

# Single-Photon Interference

Liza Mulder\* and Isabel Lipartio<sup>†</sup>

*Department of Physics, Smith College, Northampton, MA 01063*

(Dated: November 19, 2014)

Abstract

## I. INTRODUCTION

## II. METHODS

We used the Teach-Spin "2-Slit Interference One Photon at a Time" Apparatus for this experiment. The apparatus comes with a long black box containing an adjustable light source (with green filter to restrict wavelength and intensity), a 670nm laser source for alignment, four magnetic slit-holders along the length of the box for adding slits in the path of the light, and two detector options at the end: a photodiode (for laser light) and a photomultiplier tube (for lightbulb illumination). We placed a single columnating slit in the first holder to focus the light from the lightbulb. This created vertical a single-slit diffraction pattern, which we centered on the next set of slits. In the second slit holder, in the middle of the box, we placed the double-slit, and immediately following that we placed the slit blocker (a wide single-slit) so we could choose to allow light through one slit, both slits, or neither. At the far end of the box we placed a single slit for the detector slit - by moving this slit holder lengthwise across the channel we could "scan" the interference pattern and measure photon counts at regular intervals.

Behind the detector slit was a photomultiplier tube (PMT). A PMT generates an electrical current

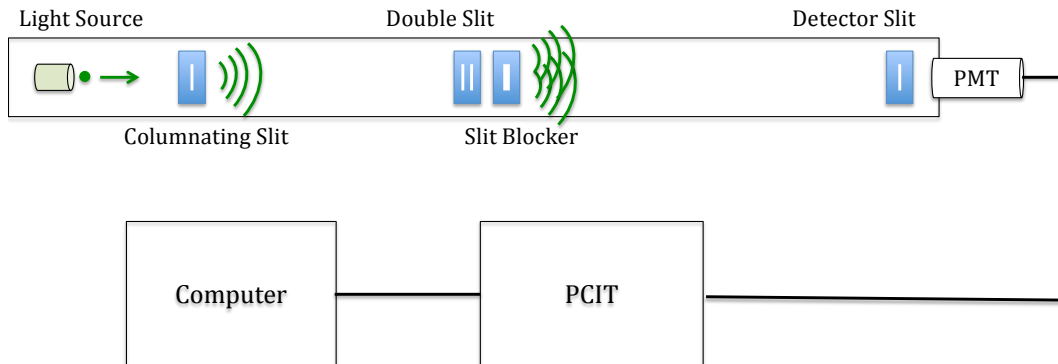


FIG. 1. Teach-Spin apparatus to measure quantum interference: a 1m-long black box containing an adjustable light source (450nm), columnating single slit, double slit, slit blocker, detector slit, and photomultiplier tube (PMT) detector. We sent the PMT output to a pulse-counter interval timer (PCIT), and from there to the computer.

### III. RESULTS

### IV. ANALYSIS

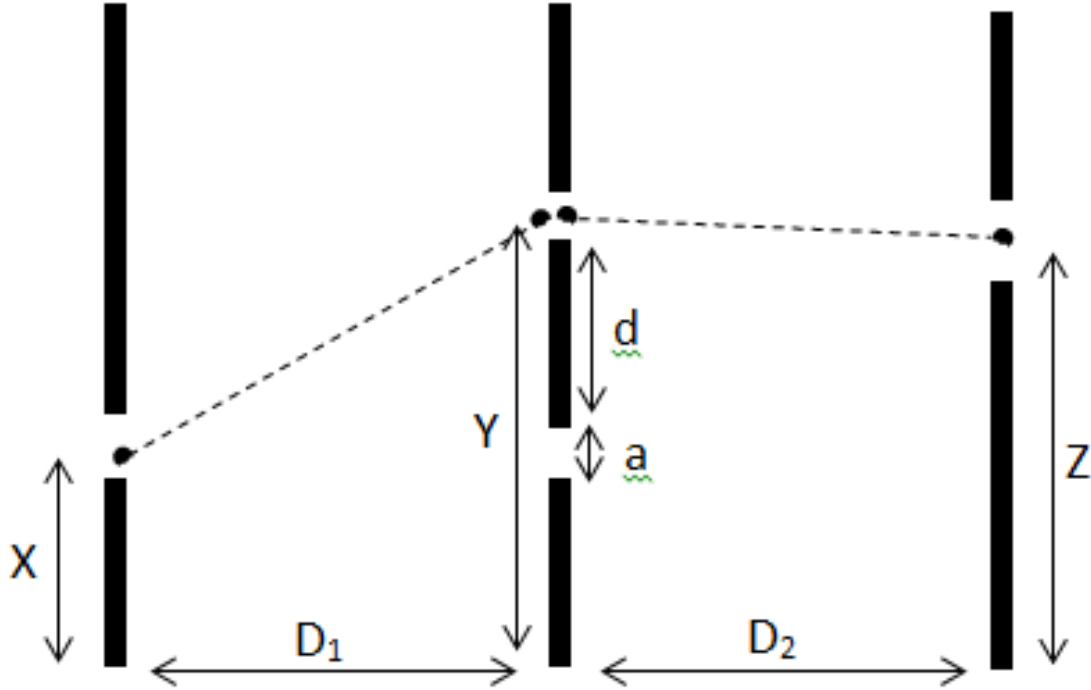


FIG. 2. The set-up and variables used in the Fresnel Approximation. Note that the variable " $Z$ " in the fresnel formula is what we've been calling " $X$ " in our other calculations - the position of the detector slit.

### V. DISCUSSION

### VI. CONCLUSION

---

\* emulder@smith.edu

† iliparti@smith.edu