Ionizing radiation is widely used in the treatment of various cancerous diseases. However, in spite of improved techniques for focusing the radiation dose, it is still impossible to avoid the damage of healthy cells surrounding the tumor. This leads to adverse clinical effects of radiotherapy, which include: early, acute and late response of normal tissues, the appearance of erythema or hair loss. Breast cancer is one of the most commonly diagnosed cancers in the world. It is estimated that breast cancer accounts for 25% of all cancers, which amounts to 1.7 million cases a year. It is predicted that in the USA, 1 in 8 women (around 12.4%) will certainly develop breast cancer at some point in their lives. The most widespread treatment of this disease is radiotherapy, which, unfortunately results in numerous side effects, such as radiation skin damage. Not only patients are exposed to the adverse effects of radiation, but also medical personnel conducting diagnostics using ionizing radiation (e.g. gamma radiation, X radiation, isotopes). Due to these side effects, new chemical agents are still being sought that would perform a radioprotective function against normal tissues by reducing oxidative stress generated by radiation, and at the same time, would be free of side effects.

In the proposed project, we plan to determine whether metallofulerenols (MFs, hydrophilic carbon compounds with encapsulated rare earth metals) have stronger protective properties against irradiation than previously used radioprotectors. Assuming that the presence of rare earth elements increases the electron affinity of the whole MF molecule, it can be expected that the increased reactivity of MFs with organic and inorganic radicals will be very beneficial for the radioprotection of normal cells. The combination of the ability to effectively scavenge radicals with the high polarity and bioavailability of MFs makes them potentially very promising tool that would inhibit oxidative damage resulting from radiotherapy.

Due to convenient location at the lipid/water interface, MFs should show a higher degree of selectivity, which will be a very important advantage over other radioprotective agents. Therefore, the main goal of the project is to investigate the antioxidant and radioprotective properties of MFs ($M_3N@C_{80}(OH)_n$; M = Sc, Gd, Er, Lu; n> 30), as potential therapeutic agents that may find application in the treatment of diseases, such as breast cancer. To date, there is no explanation regarding the antioxidant properties of MFs considering the physical and chemical parameters of lipid systems and the value of rate constant for reaction of MFs with the products of water radiolysis. Also, an integral part of the research will be the testing of new metallofulerenols properties *in vitro* on five different cell lines.

By achieving comprehensive results, the presented project will significantly broaden and refine the existing knowledge on the possibilities of using metallofulerenols in radiobiology and radiotherapy.

An indirect effect of research planned within the framework of the project will be to enable a more effective fight against cancer in the future while reducing the risk of side effects.