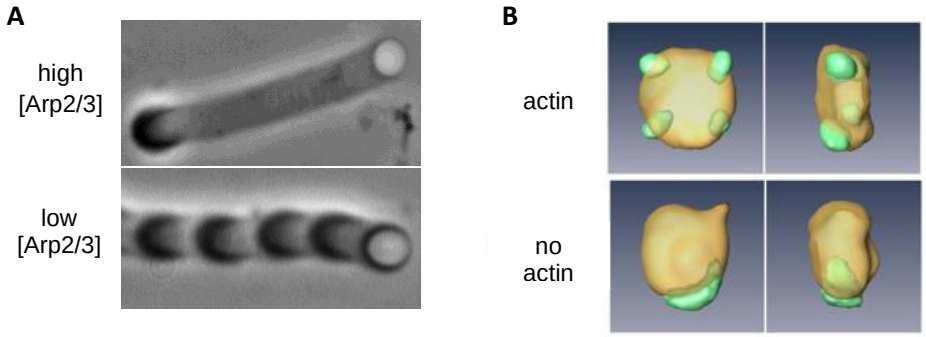
Cell membrane remodeling by the actin cytoskeleton: biomimetic approaches of cell processes

E. Helfer[1]
1 Aix Marseille Univ., CNRS, CINAM, Marseille, France

Actin is a major protein of the cytoskeleton which takes part into many cell processes, e.g. cell division, migration or morphogenesis, by remodeling cell membranes. For example, cell can induce the polymerization of polarized actin filaments into a branched meshwork oriented towards the plasma membrane. This dynamic meshwork exerts a pushing force against the cell plasma membrane, leading to a flat deformation, called protrusion, which is the first step of cell migration. Actin filaments self-assemble into various structures, which interact with different types of membranes to exert different functions in the cell (deformation, scission…). For that, the actin structures needs to be tightly controlled in time and space. Such complexity has raised interest from both physics and biology communities.

Here, I will describe two works that show the versatile interaction of a specific actin structure, the actin branched network, with cell membranes. This network is generated by a protein complex, the Arp2/3 branching complex, which creates crosslinks between the actin filaments. I will first show an *in vitro* approach in which we reconstituted the branched actin meshwork at the surface of synthetic membranes (giant unilamellar vesicles, GUVs). The growth of the actin network against the membrane induces GUV propulsion. From macroscopic observations on GUVs we showed that their regime of motion (Fig. A) depends on the competition between free diffusion and segregation on the surface of the protein which nucleates the actin meshwork [1]. In a second part, I will describe a cell biology study on the role of the same actin meshwork in intracellular transport. We studied the surface distribution of another actin nucleator, WASH, on intracellular vesicles (called endosomes). Our observations in cells showed that actin contributes to the control of WASH surface organization on the endosomal membrane (Fig. B) [2]. We are currently working on a new are *in vitro* reconstitution project based on these results. These two examples, where actin plays different roles, show how actin structures can exert different functions in cells, depending where their assembly is triggered.



1. Delatour V*, Helfer E*, Didry D, Lê KHD, Gaucher J-F, Carlier M-F, Romet-Lemonne G, *Arp2/3 controls the motile behavior of N-WASP-functionalized GUVs and modulates N-WASP surface distribution by mediating transient links with actin filaments*, Biophys J 94, 4890-4905, 2008.

2. Derivery E*, Helfer E*, Henriot V, Gautreau A, *Actin polymerization controls the organization of WASH domains at the surface of endosomes* PLoS One 7, e39774, 2012.