

Measurement of TeraHertz Circular Dichroism

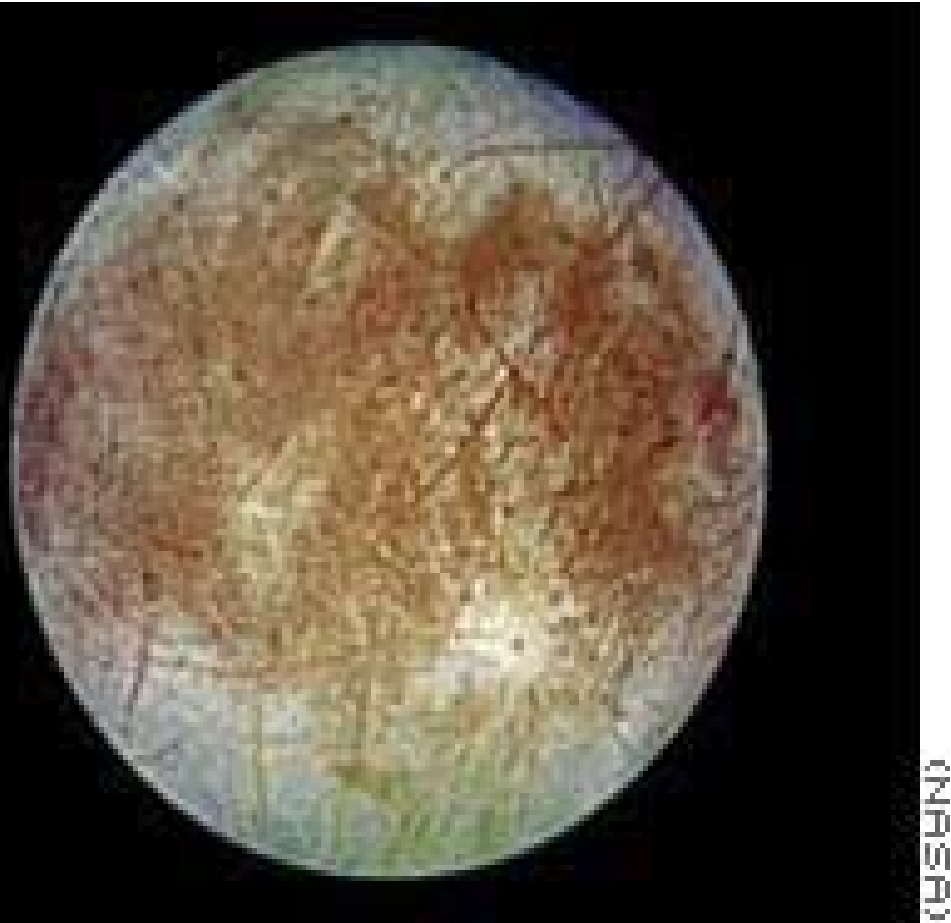
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PI: Professor Jim Allen and
Professor Kevin Plaxco

RET 2002 Summer Program

Funding: NASA Astrobiology, US Army

Does life exist elsewhere in the Universe?



(NASA)

Plan of work

- Measure the THz CD signatures of biopolymers to assess feasibility of TCD spectroscopy as a life detection strategy

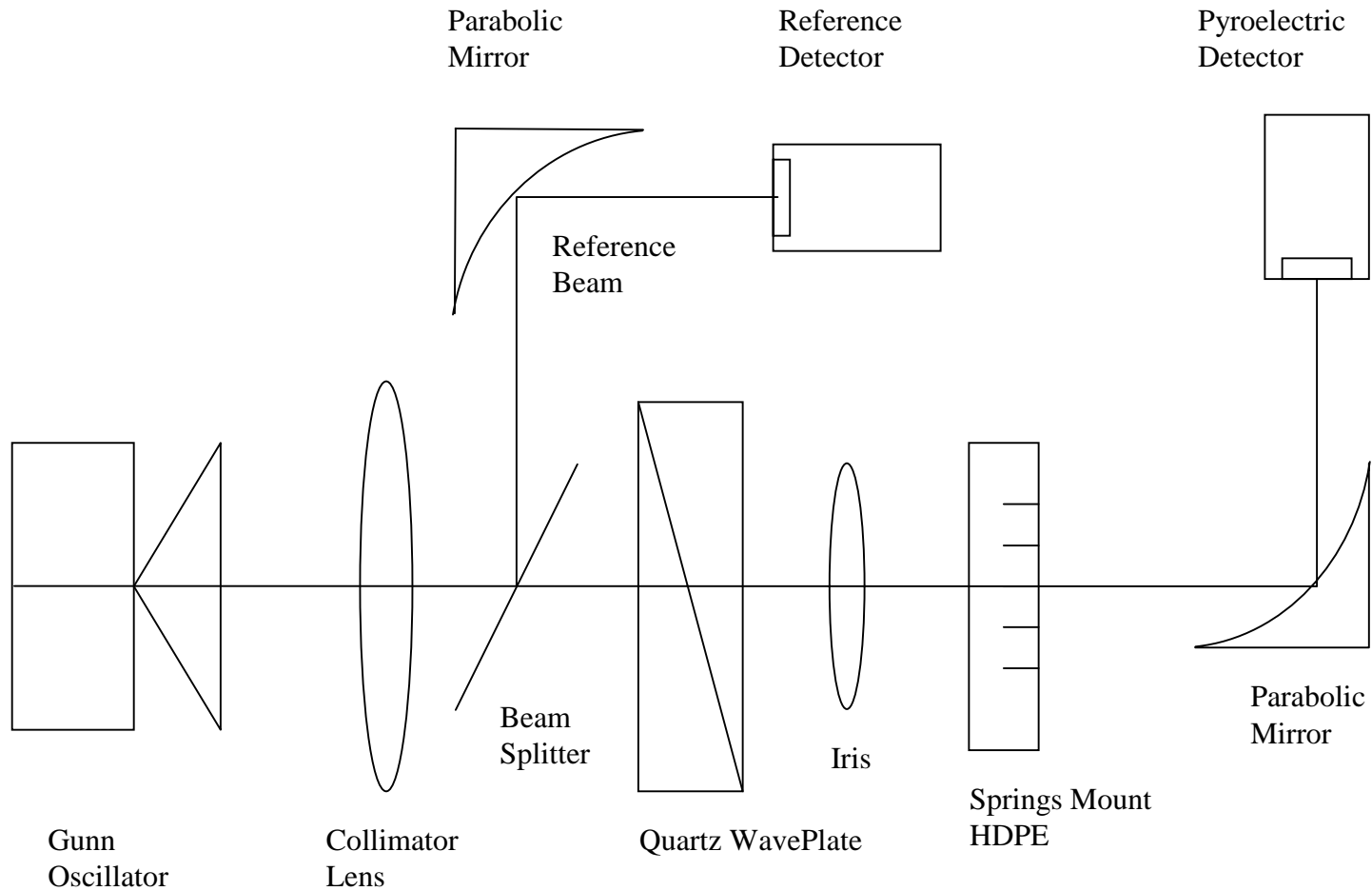
Why TeraHertz radiation?

