Contribution ID: **103** Type: **Oral**

The Giant Radio Array for Neutrino Detection

Tuesday, 18 June 2024 12:50 (15 minutes)

Ultra-high-energy (UHE) cosmic neutrinos, with energies above 100 PeV, are
unparalleled probes of the most energetic astrophysical sources and weak interactions at energies beyond the reach of accelerators. GRAND is an envisioned observatory of UHE particles -neutrinos, cosmic rays, and gamma rays - consisting of 200,000 radio antennas deployed in sub-arrays at different locations worldwide. GRAND aims to detect the radio emission from air showers with inclined arrival direction induced by UHE particle interactions in the atmosphere and underground. The reconstruction of these very inclined air showers is a new challenge for next-generation radio experiments. For neutrinos, GRAND aims to reach a flux sensitivity of ~ 10^{−10}GeV cm^{−2} s^{−1} sr^{−1}, with a sub-degree angularmresolution, which would allow it to test the lowest predicted diffuse fluxes of UHE neutrinos and to discover point sources. The GRAND Collaboration operates three prototype detector arrays simultaneously: GRAND@Nançay in France, GRAND-Proto300 in China, and GRAND@Auger in Argentina. The primary purpose of GRAND@Nançay is to serve as a testbench for hardware and triggering systems. On the other hand, GRANDProto300 and GRAND@Auger are exploratory projects that pave the way for future stages of GRAND. GRANDProto300 is being built to demonstrate autonomous radio-detection of inclined air showers and study cosmic rays near the proposed transition between galactic and extragalactic sources. All three arrays are in the commissioning stages. It is expected that by 2028, the detector units of the final design could be produced and deployed, marking the establishment of two GRAND10k arrays in the Northern and Southern hemispheres. We will survey preliminary designs, simulation results, construction plans, and the extensive research program made possible by GRAND.

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Session Classification: Astrophysical Neutrino

Track Classification: Astrophysical Neutrino