Development of the beam diagnostic system for the radiobiological research at the proton linear accelerator I-2

A. Bakhmutova, N. Markov, A. Kantsyrev, A. Golubev*

Institute for Theoretical and Experimental Physics NRC "Kurchatov Institute", Moscow, Russia

Introduction

At the present time at ITEP there is a possibility to investigate the biological mechanisms of the low energy protons on living systems on linear accelerator I-2. The unique high current linear accelerator allows to obtain 20 MeV intense proton beams. They could be used for the radiobiological research in a wide range of absorbed doses and for different cell types. Currently some preliminary experiments were made to specify diagnostic equipment required for further investigations. This work presents the main results on the proton beam parameters measurements such as beam current, beam cross section dimension as well as the measurements of the absorbed dose and depth dose distribution using different types of detectors.

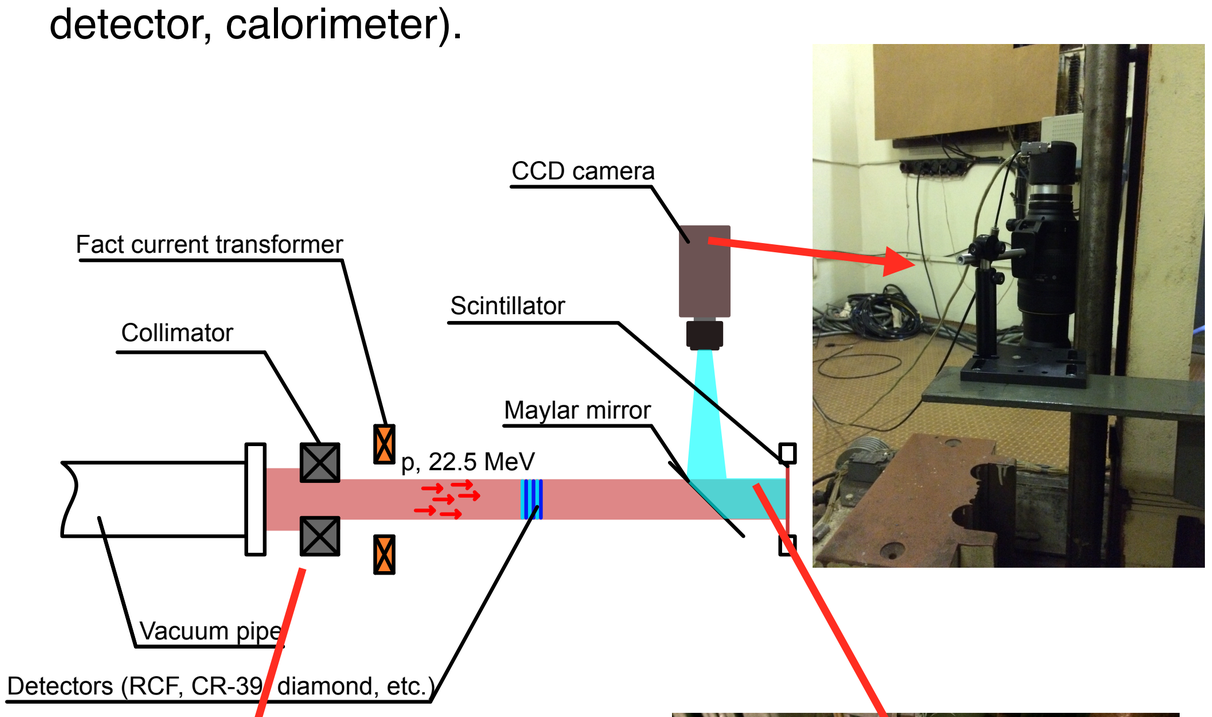
Experimental setup

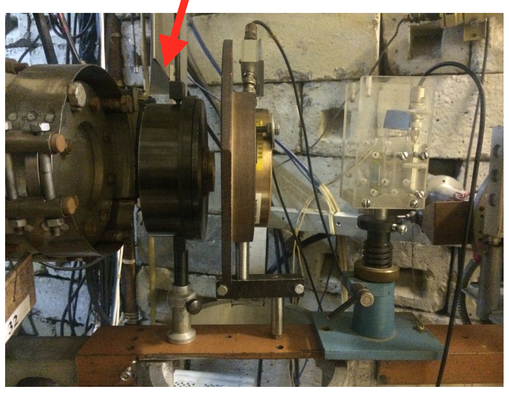
Parameters of proton linear accelerator I-2 in context of the radiobiological research

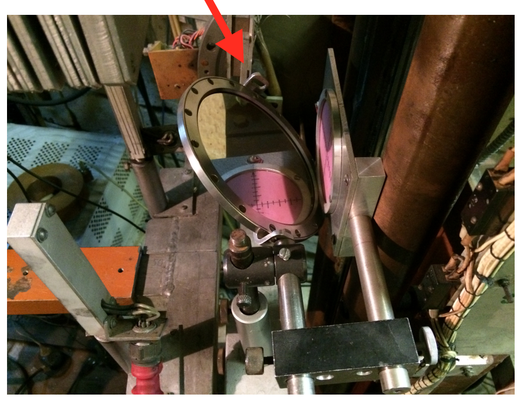
Energy max., MeV	22.5
Pulse width., mks	2 - 30
Field size max., mm	85
Particles (per pulse), 1/cm^2	10^7 - 10^{11}
Range in water, mm	~ 5
LET min., keV/mkm	2.4

Main equipment used in experiments

- Set of collimators with inner diameter from 85 to 12 mm;
- Fast current transformer FCT-082 (Bergoz) for particles measurements;
- CCD camera SDU-415 and a set of scintillators (plastic and Al2O3);
- Various type of detectors for dose, particle fluency, energy loss measurements (radiochromic films, CR-39, diamond detector, calorimeter).



