Physics and Physical Oceanography Seminar

Torsional instability of collagen fibrils as a model for soft tissue damage

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DATE: Thursday, Jan 28, 2021
TIME: 3:30 pm
Place: Webex (link will be sent out)

ABSTRACT: Soft tissue injuries such as the damage and rupture of tendons and ligaments are a major burden for the Healthcare system and represent a global expenditure of at least $300 billion a year. Even so the response of our body to soft tissue injuries is a complex process involving multiple biological pathways, it stems from the nature of the mechanical damage incurred by the tissue. In this talk, I will explore the physical nature of soft tissue damage using tendon as the model system and more its load-bearing constituent, the collagen fibril.

Collagen fibrils are bundles of 300 nm long helical collagen molecules that combine an almost crystalline axial order with a somewhat disordered lateral packing. This unique architecture coupled with intermolecular cross-linking leads to a strong and extensible biological rope with a diameter between 50 and 500 nm and an elastic modulus around 0.3 to 1 GPa. I will present recent advances in mechanical testing and imaging of single collagen fibrils using atomic force microscopy and compare the results with damage motifs observed in ruptured and overloaded tendons. These results have led to the idea that because of the rope nature of collagen fibrils, tension or compression stresses are always coupled to a torsional response which in turns lead to plastic damage at the molecular and supramolecular level. If time permits I will briefly discuss the way our body may respond do this type of damage at the collagen fibril level.

ALL ARE WELCOME!