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

Experimental Objectives

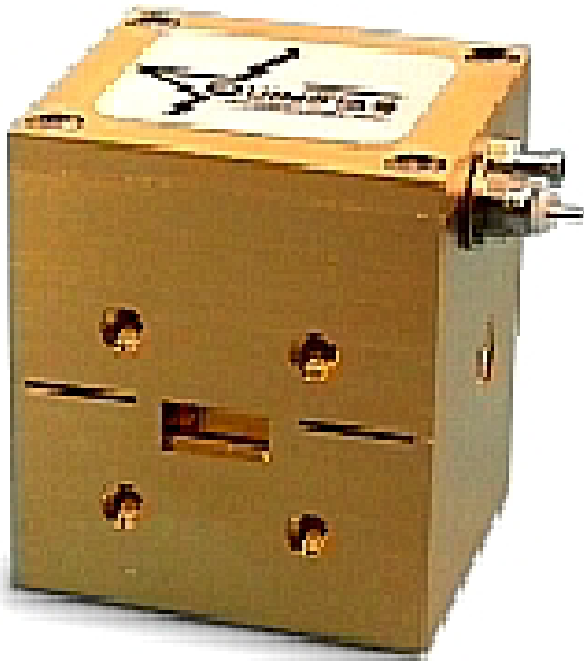
- Design and construct TeraHertz circular dichroism (THz CD) spectrometer
- Measure THz CD signal in macroscopic system of compression springs

