Shaping epithelial sheets in two and three dimensions

Epithelial cell monolayers are the simplest living tissues that exist in nature, yet they are responsible for a complex repertoire of physiological functions. This repertoire includes the ability to self-repair after injury, to adopt complex shapes during morphogenesis, to compartmentalize organs into functional units, and to protect organisms against environmental pathogens. To achieve this broad diversity of functions, epithelial sheets finely tune their shape, structure and mechanics. The goal of this PhD thesis is to study the mechanisms by which epithelial sheets adopt their 2D and 3D shapes. These mechanisms include the regulation of cytoskeletal tension, cell adhesion, cell division, and transepithelial pressure. Experimental systems will include cell monolayers and stem-cell derived organoids. The thesis will involve tools in life cell microscopy, force microscopy, optogenetics, cell and molecular biology, and micro- and nano-manipulation. In addition, the project will rely on novel technologies developed in our laboratory. The study will be carried out in collaboration with Prof Marino Arroyo (UPC, modelling).