Simulation Status of the Tau Air-Shower Mountain-Based Observatory

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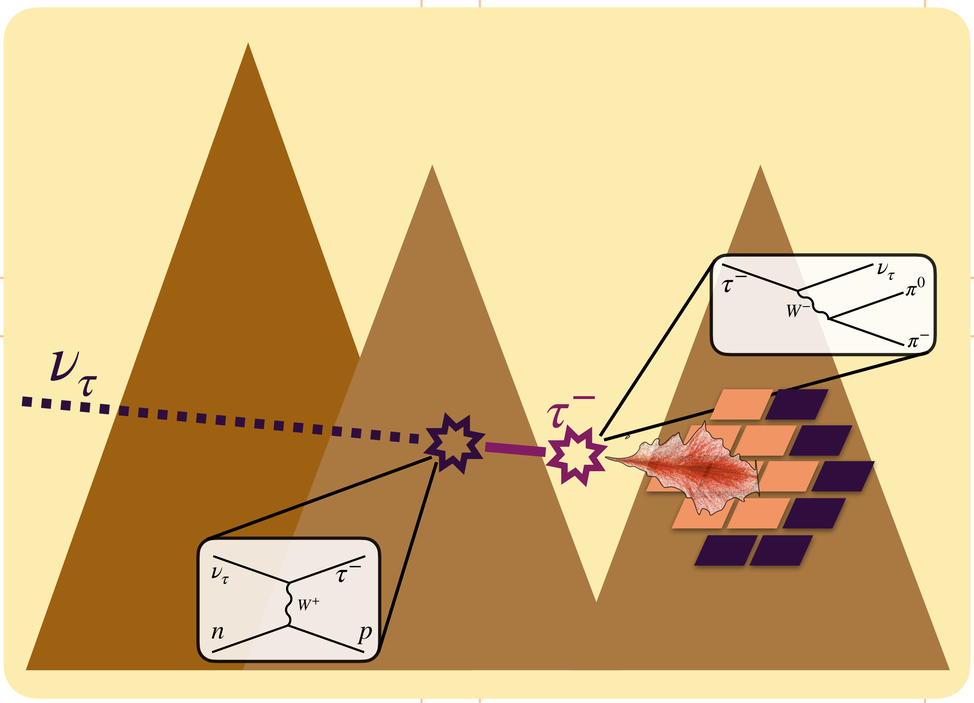
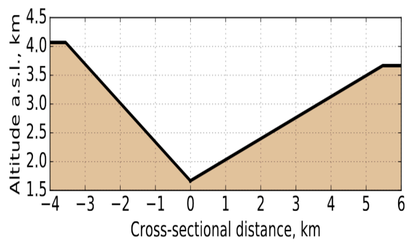
Detection Principle

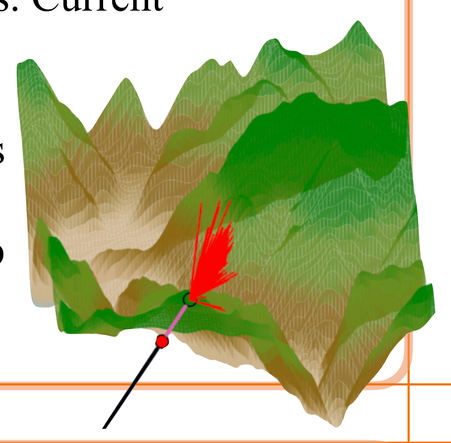


A ν_τ can interact in the mountain and create a τ^-. If the τ^- decays hadronically in the valley, it can created an extensive air shower (EAS) that can be detected by an array of particle detectors

