PROJECT SUMMARY

OVERVIEW

This proposal concerns the establishment of a research laboratory that integrates into an active network of international laboratories (see Annexes) and that deals with cross-disciplinary scientific research in the field of Nanoscience for Biology and Precision Medicine applied to infectious diseases (e.g., COVID 19) and oncological diseases. The laboratory's mission will be to carry out research programs already active and funded by foundations, national bodies, the EU Commission, NSF and NIH and to activate a vigorous research fund raising, both nationally and internationally. The project for a laboratory for Precision Nano-Medicine and for the advancement of knowledge in the field of Life Sciences represents an important long-term investment, justified by the potential repercussions in the health, educational and economic-productive fields of our region. Specifically, the main research programs incubated in the proposed research laboratory aim to develop transformative biosensing technologies for high throughput and specificity based on nanostructured metasurfaces for liquid biopsy to identify tandemly nucleic acids and proteins. **In particular, we aim to develop de novo technologies that allow to identify, track and monitor biomarkers by harnessing electromagnetic fields at the nanoscale with ultimate sensitivity and specificity.**

INTELLECTUAL MERIT

There are three intellectual merits to this proposal. First, this research develops artificial intelligence designed sensing platforms based on nanostructured metasurfaces to enhance light – matter interactions for identifying and quantifying biomarkers of interest for infectious diseases as COVID 19 and to diagnose and monitor the evolution of tumors. Second, the complementary methods used will find more general applications in Biology, Medicine, Materials Science and Energy research. Third, this research enables new methods for the diagnosis and the prognosis of lethal diseases by identifying the chirality of biomarkers. Specifically, gene-protein tandems will be targeted to be able to associate chiral changes with mutations and anomalous metabolic processes.

BROADER IMPACTS

This project will have unparalleled broader impacts both scientifically and socio-economically. Not only will transform medical diagnostic technologies, but also it will play an active role in training and education of young scientist in cutting edge disciplines and technological areas. The diagnostic platforms developed will be highly adaptive to other applications and various environments due to the nature of highly tunable metasurfaces and low-cost, low-power, miniaturized optical tools. Specific sensory systems to detect structural changes in proteins, or single base mutations in nucleic acids, have not yet been developed. **This project will have a broad and far reaching impact in science and technology that will span not only across several fields and disciplines as biology, medicine, chemistry, physics and material science, but also chemical and biopharma industries.**