Cytoskeletal Mechanics of Blood Platelets

Aastha Mathur, Serge Dmitrieff, Sandra Correia, Romain Gibeaux, Iana Kalinina, Tooba Quidwai, Jonas Ries and Francois Nedelec
Cell Biology and Biophysics, EMBL Heidelberg, Germany

The cytoskeleton is a conserved filamentous system made of proteins that are specialized into scaffolding and force production in living cells. It drives many essential processes *in vivo* such as cell division, cell motility and morphological changes. The cytoskeleton is a dynamic and versatile system that can adopt different architectures, depending on the task at hand. A general objective of our research is to analyze the dynamics and mechanical properties of these architectures to understand how they are adapted to perform their particular role. In this talk, I will first introduce the physical characteristics of the cytoskeletal components, and the different approaches that are used to study the collective behavior of cytoskeletal systems. I will then present with our experimental characterization of blood platelets, which play a major role in hemostatis, the process of stopping blood loss from injured vessels. While floating free in the blood in the so called 'resting' state, platelets have a discoid shape. Their size in this case can be understood from the competition between the elasticity of a circular bundle of microtubules, and surface tension at the cell edge. Such a mechanical equilibrium predicts a scaling law that is verified by imaging a large number of individual platelets live, from Mouse and Human blood samples. I will then discuss the dynamics that is observed at the onset of platelet activation, on the path towards platelet adhesion and aggregation. The ring maintaining the shape of platelets initially coils, but is able to recover within 30 minutes. This can be explained as the ring is made of microtubules that alternate between growing and shrinking states, and can reform with a smaller radius. Importantly, we find that this response is dependent on the size of platelets, with possible implications for the physiology of platelets *in vivo*.