

Characteristics of Various Polarizing Beam Splitter Cubes (PBC)

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Optics Rotation
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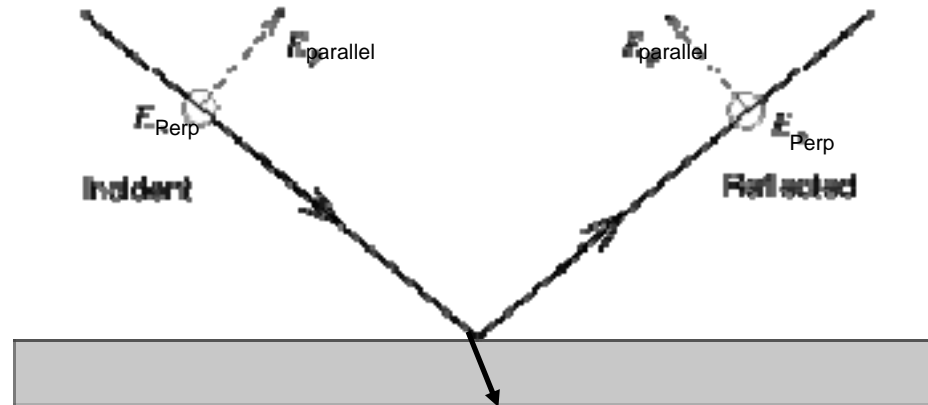
Outline

1. Motivation
2. Various Polarizers
3. Measurements at 632.8 nm
4. Measurements at 1083 nm
5. References and Acknowledgments.

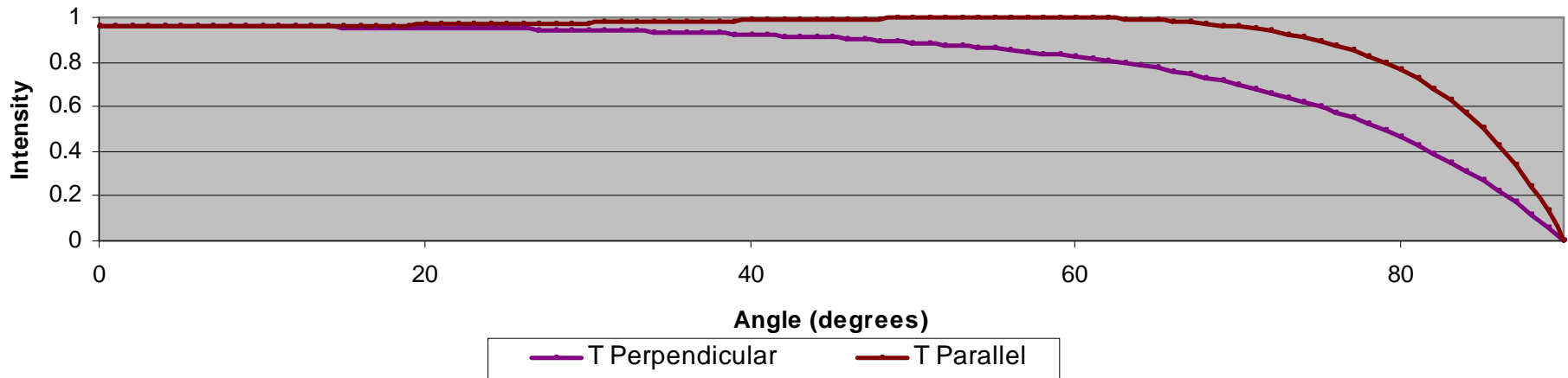
Motivation

- There are many PBC's that are used in association with the lithography experiment that have suspect specifications.
- Do the characteristics of a PBC depend on wavelength?

