Patterns of active filaments

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Biological structures are often based on filamentous structures, the most important example being the cytoskeleton, a composite network of several filamentous elements, namely microtubules, actin filaments and intermediate filaments. These filaments have length of several to tens of microns and nanometer-size diameters. Importantly such filament are typically active, e.g. because they are driven by molecular motors as in the case of microtubules and actin filaments. This results in a variety of non-equilibrium structures and in unusual rheological properties. On larger scales, filamentous bacteria with lengths of hundreds of microns and diameters of the order of one micron provide other examples for active filaments, due to their larger size more easily accessible to microscopy. These filaments can also active due to their motility such as, for example, gliding on surfaces. In dense monolayers, they form intriguing patterns including nematic order and larger spools or spirals.