### Introduction

Synchrotron radiation is a powerful tool used in many fields of science ranging from materials characterization to structural biology. Each year thousands of scientists travel to SLAC National Accelerator Laboratory to use high-resolution x-rays emitted from a relativistic electron beam circulating in the SPEAR3 synchrotron light source.

The electron beam is manipulated by SPEAR3 operators depending on the research being done. By changing the beam’s characteristics, the height of the beam is affected. Knowing the correct height enables the most beneficial results.

In this project, we:

1. Constructed a visible-light interferometer to measure the height of the relativistic electron beam
2. Measured the contrast of the interference pattern as a function of the vertical slit separation
3. Measured changes in the vertical beam size while keeping the slit separation fixed

### Methods

To measure the vertical beam size, an interferometer was constructed. It consists of:

- Adjustable two-slit apparatus
- 2 m Focusing lens
- Retro-mirror
- 550 nm Bandpass filter with width of 10 nm
- Neutral density filter
- Glan-Thompson polarizer
- 0.4-4X Zoom lens
- CCD Camera

### Experimental Results

Measured change in contrast as a function of interferometer slit separation.

![Interferometer schematic](image)

Experimental set-up

The contrast, or visibility, of the interference pattern is then numerically fit to a model and mathematically translated into vertical beam size.

### Results (cont’d)

Measured change in beam size while maintaining constant slit separation by adjusting skew quad coupling magnets.

![Contrast vs. skew quad adjustment](image)

The visible-light interferometer can measure beam size of an incoherent light source with a height of 25 μm located 17 meters away. The interferometer will remain in SPEAR3 as an on-line beam diagnostic. For example, with a few minor adjustments, the interferometer can be applied to measure the horizontal beam size.

### Conclusions

The electron beam is affected. Knowing the correct height enables the most beneficial results. Enables the most beneficial results.

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