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

Where: Laboratoire Physico-Chimie Curie (CNRS UMR168 ; Institut Curie, Paris 05)

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Thesis possibility after internship? YES

The surface of eukaryotic cells consists of a fluid lipid membrane densely populated with proteins. This membrane exhibits dynamic lipid reorganization and flow, processes known to be modulated by the network of actin filaments known as the actin cortex. The actin cortex is physically coupled to the membrane, notably by class I myosin motors (myo1). Myo1 plays a key role in various cellular processes involving dynamic reorganization of both actin and the membrane. Additionally, myo1 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 at the actin-membrane interface modulate and coordinate membrane flow and dynamic actin reorganization. To this end, we have generated nematic actin structures assembled on lipid membranes (Fig. 1A). Recently, we have observed dynamic reorganization of actin filaments driven by myo1 motors (Fig. 1B).

The goal of the internship is to study how actin filament length and membrane viscosity affect the organization of actin filaments driven by myo1 motors.

We will use fluorescence microscopy (TIRF) and polarization microscopy to monitor the process of actin rearrangement and to detect the orientation of the actin filaments, respectively.

We are collaborating with Sophie Brasselet (Fresnel Institute, Marseille) to detect the orientation of actin filaments using polarization microscopy (Fig. 1C). Our results will guide the theoretical description of myo1-driven actin reorganization in collaboration with H-Y Chen (NCU, Taiwan).

Figure 1.