LUNAR EXPLORATION NEUTRON DETECTOR EVALUATION OF POTENTIAL LCROSS IMPACT SITES I.G. Mitrofanov[1], R.D. Starr[2] and the LEND/LRO Instrument Team, [1]Space Research Institute, RAS, Moscow, 117997, Russia, imitrofa@space.ru, [2]Department of Physics, The Catholic University of America, Washington, DC 20064, richard.starr@gsfc.nasa.gov

Introduction: The Lunar Exploration Neutron Detector (LEND) is a contributed instrument of the Federal Space Agency of Russia for the science payload on NASA's Lunar Reconnaissance Orbiter (LRO) mission. LEND will determine hydrogen distribution in the lunar subsurface to depths of 1-2 meters with high sensitivity and spatial resolution that may provide valuable targeting information for the LCROSS experiment [1]. LCROSS impact is scheduled to occur ~90 days following LRO orbit insertion. The sensitivity of LEND is sufficient to provide, within the first 1-2 months of lunar orbit, evaluation of several potential impact sites for LCROSS.

Instrumentation: LEND is comprised of eight ^{3}He counters for detection of thermal and epithermal neutrons and a stylbene scintillation spectrometer for detection of fast neutrons (Figure 1). Four of the ^{3}He counters are collimated with a combination of polyethylene and ^{10}B powder. These detectors are also surrounded by Cd shields to filter out thermal neutrons with energies below ~0.4 eV so they are primarily sensitive to epithermal neutrons. The epithermal neutron flux is very sensitive to the presence of hydrogen in the lunar regolith and the collimated LEND ^{3}He counters will provide detection of hydrogen near the poles to levels of 100 ppm or better with spatial resolution of 5 km (Half Width Half Maximum). If the hydrogen is associated with water, a detection limit of 100 ppm of hydrogen corresponds to ~0.1 wt% of water ice homogeneously distributed in the regolith. Over the course of the one-year LRO mission LEND will be able to produce global maps of hydrogen content with resolution of 5-20 km [2].

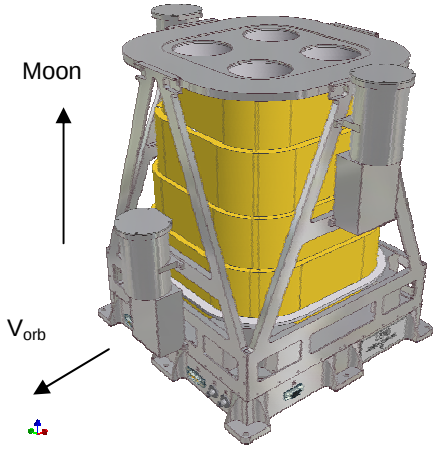

Figure. 1. Schematic view of LEND.

Possible signature of water ice in neutron data: The first global mapping of neutron emission from the Moon was performed in 1998 by the uncollimated Neutron Spectrometer on NASA's Lunar Prospector mission [3]. It was found that the epithermal neutron flux decreased in polar regions of the Moon as compared with lower latitudes and that these regions of reduced epithermal flux corresponded to floors of craters that are permanently shadowed suggesting water ice as a possible source of the signal. Data from the collimated LEND detectors will provide hydrogen maps with spatial resolution superior to what was possible with the Lunar Prospector Neutron Spectrometer.

LCROSS navigation by LEND: An initial LRO commissioning orbit may last as long as 60 days. This orbit will be 30 km by 216 km with its periapsis near the South Pole. If the commissioning orbit extends to the full 60 days only targets near the South Pole will be studied with sufficient sensitivity to provide targeting information prior to LCROSS impact.

Several candidate water ice traps within 5 degrees of either the North or South Pole have been identified [4]. Southern candidates are considered potential targets for LCROSS impact and investigation. The LEND team will perform neutron data analysis during the LCROSS flight for selection of the target with largest probable content of water ice in the subsurface. Providing early results of LEND observations to the LCROSS team will increase the probability of successfully targeting a water rich region.

References: [1] Mitrofanov I.G. et al. (2005) LEAG Conference on Lunar Exploration, No. 1287, p. 67. [2] Sanin A. et al. (2005) LEAG Conference on Lunar Exploration, No. 1287, p. 76. [3] Feldman W.C. et al. (1998) *Science* **281**, 1496-1500. [4] Litvak M.L. et al. (2005) LEAG Conference on Lunar Exploration, No. 1287, p. 60.