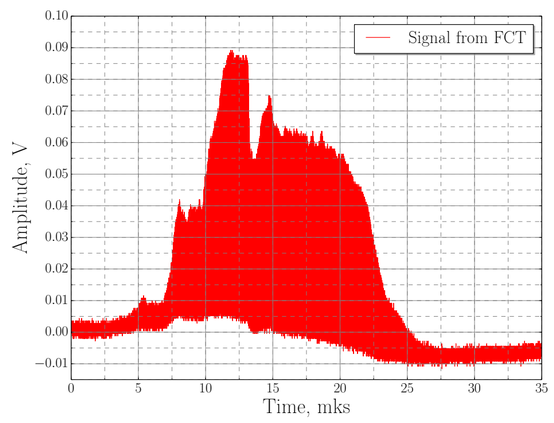


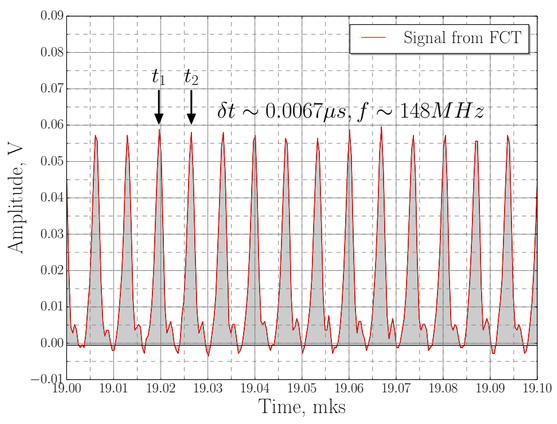


* abahmutova@gmail.com

Results of the experiment

Fluence measurements

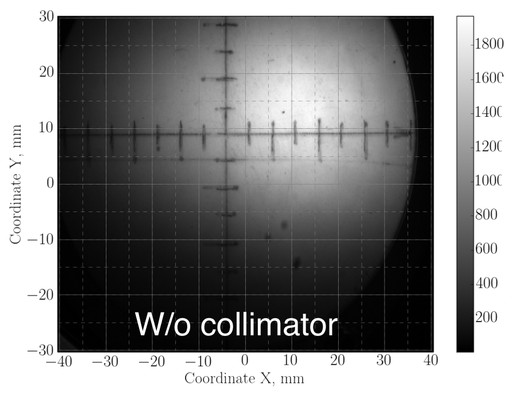


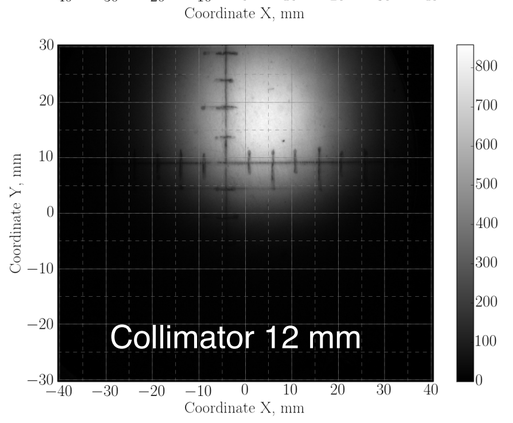


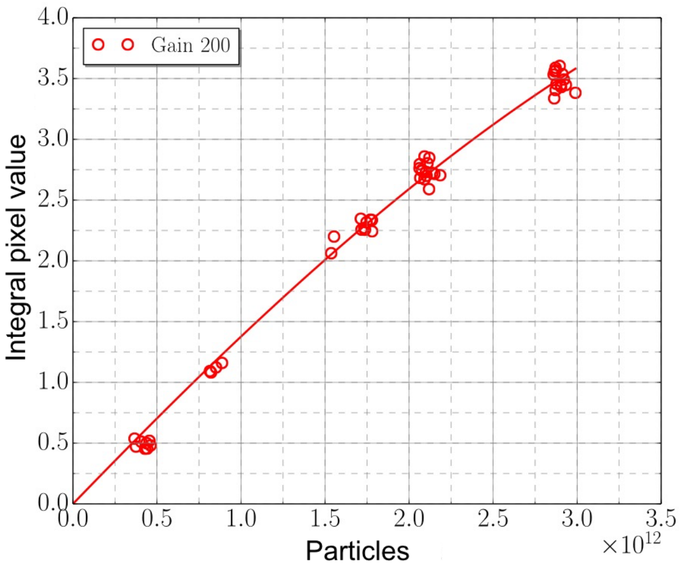
$$N = \frac{A}{q \cdot z \cdot K \cdot S_B}$$