Experimental Setup

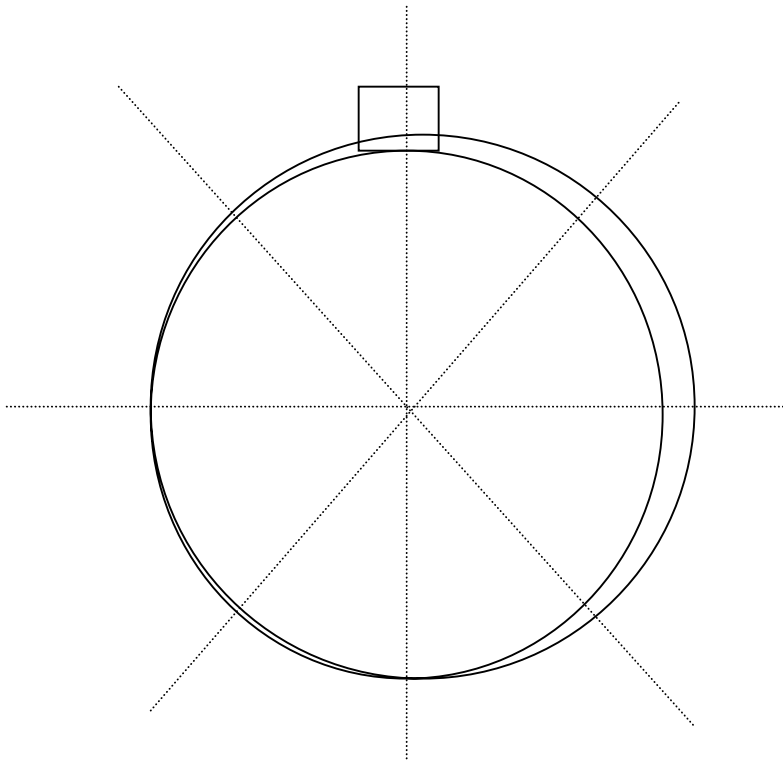


Gunn Oscillator

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

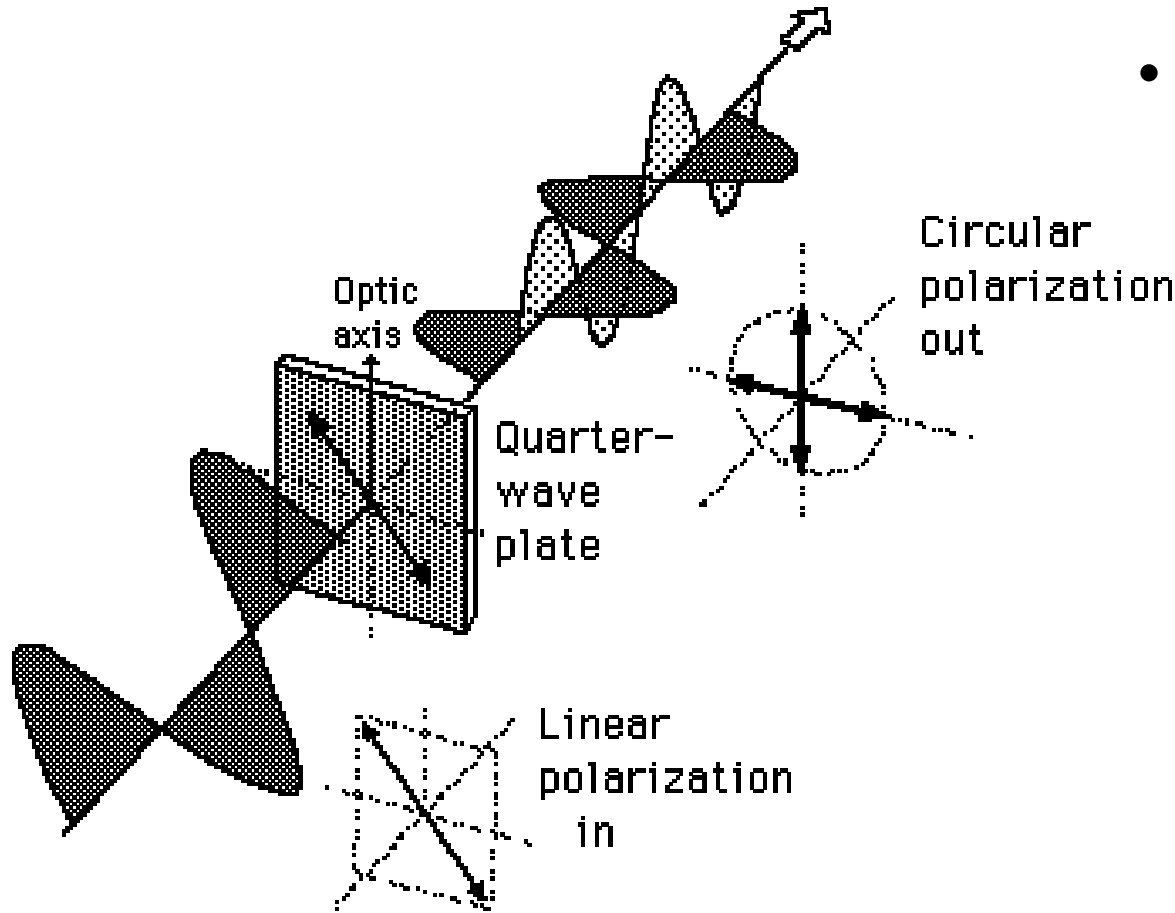


Quarter-Wave Plate



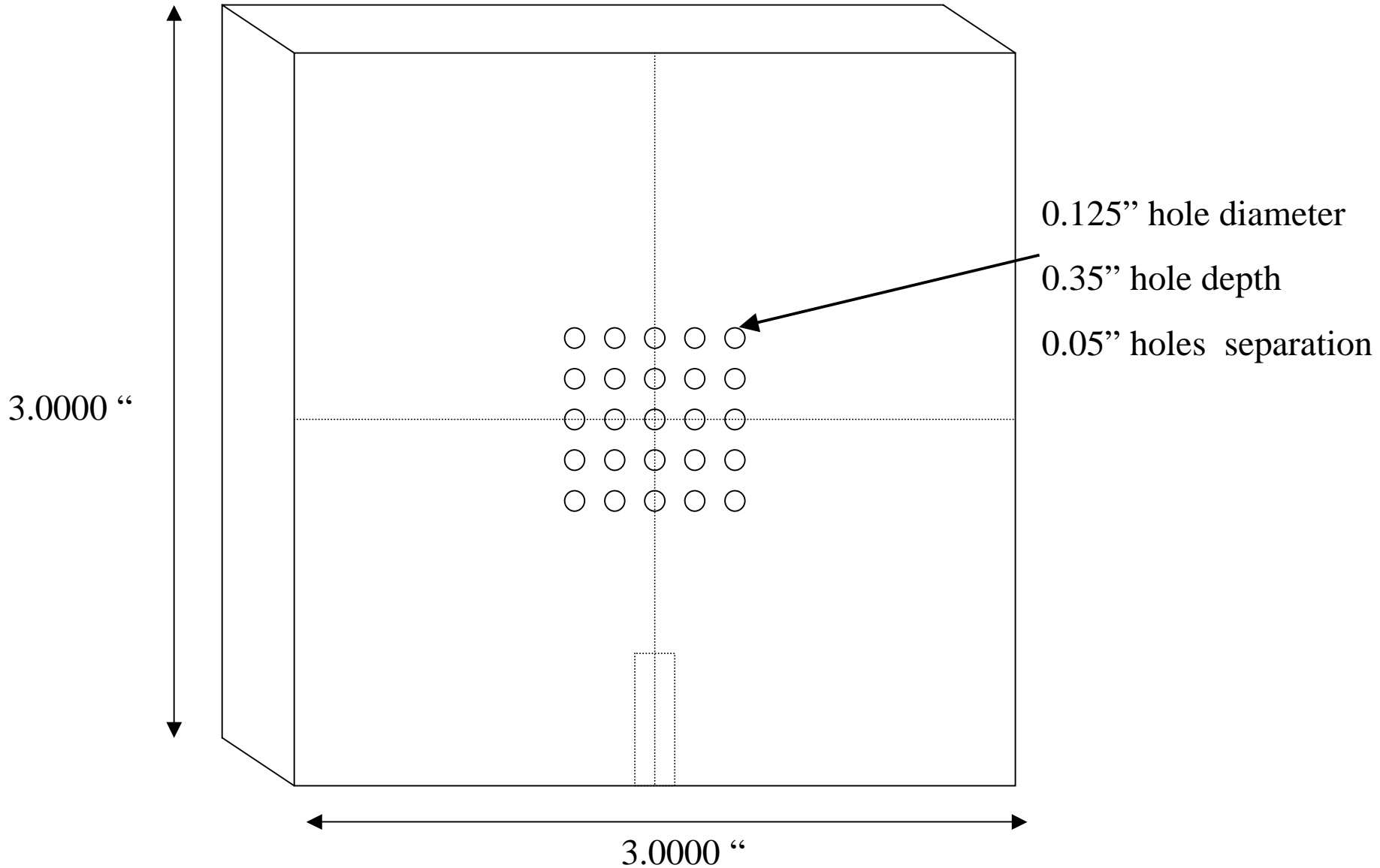
- Quartz, 13.0 mm thick
- Indices of refraction
 $e = 2.112$, $o = 2.152$
- Quarter wave plate

Converting Linear to Circular Polarization



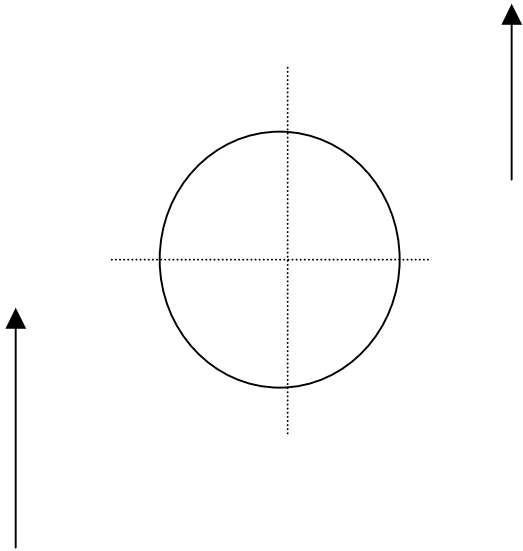
- If linearly polarized light enters a quarter-wave plate at 45° , then the light is divided into two equal components. One of these is retarded by a quarter wavelength by the plate. This produces circularly polarized light.

