NEUTRON SPECTRA DEPENDENCE ON ATMOSPHERIC PARAMETERS AT HIGH MOUNTAIN OBSERVATORIES

A. Zanini[1], R. Mayta[2], R. Ticona[3], M. Storini[4] and F. Signoretti[4]

[1]INFN, Torino, Italy - [2]Univ. Mayor de San Andrés, La Paz, Bolivia - [3]UMSA, La Paz, Bolivia - [4]IFSI- Roma/INAF, Italy

storini@ifsi-roma.inaf.it

Figure 1

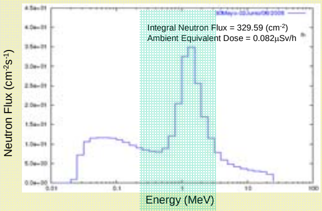
Extended measurement campaigns of neutron spectra (energy range: 10 keV – 20 MeV; see also [1-3]) have been carried out at Chacaltaya Observatory (Bolivia, 16° 21' S – 68° 07' W; 5230 m a.s.l.) during 2008, to evaluate neutron spectra in the atmosphere and the variation in the neutron flux intensity and energy distribution with atmospheric parameters. Experimental neutron spectra evaluation is provided by using the passive Bubble Detector Spectrometer (BDS) system based on bubble detectors. The influence of the different atmospheric conditions on the neutron energy distribution was carefully analyzed and results are here presented.

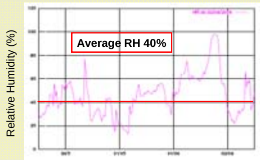
Measurement campaign at Chacaltaya Observatory

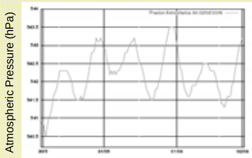
The experimental campaigns were performed by using the passive Bubble Detector Spectrometer (BDS [4]), based on six superheated drop detectors with different energy thresholds (10 keV, 100 keV, 600 KeV, 1 MeV, 2.5 MeV and 10 MeV). The detectors were inserted in a thermostatic and pressurized box, as shown in Fig. 2, to maintain a constant temperature and pressure (20°C – 1 atmosphere). This setup allowed to keep the experiment outside the Observatory building, avoiding the internal radiation background and the energy attenuation induced by the building walls. The acquired data were elaborated by using the unfolding code BUNTO [5]. Main results are:

2008 PERIOD	NEUTRON ENERGY SPECTRUM	RELATIVE HUMIDITY	ATMOSPH. PRESSURE

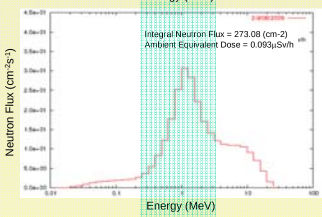
30 May / 2 June

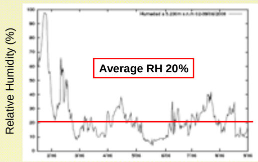


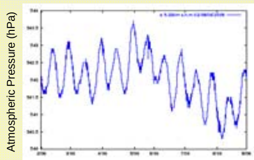




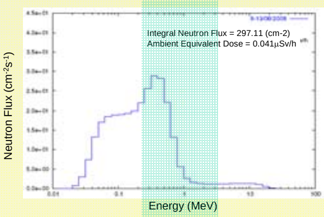
2 Jun. / 9 Jun.

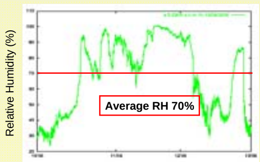


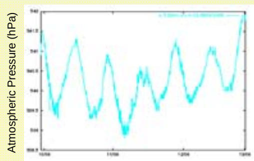




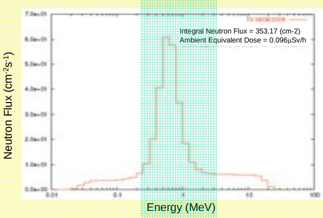
9 Jun. / 13 Jun.

