The presented research project concerns various generalizations of current, mathematical description of periodically modulated, open quantum systems. Under such name we understand physical systems, described by formalism of quantum mechanics, which interact with some external environment (reservoir) and are, additionally, coupled to external, semi-classical energy source of periodic nature. In general, because of the interaction between the system and the environment, the evolution of open system is not unitary and is modelled by so-called *quantum dynamical map*, satisfying rigorous, mathematical properties of *complete positivity* and *trace preservation*.

The description of the periodically modulated open quantum systems' evolution, currently existing in the literature, is based on so-called *microscopic construction* and utilizes the notion of *weak coupling limit*. One of objectives of this research project is to generalize the description of evolution of such systems without applying the weak coupling limit regime or microscopic approach. The project will also examine the extension of current theory of periodically modulated open systems on cases of systems showing the presence of so-called *memory effects*, evolving without Markov approximation. Open systems driven not by one, but by many periodic sources will also be considered. The general methods of mathematical physics and functional analysis will be applied within the project, especially in the context of theory of completely positive maps on C*-algebras of linear operators, with particular significance of *Floquet theorem*, which is fundamental for analysing ordinary differential equations with periodic coefficient, alongside with its generalizations in the form of so-called *multimode Floquet theory*.

The subject of research within the project is coherent with world research trends, increasingly focusing on the subject of systems with periodic and non-periodic modulation. Such systems appear to be very important from a point of view of modern quantum mechanics, leading to formulation of a whole spectrum of new theoretical models, including models of quantum thermal machines, solar cells, quantum memories and elements of quantum information processing or error correction in quantum computers. The possible results of the project will allow to significantly improve the knowledge about mathematical and physical properties of externally driven systems. They will also allow for deeper understanding of processes related to memory effects, occurring in non-markovian systems.