



Quantum Eraser Demonstration with a TeachSpin Two-Slit Apparatus

Presented at the Fall 2015 SCAAPT Meeting

By

Enson Chang

Math and Physics Department

Azusa Pacific University

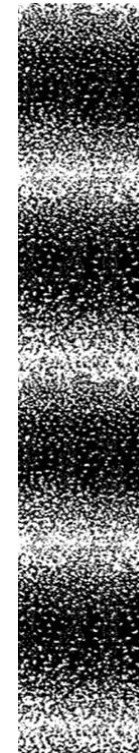
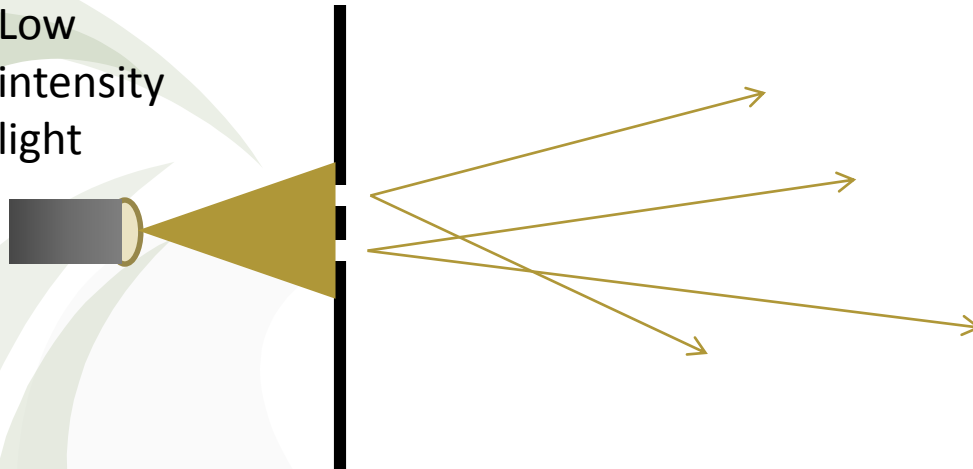
echang@apu.edu

Review of Quantum Eraser (QE)

- Young's double slit experiment

$$\text{Fringe spacing} = \lambda L / d$$

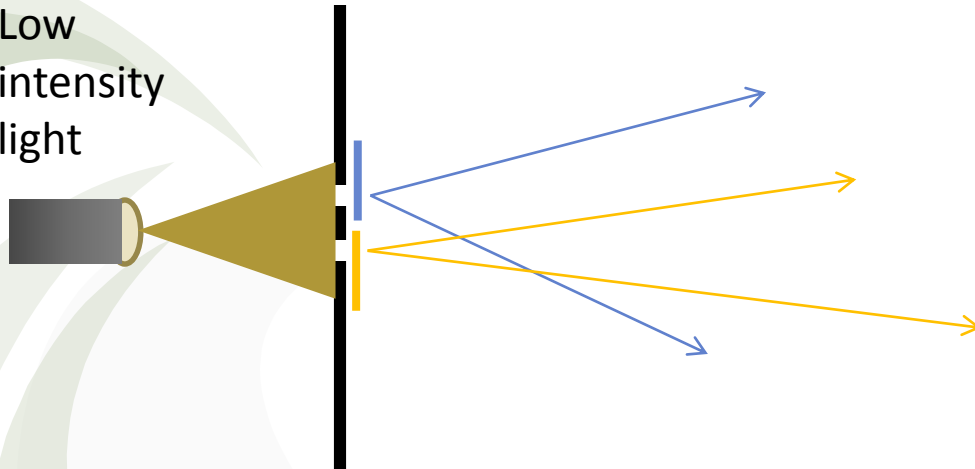
Low
intensity
light



Review of Quantum Eraser (QE) (cont'd)

