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Dynamic Elasticity Model of Resilin Biopolymers XIAO HU, SOLOMON DUKI, Department of Physics and Astronomy, Rowan University, Glassboro, NJ 08028, USA — Resilin proteins are 'super elastic rubbers' in the flight and jumping systems of most insects, and can extend and retract millions of times. Natural resilin exhibits high resilience ($> 95\%$) under high-frequency conditions, and could be stretched to over 300% of its original length with a low elastic modulus of 0.1-3 MPa. However, insight into the underlying molecular mechanisms responsible for resilin elasticity remains undefined. We report on the dynamic structure transitions and functions of full length resilin from fruit fly (D. melanogaster CG15920) and its different functional domains. A dynamic computational model is proposed to explain the super elasticity and energy conversion mechanisms of resilin, providing important insight into structure-function relationships for resilins, as well as other elastomeric proteins. A strong beta-turn transition was experimentally identified in the full length resilin and its non-elastic domains (Exon III). Changes in periodic long-range order were demonstrated during this transition, induced either by thermal or mechanical inputs, to confirm the universality of proposed mechanism. Further, this model offers new options for designing protein-based biopolymers with tunable material applications.

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