

- warnings of hydrometeorological hazards and recommendations to the population about the rules of conduct in case of occurrence of these phenomena;
- on-line broadcast from surveillance cameras and other useful information and other.

Thus, developed structure and content of Web-site “Ecological portal of the Republic of Belarus” of the Ministry of Natural Resources and Environmental Protection of the Republic of Belarus will allow creating a server platform for informing the population of the Republic of Belarus, business entities and potential investors about the environmental situation in the country in certain areas.

---

## SIMULATION OF RADIATION THERAPY USING PROTON AND CARBON-12

---

**H. Brynkevich<sup>1</sup>, Y. Blagodarova<sup>1</sup>, M. Batmunkh<sup>2</sup>**

*<sup>1</sup>Belarusian State University, ISEI BSU,  
Minsk, Republic of Belarus*

*<sup>2</sup>Joint Institute for nuclear research, JINR,  
Dubna, Russian Federation  
annabrijerry@gmail.com*

The article describes simulation of charged particles track structure in the biological media and calculation DNA double-strand breaks.

*Keywords:* DNA, DSB, radiation therapy, proton, computer modeling.

The energy losses of charged particles as they pass through matter occur mainly because of their collisions with the electrons of the atoms. These losses are called ionization losses. For heavy particles dependence is described by Bragg curve. The shape of the curve is associated with a small energy transfer at the initial segment of the path, where the speed of the particle is large and the time of interaction is small. The loss of energy increases as the particle loses its speed, which leads to an even greater loss of energy.

There are several types of DNA damage. Double-strand breaks, in which both strands in the double helix are severed, are particularly hazardous to the cell because they can lead to genome rearrangements. It was noted that double-strand breaks is irreparable because neither strand can then serve as a template for repair. The cell will die in the next mitosis or in some rare instances, mutate. So, in radiation therapy, DSB are important as they lead to irreversible damage to cancer cells.

Geant4 (for GEometry ANd Tracking) is a platform for the simulation of the passage of particles through matter using Monte Carlo methods. Application areas include high energy physics and nuclear experiments, medical, accelerator and space physics studies.

Using the Gaint4 was found out the depth of penetration and energy loss for a protons with energies of 130 and 155 MeV, Carbon-12 ions with energies of 245 and 295 MeV per nucleon in water phantom and in the brain phantom. Also was calculated the DSB number per particle per micrometer for protons and for Carbon-12 ions in brain material, which is close to Bragg peak.

---

## RECYCLING IS THE SOLUTION OF ENVIRONMENTAL PROBLEMS

---

**A. Checkmenyova, N. Kunets**

*Gymnasium № 32 of Minsk,  
Minsk, Republic of Belarus  
kunets\_na@mail.ru*

In this research I tried to give young people a chance to learn about companies in Belarus that recycle rubbish, to encourage and enable them to take part in different promotions, to discover how they can contribute to restoring natural resources and what can be done in this direction.

*Keywords:* recycle rubbish, nature, solution, environmental problems, pollutants.

To promote awareness among young people of the importance of their participation in various actions dedicated to nature protection.

To make people thinking and taking care about nature.