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Fano Resonances in the Resonance Raman Spectra of Tubulin and Microtubules Reveals Active Quantum Effects

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Microtubules are self-assembling biological nanotubes made of the protein tubulin that are essential for cell motility, cell architecture, cell division and intracellular trafficking. The unique mechanical properties of microtubules give rise to a high resilience and stiffness due to their quasi-crystalline helical structure. It has been theorized that this hollow molecular nanostructure may function like a quantum wire where optical transitions can take place, where photo-induced changes in microtubule architecture may be mediated via changes in disulfide or peptide bonds or stimulated by photoexcitation of tryptophan, tyrosine or phenylalanine groups, resulting in subtle protein structural changes owing to alterations in aromatic flexibility. Here we present the Raman scattering spectra of microtubules and its constituent protein tubulin in both dry powdered form and in aqueous solution and determine if molecular bond vibrations show active Fano resonances which are indicative of quantum coupling between discrete phonon vibrational states and continuous excitonic many-body spectra.

Biography

Travis J.A. Craddock, Ph.D. (Physics) is an Associate Professor in the Departments of Psychology & Neuroscience, Computer Science and Immunology at Nova Southeastern University (NSU) in Fort Lauderdale, Florida. He is the Director of the Clinical Systems Biology group at NSU's Institute for Neuro-Immune Medicine where he applies computational biophysics methods towards the purpose of identifying novel diagnostics and treatments for illnesses involving neuroinflammation. Dr. Craddock received his Ph.D. in biophysics at the University of Alberta where his graduate research activities focused on biomolecular information processing, and nanoscale descriptions of memory, and cognitive dysfunction in neurodegenerative disorders. His current research activities are focused on using a theory driven approach to understand the underlying molecular regulation of chronic illness resulting from exposure to neurotoxins, such as anesthesia and nerve agents, in order to improve diagnosis and treatment strategies. This work is primarily funded by the U.S. Department of Defense.

SESSION SPEAKER