HDPE Spring Mount

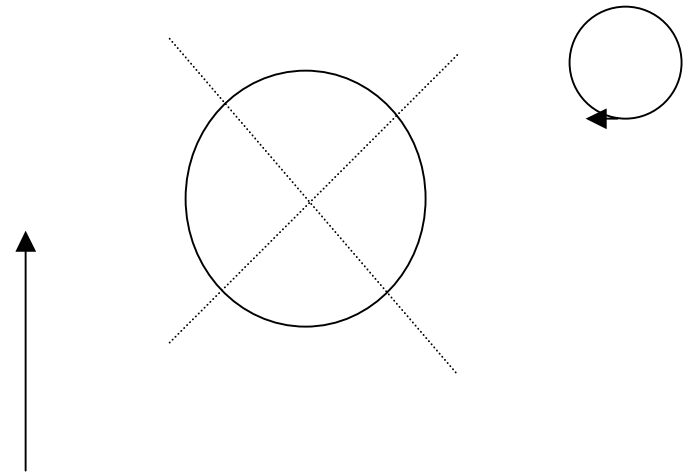


Changes in Polarization

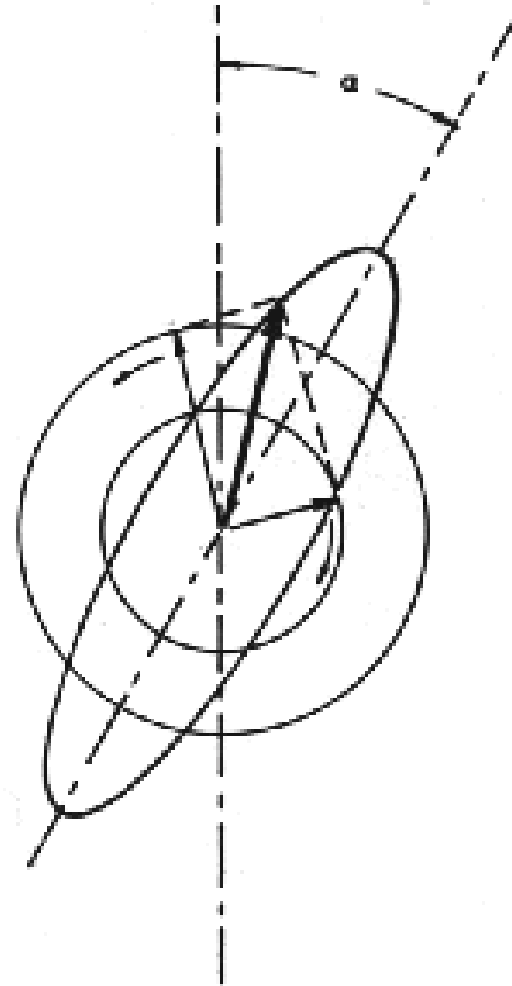
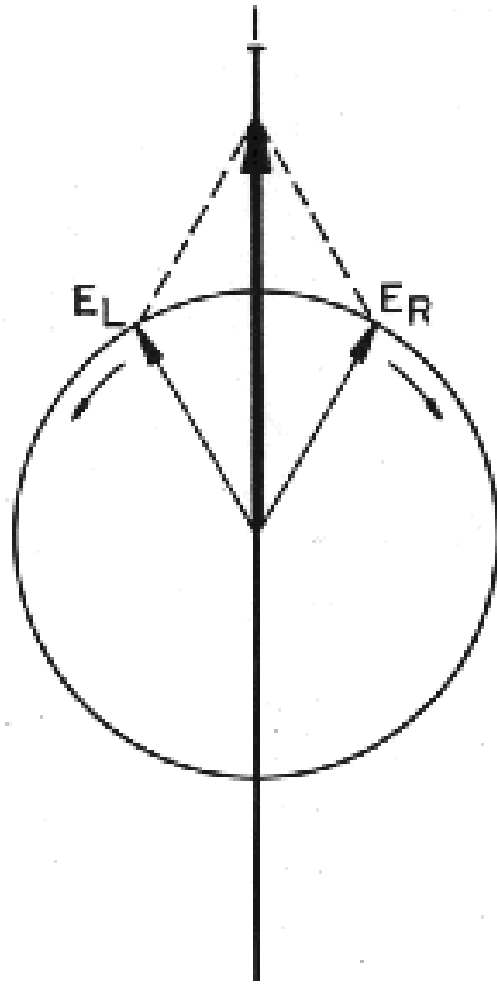
- Linear Polarization



