ELECTROMAGNETIC CALORIMETRY ON A BASE OF LEAD TUNGSTATE SCINTILLATOR AT DIFFERENT TEMPERATURES

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Radiation damage of PWO optical transmission was described in numerous papers. Summary of the results is in [1, 2]. Measurements were performed at room temperature mostly for CMS needs, where as for the PANDA Electromagnetic Calorimeter purposes at -25^{o}C [3].

Kinetics of the transmission irradiation damage and operation temperature recovery are very important to build a high-precision electromagnetic calorimeter. Several damage and recovery kinetics models were proposed [4–6]. They are phenomenological however, were found to be useful at certain stage of the crystal technology development. Moreover, it has been determined that PWO transmission damage is dose-rate dependent up to some saturation level at which the rate of defect filling by radiation-created carriers becomes equal to their release rate. However, temperature dependence of the radiation damage kinetics was not investigated yet.

The purpose of this study was to define a possible impact of the PWO crystals cooling to 10^{o}C on the radiation damage of crystals optical transmission and Light Yield changes at LHC operation.

Comparison of the changes in gamma-radiation induced absorption and light yield at temperature 22 and 10^{o}C from the lead tungstate scintillation crystals during LHC operation has been performed for the barrel region of the ECAL. Change in light yield has been simulated for 200 h of LHC operation at current LHC luminosity (1034 $cm^{-2}sec^{-1}$). Measurements have been performed to justify advisability of the ECAL Barrel operation temperature decrease from 18 to 10^{o}C.

1. Inorganic Scintillators for Detector Systems. Physical Principles and Crystal Engineering. Series: Particle Acceleration and Detection. Lecoq, P., Annenkov, A., Gektin, A., Korzhik, M., Pedrini, C. 2006, XII, 251 p. 125 illus., Hardcover. ISBN: 3-540-27766-8. Springer, 2006.
2. Radiation hardness qualification of PbWO4 scintillation crystals for the CMS Electromagnetic Calorimeter', The CMS Electromagnetic Calorimeter Group: P. Adzic et al., J.Inst. 5 P03010 (2010).

3. R. W. Novotny, W.M. Doering, V. I. Dormenev, S. Felsing, M. V. Korzhik, S. Luggert, P.A. Semenov, A. N. Vasiliev. Radiation Hardness and Recovery Processes of Cooled PWO-II Crystals for PANDA. Conference Program of IEEE 2008 International Conference, 19-25 October 2008, Dresden Germany. (N55-2).
4. D.A. Ma, R.Y. Zhu and H. Newman, NIM A 356 (1995) 309.
5. A. Annenkov, E. Auffray, A. Fedorov, S. Gninenko, N. Golubev, M. Korzhik, P. Lecoq, V. Ligun, A. Lobko, O. Missevitch, J.-P. Peigneux, Yu.D. Prokoskin, A. Singovski, Radiation damage kinetiks in PWO crystals, CMS NOTE 1997/008, CERN, Geneve, February21, 1997.
6. D.J.A. Cockerill, Estimates for the changes in light yield from the CMS ECAL during LHC operation. CMS IN-2010/026.