- Tagging the photons with H and V polarizers
- Interference disappears

Low
intensity
light



No Interference

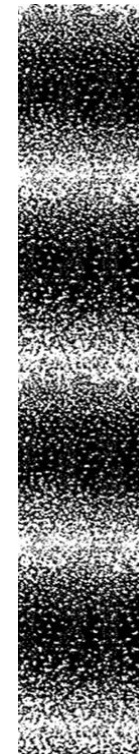
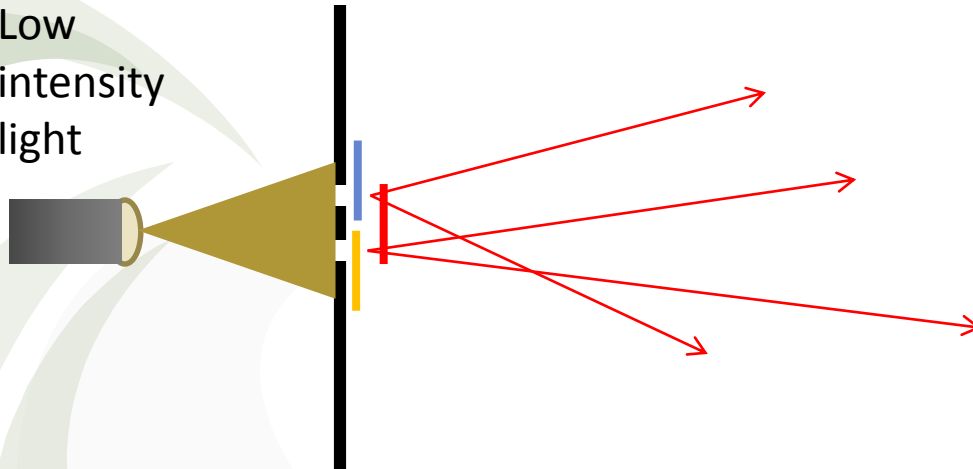


Review of Quantum Eraser (QE) (cont'd)

- Erase the tags with diagonal polarizer
- Interference reappears

Fringe spacing = $\lambda L/d$

Low
intensity
light

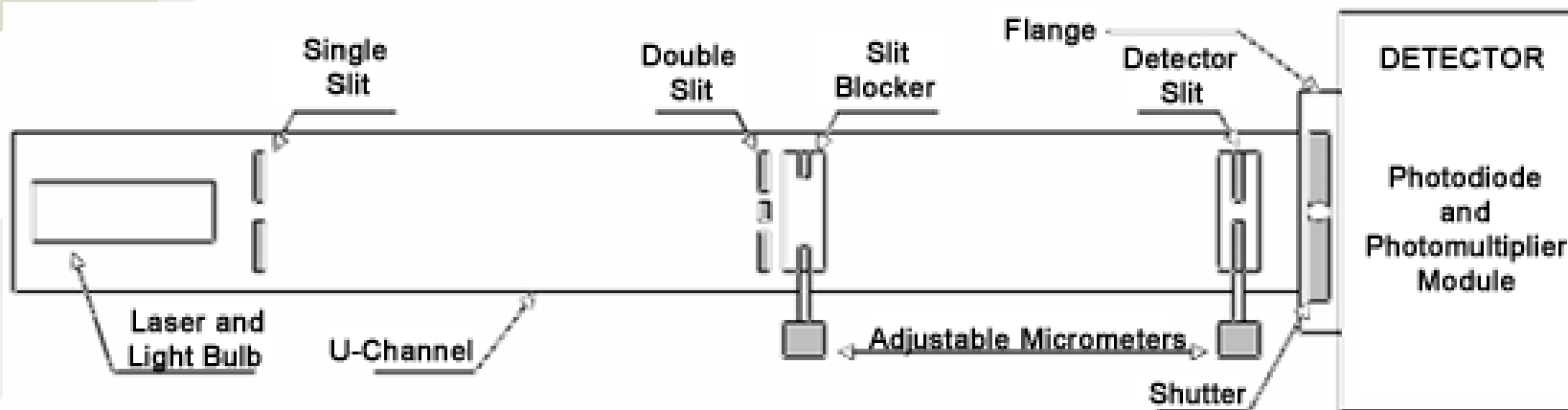
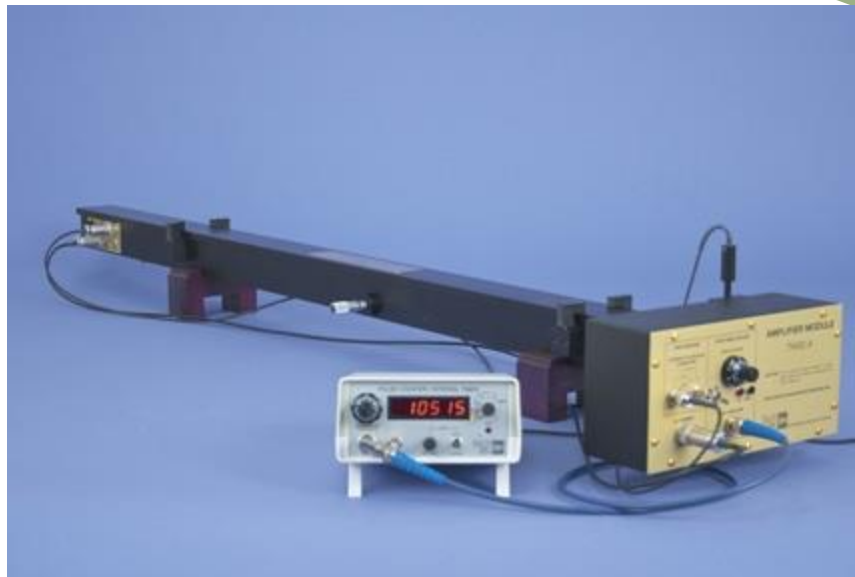


