The main scientific goals of the presented project **are optimisation of planned synthesis, and characterisation of presumably biologically active phosphine ligands with naturally occurred derivatives of the alkaloids** (*e.g.*, *N*-methylphenylethylamine), **as well as mononuclear phosphino complexes** (M = Ir^{III}, Ru^{II}, *etc.*). **Afterwards, they will be selectively delivered to selected cancer cell lines.** Furthermore, to provide better drug delivery into the tumour, **the magneto nanoparticle systems** (such as liposome, micelle with a magnetic material, *e.g.*, ferrite particles) with external high-gradient magnetic fields, will be implemented. Therefore, this **potential dual-targeted drug delivery system (Fig. 1)** will improve the selectivity connected to higher cytotoxicity towards cancer, and decreased number of the side effects.

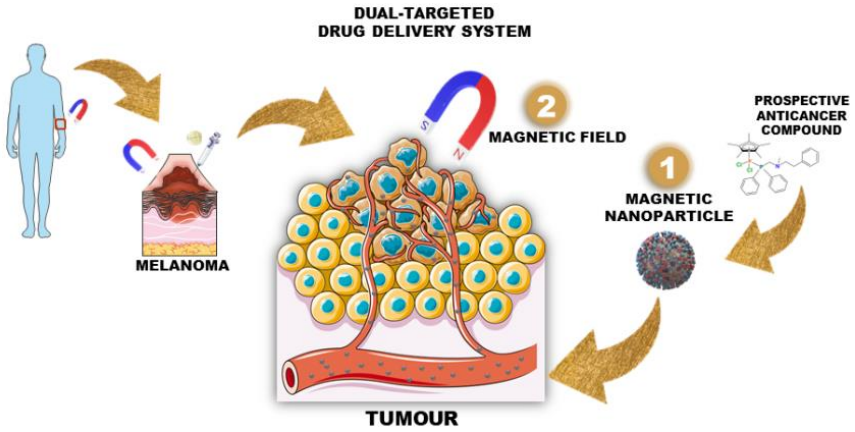

Figure 1. Dual targeting of the synthesised compounds to the melanoma tumour.

Presently, cancer is known as one of the most life-threatening in the whole world. The most universal method for treatment is chemotherapy, which rely on delivery of the drug to cancer cells. However, it is well-known that cancer cells **generate resistance** towards medicines. Moreover, another problem is that currently used substances with cytotoxic properties have been found to be **not selective enough**. They cause serious side effects (*e.g.*, hair loss or nausea). Due to these disadvantages, researchers have been working on new metal-based structures that could be more efficient.

To improve the efficiency of chemotherapy the Smart Drug Delivery System (SDDS) has been developed. SDDS is responsible for controlled release of antitumor drugs in cancer cells without affecting normal ones. The fundamental part of this system is nanocarriers, such as **liposomes or micelles**. Therefore, application of **the magnetic nanoparticles** that contain superparamagnetic SPIONs (iron compounds approved by the FDA), claimed the attention in the selective drug delivery system. Wherewithal an external magnetic field it is possible to provide magnetic nanoparticles to targeted cancer cells, *e.g.*, skin cancer. Furthermore, the dosage of the drugs as well as the side effects on the healthy tissue could be reduced even more than by using entirely nanocarriers without these specific properties.

In order to complete this project, we are going to perform appropriate research, such as:

1) design and synthesis of phosphine ligands derived from biologically active alkaloids or their derivatives, as well as mononuclear metal-based phosphino complexes (*e.g.*, M = Ru^{II}, Ir^{III});
2) adjudication of both purity and physicochemical properties of the received ligands and mononuclear metal complexes using different techniques;
3) synthesis of the magnetic nanoparticles and encapsulation of selected compounds;
4) characterisation of nanoparticles before and after encapsulation of selected compounds by the use of several methods, including magnetic measurements;
5) investigation of interactions between examined compounds and biomolecules (*e.g.*, DNA, human serum albumin, or glutathione – potential cellular targets);
6) examination of biological activity *in vitro* of studied compounds towards selected cancer and healthy cell lines.

The substantial result expected from completing this project is to *obtain novel bioinorganic compounds that could be effectively encapsulated into magnetic nanoparticles.* In the future, these compounds could be the base for the *in vivo* studies. Furthermore, such systems could be potentially used in the dual targeting the tumour tissue (use of nanoparticles and high-gradient magnetic fields) due to their satisfactory biological activity.