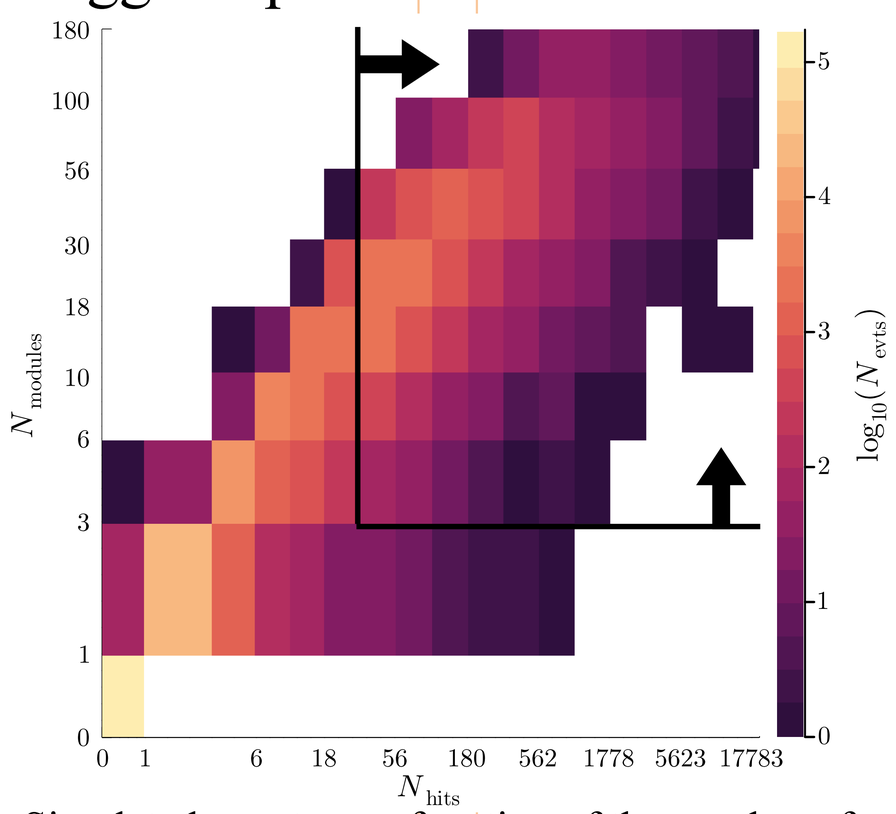
Towards a Full Monte Carlo



Initial rate estimation[1] used simplified valley geometry and analytic approximation of EAS physics. While this is an important first step, it makes a full Monte Carlo is necessary for several reasons. Current simulation uses realistic geometry and simulates EAS with CORSIKA8[2]. This gives timing information, which we can use to develop reconstructions.

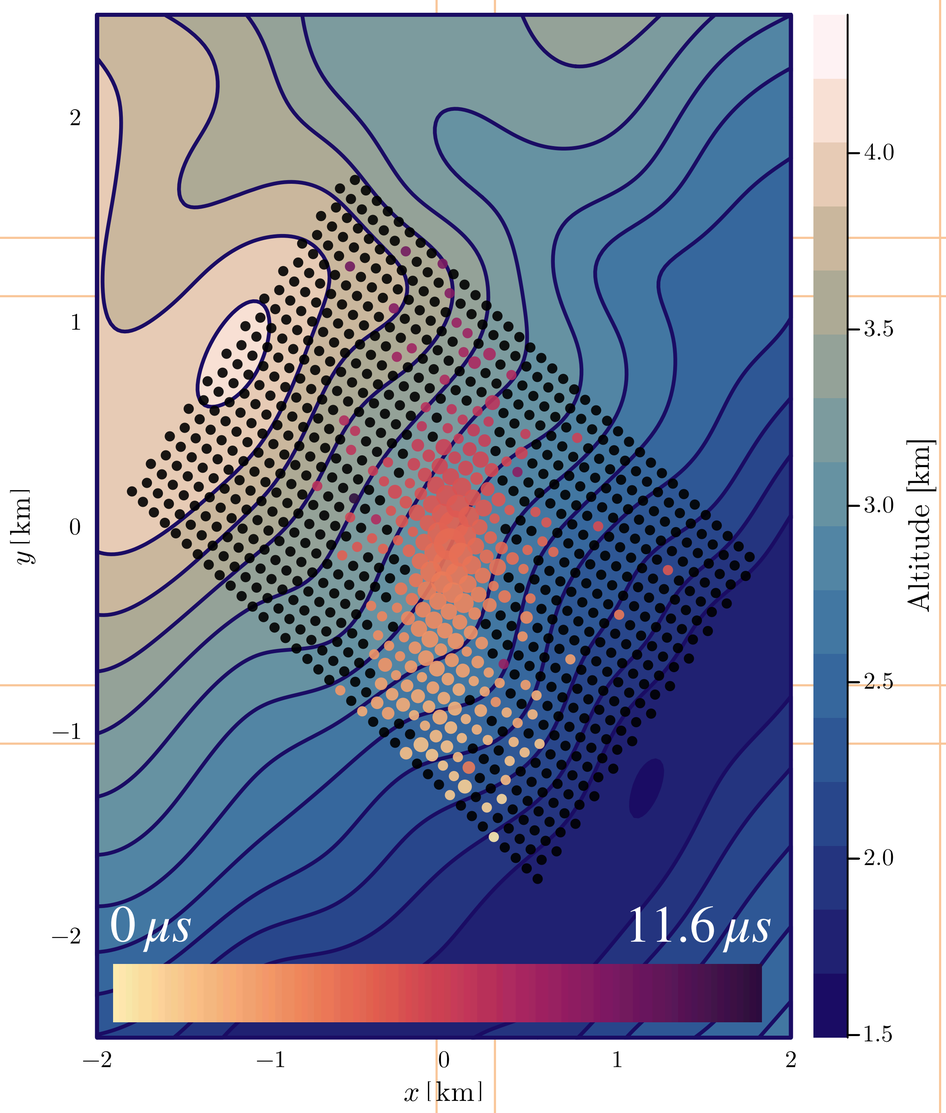


Trigger Optimization



Simulated events as a function of the number of modules which detected a particle and the number of detected particles. The thresholds from the previous study—shown as black lines—leave only 13,637 events that can trigger the detector. We are working to optimize these to maximize the event rate.

