EV-Radar: Rapid detection and recognition of extracellular vesicles

An internship position for Master students (Physics, Medical Natural Sciences, Biomedical Sciences) is available at the Biomedical Engineering and Physics department and the Vesicle Observation Center of the Academic Medical Center. In our group, new treatment and diagnostic procedures based on innovative physical techniques are developed. Research is performed by a multidisciplinary team that includes physicists, engineers, mathematicians, medical doctors, biologists, and chemists.

Background. Human body fluids are "liquid biopsies". Analysis of the composition of "liquid biopsies" provides detailed insight in the health or disease status of an individual. A key component of body fluids are extracellular vesicles (EVs; Fig. 1A). Because the concentration, composition and function of EVs chance in disease, accurate EV measurements will provide new clinical information.

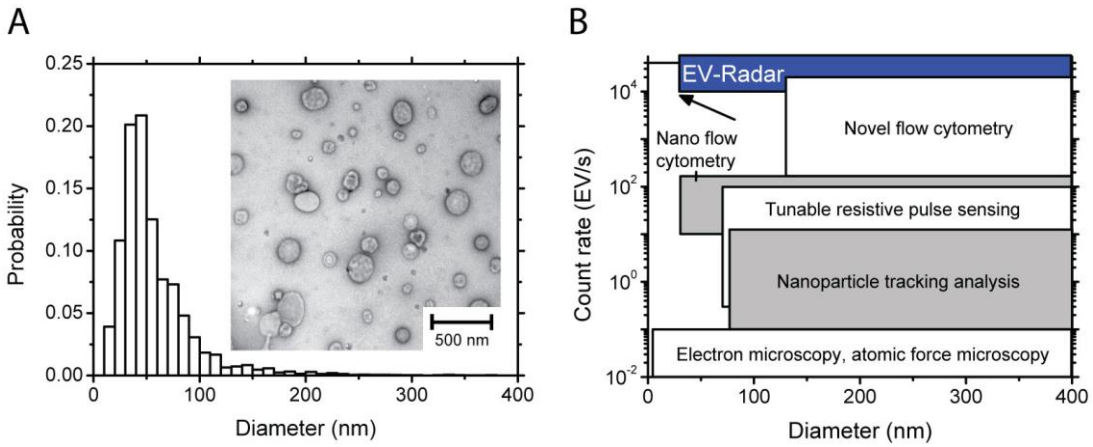

Figure 1. (A) Size distribution and transmission electron micrograph of extracellular vesicles (EVs) from urine. (B) Count rate versus sensitivity in terms of EV diameter of EV-Radar compared to current detection methods.

Problem. Because most EVs have a diameter ≤100 nm (Fig. 1A), currently used detection techniques either overlook the majority of EVs due to a lack of sensitivity, or techniques are too slow for routine clinical applications (Fig. 1B).

Solution. In project EV-Radar, we will combine the sensitivity of dark-field microscopy with the speed of flow cytometry to achieve the first nanoparticle analyzer capable of characterizing single EVs ≥30 nm at a clinically useful rate of 10^4 EV/s. Characterization of 10^4 EV/s enables a significant count of disease-specific EVs within minutes, which is required to establish EV-based biomarkers.

Tasks. Your primary task is to design the optics of EV-Radar. This involves a literature search on dark-field microscopy configurations, map out suitable optical components, and perform simulations to optimize the design and estimate its sensitivity. If the design is completed, optical components will be ordered and development, characterization and initial testing will start.

Contact

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