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über

The folded protein as a soft viscoelastic material

Abstract:

In this talk, I will discuss our recent measurement of viscous and elastic response of single folded domain of a protein. We provide a periodic forcing of ~10 pN and measure resulting extensions ~ 5 pm produced in a protein domain. This perspective, wherein a protein domain is treated as a soft viscoelastic solid, provides its dynamical characterisation important to its function. Previous attempts of doing this have been riddled with artefacts due to the hydrodynamics of an oscillating force probe. For instance, the cantilever in AFM measurements is many orders of magnitude larger in size compared to a globular protein. We have developed a novel AFM scheme based on fibre based interferometric detection of the cantilever's displacement. The method provides quantitative estimates of both, force applied on the folded molecule as well as strain produced in it [1, 2]. In particular, I will present our first results on immunoglobulins of titin, the giant muscle protein responsible for passive elasticity in muscle sarcomere. In contrast to myosin motors, their role in force generation and work production is only recently being appreciated [3]. Together with support from molecular dynamics simulations, we remark that the viscous response observed in these domains originates from relatively slow fluctuations between the native state and its mechanical intermediate that appears around ~ 100 pN of force.

References:

1. S. Deopa et al. *Direct and Simultaneous Measurement of the Stiffness and Internal Friction of a Single Folded Protein,* J. Phys. Chem. Lett. , 13, 40, 9473–9479 (2022)
2. S. Deopa and S. Patil, *Viscoelasticity of single folded proteins using dynamic atomic force microscopy*, Soft Matter 19, 4188 (2023)
3. J. K. Freundt, and W. A. Linke, *Titin as a force-generating muscle protein under regulatory control*. Journal of Applied Physiology, 126, 5, 1474 (2019)

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