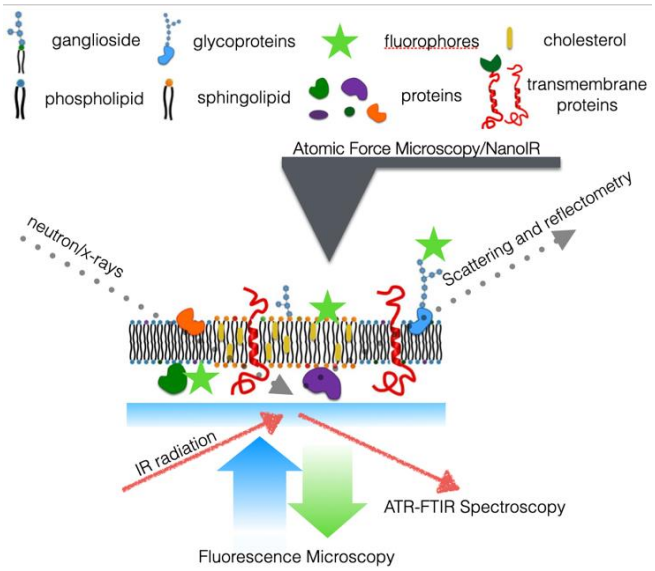
Interaction dynamics of extracellular vesicles isolated from pathological contexts with cellular as well as model plasma membrane systems

Project description:

Extracellular vesicles (EVs) are nanosized, cell-derived vesicles devoted to the transport of macromolecules, metabolites and nutrients throughout the body. EVs are ubiquitously involved in most physiologically relevant processes and they contain specific signatures from the originating cells and can strongly influence the fate of recipient cells. Hence, EVs have been proposed not only as biomarkers in several diseases but also as therapeutic agents in several frameworks ranging from immune therapy to vaccination and from regenerative medicine to drug delivery. However, despite their recognized biomedical relevance, the field is not yet fully mature and the correlation of biophysical and biochemical properties of isolated EV subpopulations with their biological function is under continuous debate. Moreover, an overall understanding of cell internalization mechanisms of EVs is still lacking. The nanoscale spatio-temporal details on how EVs interact, adsorb, and fuse with target cells, as well as the factors influencing the biogenesis and release of the molecular cargo, although crucial to devise EV-based therapies, still lack a comprehensive description. The literature suggests a wide variety of routes for cellular uptake, depending on the specific composition of the cellular membrane, EV function(s) and their physico-chemical properties. It is expected that uptake dynamics and membrane fusion mechanisms are tightly related to the potency and function of EVs and are found to play a key role in EV-based drug delivery applications. The project aims at elucidating the EV/recipient cell interactions on cell lines (from neurodegenerative diseases / cancer models) and also artificial lipid membranes as tunable model platforms to mimic natural cell membranes. The experimental work will be based on the expertise of the hosting research group, which exploits atomic force microscopy and dynamic fluorescence microscopy on model membrane systems and cells. These techniques are expected to be integrated during the project with Infrared Microscopy and Scattering techniques (X-rays and neutrons) through our collaborators at Elettra (SISSI beamline) and at the University of Milan (prof. Rondelli's group) in order to gain structural, morphological and chemical insights of the interaction of EVs with the model membranes and cells. The ideal PhD candidate is expected to have a Master degree in Physics, Chemistry, Biotechnology or Biology, high drive to solve challenges independently, attitude to work in an international research environment with collaboration spirit, and good English skills. Previous experience with cell cultures, EVs isolation and/or Atomic Force Microscopy will be an added value.



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Refs: Perissinotto et al Nanoscale, 2021,13, 5224; Senigagliesi et al., Biomolecular Concepts 2022, 13, 322