Terahertz Spectroscopy of Biopolymers in Water: Absorption and Circular Dichroism.

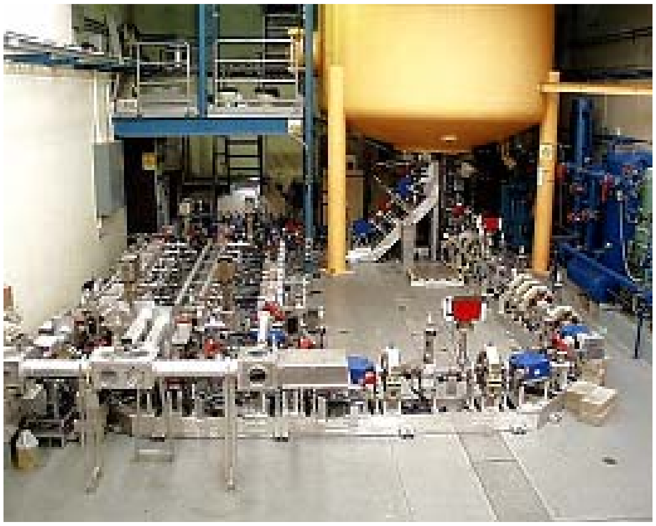
Jing Xu[1], Kevin W. Plaxco[2], S. James Allen[1]

[1]Physics, [2]Chemistry and BioChemistry, UCSB

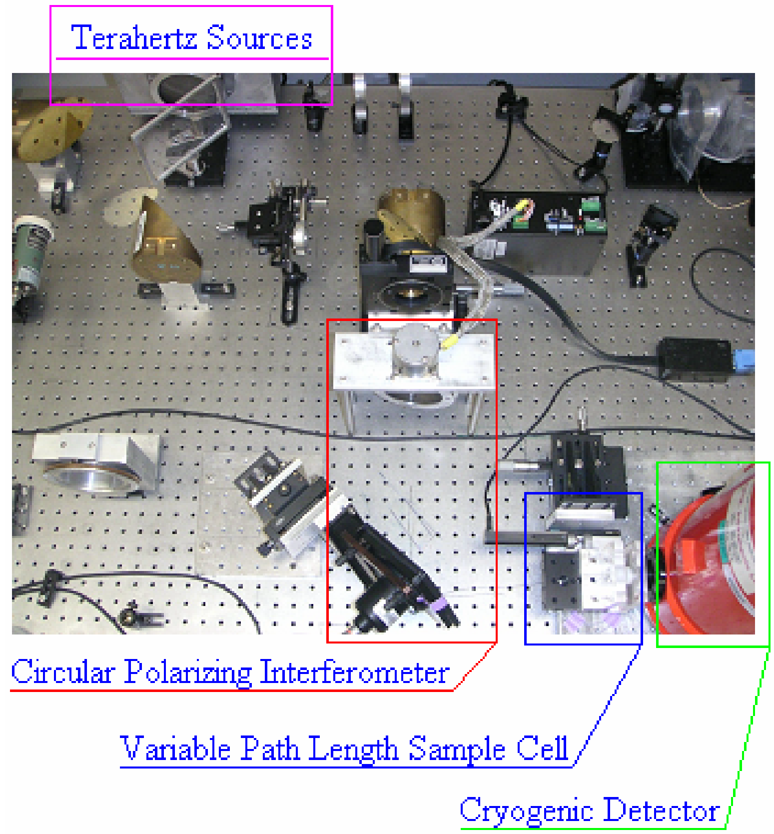
We have developed a broad band terahertz spectrometer suitable for studying biomolecules in biologically relevant water solution. Radiation is provided by harmonic multipliers* (up to 210 GHz) and the UCSB free-electron lasers (up to 4.8 THz). The spectrometer combines these sources with a cryogenic detector, a variable path length sample cell, and a circular polarizing interferometer. The spectrometer offers an opportunity to probe the terahertz dynamics of biopolymers in their natural water environment by terahertz absorption, and terahertz circular dichroism (TCD) spectroscopy. Terahertz absorption is achieved by brute forced intense incident radiation, however, the measurements are dominated by water absorption and require careful background removal. In contrast, TCD is not contaminated by water. TCD utilizes the geometrical property, net chirality, present only in biological materials. Non-biological medium such as water does not possess net chirality, thus do not produce any circular dichroism regardless of their absorption strengths. TCD spectroscopy has diverse potential applications including real time observation of protein folding, life detection (or lack thereof) in Martian rock, and identification of pathogens. However, TCD signature is exceedingly small and difficult to detect.

