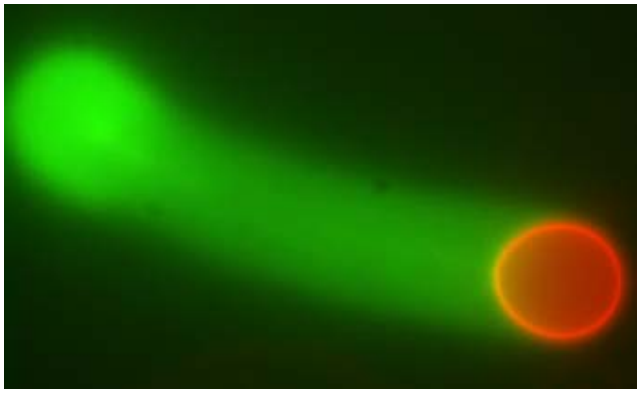
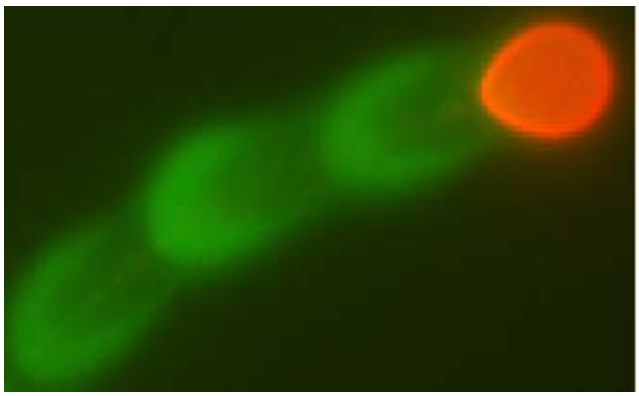
Actin-based propulsion of vesicles: from mesoscopic observations to molecular mechanisms

Emmanuèle Helfer
Cytoskeleton Dynamics and Motility, Laboratoire d'Enzymologie et Biochimie Structurales, Gif-sur-Yvette

Cell motility, in response to extracellular signals, allows directional movement, cell division or materials transport. The combined actions of molecular motors and remodeling of the cytoskeleton generate forces and movement. Biochemical studies of actin dynamics regulation shed light on several protein machineries that initiate actin filament assembly by different mechanisms, leading to varying 'actin-based motile processes' like cell protrusions, invaginations, organelles propulsion. In particular, the site-directed assembly of actin filaments in a branched network generates forces responsible for the formation of lamellipodial protrusion and for the propulsion of intracellular organelles and pathogens. To characterize the assembly of this branched actin array, we reconstituted the propulsion of Giant Unilamellar Vesicles (GUVs) functionalized with an activator of actin polymerization in a biochemically controlled medium. Our study of 2 regimes of propulsion, continuous and saltatory, allowed us to show that actin filaments bind transiently to membrane-bound activators via the Arp2/3 branching complex, and that the movement is driven by the balance between free diffusion and segregation of the activator at the membrane.