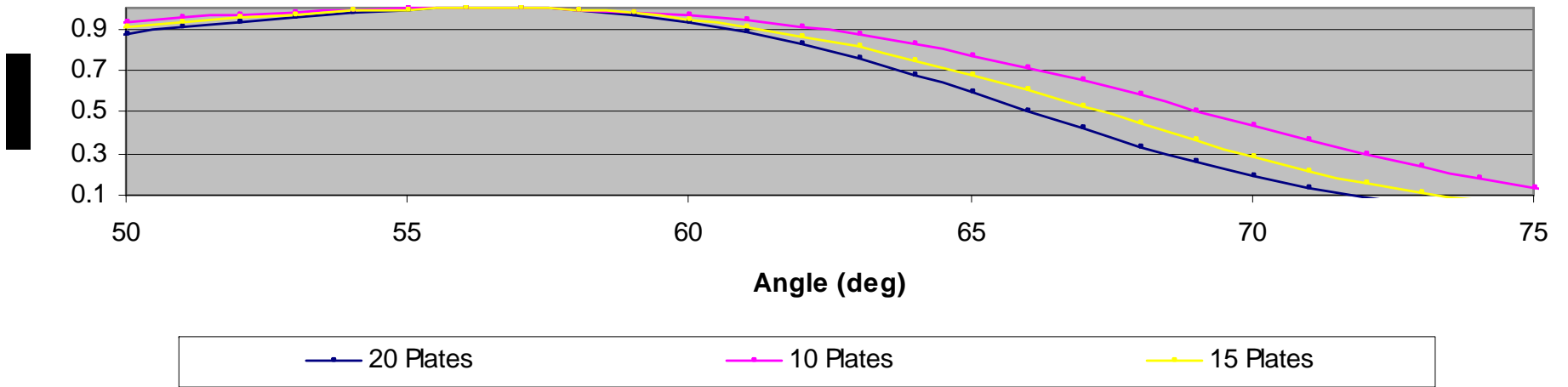
Pile of Plates



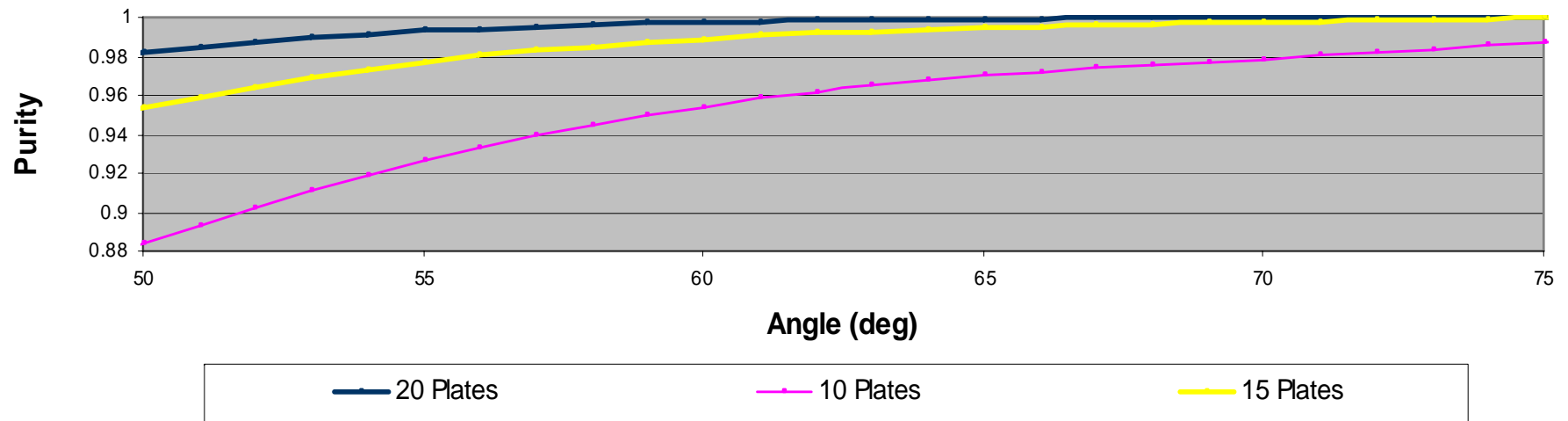
Transmission Amplitudes Versus Angle



Transmission Parallel Versus Angle

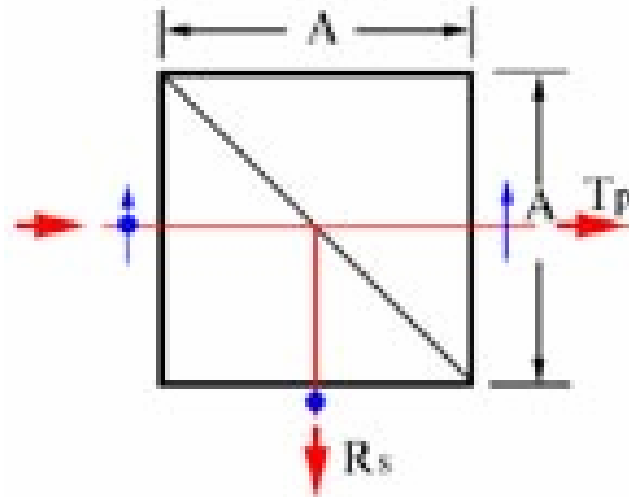


Purity Versus Angle



$$\text{Purity} = \frac{T_{pa}}{T_{pa} + T_{pe}}$$