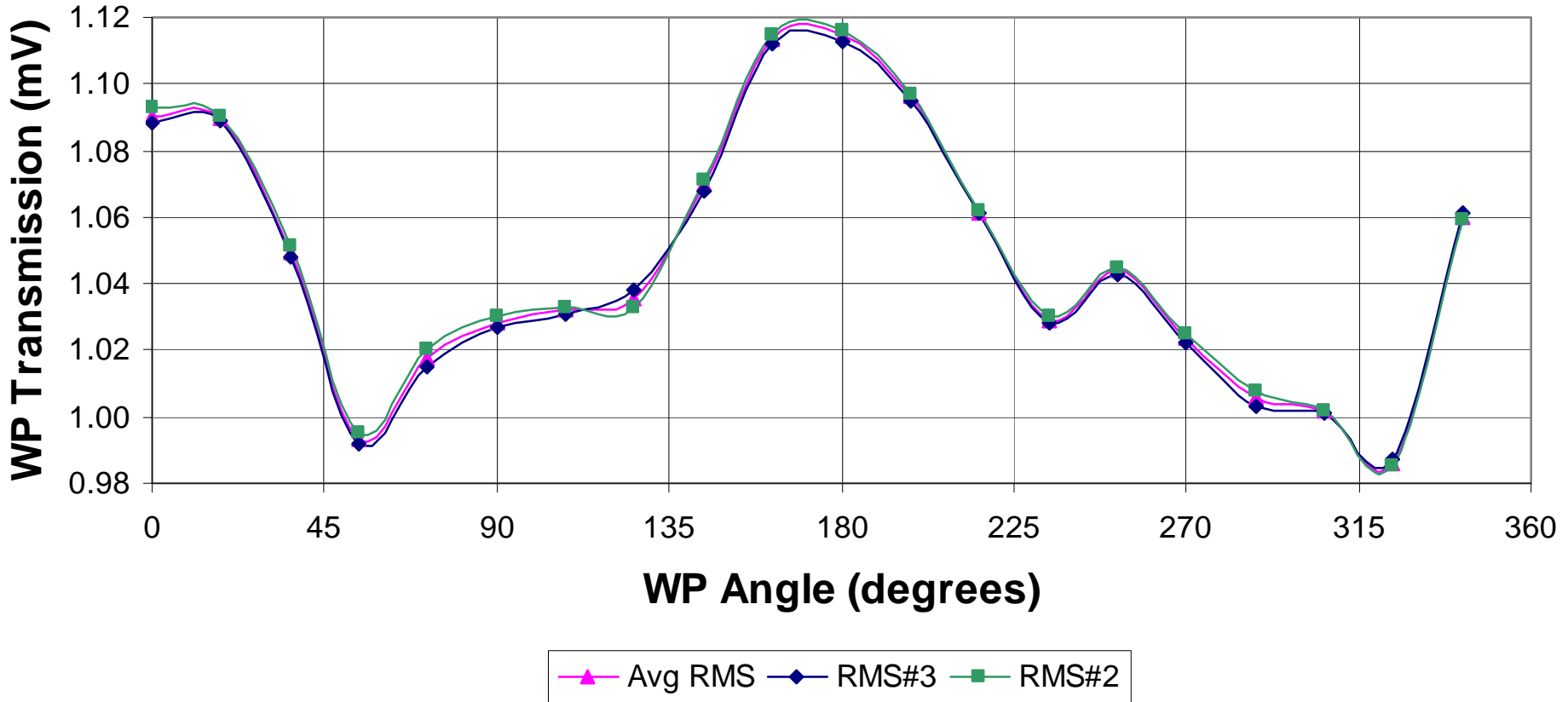
Circular Polarization



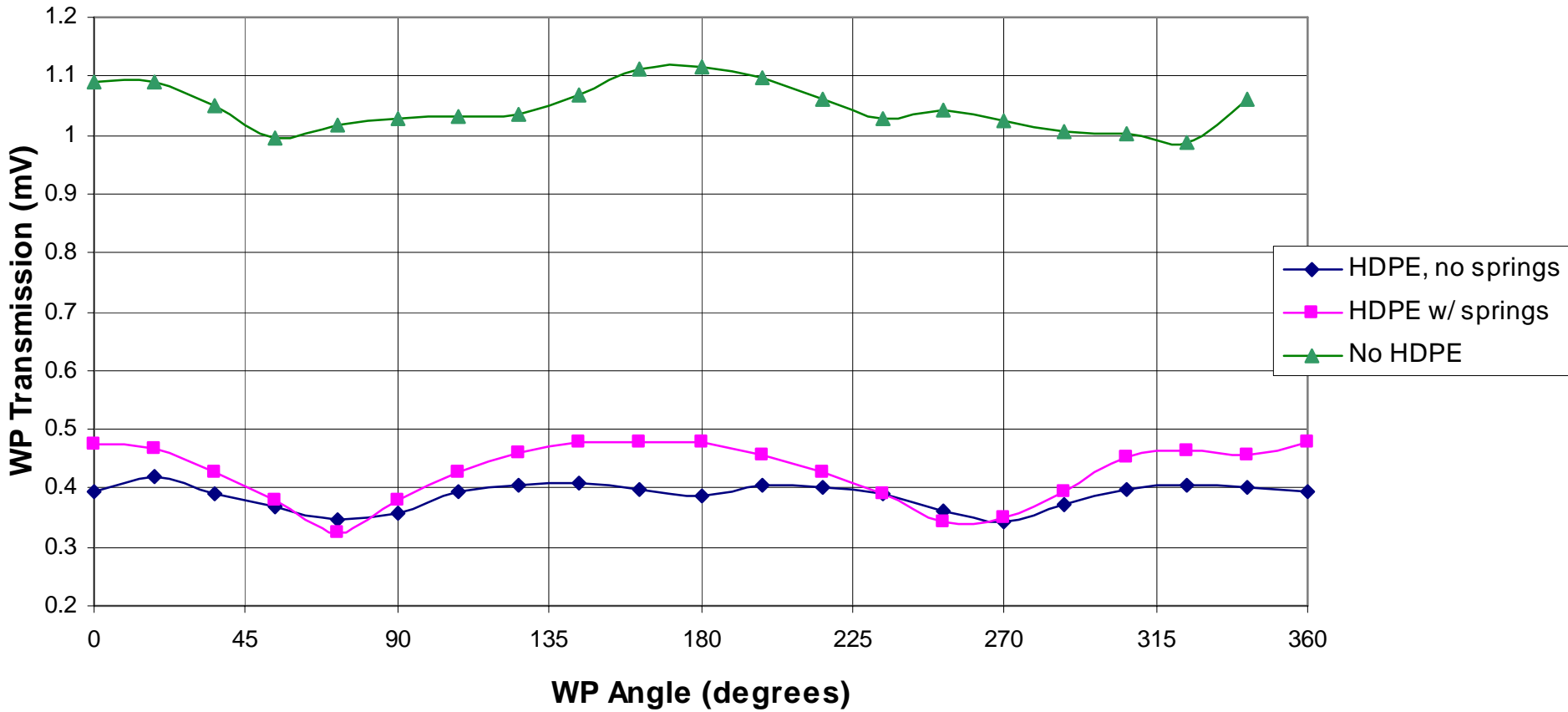
