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Very High Energy Physics and Astronomy with Tau and Photon Probes

Saturday, 9 July 2022 16:00 (15 minutes)

Very-high energy physics (VHEP) is the development of a higher energy frontier that is complementary to HEP using accelerators to investigate interactions in space caused by fundamental particles and to study the structure and fundamental interactions of elementary particles. Probing for VHE elementary particles will also enable the discovery of VHE celestial objects and the elucidation of their phenomena. In VHE objects, 1st- and 2nd-generation neutrinos should be emitted with photons from the process by accelerated protons, but they remain unidentified. Comparison of VHE neutrino and photon flux spectra from the same object will also allow for fundamental particle physics and cosmological investigations. VHE neutrinos and photons can also probe super-heavy dark matter.

Neutrinos and photons are well-known elementary particles from the Standard Model and travel straight in magnetic fields, making them powerful probes for very-high energy physics and astronomy (VHEPA). Neutrino oscillations cause neutrino fluxes to homogenize between generations during propagation. Tau neutrino observations are also tau appearance experiments. VHE tau neutrinos skim the earth, are converted to tau, and after decaying in air become an upward air shower at a shallow elevation angle, emitting Cherenkov and fluorescence light.

The Neutrino Telescope Array (NTA) unit is a unique wide-angle, high-precision optical system with an optical bifurcation trigger imaging system, based on Ashra-1, the first Earth-skimming tau search from a celestial object. The NTA, consisting of four stations installed near the summit, simultaneously binocularly images air shower Cherenkov light and fluorescence above 1 TeV emitted within a $360^\circ \times 32^\circ$ field of view with a high precision of less than 0.1°. This detection scheme is particularly powerful for the simultaneous monitoring observation of Cherenkov and fluorescence light from VHE tau and photons.

For example, it will be possible to detect and identify PeV-EeV sources hidden in the galactic plane and halo with the highest sensitivity, and to search for dark matter with high efficiency. We will report on the possibilities for VHEPA, opened up by the superior performance of NTA.

In-person participation

No

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