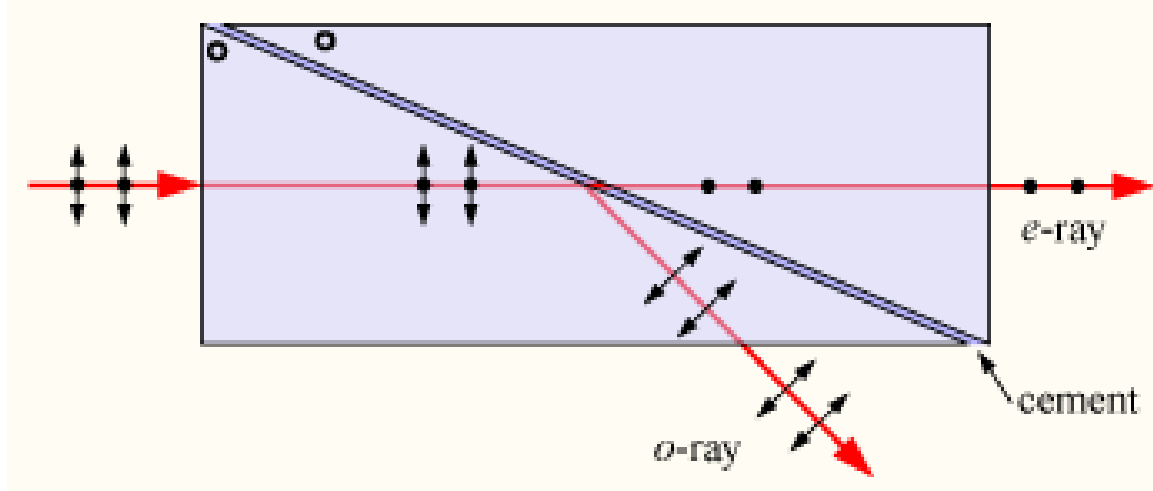
Polarizing Beamsplitter Cube



- Made with BK7 Glass²
- Dielectric coating at the internal cemented interface and antireflection coatings on all external surfaces.
- The PBC should have an extinction ratio of better than 10^{-2} in the transmitted beam.

