Characterization of emergent leakage neutrons from multiple layers of hydrogen/water in the lunar regolith by Monte Carlo simulation

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Introduction: The leakage lunar neutrons produced by precipitation of galactic cosmic ray (GCR) particles in the upper layer of lunar regolith and measured by Lunar Exploration Neutron Detector (LEND is investigated by Monte Carlo simulations. Previous Monte Carlo (MC) simulations have been used to investigate neutron production and leakage from lunar surface in order to assess the elemental composition of lunar soil [1-6] and their effect on the leakage neutron flux.

In this investigation, we use Geant4[7] to calculate neutron production by spallation process of GCR particles [8,9] in the top lunar soil. Multiple layers of differing hydrogen/water at different depths in the lunar regolith model are introduced to examine enhancement or suppression of leakage neutron flux. We find that the majority of leakage thermal and epithermal neutrons are produced in 25 cm to 75 cm deep from the lunar surface. Neutrons produced in top shallow layer escape from lunar surface mostly as fast neutron. This provides a diagnostic tool in interpreting leakage neutron flux enhancement or suppression due to hydrogen concentration distribution in lunar regolith. We also find that the emitting angular distribution of thermal and epithermal leakage neutrons can be described by $\cos^{3/2}(\theta)$ where the fast neutrons emitting angular distribution is $\cos(\theta)$.

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