

Name of research institute or organization:

Istituto Nazionale di Fisica Nucleare, Torino (Italy)

Title of project:

Neutron background measurements at Jungfrauoch Research Station

Project leader and team:

Alba Zanini, Project leader

A.Ferrantelli, P.Morfini, L.Visca, O.Borla

Project description:

From 21st of May 2005 until 28th of May 2005 a short time neutron cosmic ray background measurement was carried out at the Sphinx laboratory, located at Jungfrauoch research station, 3580 m geographical co-ordinates 7° 59' 2" E, 46° 32' 53" N. The experimental set up included a set of 10 integral neutron dosimeter (BD-PND) working in the energy range 100 keV-20 MeV, a bubble detector spectrometer able to detect neutron in the energy range 10 keV-20 MeV, available by the BTI Inc., (constituted by 18 dosimeter). The bubble detector readings are elaborated by using the unfolding code BUNTO especially developed for this application [1]

Results

The data collection was carried out with two different instruments in such a way to cross-check the results.

The measurements were stopped after 576000 seconds (160 h).

Table 1 lists the neutron dose equivalent rate obtained using two different methods. The BD-PND dose is measured counting the tracks in the dosimeter and using the conversion coefficients provided by BTI. The BDS dose equivalent rate is obtained coupling the dosimeter readings with the BUNTO unfolding code.

Detector	Energy range	H rate
BD-PND	100 keV- 20 MeV	(9E-02±2 E-02) µSv/h
BDS	10 keV to 20 MeV	(5E-02±1 E-02) µSv/h

Table 1: Neutron dose equivalent rate measured at Jungfrauoch.

As it can be noticed the dose rate calculated using the BDS spectrometer is different from the dose rate measured with BD-PND integral dosimeters. The difference is due to the fact that the BDS dose rate is calculated applying the conversion coefficients to the reconstructed spectrum shown in figure 2. The same neutron background measurements have been carried out during the year 2003 in the high mountain laboratory (Testa Grigia, Matterhorn 3480m), using the same detection system, in figure 1 the two spectra are shown together.

As it can be noticed, the expected 1 MeV peak in cosmic rays neutron spectrum is not correctly reconstructed by the unfolding procedure for Jungfrauojoch spectrum. The reason is probably due to the fact that the BDS system was not inserted into a pressure box (while it was during Testa Grigia experiments) so that the readings are affected by the high altitude pressure conditions.

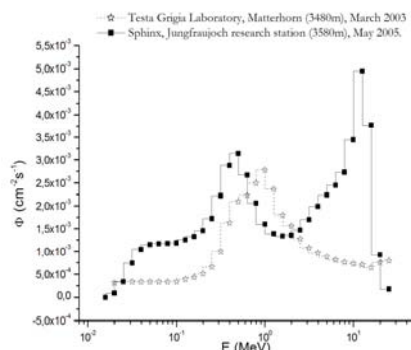


Fig. 1: Jungfrauojoch and Testa Grigia neutron spectra.

Due to the short time exposure and the lack of pressurized container, the measurements are to be considered as a preliminary test. It is necessary to repeat the measure using the pressure box in such a way to cross check the neutron spectrum with the data from other high altitude laboratories. The pressure box will be provided by ASI (Agenzia Spaziale Italiana).

This device is realized by Kayser Italia Factory and is in use for ASI balloon flights and is able to maintain pressure and temperature in extreme conditions as encountered at 40000 meters of altitude. By using this device, it should be possible to perform the neutron measurements outside the laboratory, avoiding the neutron background due to the concrete walls of the building.

References

- [1] A Zanini, F Fasolo, L Visca, E Durisi, M Perosino, J R M Annand and K W Burn, Test of a bubble passive spectrometer for neutron dosimetry, *Phys. Med. Biol.* 50 No 18 (2005) 4287-4297.

Key words:

Neutron spectra, bubble detectors.

