Measurement of TeraHertz Circular Dichroism

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Does life exist elsewhere in the Universe?

Plan of work

• Measure the THz CD signatures of biopolymers to assess feasibility of TCD spectroscopy as a life detection strategy
Why TeraHertz radiation?

• THz spectral features are a universal property of folded polymers > 500 atoms
• Frequency at which biological, chiral molecules exhibit strong CD

Experimental Objectives

• Design and construct TeraHertz circular dichroism (THz CD) spectrometer
• Measure THz CD signal in macroscopic system of compression springs
Experimental Setup

Parabolic Mirror

Reference Detector

Pyroelectric Detector

Gunn Oscillator

Collimator Lens

Beam Splitter

Quartz WavePlate

Iris

Springs Mount HDPE

Parabolic Mirror
Gunn Oscillator

- 140 GHz, ~ 2.1 mm
- linearly polarized
- Quinstar Technology
- Model QTM
Quarter-Wave Plate

- Quartz, 13.0 mm thick
- Indices of refraction
  $e = 2.112$, $o = 2.152$
- Quarter wave plate
Converting Linear to Circular Polarization

- If linearly polarized light enters a quarter-wave plate at 45°, then the light is divided into two equal components. One of these is retarded by a quarter wavelength by the plate. This produces circularly polarized light.
HDPE Spring Mount

3.0000"

3.0000"

0.125” hole diameter
0.35” hole depth
0.05” holes separation
Changes in Polarization

- Linear Polarization
- Circular Polarization
Circular Dichroism
Wave Plate Transmission vs Wave Plate Angle

WP Transmission (mV)

WP Angle (degrees)

HDPE, no springs
HDPE w/ springs
No HDPE
LABVIEW Data Acquisition
Too Much Variation in Transmission?

Empty Beam Path Transmission (mV)

WP Orientation Index
See Springs??

No Springs: Transmission (mV)

WP Orientation Index
See Springs??

WP Orientation Index

Yes Springs: Transmission (mV)

WP Orientation Index
First sign of THz CD?
Discussion/Conclusion

- Orientation of quartz plate axis
- Etalon effect
- Reference beam
- Collimation/ beam profiles
- Signal to Noise ratio
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