Some Existing Demonstrations

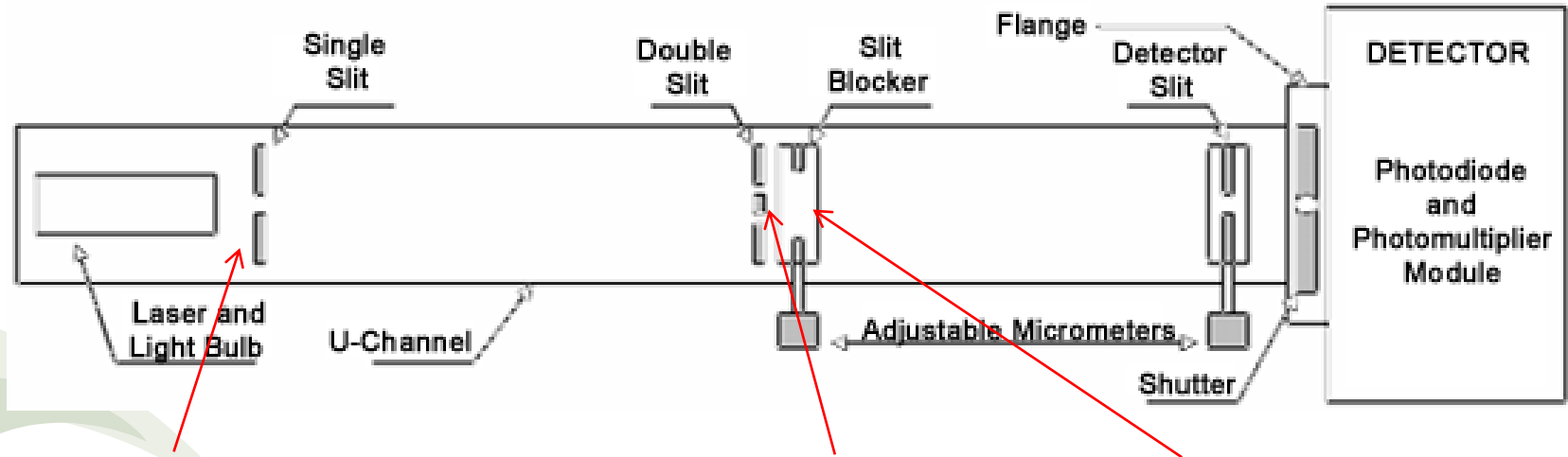
- Classical waves
 - Hillmer, R. and Kwiat, P. (2007), “A do-it-yourself quantum eraser,” *Scientific American*, **296** (5), pp 90 - 95
 - You-Tube videos
- Single photon apparatus
 - Rueckner, W. and Peidle, J. (2013), “Young’s double-slit experiment with single photons and quantum eraser,” *Am. J. Phys.*, **81** (12), pp 951 – 958
 - Schneider, M.B. and LaPuma, I.A. (2002), “A simple experiment for discussAm. J. Phys., **70** (3), pp 266 - 271



