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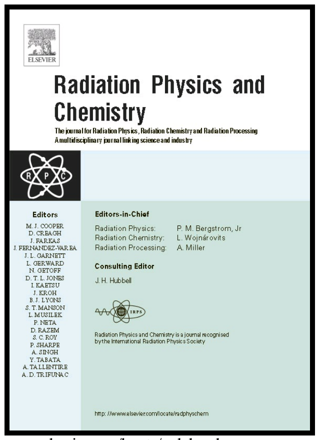

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PII: S0969-806X(18)30439-0
DOI: https://doi.org/10.1016/j.radphyschem.2018.08.009
Reference: RPC7960

To appear in: *Radiation Physics and Chemistry*

Received date: 19 May 2018
Revised date: 1 August 2018
Accepted date: 11 August 2018

Cite this article as: Mihaela Pârvu, Ana Chiriacescu and Ionel Lazanu, Short analysis of cosmogenic production of radioactive isotopes in argon as target for the next neutrino experiments, *Radiation Physics and Chemistry,* https://doi.org/10.1016/j.radphyschem.2018.08.009

Short analysis of cosmogenic production of radioactive isotopes in argon as target for the next neutrino experiments

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Abstract

The reduction of the radioactive background, the knowledge of its sources and mechanisms of its production, as well as the characteristics of its signals represent important steps for the next generation neutrino experiments, because thus the sensitivity of huge detectors is increased, and also the capability to discriminate between various particles interacting with the detector. Liquid - gaseous argon as LAr TPC technology represents a major option as target and an excellent tracking - calorimeter detector. In this class of detectors, both the scintillation light emitted and the charges produced by ionization are used to detect and identify the characteristics of the primary and secondary particles. Cosmogenic sources of background or activation of different materials become more important in this context. The radioactivity induced by cosmogenic reactions in Ar is discussed by considering muon capture and reactions induced by neutrons as sources of background. The ratio between the vertical and horizontal components of the very low energy terrestrial muons at ground level is measured in a particular location and the total flux of the low energy component of muon spectra is estimated using the EXPACS code, developed in the frame of the PARMA model. For neutron interactions, only the simulated cross sections for possible production of radioactive isotopes of argon are considered using the TALYS and EMPIRE software codes, highlighting the similarities and differences between the results of these nuclear codes and the level of concordance with the few existing experimental data. A short discussion about the scintillation processes in the argon bulk and the possible effects due of the presence of radioactive isotopes is presented.

Key words: cosmic rays, argon, cosmogenic radioactivity, muon, neutron, plastic track detectors

Introduction

The new generations of experiments in particle and astroparticle physics for searches of new particles, rare processes or phenomena require more experimental precision as well as a reduction of the radioactive background. The new detector of the DUNE experiment (Deep Underground Neutrino Experiment) for example, currently in the state of prototype construction and testing and of measuring the interactions produced by cosmic rays will enable to answer the fundamental problems of the nature of matter and of the evolution of the Universe. The experiment operates a huge detector with liquid argon and aims to highlight the interactions of neutrinos.

The prototypes of the DUNE detector will be operated at the ground level at CERN, while the final detector will be installed underground at 1,475 meters at the Sanford Underground Research