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Potential for neutrino experiments to determine the fraction of protons in UHECRs

When ultrahigh-energy cosmic rays (UHECRs) interact with extragalactic photon backgrounds they can create neutrinos. Protons, compared with heavier nuclei, are especially efficient in producing such cosmogenic neutrinos. In our recent paper [1], we show that the expected cosmogenic neutrino flux at an energy of ~1 EeV mainly depends on the evolution with redshift of UHECR sources and the fraction of protons in UHECRs. Therefore, assuming a certain source class, a constraint on the composition of UHECRs can be obtained. Current neutrino experiments indicate that the combination of a large proton fraction and a strong source evolution is not possible. Upcoming neutrino experiments have a good chance of detecting a cosmogenic neutrino flux at ~1 EeV for most realistic source evolutions even for small (~1%) proton fractions. In this way they will be able to give an estimate for the fraction of protons in UHECRs without relying on hadronic interaction models.

[1] A. van Vliet, J. R. Hörandel and R. Alves Batista, *Determining the fraction of cosmic-ray protons at ultrahigh energies with cosmogenic neutrinos*, PRD **100** (2019) 021302(R)

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