Internet data bases:

www.to.infn.it/~zanini

Collaborating partners/networks:

Marisa Storini IFSI-INAF Roma

Scientific publications and public outreach 2005:

Refereed journal articles

Akkurt, I, J.O. Adler, J.R.M. Annand, F.Fasolo, K. Hansen, C.Ongaro, A.Reiter, G. Rosner, A. Zanini, Photoneutron Yields from Tungsten in the Energy range of the Giant Dipole Resonance, *Physics in Medicine and Biology* **48**, 3345-3352, 2003

Zanini,A, E. Durisi, F. Fasolo, C. Ongaro, L. Visca, U. Nastasi, K.W. Burn, G: Scielzo, J.O. Adler, J.R.M. Annand, G. Rosner, Monte Carlo Simulation of the Photoneutron Field in LINAC Radiotherapy Treatments with Different Collimation Systems, *Phys. Med. Biol.* **49** (4) 571-582, 2003

Rosi,G., G. Gambarini, V. Colli, S. Gay, L. Scolari, O. Fiorani, A. Perrone, E. Nava, F. Fasolo, L. Visca, A. Zanini, Dose Measurements in the Thermal Column of the TAPIRO reactor, *Rad. Prot. Dosim.* **110**, 651-654, 2004

Zanini, A., E. Durisi, F. Fasolo C. Ongaro, U. Nastasi, K.W. Burn, J.R.M. Annand, Neutron Spectra in a Tissue-Equivalent Phantom during Photon Radiotherapy Treatment by linacs, *Radiation Protection Dosimetry* **110**, 1-4, 157-160, 2004

Zanini, A., E. Durisi, F. Fasolo, M. Storini, O. Saavedra, L. Visca, M. Perosino, Neutron Spectrometry at High Mountain Observatories, *Journal of Atmospheric and Solar-Terrestrial Physics*, (2005) **67** 8-9, 755-762, 2005

Zanini,A., F Fasolo, L Visca, E Durisi, M Perosino, J R M Annand and K W Burn, Test of a bubble passive spectrometer for neutron dosimetry, *Phys. Med. Biol.*, (2005) **50** 18, 4287-4297.

Book sections

Esposito, D., C. Faraloni, F. Fasolo, A. Margonelli, G. Torzillo, A. Zanini and Maria Teresa Giardi, in *Biotechnological Applications of Photosynthetic Proteins: Biochips, Biosensors and Biodevices*, Maria Teresa Giardi and Elena V. Piletska (eds.), *Biodevices for Space Research*, Springer Science+ Business Media, New York, New York U.S.A. 212-215, 2005.

Manfredotti, C., C.Ongaro, L.Tommasino and A.Zanini in *Researcher's Reference Manual and Data Book*, Peter KF Grieder (ed.) *Neutron spectra*, Elsevier Science, ISBN 0444507108, 110-112, (2001).

Conference papers

Zanini, A., M. Pelliccioni, E. Durisi, F. Fasolo, L. Visca, C. Ongaro, O. Saavedra, Differential Neutron Flux in Atmosphere at Various Geophysical Conditions, 28th International Cosmic Ray Conference Tsukuba (Japan), 31st July – 7th August 2003.

Durisi, E., F. Fasolo, C. Ongaro, O. Saavedra, P.P.Trapani, L. Visca, A.Zanini, High Mountain Observatory Network for studying the role of cosmoc ray flux variability on the atmospheric processes, *Proc.International Conference on Cosmic Rays and Dark Matter*, July 28-30,2003, Nagoya, Japan.Universal Academy Press Inc. *Frontier Science Series* **42**, ISSN 0915-8502

Edited books

Zanini,A. (ed.) *Radiation Dosimetry: basic technologies, medical applications, space applications*, Frascati Physics Series **29**, 2002 (ISBN 88-86409-36-2)

Ongaro. C., A.Zanini (eds.) *Neutron Spectrometry and Dosimetry: experimental techniques and MC calculations*, OTTO editore. 2004 (ISBN 88-87503-86-9)

Theses

Perosino M., Biosensor for radiation detection in space application, Thesis, Università Torino, 2004

Iannarelli R., Evaluation of radiation damages to instrumentation in Bepi Colombo mission to Mercure, Università Torino, 2005

Durisi E., Study of a compact Neutron Source based on D-D fusion reaction for NCT application, PhD Thesis Università Torino, 2005

Magazine and Newspapers articles

“Sugli aerei un fantoccio antiradiazioni” Il Tempo, 6 Marzo 2003

“Radiazioni in volo”, Le Scienze, Italian edition of Scientific American, **417**, May 2003

Radio and television

“Jimmy, the flying phantom “spazio12, Interview for the Scientific program Leonardo, RAI 3 on Jimmy, the anthropomorphic phantom used on Alitalia flights for neutron dose evaluation. July 2003.

Address:

INFN Sezione Torino
Via Pietro Giuria n.1
10125 Torino
Italy

Contacts:

Alba Zanini
Tel.: 039 011 6707378
Fax: 039 011 6699579
e-mail: zanini@to.infn.it