Control of bi-dimensional localized biochemical structures through fluctuations and non-linearities

A. Kerjuan,[b] C. Albiges-Rizo[b], and O. Destaing[b], <u>B. Fourcade</u>[a*]

a. LIPhy, Université Grenoble-Alpes, CNRS.
b. Albert Bonniot Institute, Inserm, CNRS, Université Grenoble-Alpes.

*Bertrand.Fourcade@univ-grenoble-alpes.fr

Diffusion and reaction can work in consonance to produce stable stationary structures. In this work we focus on static and dynamic localized structures where essential non-linearities result from feedback mechanisms. Using stochastic simulations to model receptors diffusing on membrane and interacting with actin-ligand complexes, we study how self-sustained structure emerge in cooperative cell-adhesive phenomena. Our model underlines the role of receptor mobility and recruitment as a pivotal mechanism for self-organization. We describe a whole set of bifurcations between different families of transient, static and dynamic localized structures as a function of key parameters such as the the excitability of the adhesive complex medium. Finally, we illustrate this modelling approach in the framework of optogenetic experiments where we assume that the excitability of medium can be tuned via the light activation of a key kinase protein (Src) diffusing from the cytosol to the adhesive sites via a direct or a membrane indirect recruitment.
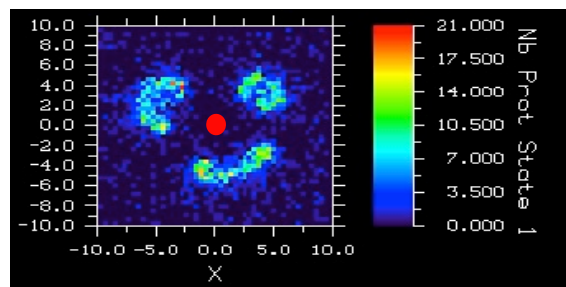
Figure 1: Example of excited adhesive structures given by a density plot for the number of receptor molecules per unit surface. This example corresponds to a dynamic solution of incomplete expanding rings following a local excitation (red circle centered at the origin).