According to the World Health Organization reports, neurodegenerative diseases are one of the significant issues of the 21st century. **Parkinson's disease (PD),** characterized by motor dysfunction, is the second most common neurodegenerative disease after Alzheimer's disease. It is expected that PD morbidity will be dramatically growing as life expectancy increases. Besides, therapeutic options for treating neurodegenerative pathology are still very disappointing. Available therapies for PD only treat symptoms of the disease. This is even more important as the need for care, due to impaired movement and activity of PD patients, and its cost integrated with healthcare is being escalated and represents a significant social and economic burden in many countries around the world.

The pathological hallmark of PD is an accumulation of misfolded α-synuclein (ASN) aggregates, which spread in the brain over time. ASN in physiological conditions is a non-folding protein involved in synaptic functions. However, under unknown circumstances, its structure changes that ultimately lead to fibrillation. A growing body of evidence supports the hypothesis that ASN pathology might initially be triggered by exogenous assault targeting the gut and invades the brain via "prion-like" transport through the vagus nerve. Since the progressive cascade of events plays a crucial role in the pathogenesis of the α-synucleinopathy, targeting the infectious ASN aggregation has been explored as a potential disease-modifying treatment. Wide ranges of potential aggregation inhibitors have been studied, both small and biological molecules. **Graphene,** one of the most promising nanomaterials, recently has been adopted in the research on targeting infectious ASN aggregates and represents an entirely new approach to this topic. Therefore, **this project aims to examine various functionalized graphene nanoparticles (GNPs) to select ones able to prevent the formation or disrupt existing proteinaceous inclusions of ASN and thus prevent the prion-like transcellular propagation of the pathogenic protein.**

The effectiveness of the graphene-based treatment against PD neurodegeneration will be verified both in in vitro and in rodent experiments.

The interdisciplinary nature of the project requires the involvement of members of the research team with different competencies. Moreover, within scientific cooperation with **Florida Polytechnic University** and **Royal Melbourne Institute of Technology**, the tested GNPs are produced.