Dosimetry for the Vertical Beam Line ◇

P. Quicken, J. Besserer, J. de Boer, W. Carli, P. Hartung, M. Moosburger, L. Rohrer, and H. Steffens

A vertical beamline has been installed to investigate the radiobiological effects of protons and other ions on living cell cultures. A dosimetry system was developed for this purpose, consisting of two components. One component is used for measuring the profile of the beam intensity and the other component monitors the beam during the exposure to determine the applied dose. Both detectors count single particles in silicon pin-diodes.

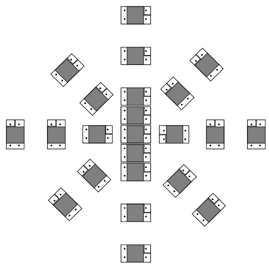

Fig. 1: The detector measuring the profile of the beam

The arrangement of the pin-diodes in the beam-profile detector is shown in Fig.1. Each pin-diode is coupled to a fast charge-sensitive preamplifier (Le Croy HQV 802). The 23 diodes are distributed radially within a 8.5 cm diameter circle. They have 25 mm^2 sensitive area and 210μm depletion thickness [1]. The counting rate is reduced by a screen with 1 mm diameter holes placed in front of each diode.

Fig. 2: The detector monitoring the beam

The beam-monitor detector consists of 4 pin-diodes arranged on a ring of 3.5 cm radius surrounding the beam exit window. The counting rate is again reduced by a screen. The detector signals are accumulated in by a presetable scaler which cuts off the beam to limit the number of particles during exposure.

The system has been tested in some preliminary biological experiments.

The limiting factor in the longtime stability of the system is due to radiation damage of the pin-diodes. The leakage current increased (Fig.3) whereas the intrinsic energy resolution decreased (Fig.3). There was, however, no counting loss observed due to radiation damage when the pin-diodes were exchanged after being hit by 10^{11} particles/mm^2.

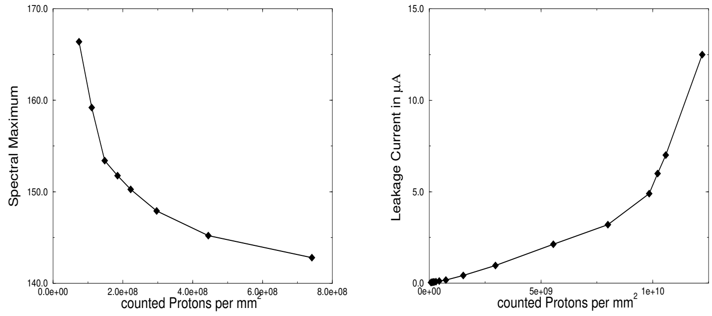

Fig. 3: Radiation Damages

The performance as a function of counting rate is displayed in Fig.4.

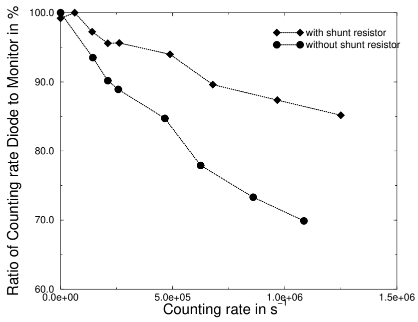

Fig. 4: Counting Rate Test

Using a shunt resistor in parallel to each channel of the preamplifier, counting rates up to 1 MHz are possible with less than 10 % losses.

This dosimetry system is in a testing phase but it looks promising for radiobiological applications.

References

[1] Siemens Data Sheet of SFH 870/F170

◇ Supported by the Bavarian Minister for Environmental Affairs