According to World Health Organization World Cancer Report 2014, cancer is a leading cause of death worldwide and the number of new cases is expected to rise by about 70% over the next 2 decades. Therefore, it is necessary to seek for new effective drugs and deepen our understanding of the mechanisms of actions of already existing medicines. It will allow us to increase the treatment efficiency. Anthracycline antibiotics such as doxorubicin and daunorubicin constitute one of the most important group of drugs used today in cancer chemotherapy. They find application in the treatment of different types of cancer including breast cancer, ovarian cancer, lung carcinoma, acute leukemia, multiple myeloma and several sarcomas. Despite the fact that they have been used in cancer treatment for over forty years, many aspects of their impact remain to be fully resolved.

The main objective of this research project is to obtain the detailed explanation of the mechanisms of the interactions of the selected anticancer drugs belonging to the anthracycline antibiotics with cell membranes. Simple models of cell membranes will be used and their composition will be chosen in such a way that it closely resembles the composition of real membranes of both healthy and cancer cells. The influence of selected factors including: membrane composition, presence of cholesterol, hydrophobicity of a drug and pH and ionic composition of the extracellular environment on the transport process will be established. In the presence of the drug in the lipidic layers and depending on the changes in the factors mentioned above the morphology and especially the formation of domains will change. The unique combination of various techniques including microscopy, spectroscopy and electrochemistry as well as neutron reflectivity will allow us to obtain for the first time a very detailed description of the changes in the structure and orientation of single lipid molecules due to the drug interactions. Additionally, the exact location of the drug in the model membrane and its quantitative content will be also determined. The results obtained within this project will be important for further studies on the improvement of drug efficiency. The comparison of the results obtained for the selected anthracycline derivatives with small differences in the structure will allow us to correlate those subtle structural differences with the influence on the efficiency of the drug transport through membranes. Such information is important with respect to the design of new drugs.