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Temperature dependence of phonons in photosynthesis proteins[1]
MENGYANG XU, University at Buffalo, The State University of New York, DEAN MYLES, Oak Ridge National Laboratory, ROBERT BLANKENSHIP, Washington University in St. Louis, ANDREA MARKELZ, University at Buffalo, The State University of New York — Protein long range vibrations are essential to biological function. For many proteins, these vibrations steer functional conformational changes. For photoharvesting proteins, the structural vibrations play an additional critical role in energy transfer to the reaction center by both phonon assisted energy transfer and energy dissipation. The characterization of these vibrations to understand how they are optimized to balance photoharvesting and photoprotection is challenging. To date this characterization has mainly relied on fluorescence line narrowing measurements at cryogenic temperatures. However, protein dynamics has a strong temperature dependence, with an apparent turn on in anharmonicity between 180-220 K. If this transition affects intramolecular vibrations, the low temperature measurements will not represent the phonon spectrum at biological temperatures. Here we use the new technique of anisotropic terahertz microscopy (ATM) to measure the intramolecular vibrations of FMO complex. ATM is uniquely capable of isolating protein vibrations from isotropic background. We find resonances both red and blue shift with temperature above the dynamical transition. The results indicate that the characterization of vibrations must be performed at biologically relevant temperatures to properly understand the energy overlap with the excitation energy transfer.

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