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Atmospheric Neutrino Physics with JUNO

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The atmospheric neutrino flux represents a continuous source that can be exploited to infer properties about Cosmic Rays and neutrino oscillation physics. The JUNO observatory, a 20 kt liquid scintillator (LS) currently under construction in China, will be able to detect atmospheric neutrinos down to lower energies, with respect to Cherenkov detectors, given the large fiducial volume and the high light yield. The light produced in neutrino interactions with the LS will be collected by a double-system of photosensors: 18.000 20" PMTs and 25.000 3" PMTs. The LS detector is surrounded by a Cherenkov water pool, equipped with 2.400 20" PMTs, which is designed to reject atmospheric muons with high efficiency. The rock overburden above the experimental hall is around 700 m and the experiment is expected to see the first data in 2022.

In this work, potential JUNO measurements in the field of atmospheric neutrinos are evaluated. A sample of Monte Carlo events has been generated from theoretical models of the atmospheric neutrino flux, through the GENIE software. To evaluate the JUNO performances, the events have been processed by a full GEANT4 - based simulation, which propagates all the particles and the light inside the detector. The different time evolution of light on the PMTs allows to discriminate the flavor of the primary neutrinos. To reconstruct the time pattern of events, the signals from 3" PMTs only have been used, because of the excellent time resolution. A probabilistic unfolding method has been used, in order to infer the primary neutrino energy spectrum by looking at the detector output. JUNO will be particularly sensitive in the energy range (100-1000) MeV, where neutrino-induced events can be fully contained within the instrumented volume. The energy region is particularly interesting, for several reasons: first, the flavor oscillation effects due to the large neutrino mass-splitting are maximized; then, the region covers an area of interest for other studies too, like the search for nucleon decay and relic supernovae neutrinos.

Collaboration name

JUNO

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