§5. Development of a Neutron Monitor for DD Experiment by Means of LHD

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We are developing a neutron monitor based on a new concept for radiation protection of DD experiment by means of LHD. The instrument measures the neutron dose rate in the unit of μSv/hour with approximately correct equivalent dose response which is given by ICRP in the energy range from thermal to 20MeV without moderator [1]. The instrument is a complete measuring assembly consisting of a neutron detection unit and of an electric unit and a memory unit combined together. The detection unit consists of a NE-213 or BC-501A liquid scintillator and of high neutron sensitivity surrounded with liquid scintillator with double layer pressurized ^{3}He ionization chamber without moderator. The pulses from the liquid scintillator are led to a circuit of n-γ discrimination by the pulse shape method or by the digital charge comparison method. The pulses from each layer of ^{3}He ionization chambers are amplified in the charge sensitive amplifier. The process pulses are indicated on display unit in counting rates from each detector respectively and stored by memory. The memory pulses are analyzed into separate adequate energy ranges by a certain computer.

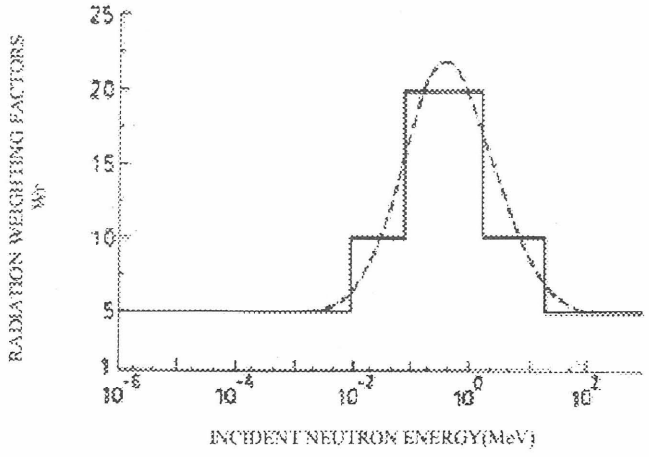

Fig.1 Radiation weighting factors for neutron. The smooth curve is to be treated as an approximation.

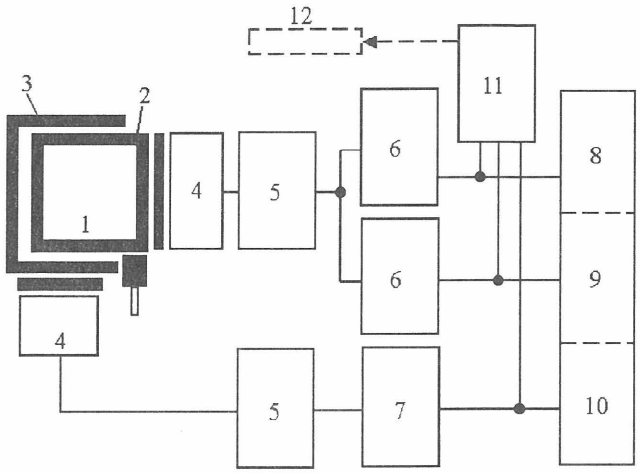

Fig.2 Block diagram of the neutron monitor.

1.Liquid scintillator, 2.^{3}He ionization chamber of second part, 3. ^{3}He ionization chamber of third part, 4.Photo-multipliers, 5.Preamplifier, 6.Pulse shape discriminators, 7.Charge sensitive amplifier, 8-10.Display unit for fast, epithermal and thermal neutrons. 11.Memory unit, 12.Computer

The fundamental dosimetric quantity in radiological protection is the absorbed dose D. Furthermore, ICRP recommended to evaluate in the equivalent dose. The average and R radiation dose D_{TR} in tissue T is given by the expression

$$H_T = \Sigma \omega_R \cdot D_{TR}$$

Where H_T is the symbol of equivalent dose, ω_R the radiation weighting factor. For neutron, radiation weighting factors were given in Fig.1. The instrument is designed to detect the neutron from 0.025eV-20MeV in counting rate and to analyze to absorbed dose based on the counting rate. The ultimate information of the equivalent dose is estimated from the product of the absorbed dose and the radiation weighing factor for neutron in each group respectively by microprocessor or computer.

Reference

[1] ICRP Publication 60 (1990).