

Using cosmogenic neutrinos to determine the fraction of protons in ultra-high-energy cosmic rays

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When ultra-high-energy cosmic rays (UHECRs) travel through the universe they create cosmogenic neutrinos via several interactions. The expected flux at Earth of these cosmogenic neutrinos generally depends on multiple parameters describing the sources and propagation of UHECRs. However, at a neutrino energy of ~ 1 EeV a 'sweet spot' occurs where this flux only depends strongly on two parameters, the source evolution and the fraction of protons in UHECRs. Current neutrino experiments are already constraining these parameters, showing that the sources of UHECRs cannot have a large proton fraction and strong source evolution. Upcoming neutrino experiments will be able to further constrain the fraction of protons in UHECRs even for a negative source evolution.

Primary author: Dr VAN VLIET, Arjen (DESY Zeuthen)

Co-authors: Dr HÖRANDEL, Jörg (Radboud University Nijmegen); Dr ALVES BATISTA, Rafael (Universidade de São Paulo)

Presenter: Dr VAN VLIET, Arjen (DESY Zeuthen)

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