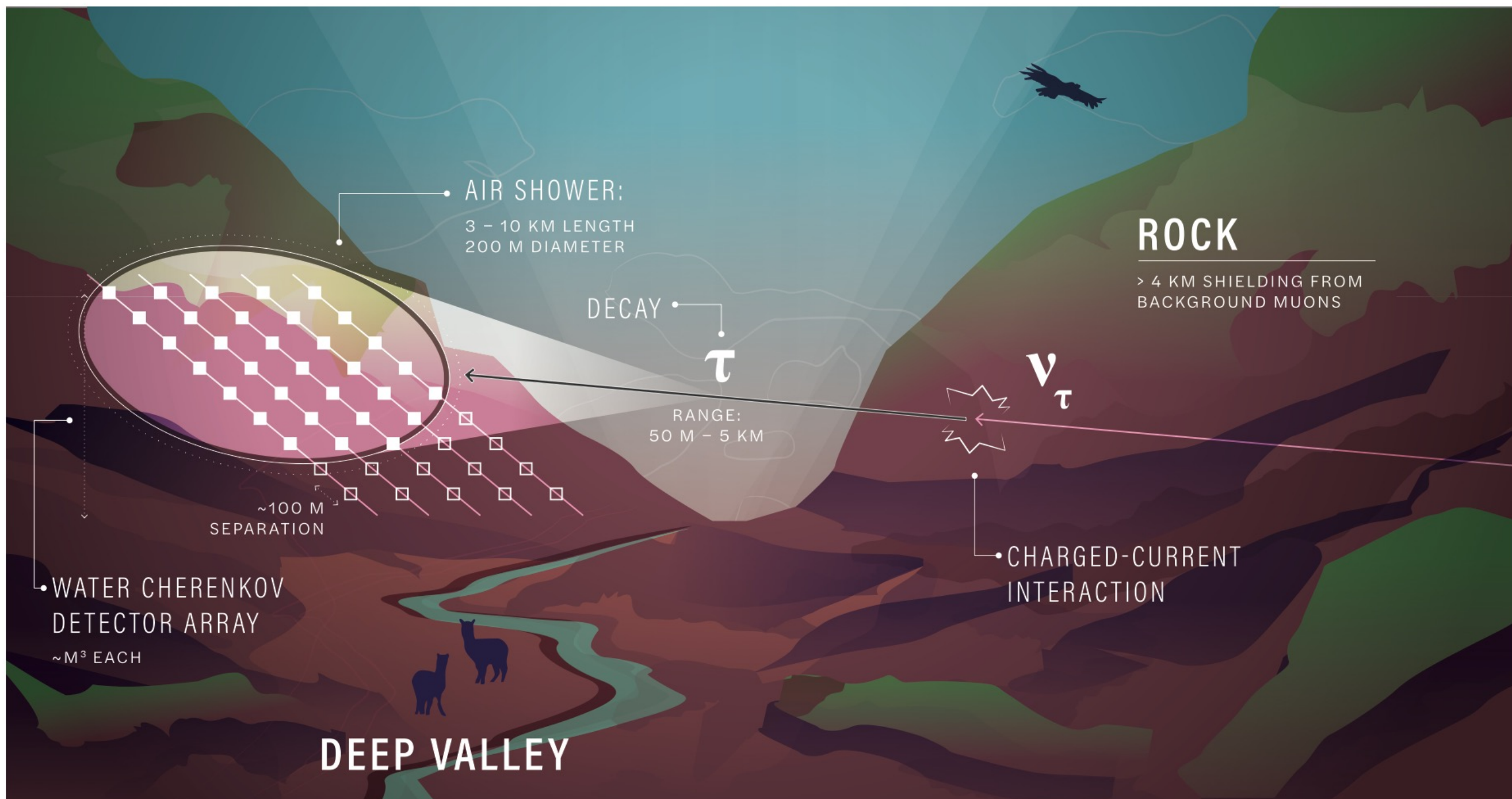
- Astrophysical flavor ratio can probe sources and new physics
- How can we better constrain these measurements?