TeachSpin's Two-Slit Apparatus



Modifications to Make a Quantum Eraser Demonstration



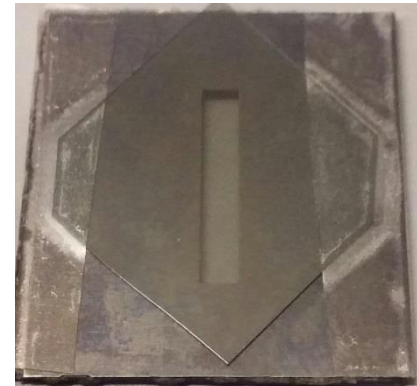
Light Polarizer



Original Slits

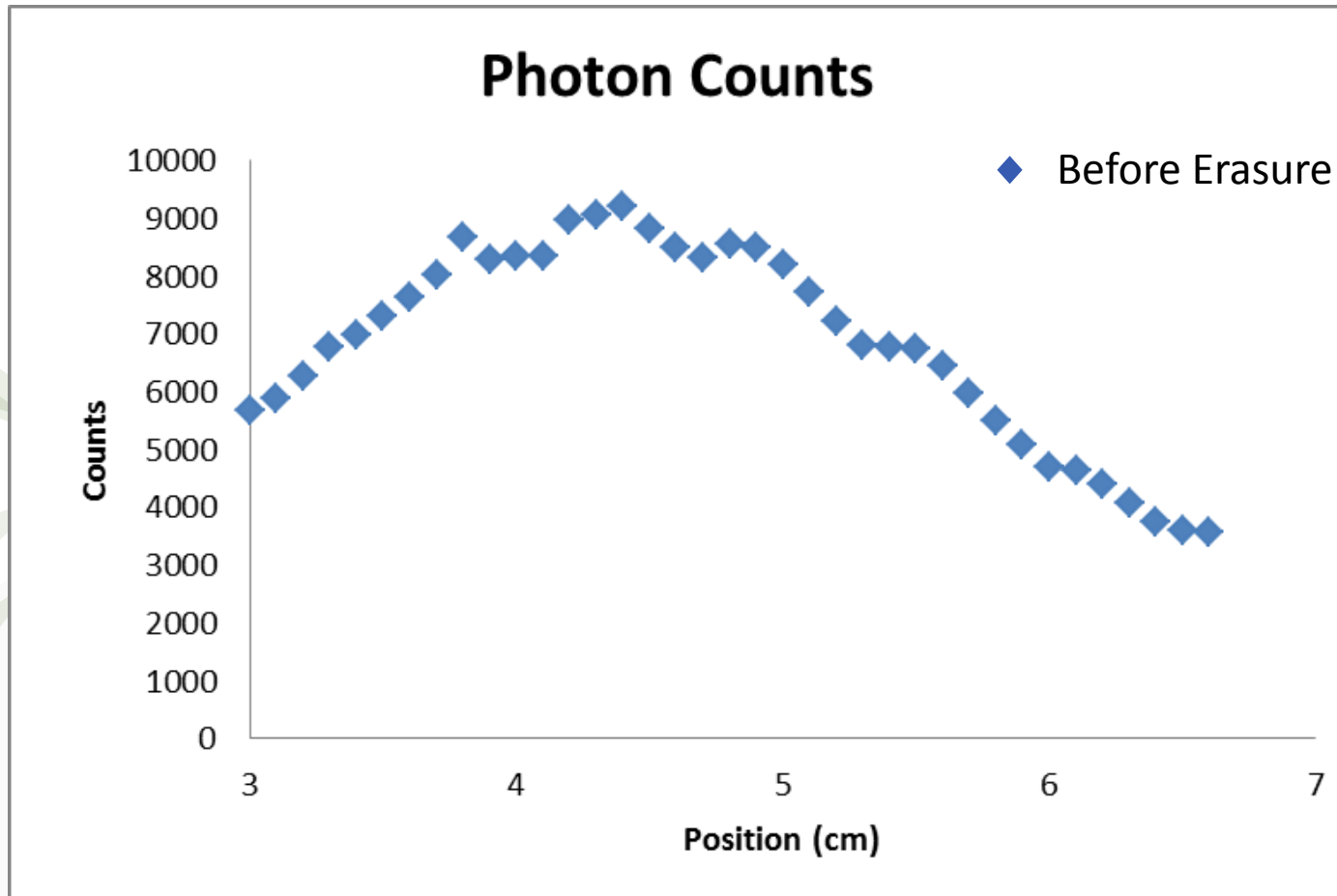


Slits, \perp Polarizers

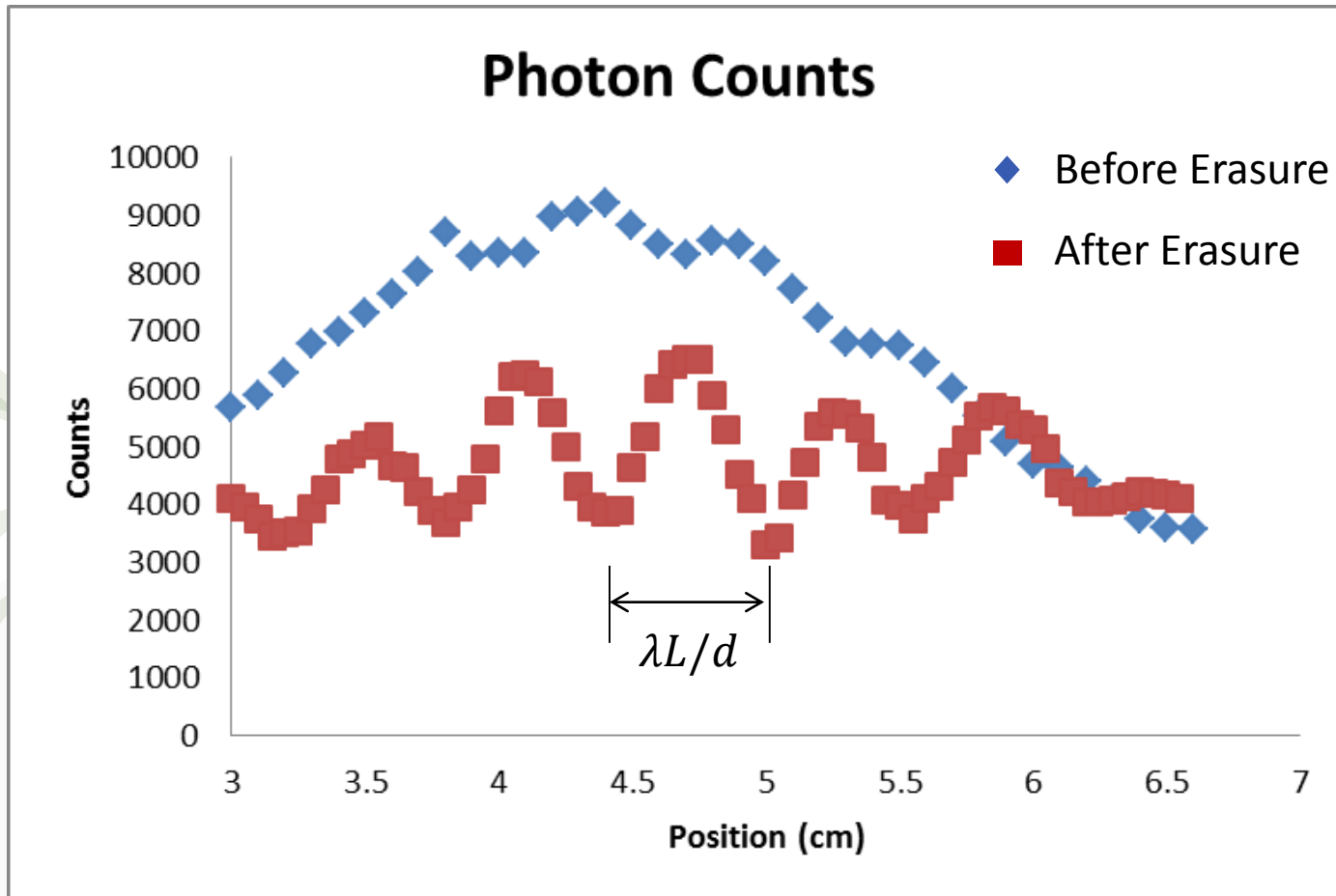


Eraser

Photon Counts Before Erasure



Photon Counts After Erasure



Additional Student Exercise

- Calculate interference pattern for different polarizations of the incoming photons
 - Analysis explains why unpolarized light does not work for QE

