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The flavor of high-energy cosmic neutrinos as a tool for particle physics and astrophysics: current status, future prospects

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High-energy cosmic neutrinos, with energies in the TeV-PeV range, provide a way to push the energy frontier of particle physics. Their flavor composition — the relative contribution of each neutrino flavor in the total flux — is a powerful observable that is unique to neutrinos. The flavor composition detected at Earth depends on the neutrino production process — and so can probe the astrophysics of the sources — and on the flavor transitions that the neutrinos undergo en route to Earth — and so can probe neutrino physics. Because many high-energy new-physics models propose significant modifications to the flavor composition, there is a large potential to test neutrino physics by measuring the flavor composition with increasing precision. Representative new-physics models include unstable neutrinos, new neutrino interactions, sterile neutrinos, and the violation of fundamental symmetries. We will show concrete examples that illustrate how the tests of particle physics physics — and of astrophysics — via the flavor composition are accessible already today, and how the coming decade may extend these tests to energies a thousandfold higher.

Summary

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