Next-Generation Prospects

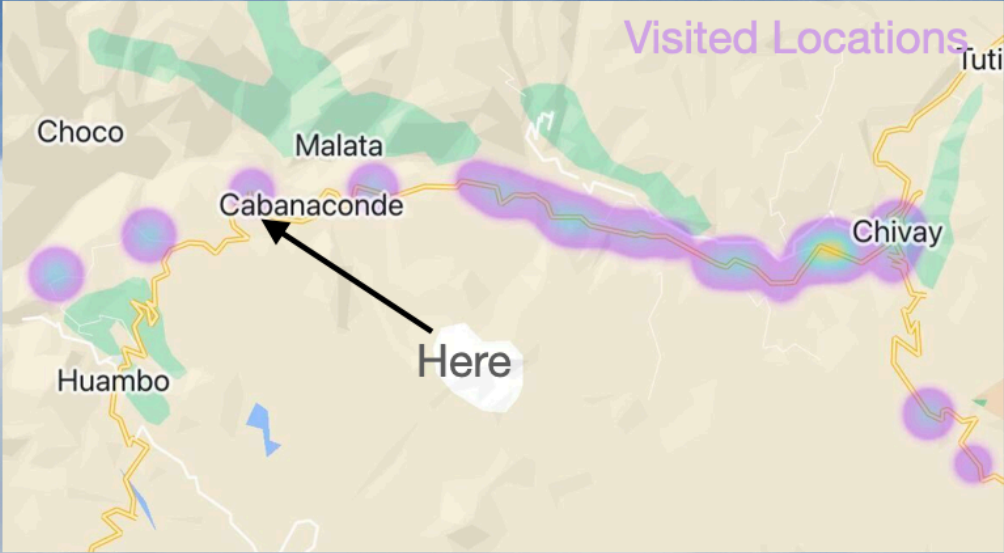
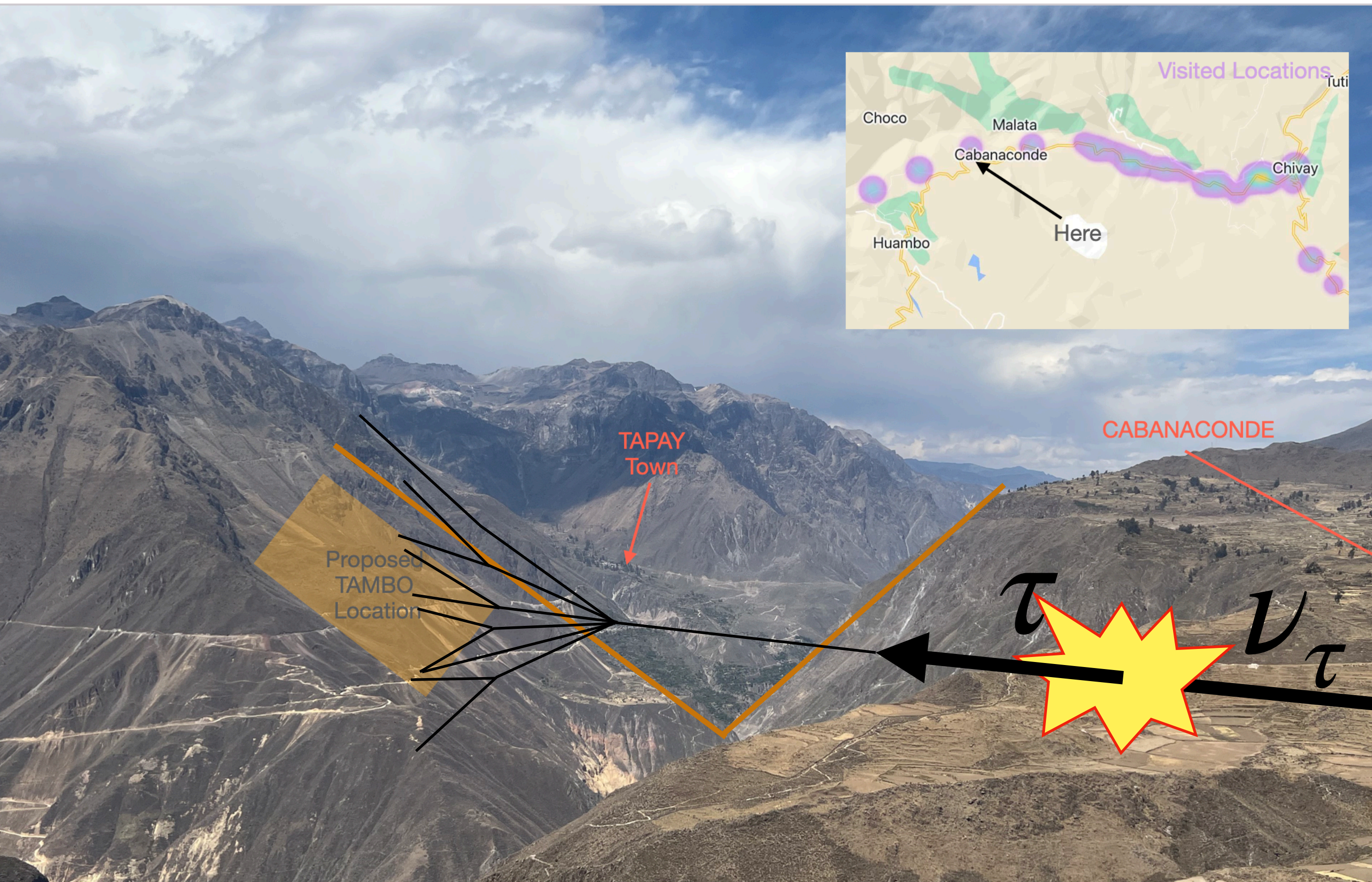


