Irradiation with ionizing radiation, gammas, or X-rays is one of the important therapies for cancer. Its effectiveness is at least reasonable, but patients suffer greatly from its harmful effect on healthy cells, making this therapy very taxing on the body. The scientific community recognizes the importance of developing new methods of cancer therapies that are more effective but also less deleterious for the healthy tissues around the cancer ones. This project is from the area of materials science as it is going to challenge the development of micron- and nano-sized scintillators and persistent luminescence phosphors emitting in UV-C range (~200 – 280 nm) upon exposure to X-rays. The far-going goal is to use such materials to harvest the energy of X-rays preferentially within the cancer cells with minimized exposure of healthy ones. Phosphors can be precisely targeted to cancerous tissues, absorbing most of the incoming X-rays and thus minimizing the exposure of healthy cells to UV-C radiation. This precision reduces collateral damage, a common issue with traditional radiotherapy. UV-C radiation is very effective in damaging the DNA of cancer cells, and this is at the core of the project idea.

This is, however, not a medical project. The proposed research is a unique blend of chemistry, materials chemistry, and physics, drawing on our extensive experience and knowledge of using scintillation in medical diagnostics. This unique approach has led us to propose specific chemical compositions for this research. Scintillators, known for their high light output and efficiency in converting ionizing radiation into visible light, could be adapted to emit UV-C, offering a novel and effective way to deliver high doses of UV-C to cancer cells.

Our research will focus on fabricating luminescent materials capable of generating UV-C radiation when exposed to X-rays. The phosphors will be activated with Pr3+ or Yb3+ and the host materials for the activators will be selected from strongly ionic compositions – phosphates and fluorides. Our preliminary research has provided strong evidence for the feasibility of our approach. While the field of UV-C emitting phosphors and scintillators for cancer treatment is still in its early stages, the potential is promising. Studies have shown the ability of UV-C light to induce apoptosis (programmed cell death) in cancer cells. The current focus is on developing biocompatible phosphors and scintillators that can be safely administered to patients. Therefore, the development of efficient UV-C emitting scintillators and/or persistent luminescence phosphors is a crucial next step, and we plan to conduct systematic studies to draw robust conclusions.

Investigating UV-C emitting phosphors, especially scintillators, holds significant promise for the future of cancer treatment. By leveraging their unique properties, we can develop targeted, efficient, and less invasive therapies that offer new hope to patients. However, this requires methodical studies to elaborate phosphors attractive for the next steps of the idea. And this is what the project is about.