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(I) Single-molecule mechanical studies of unstable protein building blocks

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The most abundant protein on earth, collagen, forms the basis of our connective tissues and the extracellular matrix that surrounds our cells. It performs important structural and mechanical roles, holding our bodies together and helping our tissues to withstand a wide variety of forces. Surprisingly, collagen proteins are structurally unstable at body temperature.

In this talk, which will be aimed at a very general Physics audience, I will introduce some of the fascinating physical properties of the unique triple-helix structure of collagen, and will highlight the results of our investigations into the sequence dependence of its mechanics and stability. Our single-molecule approaches include centrifuge force microscopy, optical tweezers and atomic force microscopy. Our work is revealing clues as to how stability is encoded within collagen's sequence, and how collagen's triple helix balances structural stability with responsiveness to applied force and chemical environment.

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