² http://www.casix.com/product/prod_opt_beamsplitter_pbs.html

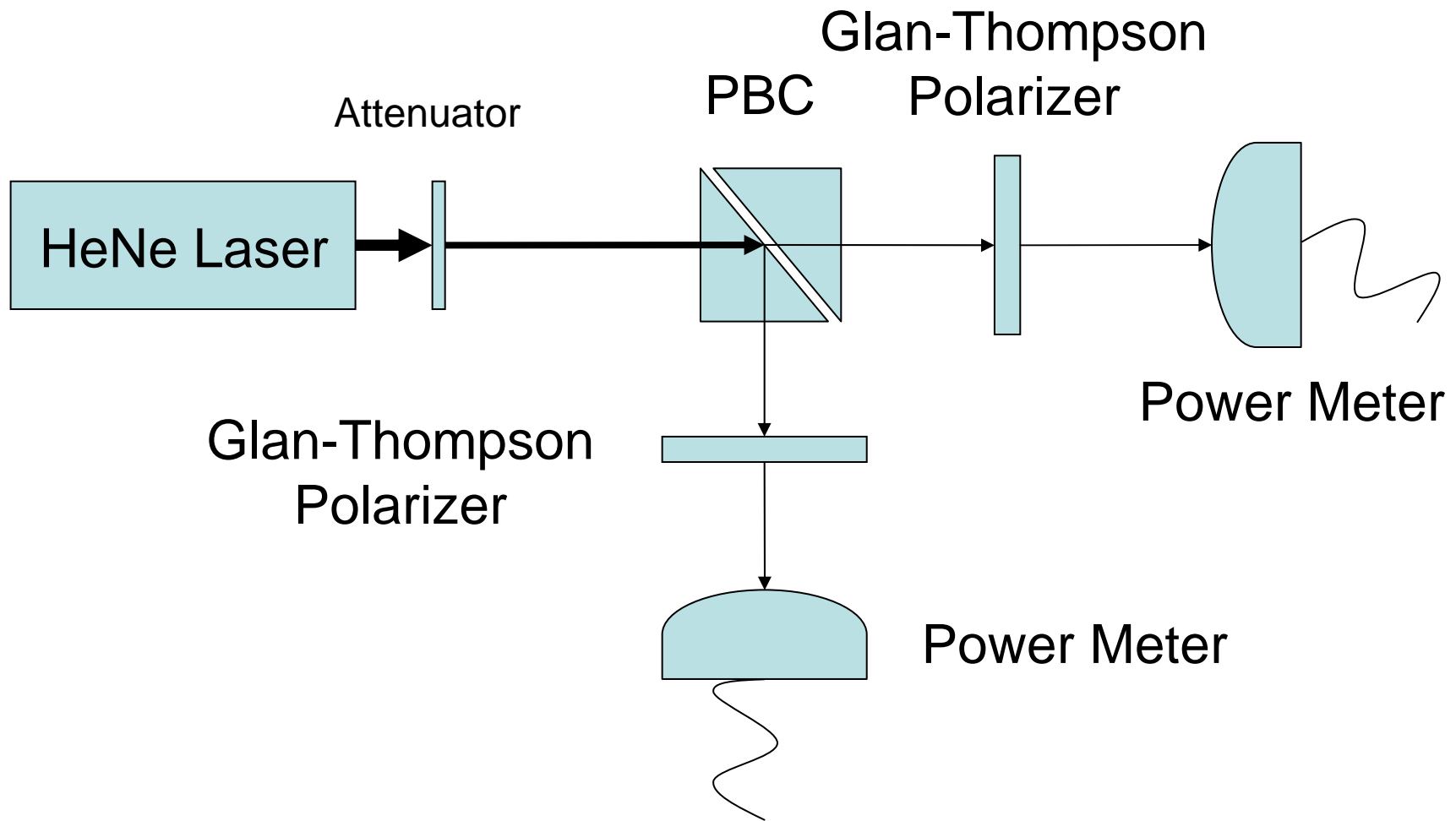
Glan-Thompson Prism



- The Glan-Thompson Prism is made of 2 calcite prisms with an air gap between them and antireflection coatings on external surfaces³.
- Calcite is birefringent so the e-ray and o-ray experience different indices of refraction. The e-ray is partially transmitted while the o-ray is totally reflected.
- Extinction ratios can be of the order 10^{-6} .