Circular Dichroism



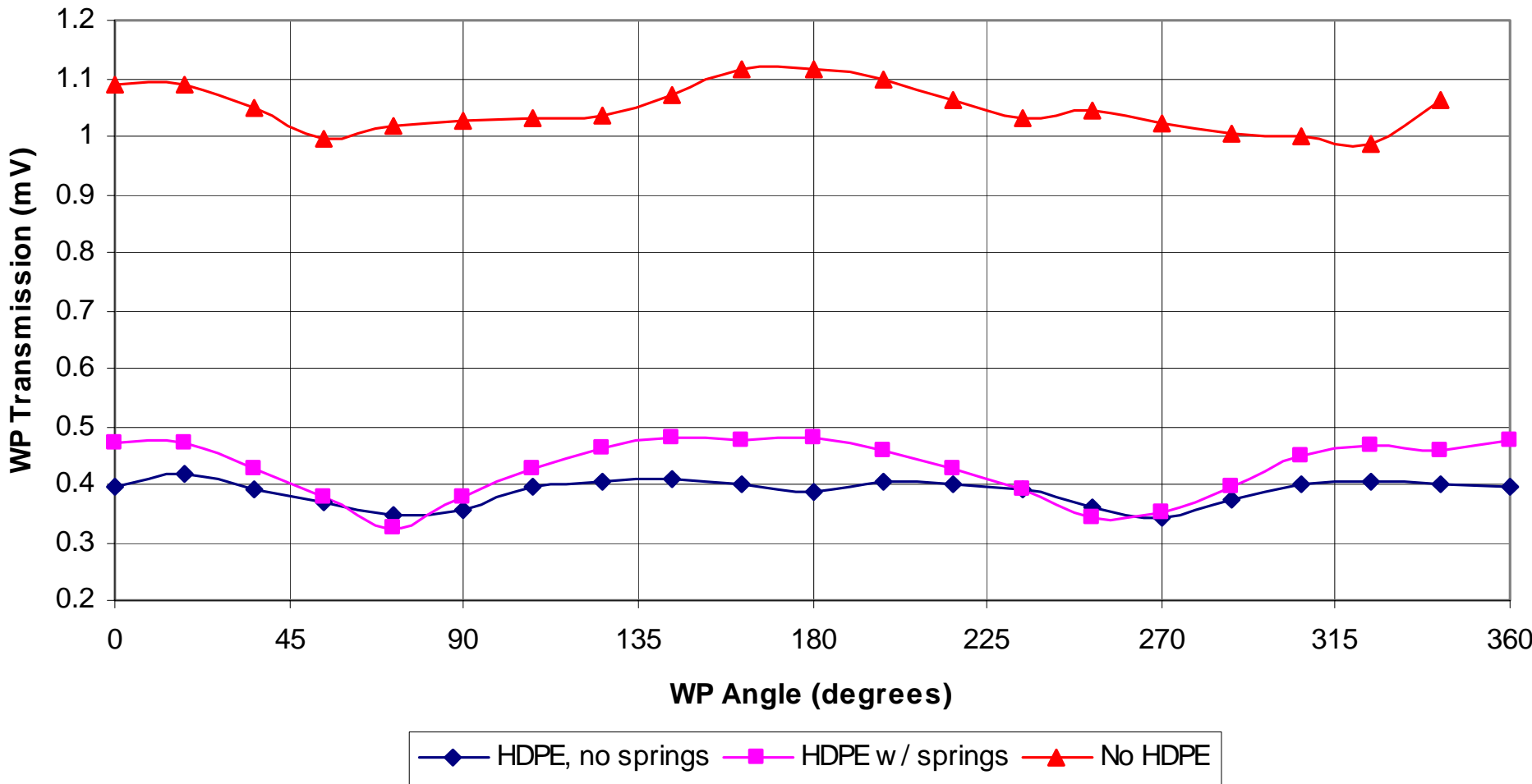
Wave Plate Transmission vs Wave Plate Angle