- Community has heeded call for UHE neutrino observatories
 - But fewer experiments planned for 1-100 PeV
- TAMBO will:
 - Bridge the gap between HE & UHE observatories
 - Perform unambiguous measurement of astrophysical ν_τ flux



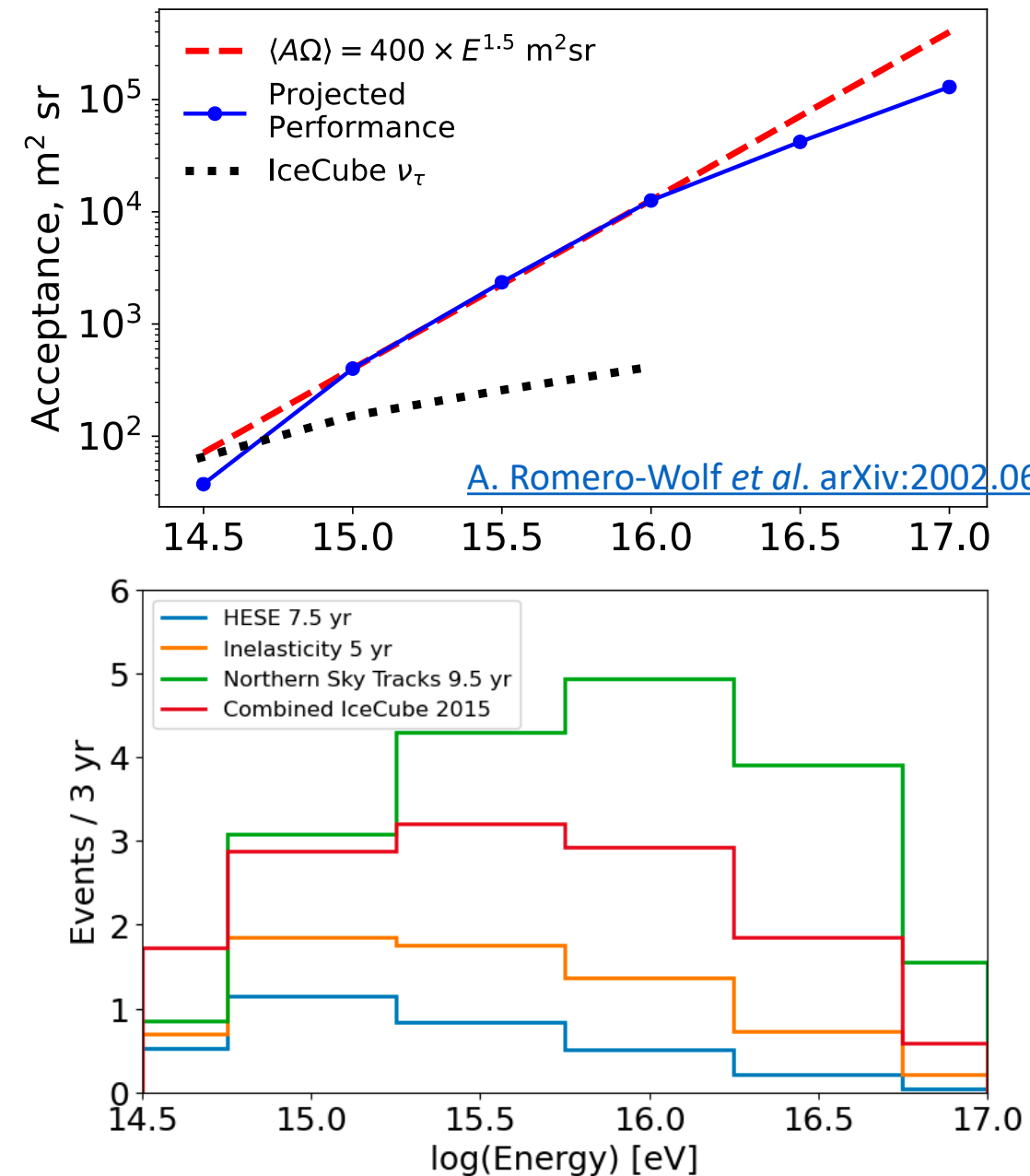


TAU AIR-SHOWER MOUNTAIN-BASED OBSERVATORY (TAMBO) • COLCA VALLEY, PERU



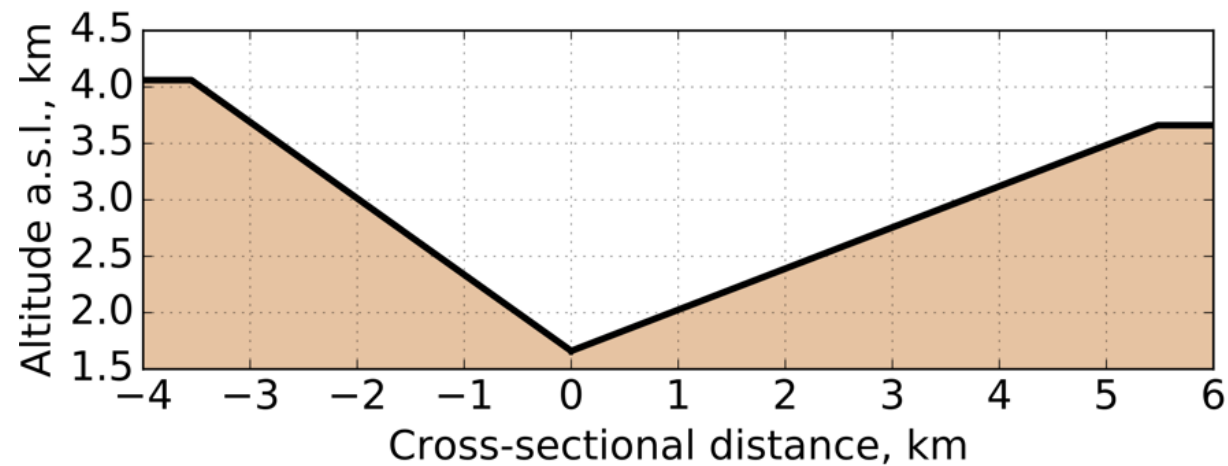
What Can We See with TAMBO?

- Baseline design: 22k detectors, 150 m spacing
- Probe diffuse spectrum from 1-100 PeV
- Synergistic flavor ratio measurements
 - ν_τ discrimination difficult for many neutrino telescopes
 - IceCube has identified only 2 ν_τ in 7.5 years (2.8σ)
- Dark matter from the Galactic Center
- Unique geometry for cosmic ray measurements



