LRO LEND OBSERVATIONS OF NEUTRONS AS EVIDENCE FOR POLAR HYDROGEN. I. G. Mitrofanov[1], M. L. Litvak[1], A. B. Sanin[1], D. V. Golovin[1], W. V. Boynton[2], G. Chin[3], J. B. Garvin[3], L. G. Evans[4], K. Harshman[2], A. S. Kozyrev[1], T. McClanahan[3], R. Sagdeev[5], V. Shevchenko[7], V. Shvetsov[8], D. Smith[9], R. Starr[6], J. Trombka[5] and M.Zuber[9]. [1]Institute for Space Research, 117997 Moscow, Russia imitrofa@space.ru, [2]University of Arizona, Tucson, AZ USA, [3]NASA Goddard Space Flight Center, Greenbelt, MD USA, [4]Computer Science Corporation, Greenbelt, MD USA, [5]University of Maryland, Collage Park, MD USA, [6]Catholic University, Washington DC, USA, [7]Sternberg Astronomical Institute, Moscow, Russia, [8]Joint Institute of Nuclear Research, Dubna, Russia, [9]Massachusets Institute of Technology, Cambridge, USA.

Introduction: The first suggested detection of water ice in polar craters was claimed by the bistatic radar team of the *Clementine* mission [1], but this result was not supported by subsequent high-resolution Earth-based radar measurements [2]. Indirect evidence for the presence of water ice in polar regolith was provided by the *Lunar Prospector Neutron Spectrometer* (LPNS), in the form of extended suppression of neutron emissions around both lunar poles [3]. The first direct detection of H_2O and/or OH in the top layer of the lunar polar regolith was performed by means of the M^3 hyperspectral IR mapping spectrometer onboard the ISRO *Chandrayaan-1* mission [4]; however such IR data characterizes only the uppermost few micrometers of the regolith. The final proof for the presence of localized areas with a relatively high content of water and another volatiles at the lunar poles has been recently provided by the remote sensing measurements of NASA's LRO and LCROSS missions [5 – 7].

Observations: studying local Neutron Suppression Regions (NSRs), as potential locations of polar Hydrogen. Currently available LEND neutron data has allowed us to identify several local areas around both lunar poles which most plausibly display rather high content of Hydrogen with about several % of WEH (Water-Equivalent Hydrogen) within a ~1 meter thick layer of the regolith. They are detected as localized *Neutron Suppression Regions*, or NSRs. Among all of them, the strongest suppression effect of epithermal neutrons is found associated with the NSR of *Cabeus* [5]. The NSR of *Cabeus* has a total area of about 700 km^2. The average enhancement of Hydrogen in this NSR is about 360 ppm in comparison with the local vicinity. The northern part of this NSR, with an area of about 300 km^2 , lies in the permanently shadowed region (PSR) of *Cabeus*; the surface of this part is never illuminated by direct sunlight, and its temperature is constantly below 100 K [8]. The southern part of the *Cabeus* NSR , with an area of about 400 km^2 , is illuminated during the lunar polar day, when surface temperatures increase well above 100 K, suggesting that water ice should intensively sublime from the regolith.

Another well-observed NSR with an area about 1500 km^2 was detected within another polar crater known as *Shoemaker*. Its boundary coincides very well with the outer contour of PSR in the bottom of this crater. The average enhancement of Hydrogen in the NSR is about 190 ppm. Figure compares a profile of the surface topography of the crater (from LOLA) along 50° longitude together with the profile of neutron suppression from LEND. The two profiles are surprisingly similar at the northern edge (a clear illustration of LEND "imaging" capability at a scale of ~10 km), but at the poleward edge, the local topography is clearly changing at a much higher rate than neutron suppression. The surface of the NSR in *Shoemaker* is permanently cold, and there exist nearly ideal conditions for permanent storage of frozen water in the regolith. On the other hand, there are many another craters at both the south and north poles, which also have associated PSRs, but do not manifest any detectable signature of neutron suppression.

The third example of a well-defined NSR is located at the northern polar crater *Rozhdestvesnky*. The LEND-based NSR (with a total area of about 240 km^2) is also coincident with the PSR within this crater. The average enhancement of Hydrogen in this PSR is about 330 ppm.

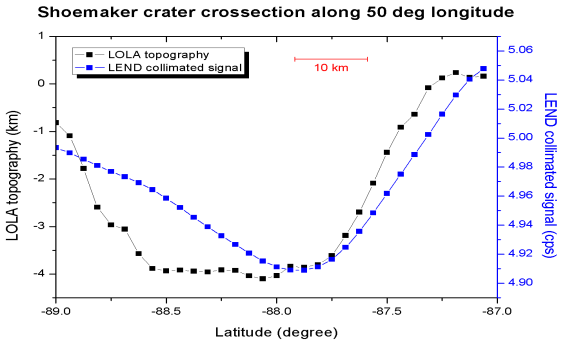

Figure: *Shoemaker* crater cross-section along 50° longitude for LOLA topography (*black*) and LEND neutron counting rate (*blue*).

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