LUNAR PROSPECTOR INTEGRATED NEUTRONS BELOW 500keV. I. Genetay, S. Maurice and C. d'Uston[1] , R. C. Elphic, W. C. Feldman, O. Gasnault, D. J. Lawrence[2], [1]Observatoire Midi-Pyrénées, 14 avenue Edouard Belin, 31400 Toulouse, FRANCE (genetay@ast.obs-mip.fr), [2]Los Alamos National Laboratory, Group NIS-1, MS-D466, Los Alamos, NM , 87545, USA.

Introduction: It has been shown previously that data from Lunar Prospector neutron spectrometers yield information about lunar regolith elemental composition [1]. Here, we present the 0-500keV neutron data, a new type of measurement made using the Anti Coincidence Shield (ACS) of the Gamma Ray Spectrometer (GRS). These Broad Band neutrons (BB-neutrons) are measured independently of the 0-100eV Neutron Spectrometer (NS) data and reinforce their results, such as the REE (Rare Earth Elements) presence in northern Mare Imbrium [2], the iron presence in mare basalts [1] and the H-deposits at the Lunar Poles [3].

BB-neutron production and detection: Interaction between galactic cosmic rays and regolith nuclei is the main source of high energy neutrons that subsequently moderate in the lunar regolith. Three neutron energy bands are discriminated: fast (E>500keV), epithermal (0.4eV<E<500keV) and thermal (E<0.4eV). While thermal and (0.4-100eV) epithermal neutron measurements are made using the NS, a band of 0-500keV neutrons is made using the ACS of the GRS with a technique that is similar to the technique used to measure 0.5-8MeV fast neutrons.

BB-neutron data: From January 1998 to July 1999, Lunar Prospector orbited the Moon. In December 1998, its altitude was lowered from ~100km to ~30km. We restrict our study to the low altitude data set, which provides the best spatial resolution of the lunar surface. Starting from more than 200% over the statistics, the standard deviation has been reduced to 10% over the statistics by the reduction data scheme. The BB-neutron map (figure) uses a cylindrical projection of the Moon. As the presumed size of the detector response spatial resolution is around 60km, the map uses 2°x2° equal area pixels. The intensity scale extends from 138 counts per 32 seconds (in dark blue) to 161 counts per 32 seconds (in yellow).

Results: The 0-500keV neutron map bears a strong resemblance with the 0.4-100eV epithermal neutron map, especially for the REE absorptions in northern Mare Imbrium but also for the hydrogen absorptions at the poles. Basalt terrains emit more BB-neutrons than epithermal neutrons which is similar to the fast neutron signature in BB-neutrons. Futhermore, the 0-500keV neutrons include a signature from thermal neutrons. The BB-neutron map can be reconstructed using a combination of the epithermal map [for ~60% of the signal], the fast map [for ~30% of the signal] and the thermal map [for ~10% of the signal]. So, the 100eV-500keV neutron band appears to be made of 2 components. (1) The first one behaves like 0.4-100eV epithermal neutrons; (2) high energy epithermal neutrons behave like fast neutrons. The boundary between both domains is to be determined.

Conclusion: The Lunar Prospector NS detected 0-100eV neutrons. The ACS of the GRS provides 0-500keV neutron data. This energy band is much broader than that of the NS one but the efficiency of the measurements is 4 times lower. Both data sets are interrelated. Altough BB-neutrons contain new information on 100eV-500keV neutrons, their signal can be broken into two components: one is similar to the 0.4-100eV neutrons and the other is similar to the fast neutron signature. BB-neutrons therefore reinforce and complement the previous results obtained with thermal, epithermal and fast data sets.

Neutron Spectroscopy is a new way of probing planetary bodies that have sufficiently thin atmospheres such as the Moon, Mars or Mercury. Lunar Prospector measurements have provided the opportunity to develop this new technique and investigate its information content for planetary exploration. An extension of this work is planned with Odyssey (Mars 2001).

References: [1] Feldman W. C. et al. (2000), *JGR*, *105*, *20347*. [2] Maurice S. et al. (2000) *LPSC XXXI* and Elphic R. C. et al. (2000) *LPSC XXXI*.[3] Feldman W. C. et al., (2000), *JGR*, *105*, 4175-4195.

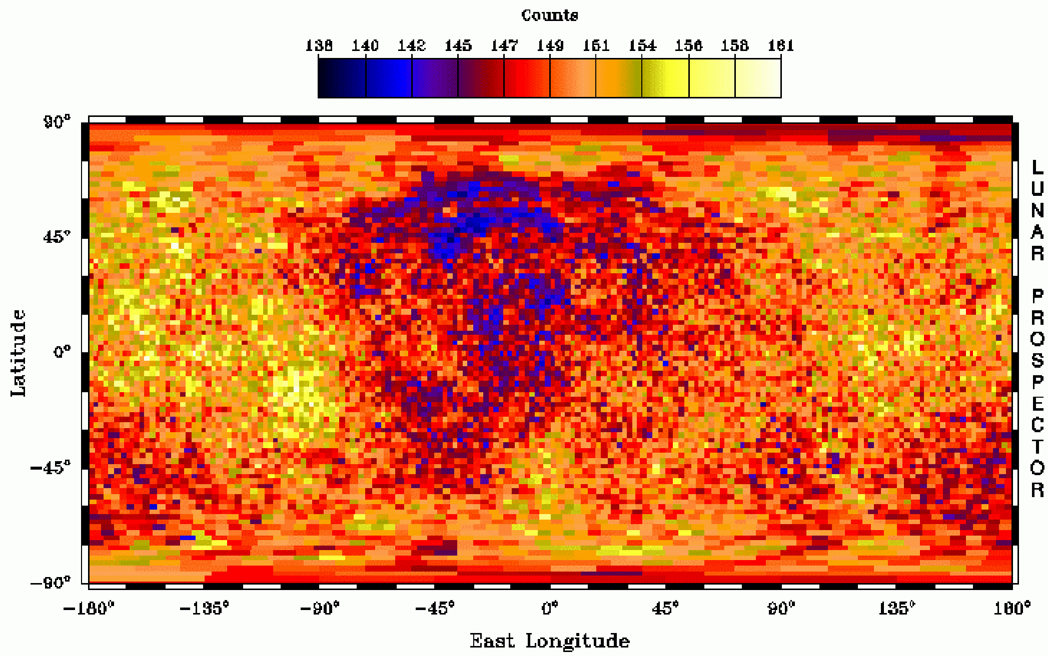

Figure : This BB-neutron map uses 2ºx2º equal area pixels on a cylindrical projection of global Moon.