We have precisely isolated, for the first time, the 75 GHz - 3.72 THz absorption of solvated prototypical proteins, and are able to make direct comparison to the existing theoretical model calculations. We see no evidence of the predicted lowest normal mode at 90 GHz, instead we observe a low frequency cutoff at ~ 250 GHz for the solvated protein. On the complimentary TCD front, we have successfully demonstrated the magnetic circular dichroism in semiconductors, and placed upper bounds on the TCD signatures of prototypical proteins in solution. We will discuss efforts to recover TCD signatures of biological materials in the solution phase.

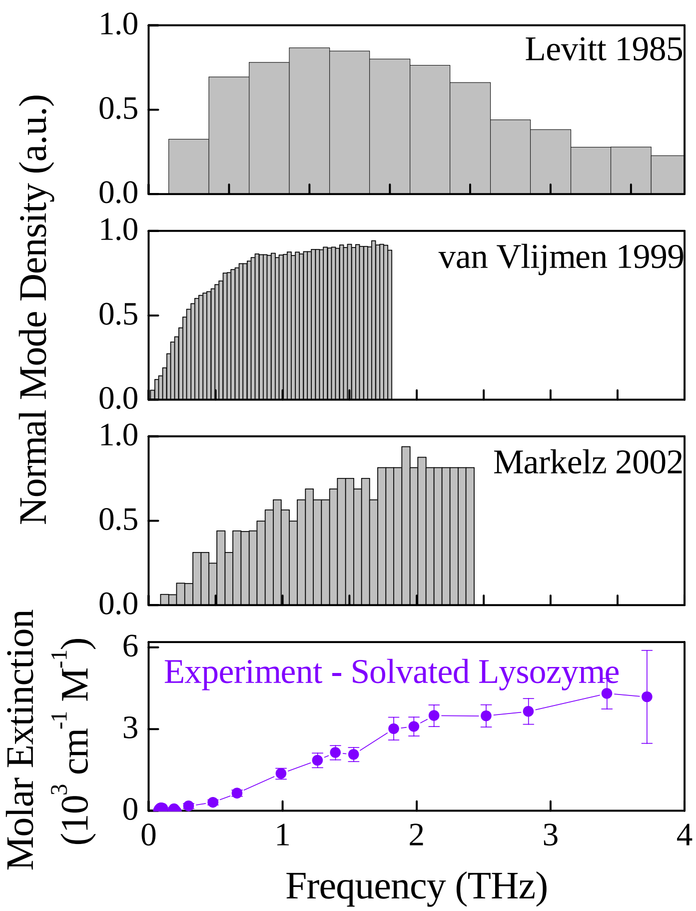
*Sources kindly provided by Mark Rodwell, Engineering, UCSB.



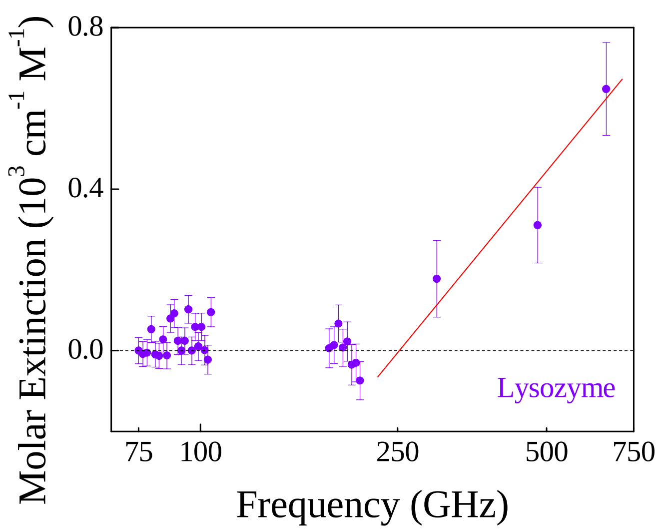
UCSB Free Electron Lasers, 0.12 - 4.8 THz.



THz Absorption and Circular Dichroism Spectrometer.



Measurement and Theoretical Model.



Low frequency cutoff at ~ 250 GHz.

Authors: J. Xu, K. W. Plaxco, S. J. Allen (UCSB)

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

BERKELEY DAVIS IRVINE LOS ANGELES RIVERSIDE SAN DIEGO SAN FRANCISCO SANTA BARBARA SANTA CRUZ

DEPARTMENT OF PHYSICS
SANTA BARBARA, CA 93106-9510
Phone: (805) 893-4707
E-mail: jingx@physics.ucsb.edu

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Dear Conference Committee,

I am a first-named graduate student author presenting an invited paper at the 2006 IEEE Lester Eastman Conference on High Performance Devices.

I am writing to request financial assistance for travel. I will greatly appreciate your support.

Best Regards,

Jing Xu