JOINT BIOENGINEERING SEMINAR SERIES

"The Physics of Proteins under Force"

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Abstract:

At the nanoscopic level force is a ubiquitous perturbation and many proteins have evolved to respond to mechanical stimuli. These proteins, generally segregated in multiple domains, behave in a unique quantized way by unfolding and refolding individual domains in a time and force dependent manner. The folding states of these domains constitute the zeros and ones of a basic computation unit which proteins use to transduce a mechanical signal into a length change. This length change directly impacts the macroscopic properties of the tissue that these proteins form. Recently, we have implemented a new single molecule technique to study proteins under force based on magnetic tweezers and HaloTag covalent attachment. This new technique allows tethering of single proteins for more than a day and at forces between 0-100 pN. Using this technique, which is ideally suited for the working range of most proteins *in vivo* (<10 pN), we have uncovered a new mechanism for muscle contraction. Surprisingly, Ig domains of titin, the protein responsible with muscle elasticity, show unfolding/refolding reactions at physiological forces. This folding of titin domains under force can deliver more contractile energy than the myosin motors, providing a so-far unrecognized contribution of titin to the force generated by a contracting muscle. These findings place protein folding as an important mechanism where tandem multidomain proteins can adjust the elasticity of tissue and deliver or store energy based on changes in the experienced force.

Bio:

Ionel Popa received his B.Sc. degree in Chemical Engineering from Gh. Asachi Technical University in 2005 and his Ph.D. in Physical and Analytical Chemistry from University of Geneva in 2010, under the direction of Prof. Michal Borkovec. He then joined the group of Julio M. Fernandez at Columbia University to study protein biophysics, where he held the positions of Postdoctoral Fellow and Associate Research Scientist. Since fall 2015, he joined the University of Wisconsin-Milwaukee, where he currently holds the rank of Assistant Professor.