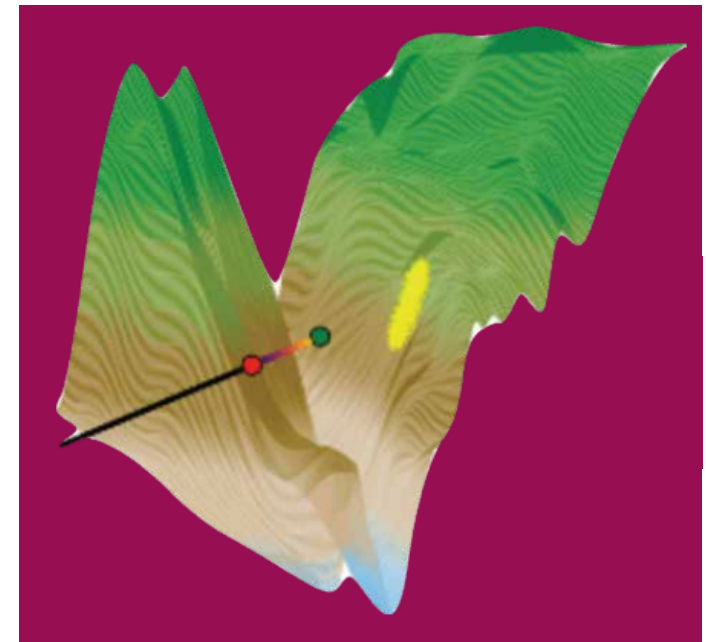
Developing Full Simulation

Preliminary Simulation



- Simplified geometry
- No treatment of τ energy losses
- Approximation of air shower physics

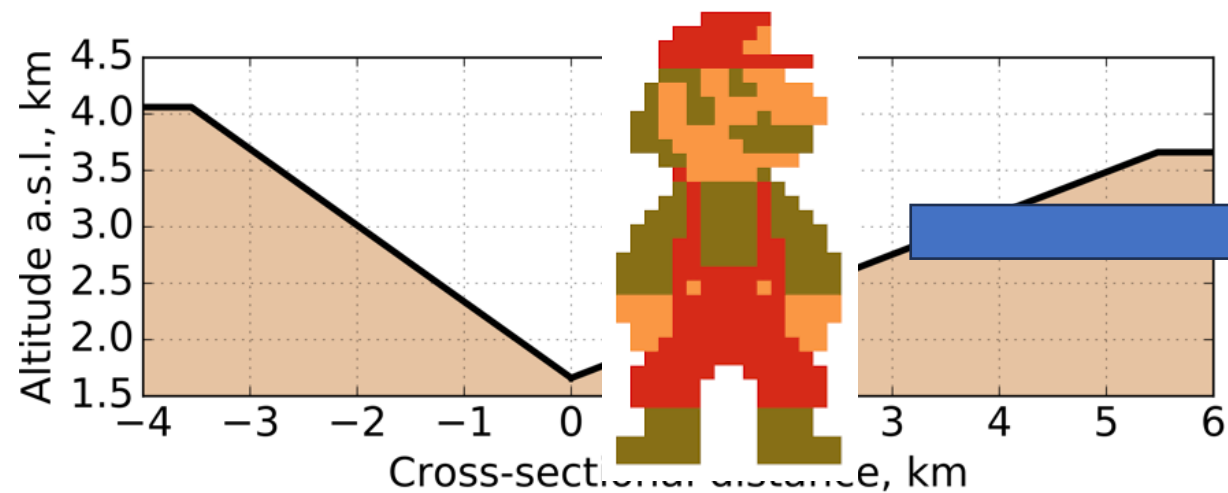
Full Simulation



- Realistic geometry
- Full treatment of τ energy losses
- Air shower simulation with CORSIKA 8

