Microfluidic manipulation of colloids and lipid membranes by interfacial and optical forces

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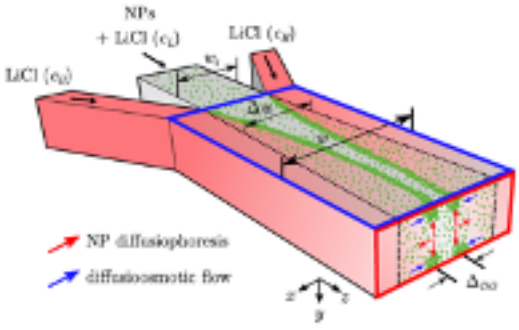
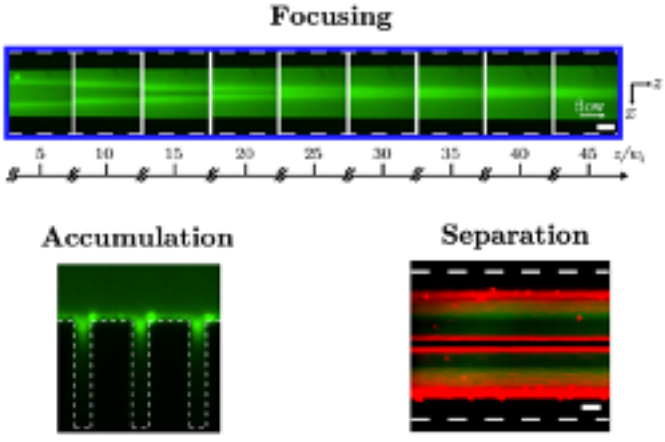
The controlled transport of particles within confined environments, such as microdevices, porous media and thin films, is a key requirement in a broad range of applications, including drug delivery, diagnostics and therapeutics. In this talk, I will present microfluidic approaches, that rely on interfacial or optical forces, to manipulate synthetic and biological particles for bioanalysis, drug-delivery and synthetic biology applications. The first part of the talk will focus on diffusiophoresis and diffusioosmosis, namely the transport of colloids and liquids by salt concentration gradients. By combining experimental analysis and numerical simulations, I will discuss new transport mechanisms for the reversible trapping and accumulation of particles within dead-end pores and for the focusing of particles within straight open channels under continuous flow settings. I will then showcase proof-of-concept microdevices that exploit these mechanisms for the continuous size-based separation and size detection of nanobeads as well as for the measurement of zeta potential and charged lipid composition of small unilamellar vesicles (SUVs). The second part of the talk will discuss the use of optical tweezers for the manipulation of giant unilamellar vesicles (GUVs) and the construction of GUV assemblies capable of exhibiting cell-mimicking behaviours, such as formation of nanotubes bridging distant GUVs, material exchange between adhering GUVs, membrane fusion and protein expression. I will also show how optical tweezers can be used to modulate the lipid composition of vesicles by delivering new membrane material through fusion events and to manipulate and controllably fuse coexisting membrane domains.





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Sala lettura, DIMA, Facoltà di Ingegneria Civile ed Industriale, Via Eudossiana 18, 00184 Roma

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