The main aim of the proposed project is the synthesis and optical characterization of lanthanide ions doped, colloidal nanoparticles for applications in combined **thera**py and diag**nostic** – ***theranosctic***. In particular, Authors plan to synthesize advanced core+multiple shell nanoparticles, that will show the possibility of light generation in two, biologically important, spectral regions: (i) 200 nm – 280 nm, and (ii) 900 nm – 1700 nm. The former is known as the UV-C and has the ability to photochemically degrade biomolecules (e.g., DNA or RNA) and, thus, can be used for efficient anti-bacterial treatment, while the latter wavelength region, called short wave infrared (SWIR), can be used for high contrast optical bio-imaging (Fig. 1). Obtaining nanomaterials showing intense luminescence in those two wavelengths regions and will thus open the possibility of combined background free bio-imaging of deep seated cells and tissues (diagnostic), with the selective light triggered destruction of targeted cells (therapy).

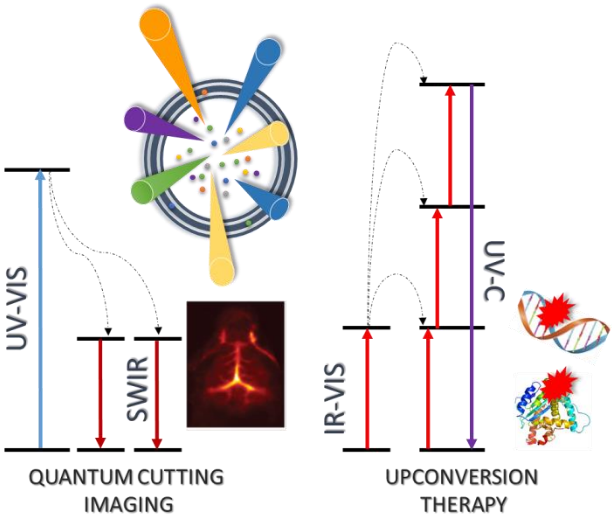

Fig. 1. The energy schematic representation of the photon management processes occurring in lanthanide doped NPs, which Authors intend to study and develop within the proposed research project.

Due to the physical character of f-f electronic transitions in rare earth ions the concurrent processes of up-conversion (UC), where two or more low energy photons are converted into one of higher energy, and quantum cutting (QC), which is realized by splitting of one photon of high energy into two ones of lower energy can be observed in lanthanide ions doped nanomaterials. The main goal of the project will thus be the synthesis and proper surface functionalization of lanthanide ions doped nanoparticles showing high efficiency of emission in UV-C and SWIR regions, as a result of UC and QC processes, respectively. Authors plan to use wet chemistry synthesis techniques to obtain colloidal nanoparticles of advanced architectures (core, core+shell, core+multiple shell) and doped with different types and amounts of lanthanide ions. The possibility to obtain the UV-C and SWIR emission based on UC and QC processes, respectively, will be verified upon the project realization by the detailed spectroscopic measurements. It is important to note, that the use of QC processes would allow to obtain extremely intense SWIR luminescence in synthesized nanoparticles, due to the fact that QC based photoluminescence quantum yield can rise up to 200%, highly improving emission intensity, and thus also the signal to noise ratio in biological imaging setups. Finally, the application of obtained nanoparticles as theranostic agents in bio-medicine will be shown based on *in-vitro* cell studies.