Developing Full Simulation

Preliminary Simulation



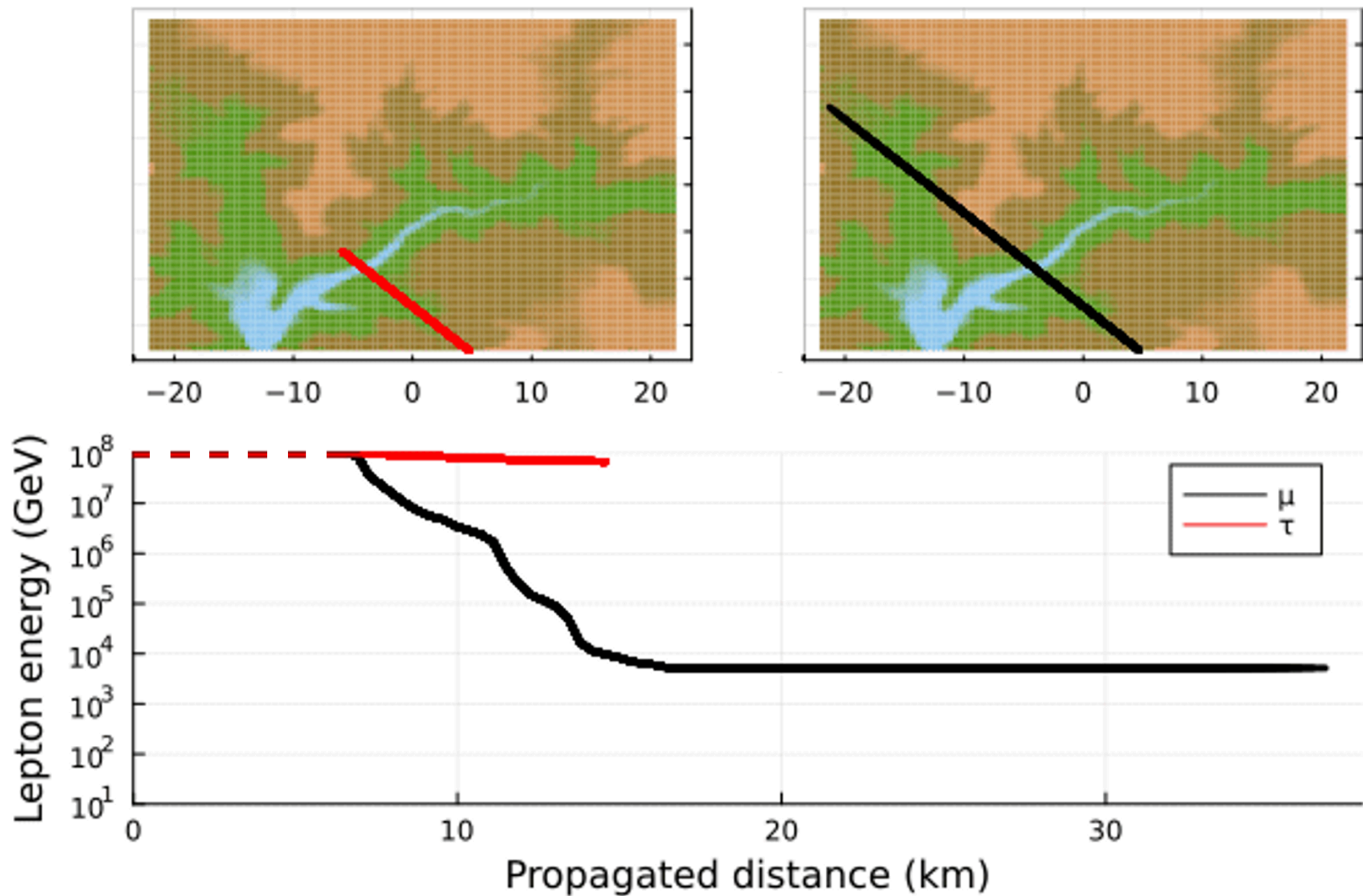
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Developing Full Simulation



