



Experiments on Photon Quantum Mechanics

Colgate University, June 13–15, 2017

(Three set-ups available for nine participants total)

Host and Mentor

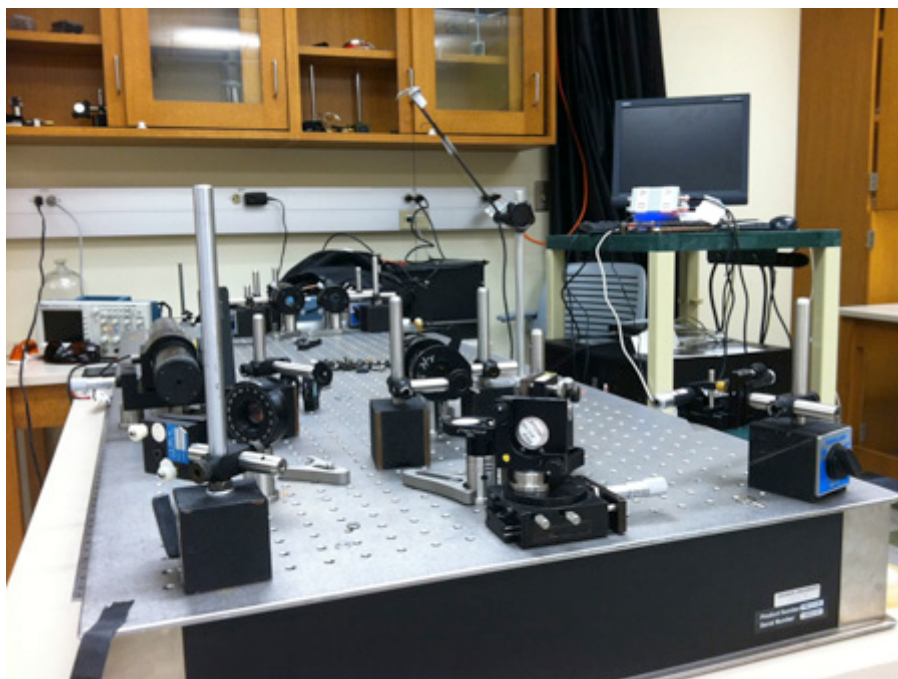


Enrique "Kiko" Galvez (Ph.D. Univ. of Notre Dame) is Charles A. Dana Professor of Physics and Astronomy at Colgate University. He has been at Colgate University since 1988, teaching physics and doing experimental physics research in atomic physics, classical and quantum optics, and undergraduate lab development. Research in classical and quantum optics is related to the topic of the experiments, and that expertise is brought into the hands-on Immersion exercises. Colgate students are mentored into similar projects; they are active participants in the research and coauthors in publications.

Enrique J. "Kiko" Galvez, Charles A. Dana Professor of Physics and Astronomy, Colgate University, Department of Physics and Astronomy, 13 Oak Drive, Hamilton, NY 13346. Email: egalvez@colgate.edu. Telephone: 315-228-7205

Theme: The general topic involves experiments with correlated photons. In the Immersion we will cover the following lab exercises, which include full hands-on setup and alignment: Spontaneous parametric down-conversion, single-photon interference, quantum eraser,

Hanbury-Brown-Twiss test, entanglement, Bell inequality violation. The goal of the workshop is to get faculty to learn how to set up and do the experiments. Although we have sessions where we discuss the significance of the experiments, most of the time is spent on hands-on experimentation. This way, participants are able to go back to their institutions and be able to put together an apparatus and implement successful experiments.



Equipment: The apparatus: 2'x5' optical breadboard with diode and HeNe lasers, down-conversion crystal, optical steering hardware, polarization optics, fiber optics, photon detection equipment, and data acquisition board/electronics and PC with Labview interface.

Curriculum: The experiments underscore fundamentals of quantum mechanics: superposition and entanglement. The goal is for students to understand what quantum mechanics has to say about light, superposition and other fundamental concepts, such as nonlocality, determinism and realism. Students grapple with challenging fundamental concepts of quantum mechanics in the context of real experiments. These experiments can be implemented in several contexts, but are well suited for the advanced lab. These have also been introduced into other parts of the physics curriculum.

Skills that may be acquired through the experiments: Laser optics (alignment etc.), photon counting, pulse electronics, Labview.

Schedule (2-1/2 days):

Day 1 AM: Basic alignment, down-conversion

Day 1 PM: Single-photon interference, white-light-fringe alignment.

Day 2 AM: Single-photon interference, waveplate tutorial, quantum eraser

Day 2 PM: Hanbury-Brown-Twiss test, entanglement (setup, correlations)

Day 3 AM: Bell inequality violation

Participants do not need to bring any equipment.

There are minimal safety considerations, such as wearing laser goggles when appropriate.

Cost of the Experiment (updated 2017)

Please note that the Jonathan F. Reichert Foundation has established a grant program ([ALPhA webpage](#); [Foundation website](#)) to help purchase apparatus used in Laboratory Immersions. Limitations and exlusions apply, but generally speaking the foundation may support up to 40% of the cost of the required equipment.

Copyright © 2007-2017 by the ***Advanced Laboratory Physics Association***.