Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

**Bridging Length Scales to Study Self-Assembly and Self-Organization** BRYAN KAYE, DANIEL NEEDLEMAN, Harvard University — A variety of proteins can assemble into large polymers as an integral part of their biological function. Studying the biochemistry and biophysics of polymer formation often involves time-resolvable measurements of the amount of polymer. Non-invasive measurements of polymer can be divided into two categories: short (spectroscopy) and large (microscopy) length scale measurements. Microscopy-based estimates of polymer amount are often dependent on spatial non-uniformity of polymer, whereas spectroscopy-based estimates of polymer amount are often based on models that are difficult to test. Here we show how both large and small length scale measurements can be combined to validate the assumptions behind both measurements while incorporating both measurements to make more accurate estimates of polymer amount. We utilize this approach with two-photon microscopy and FRET to measure the amount of tubulin (monomer) in microtubules (polymer) in order to study microtubule nucleation in cell extracts. In addition, this approach may be useful to study a wide variety of polymers, including actin filaments, viruses, lipid membranes, and other protein aggregates.

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Date submitted: 03 Feb 2016 Electronic form version 1.4