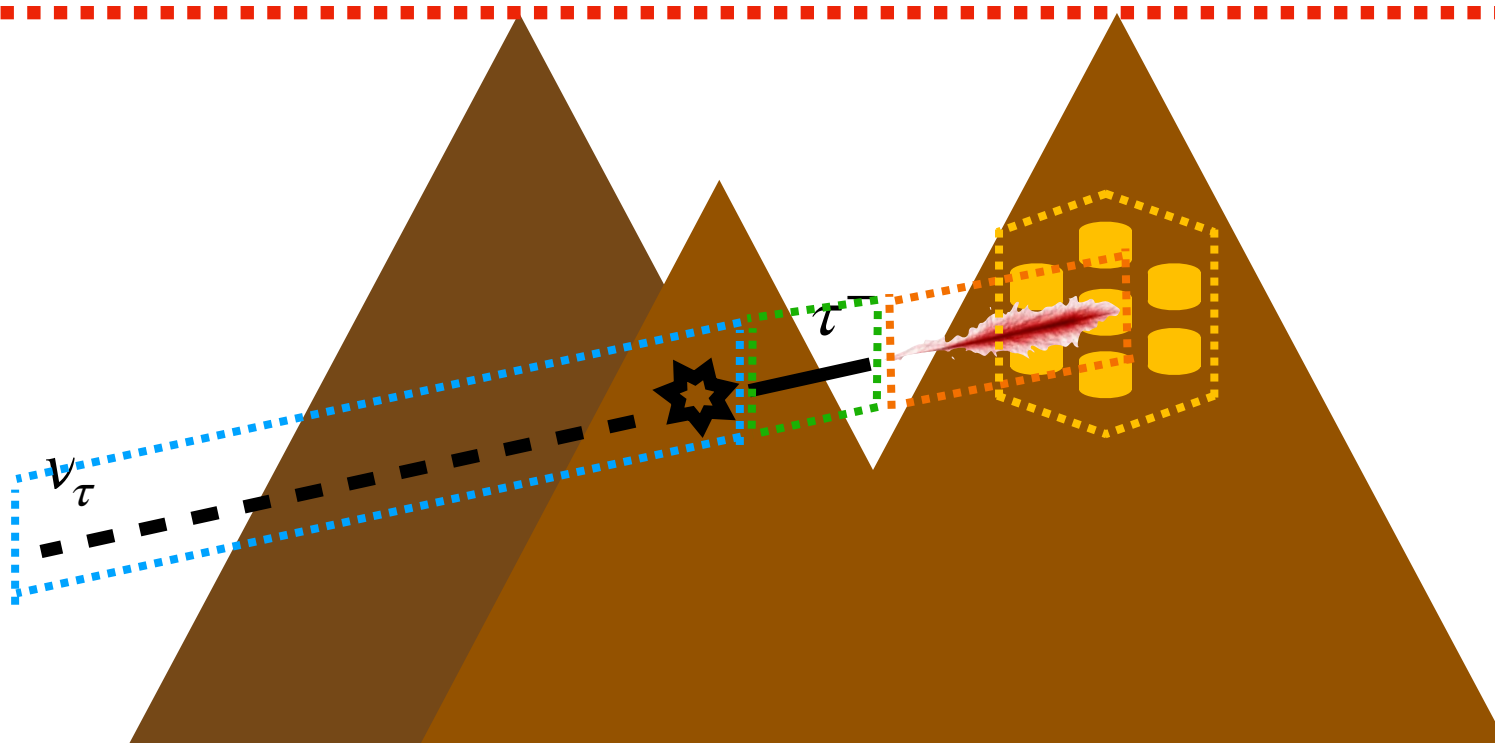
Overview of Simulation Framework



Jeff Lazar



Pavel Zhelnin



Initial neutrino injection: Select initial neutrino properties, *i.e.* energy, direction, interaction vertex, *etc.*

Charged lepton propagation: Propagate outgoing charged lepton, accounting for energy losses and decay, to find decay point