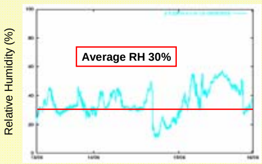


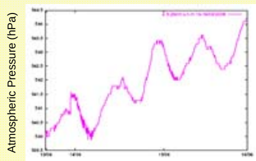




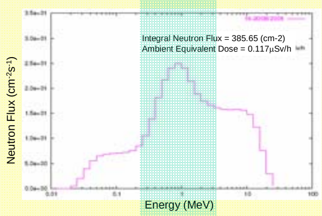
13 Jun. / 16 Jun.

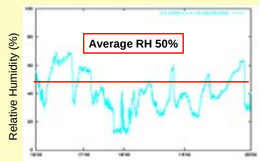


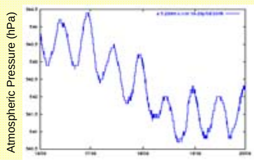




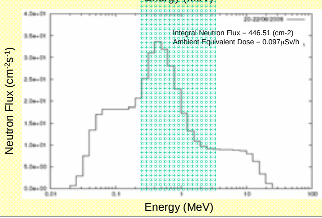
16 Jun. / 20 Jun.

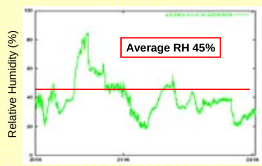


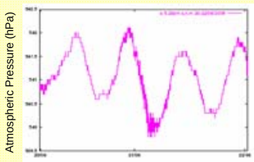




20 Jun. / 22 Jun.



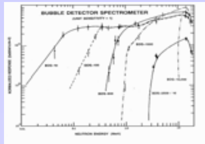




1) All the neutron spectra show an evident peak around 1 MeV.
2) Due to the high elastic cross section of neutron on hydrogen nuclei, the shape of the spectrum strongly depends on the amount of H_2O in atmosphere; i.e. - lower relative humidity → lower epithermal neutron component or - higher relative humidity → higher epithermal neutron component.

Experimental apparatus

BDS different types of detector with different thresholds and energetic responses (10, 100, 600, 1000, 2500 and 10000 keV to 20 MeV). BTI, Ontario, Canada



BDS response curves

Figure 2

Neutron measurements have been performed in a special pressurized and thermostatic chamber to compensate the low external atmospheric pressure (about 500 hPa)

DEPENDENCE OF DIFFERENT NEUTRON COMPONENTS WITHIN THE RELATIVE HUMIDITY

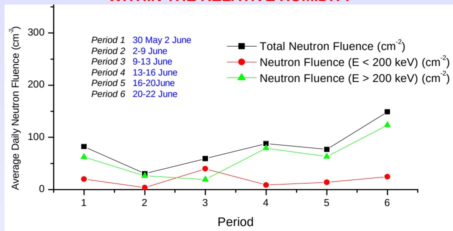


Figure 3: the low and high neutron components are shown separately together with the total neutron flux averaged on the measurement period.

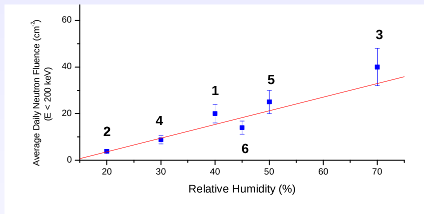


Figure 4: the intensity of the low energy neutron component (E < 200 keV) is linearly correlated with the relative humidity.

NEUTRON MONITOR MEASUREMENTS SVIRCO OBSERVATORY & TPL - ROMA (ITALY)

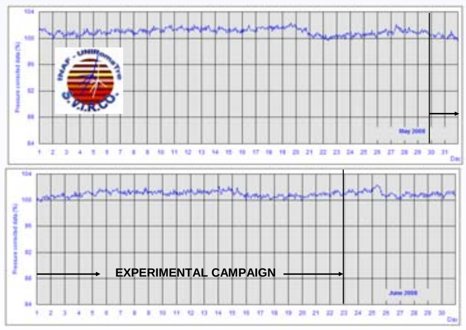


Figure 5: the nucleonic component during the experimental campaign, as registered by the Rome neutron monitor.

REFERENCES
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