Title: Molecular motor mediated flows of an actin-membrane composite

Where: Laboratoire Physico-Chimie Curie (CNRS UMR168 ; Institut Curie, Paris 05)
Advisor: Feng-Ching TSAI (feng-ching.tsai@curie.fr)
Group: MEMBRANES AND CELLULAR FUNCTIONS (led by P. Bassereau)
Website links: Personal (fctsai.com), Curie
Thesis possibility after internship? YES

Dynamic networks of myosin motors and actin polymers attached to the plasma membrane of cells enable the cells to have precise, spatial-temporal control over their surface shape. The actin cytoskeleton is physically coupled to the membrane by actin-membrane linkers, notably active linker, type I myosin motors (myo1). Myo1 plays a key role in various cellular processes involving dynamic reorganization of both actin and the membrane. Additionally, myo1 acts as a force dipole that cyclically generates mechanical forces at the actin-membrane interface. However, the precise mechanical effects of myo1's action on the dynamic reorganization of the actin-membrane coupled composite remain elusive.

Our project aims to elucidate how the mechanical forces generated by myo1 motors modulate dynamic actin reorganization. To this end, we have generated nematic actin structures assembled on lipid membranes (Fig. 1, A and C). Recently, we have observed dynamic reorganization of actin filaments driven by myo1 motors (Fig. 1, B).

The goal of the internship is to study how actin filament length and membrane curvature affect the organization of actin filaments driven by myo1 motors. We will use fluorescence microscopy (TIRF) and super-resolution microscopy (STORM), as well as single filament tracking to monitor the process of actin rearrangement and to detect the orientation of the actin filaments.

Our results will guide the theoretical description of myo1-driven actin reorganization in collaboration with Carles Blanch Mercader and Jean-Francois Joanny (Curie Institute).

Figure 1.