The goal of the project is to develop novel red- emitting carbon dots with specific chirality to serve as improved photosensitizers for **photodynamic** cancer therapy. They aim to enable more efficient and selective destruction of cancer cells while sparing healthy tissue - in other words, to create a light-activated nano-drug that precisely kills cancer cells with minimal side effects. Traditional cancer therapies, such as chemotherapy and radiation therapy, work indiscriminately, destroying healthy cells and causing numerous side effects. What is needed, therefore, are methods that are more effective and less harmful to the body. A promising alternative is **photodynamic therapy (PDT)**. The patient receives an inactive drug (photosensitizer) that accumulates in the tumor, after which the tumor is irradiated with light. The activated photosensitizer produces reactive oxygen species, destroying the cancer cells. Because PDT works locally, side effects are much less than with chemotherapy or radiation therapy.

Visible light penetrates only a few millimeters deep into the body, making it difficult to treat larger, deeper tumors. In addition, the first generations of photosensitizers had serious drawbacks - they absorbed mainly short wavelengths. Therefore, work is underway on photosensitizers that absorb red or near-infrared light, allowing deeper exposure of tumors. In this context, **carbon dots** - tiny nanoparticles with intense fluorescence and low toxicity - have emerged. Importantly, excited by light, the carbon dots generate reactive oxygen species, killing cancer cells.

Another element of the project is to give the dots a certain **chirality**. Chirality - that is, the existence of an object in two mirror versions - means that the right- and left-handed forms of the molecules can act differently in the body. As a result, the chiral dots should mainly target cancer cells, bypassing healthy ones, thus increasing efficacy and reducing side effects of therapy.

In the project, chiral carbon dots will be synthesized. They will then undergo detailed **physicochemical characterization** (including determination of particle size and optical properties) and their ability to generate reactive oxygen species under light will be tested. ***In vitro* tests** will show whether and how the carbon dots penetrate cancer cells, and whether chirality promotes their greater accumulation in cancer cells. **Cytotoxicity tests** will then verify the safety and efficacy of the nanomaterials: whether the dots do not harm the cells without irradiation, and whether they effectively destroy cancer cells when activated with light. Analogous tests on healthy cells will confirm **the selectivity of action** - that the nanomaterial mainly targets cancer.

The realization of the project will result in a new **chiral PDT photosensitizer** that will overcome previous limitations. It will make it possible to effectively destroy even deep-seated tumors with minimal damage to healthy tissues, which will translate into more effective elimination of cancer. In addition, **the results will expand the knowledge** of chiral nanomaterials. All this will be a step forward in nanomedicine and the hope for more patient-friendly cancer treatment.