3 <http://www.cvilaser.com/Catalog/Pages/Template1.aspx?pcid=135>

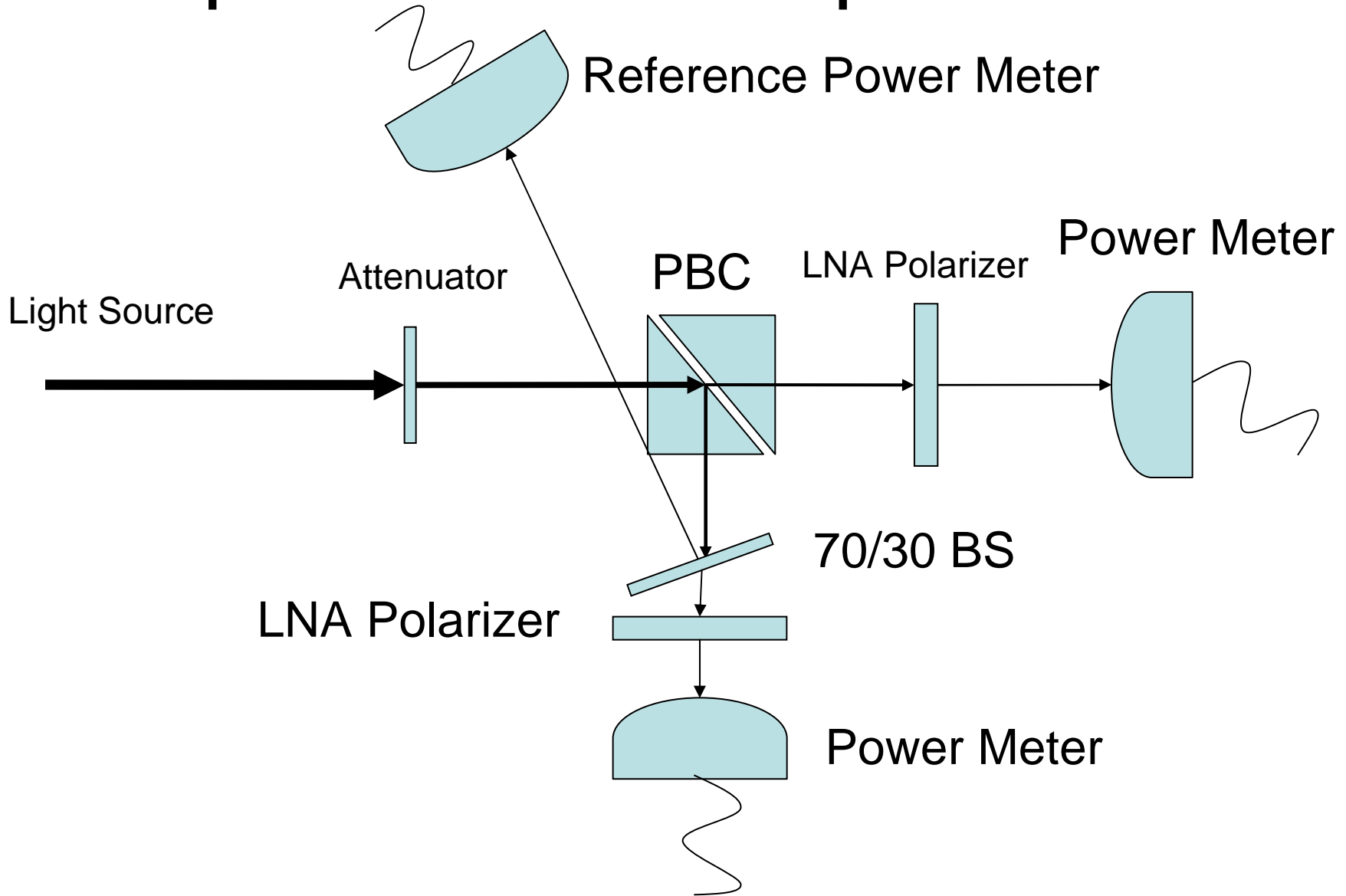
Experimental Setup for 632.8 nm



HeNe Light through a PBC

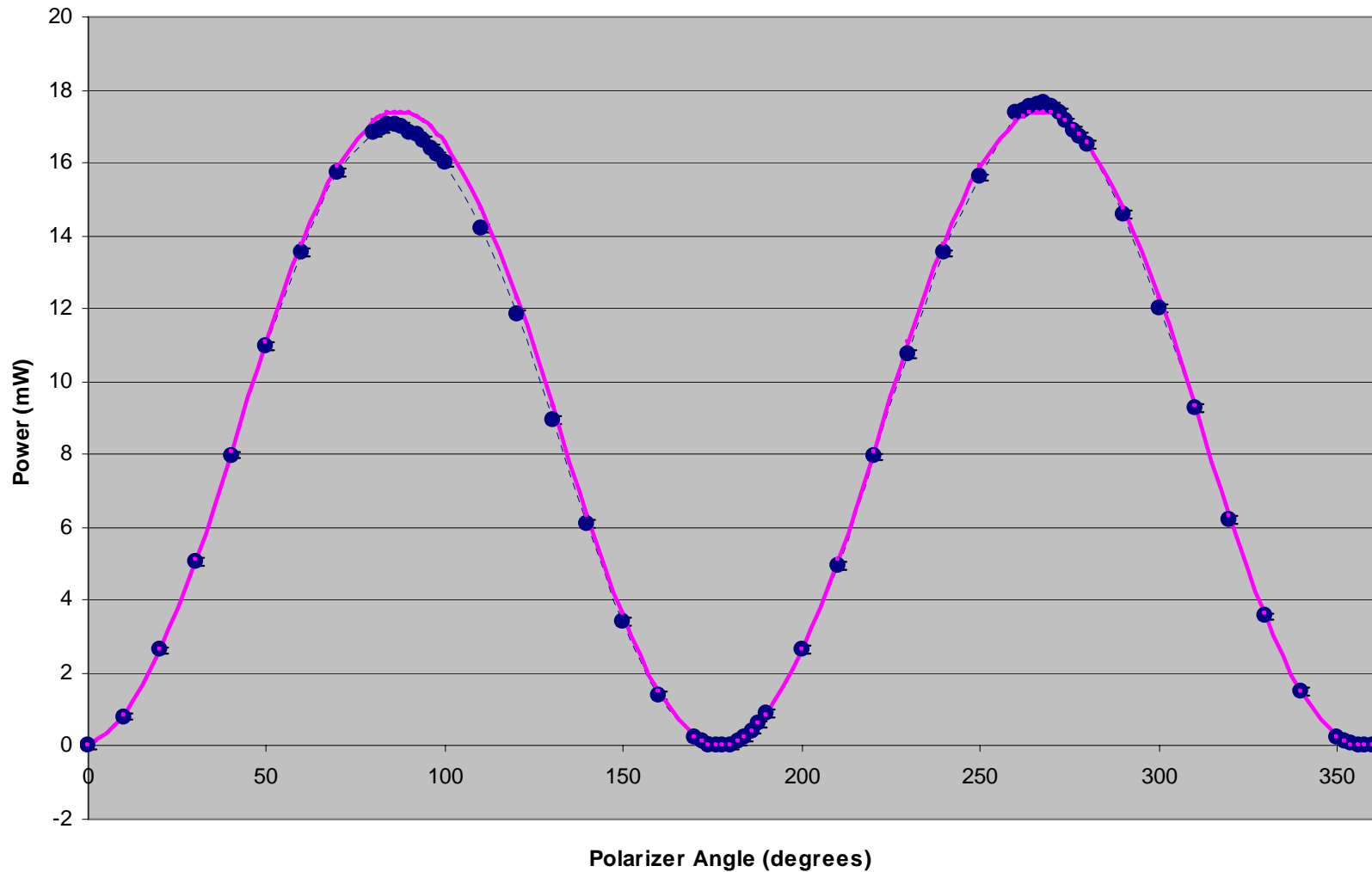
	Minimum (°)	Maximum (°)
Reflected	67+270	67+1
	67+87	67+183
Transmitted	88+178	88+87
	88	88+270

Experimental Setup at 1083 nm



Transmission Arm of PBC 1

Power Vs Polarizer Angle



PBC 1

	Minimum		Maximum	
	Angle (°)	Power (mW)	Angle (°)	Power (mW)
Transmitted	88+90	0.001	88	18.0
	88+270	0.002	88+180	18.1
Reflected	81	0.007	81+91	0.365
	81+180	0.009	81+272	0.37

$T_{\text{extinction}}$	7.5×10^{-5}
$R_{\text{extinction}}$	2.2×10^{-2}

PBC 2

	Minimum		Maximum	
	Angle (°)	Power (mW)	Angle (°)	Power (mW)
Transmitted	88+90	0.004	88	19.0
	88+271	0.005	88+180	18.7
Reflected	76	0.02	76+87	0.58
	76+182	0.02	76+272	0.57

$T_{\text{extinction}}$	2.5×10^{-4}
$R_{\text{extinction}}$	3.4×10^{-2}

PBC 3

	Minimum		Maximum	
	Angle (°)	Power (mW)	Angle (°)	Power (mW)
Transmitted	88+90	0.004	88+1	18.3
	88+270	0.005	88+180	18.2
Reflected	4+91	0.015	4+179	0.68
	4+271	0.016	4	0.64

$T_{\text{extinction}}$	2.4×10^{-4}
$R_{\text{extinction}}$	2.3×10^{-2}

Discussion

- The reflection and transmission arms are closer to orthogonal at 1083 nm than 632.8 nm.
- PBC 1 had the best extinction ratio while PBC 3 produced the most orthogonal polarizations.
- Extinction ratio for the reflection arm of all PBC's were orders of magnitude worse than their transmission counterparts.

Acknowledgements

- A special thanks to Hal, Claire, and Jason for all of their great help with this project.
- As well as thanks to the audience for being here today.