

MONTE CARLO SIMULATIONS IN SUPPORT OF ORBITAL NEUTRON DETECTION BY THE LEND INSTRUMENT ON BOARD OF LRO SPACECRAFT. Jao-Jang Su¹, Robert Khachatryan², Roald Sagdeev¹, Daniel Usikov¹, Gennady Milikh¹, Gordon Chin³

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Introduction: The early detection of lunar neutrons produced by precipitation of galactic cosmic ray (GCR) particles in the upper layer of lunar soil goes back to Apollo Moon landing (Apollo 17) epoch. Since then it has been developed into its own type of remote sensing (Lunar Prospector/1998-1999; LRO/2009-till now), which is especially sensitive for singling out the information on presence of hydrogen (e.g. frozen water inside permanently shadowed craters) from neutron based cosmo-chemistry data. The final interpretation technique relies on comprehensive Monte Carlo simulation of neutron production by GCR and subsequent leakage from the Moon. Until now such extensive simulation was carried mostly with the use of MCNPX code [1], [2].

Model Description: Here we report on the use of alternative MC code GEANT4, developed at CERN and offered as the open source software [3]. We believe that cross-comparison and inter-calibration of both codes will add more weight to the importance, versatility and reliability of Monte Carlo approach for neutron detection based planetary remote sensing. As a first step we compare basic results for neutron leakage from lunar soil (for several modeled elemental compositions). Then GEANT4 code was used to study the modification of neutron leakage in presence of top layer of dry and wet regolith. These data were applied to analysis of physical nature of SNRs (Suppressed Neutron Regions) found by LEND in polar areas of the Moon [4].

References: [1] Lawrence D.J. et al., (2006) *JGR*, 111, doi:10.1029/2005JE002637. [2] Mitrofanov I.G. et al. (2008) *Astrobiology*, 8, doi:10.1089/ast.207.0158. [3] Agostinelli S. et al., (2003) *Nuclear Instr. Method in Phys. Res.*, 506A, 250-303. [4] Mitrofanov I.G. et al. (2010) *Science*, 330, doi:10.1126/science.1185696.