Air-shower simulation: Model shower development from lepton decay

Detector response: Simulate internal hardware to model what we will see

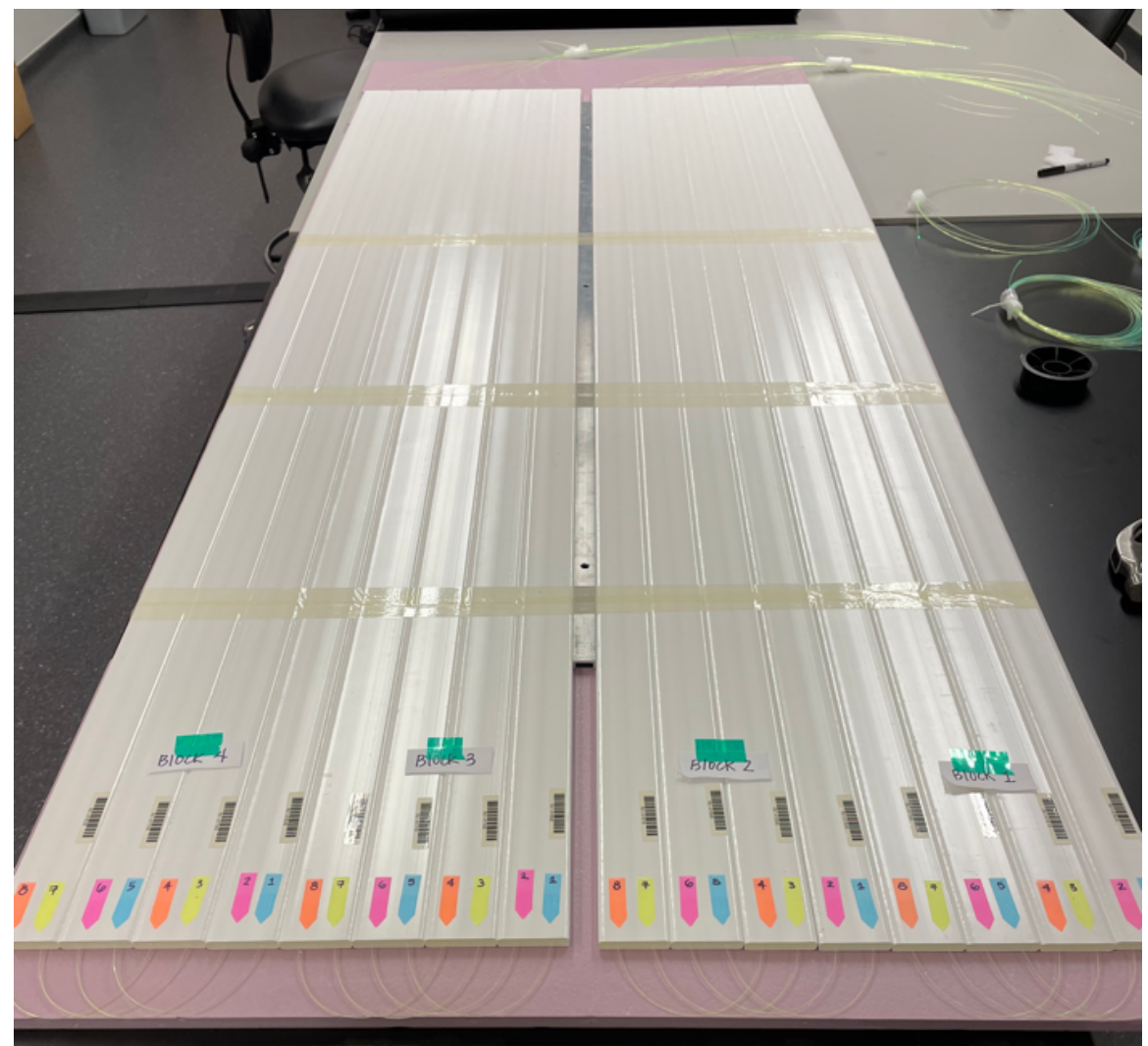
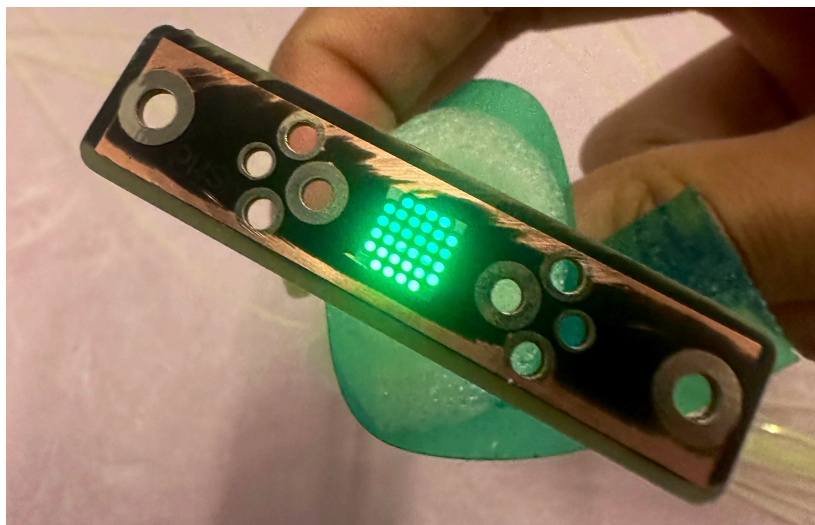
Event weighting: Remove unphysical remnants from selection of initial neutrino properties

Detector Research & Development

- Detector technology: either water Cherenkov or plastic scintillator
 - No new technology development needed!
- Special considerations for TAMBO:
 - Difficulty of deploying detectors in canyon
 - Cost of producing ~20k detectors



Diyaselis Delgado



Community Partnership

- Met with Peruvian & local officials last autumn
- Developing workshop to help scientists interface & form partnership with local communities
- Aim to engage local community as partners



Photo Credit: Universidad Nacional de San Agustín de Arequipa

Summary

- TAMBO will bridge gap between HE and UHE astrophysical neutrino experiments
- Enables searches for new physics via flavor ratio measurements
- Fully-featured simulation nearing completion
- Development of prototype detectors underway
- Interested in joining? Contact us at will_thompson@g.harvard.edu
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Thanks!



Acknowledgements

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