Wave Plate Transmission vs Wave Plate Angle



Wave Plate Transmission vs Wave Plate Angle

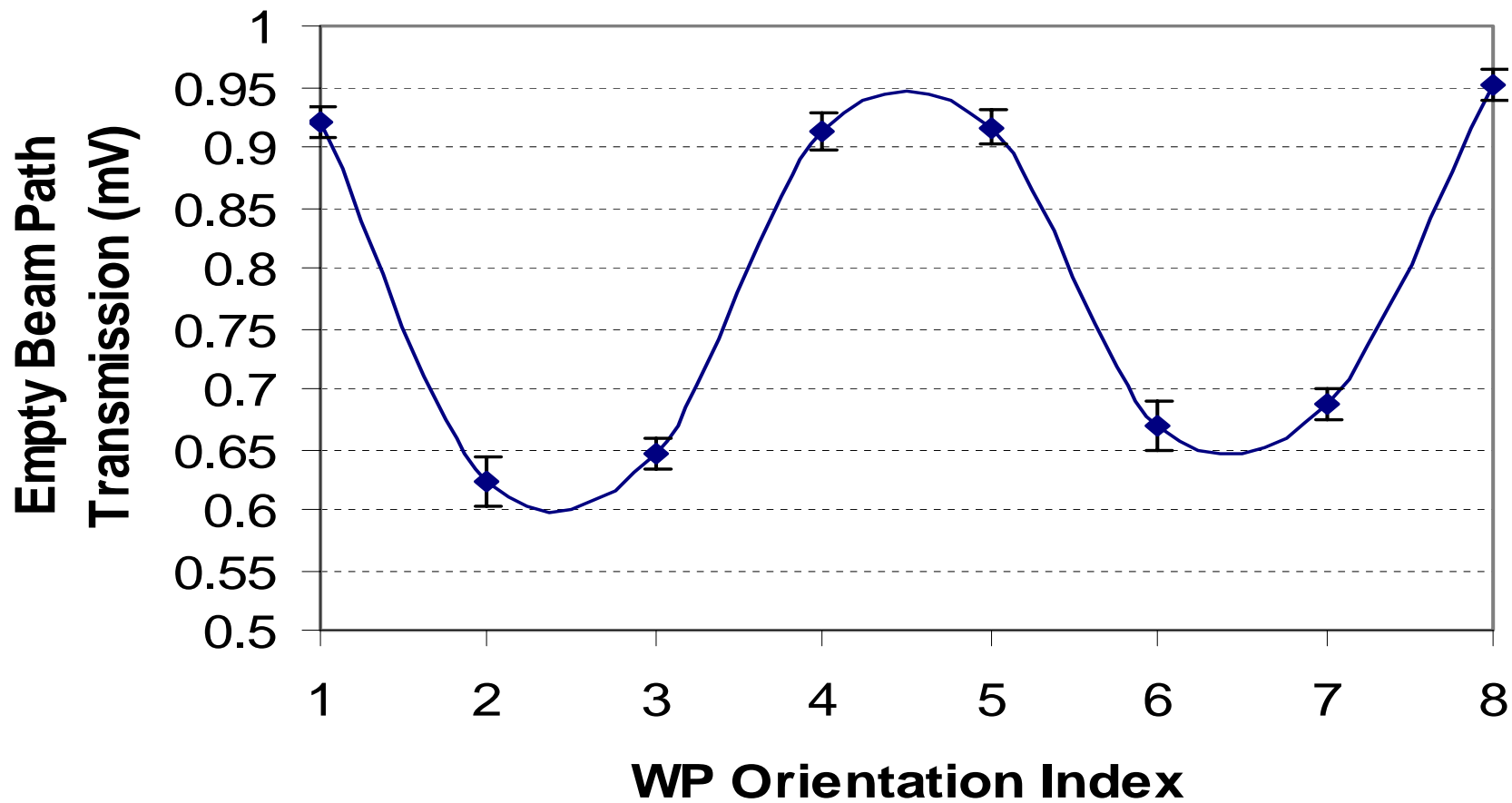


LABVIEW Data Acquisition

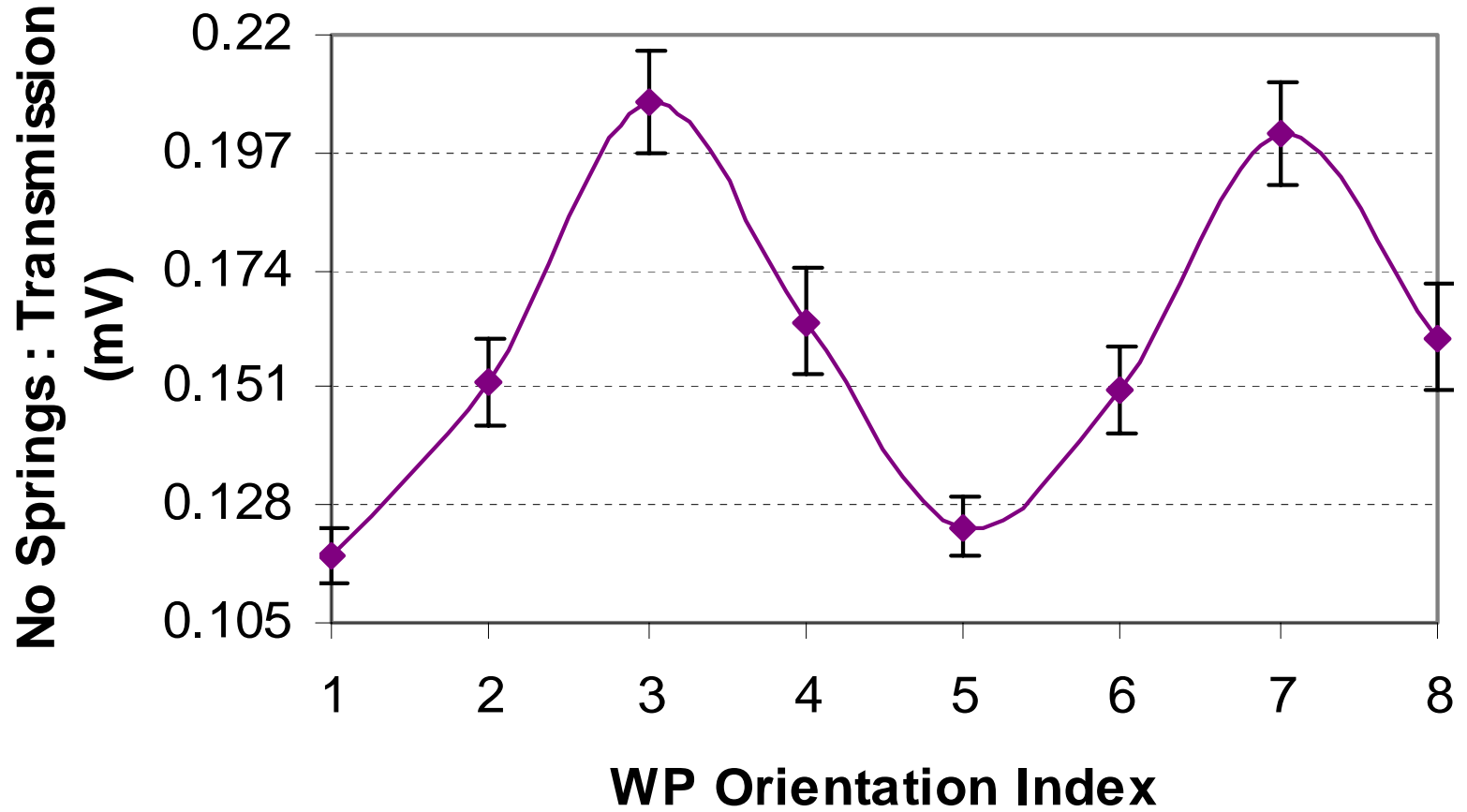
The image shows a Notepad window titled "Empty - Notepad" containing a grid of 80 data points. The data is organized into 8 rows and 10 columns. Each entry is a scientific notation value, such as 8.81306E-4, 6.21907E-4, etc. The window also shows the standard Windows taskbar at the bottom with icons for Start, Exploring - THz CD, Microsoft PowerPoint - [TH...], Empty - Notepad, and system tray icons including the clock showing 7:14 AM.

8.81306E-4	6.21907E-4	6.28177E-4	8.60111E-4	8.89889E-4	6.69662E-4	6.67349E-4	9.05339E-4		
8.89651E-4	6.24720E-4	6.32218E-4	8.63329E-4	8.93787E-4	6.74502E-4	6.70532E-4	9.10548E-4		
8.92941E-4	6.25614E-4	6.34841E-4	8.70267E-4	8.96589E-4	6.73751E-4	6.73203E-4	9.15519E-4		
8.95551E-4	6.22467E-4	6.35747E-4	8.76490E-4	8.96612E-4	6.65215E-4	6.71152E-4	9.20276E-4		
8.96172E-4	6.15565E-4	6.32505E-4	8.81592E-4	8.97280E-4	6.61603E-4	6.71498E-4	9.23566E-4		
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9.08832E-4	6.05360E-4	6.33792E-4	9.05255E-4	9.03884E-4	6.49504E-4	6.74275E-4	9.42568E-4		
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9.20252E-4	6.12596E-4	6.41660E-4	9.19203E-4	9.14196E-4	6.60054E-4	6.83812E-4	9.53320E-4		