A - integral value
q -elementary charge
z - particles charge
K - amplifier coeff.
S_B - FCT sensitivity

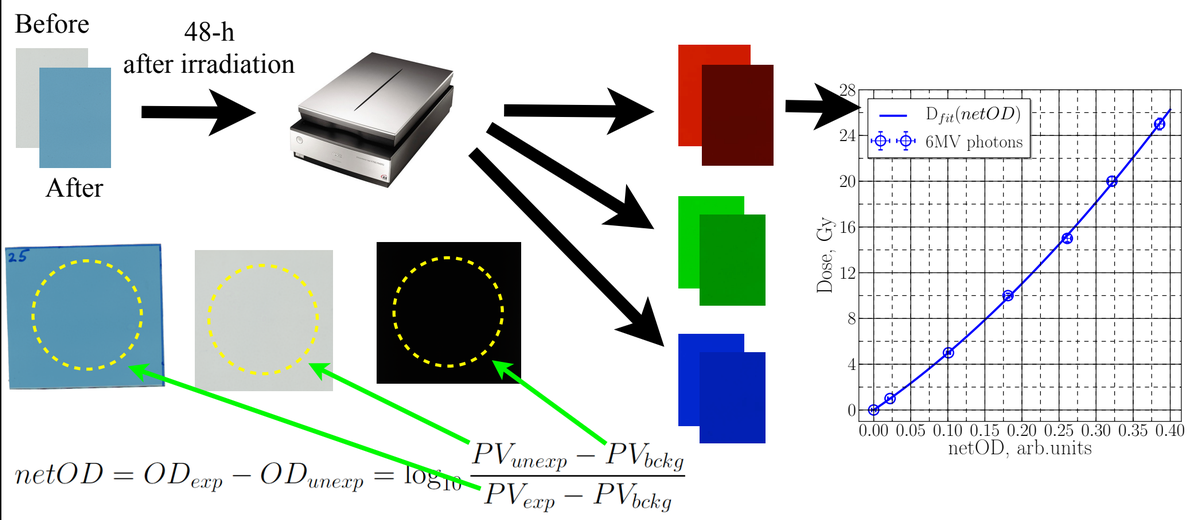
Beam uniformity



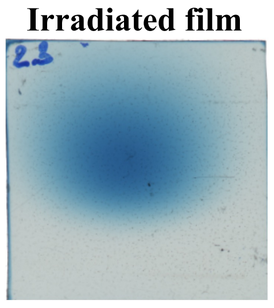




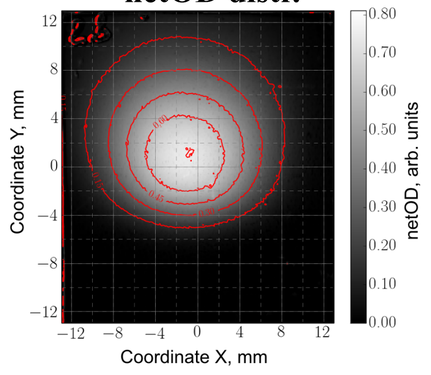
Radiochromic films (RCF) dosimetry



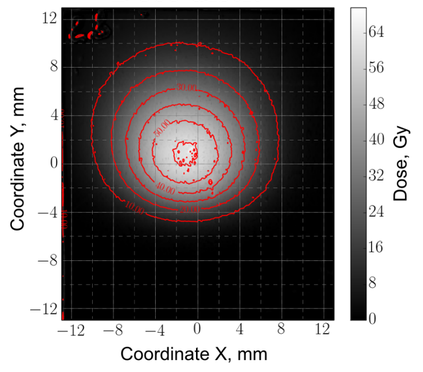
Irradiated film



netOD distr.

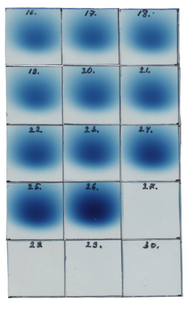


Dose distr.

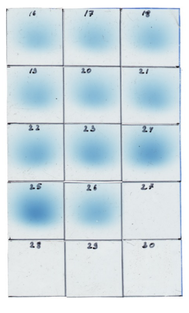


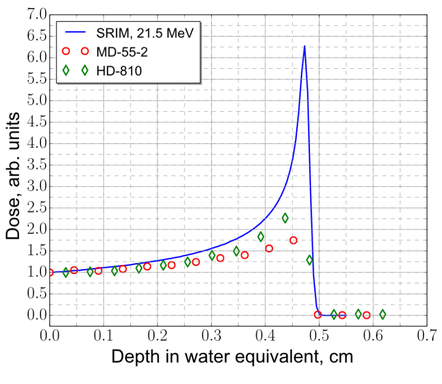
Depth-dose measurements with RCF

MD-55 -2



HD-810





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