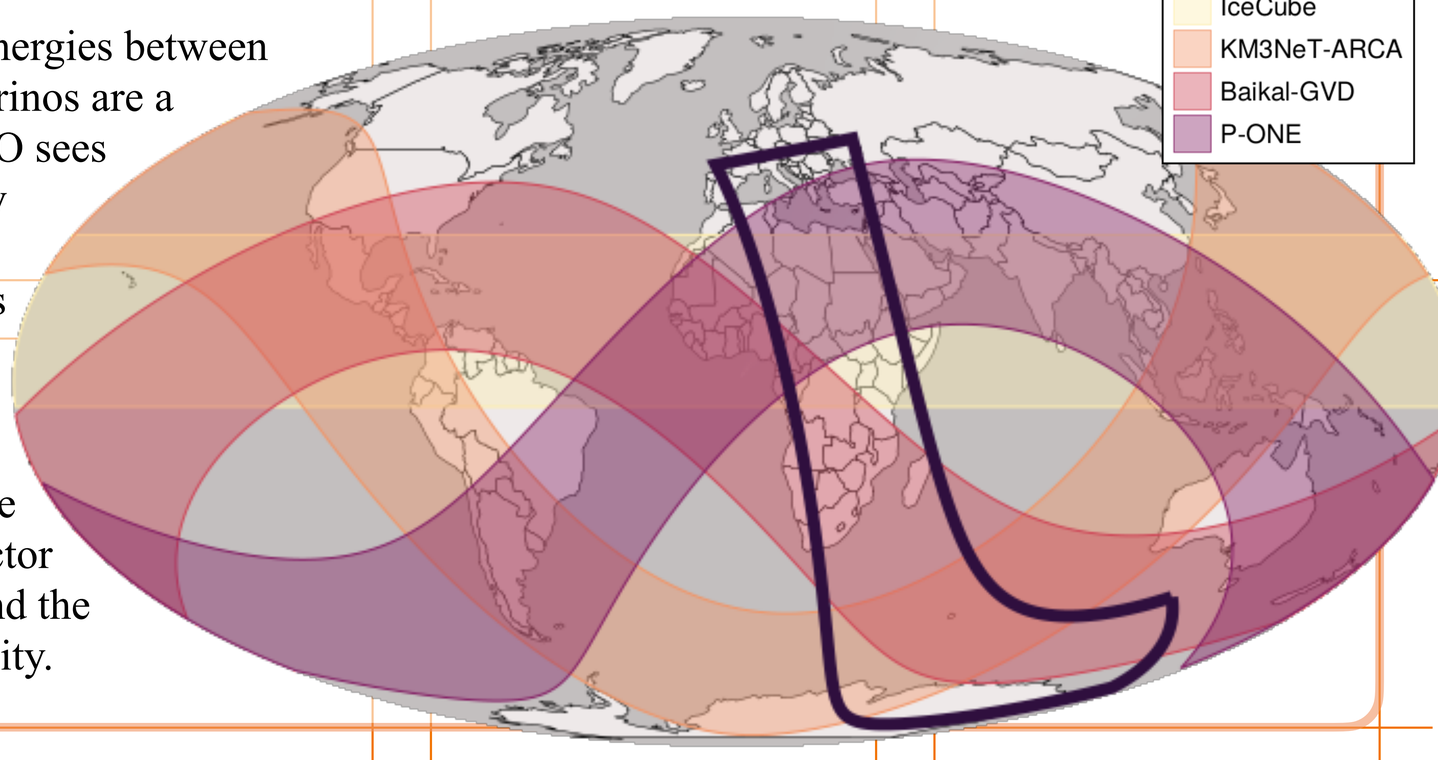
Event in the TAMBO Detector



Event display of a tau-neutrino-induced air shower crossing an example TAMBO array with 900 modules with 100 m intermodule spacing. The initial neutrino had energy $E_\nu = 23\,\text{PeV}$ and shower energy $E_s = 10\,\text{PeV}$. As the time-scale implies, the incident neutrino came from the South, and the resulting shower moved across the multi-kilometer array on the scale of microseconds.

Next Steps: TAMBO Science and the Global Neutrino Network

TAMBO offers a unique opportunity to probe neutrinos at energies between Cherenkov and radio telescopes. Since high-energy tau neutrinos are a smoking gun of astrophysical neutrinos, every event TAMBO sees is astrophysical in origin. Observing PeV events from steady sources will allow TAMBO to act as an external trigger to Cherenkov neutrino telescopes, since we expect more events at 100 TeV if sources follow power-law distributions. On the other hand, certain models of transient emission predict peaks in the PeV[3]. Thus, TAMBO offers an avenue to discovery for transient and steady sources. Our next steps are to finalize the expected event rate for a ~5,000 module detector and develop a first reconstruction so we can better understand the role TAMBO will play in the neutrino astrophysics community.



[1] A. Romera-Wolf, *et al.*, arXiv:2002.06475
[2] M. Reininghaus and Ralf Ulrich, arXiv:1902.02822
[3] M. Petropoulou *et al.*, Astrophys.J. 891 (2020) 115