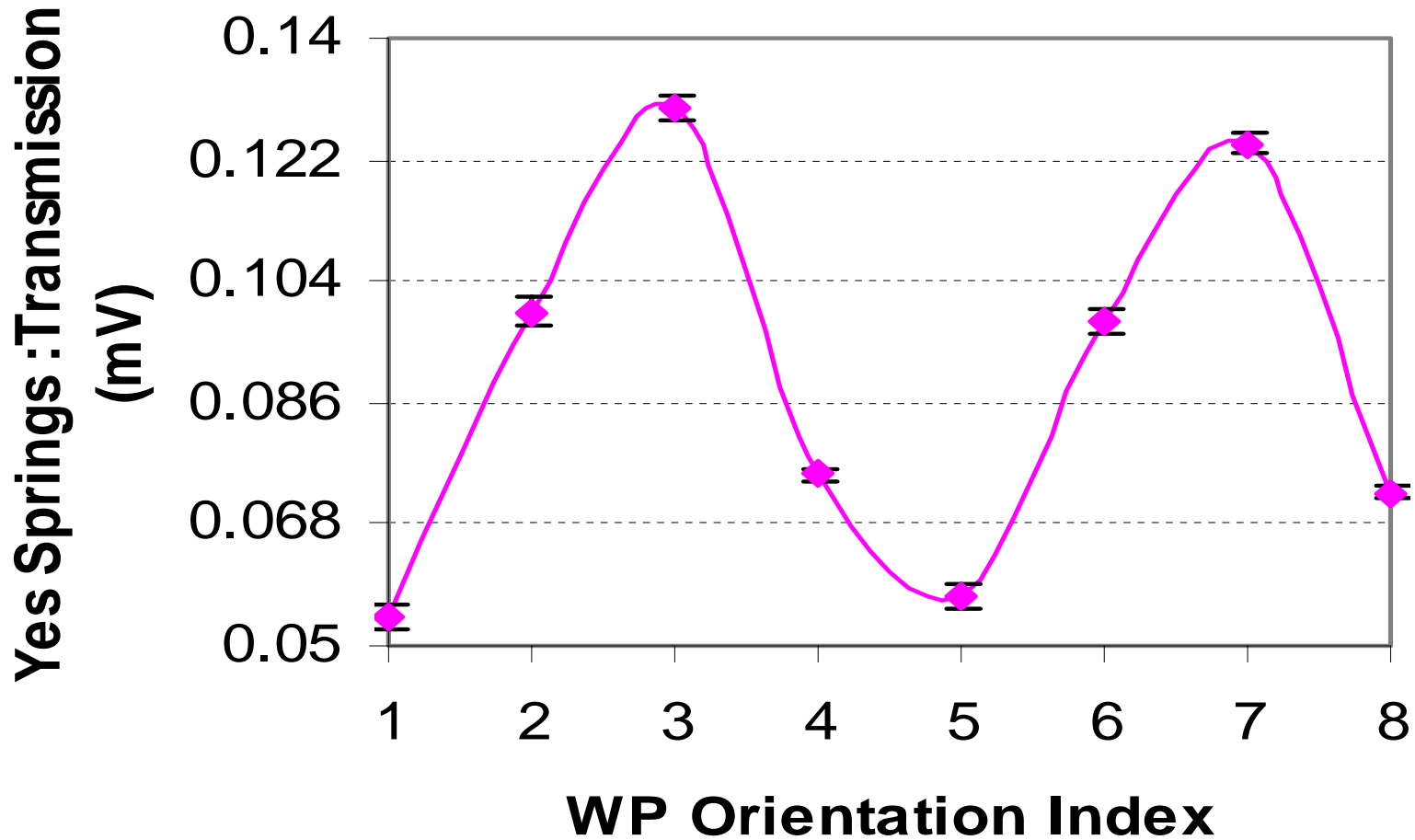
Too Much Variation in Transmission?



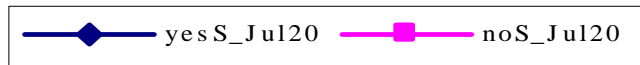
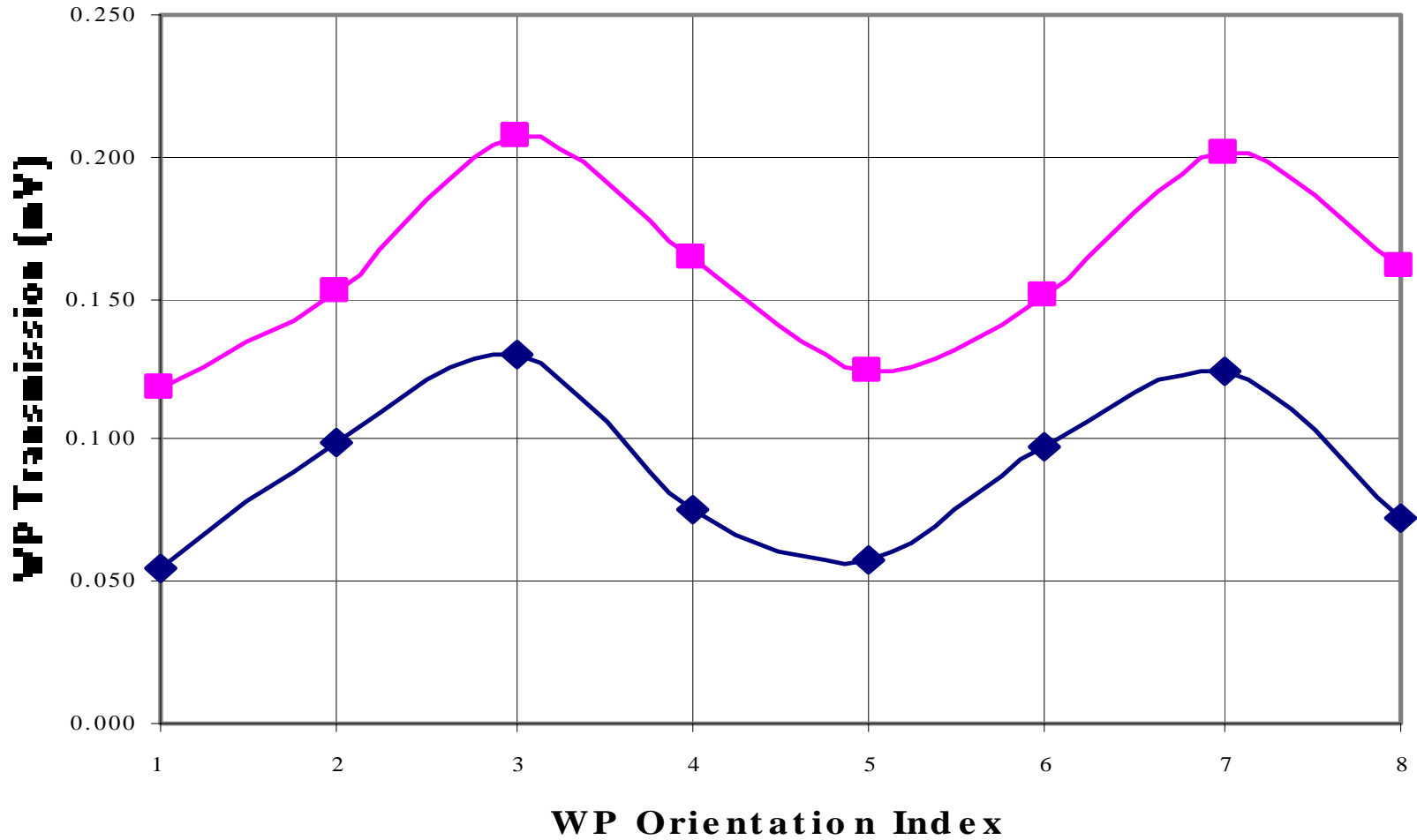
See Springs??



See Springs??



First sign of THz CD?



Discussion/Conclusion

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

Acknowledgements

- Jim Allen, Kevin Plaxco, Jerry Ramian
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- Mike Wrocklage
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