Biophysics of asexual reproduction in the planarian S.mediterranea

S. mediterranea is an important model for regeneration and stem cell research as these planarians consist

of ~30% stem cells, allowing them to regenerate an entire animal from minuscule body parts. Additionally, their genome was recently sequenced and shows a high degree of conservation with the human genome. The large stem cell contingent also allows S. mediterranea to reproduce asexually, which is a rare occurrence among multicellular organisms. Despite the important link between asexual reproduction (transverse fission) and regenerative capabilities, little is known about the mechanics of the process itself due to experimental challenges such as photophobia and lack of fission inducers.

I will give a basic introduction to the biology and population dynamics of S. mediterranea and then focus on asexual reproduction. We have developed a method to collect a large amount of data on the dynamics of transverse fission. Continuous time-lapse imaging allows us to characterize the process in detail, revealing the complexity of the event as a multi-stage process and the nature of the rupture itself. A traction force measurement setup is being developed to allow us to quantify the forces planarians exert on the substrate during a fission event by way of a tunable Polydimethylsiloxane substrate with surface imbedded 100um beads, a macroscopic analog to the Traction Force Microscopy setups used to determine local cellular forces. A major focus of this work is on the interplay between molecular processes during fission and tissue mechanics: How do physical processes and cell signaling regulate each other? Another fundamental question involves possible differences in regeneration following asexual reproduction compared to a wounding event.