Confotronics of biofilaments

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Biofilaments like those of the cytoskeleton show anomalous behaviours in various experiments that can be explained by the existence of conformational excitations. For example, the 2-d confinement of helices forms peculiar squeezed conformations often resembling looped waves, spirals or circles. These shapes as well as the unusual statistical mechanics can be understand in terms of moving and interacting localized conformational quasiparticles. A condensate of these quasiparticles emerges in recent experiments realized on intermediate filaments. As a second example, I will consider tubular lattices like microtubules. Despite significant effort, understanding the unusual mechanics of microtubules remains elusive. There are strong evidences for the existence of conformational internal degrees of freedom in the microtubule lattice that lead to filaments with unique characteristics in the world of macromolecules. I will discuss those characteristics, like the mechanical hysteresis and a peculiar rotational zero mode, which not only explain various experimental results but could also inspire novel smart materials.