Faithful maintenance of DNA sequence is a necessary condition for producing healthy daughter cells and healthy progeny of the existing organisms. However, DNA in plant and animal cells is often damaged by factors arising under normal conditions inside cells, or factors originating outside of cells, like chemicals, UV or ionizing radiation. Although nature did not produce a genetic material resistant to damage, it managed to create and optimise methods of monitoring the state of DNA, detection of damage of various types, signalling the infliction of damage and successful repair. Such processes are generally called DNA damage response, while individual processes are referred to as repair pathways.

The most dangerous type of DNA damage is breakage of both complementary strands, at the sites opposing each other. This is called a double-strand break. If the cell fails to repair such a damage it usually stops functioning and dies. Occasionally a double-strand break, which is not repaired, or is repaired imprecisely, does not lead to cell damage but leads to a cell which functions differently than the original one. Sometimes such cells can divide. Some of such cells escape the control of the whole organism - this phenomenon may lead to induction of a malignant tumour.

There are many types of proteins in the cell nucleus, that are responsible for various processes, including RNA and DNA synthesis, and DNA repair via various repair pathways. We are interested in one of these proteins, called HP1. It has been known for a number of years, and it was known that HP1 is an important factor in regulating activity of genes. Therefore HP1 is one of the factors that decide whether the gene is active or silent, i.e. whether RNA is synthesized on this template. A few years ago researchers from our laboratory discovered that HP1 is also required for DNA repair. It was quite unexpected and two research papers describing this phenomenon met with a lot of interest and opened a new research avenue. Although many research groups are interested in this problem now, the role of HP1 in DNA repair has not been elucidated so far.

The goal of the research, which I would like to pursue, is to verify a hypothesis which assumes that when HP1 is accumulated in the region surrounding a double-strand DNA break, a dense HP1 network is created, which prevents the broken ends of DNA from moving apart. This network consists of HP1 dimers linking adjacent DNA strands. By these means HP1 holds the loose DNA ends close to each other and facilitates their re-joining which is catalysed by specialised repair proteins.

In order to verify my hypothesis I intend to measure the number and localisation of HP1 dimers formed in the region of DNA damage, measure changes of an ability of chromatin to translocate, and check whether the putative increased rigidity of chromatin is linked to the number of the induced experimental DNA breaks. I will use modern, highly advanced microscopy methods of fluorescence microscopy.

My research may contribute to a better understanding of the mechanisms of repair of DNA damage, particularly the most dangerous one - the double-strand break. Understanding these mechanisms may have practical significance for optimising methods of preventing genetic disorders and cancer.