ADVANCED LABORATORY COURSE

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Reed College

OUTLINE:

- What is the Advanced Laboratory?
- Funding and Hot Topics
- ALPhA

VARIOUS APPROACHES TO ADVANCED LAB

Freshman	Intro Physics with Lab	Intro Physics With Lab
Sophomore	Intro Physics	Intro Physics
Junior/Senior	Classical Mechanics Electrodynamics	Quantum Mechanics Thermal Physics

VARIOUS APPROACHES TO ADVANCED LAB

Freshman	Intro Physics with Lab	Intro Physics With Lab
Sophomore	Intro Physics	Intro Physics Modern Physics Lab
Junior/Senior	Classical Mechanics Electrodynamics Electronics Course	Quantum Mechanics Thermal Physics

VARIOUS APPROACHES TO ADVANCED LAB

Freshman	Intro Physics with Lab	Intro Physics With Lab
Sophomore	Intro Physics	Intro Physics
Junior/Senior	Classical Mechanics	Quantum Mechanics
	Electrodynamics	Thermal Physics
	Specialty Course with Lab (e.g., Optics)	

VARIOUS APPROACHES TO ADVANCED LAB

Freshman	Intro Physics with Lab	Intro Physics With Lab
Sophomore	Intro Physics	Intro Physics
Junior/Senior	Classical Mechanics Electrodynamics Independent Project Course	Quantum Mechanics Thermal Physics

VARIOUS APPROACHES TO ADVANCED LAB

Freshman	Intro Physics with Lab	Intro Physics With Lab
Sophomore	Intro Physics	Intro Physics
Junior/Senior	Classical Mechanics Electrodynamics	Quantum Mechanics Thermal Physics

Short Internship in Research Lab

VARIOUS APPROACHES TO ADVANCED LAB

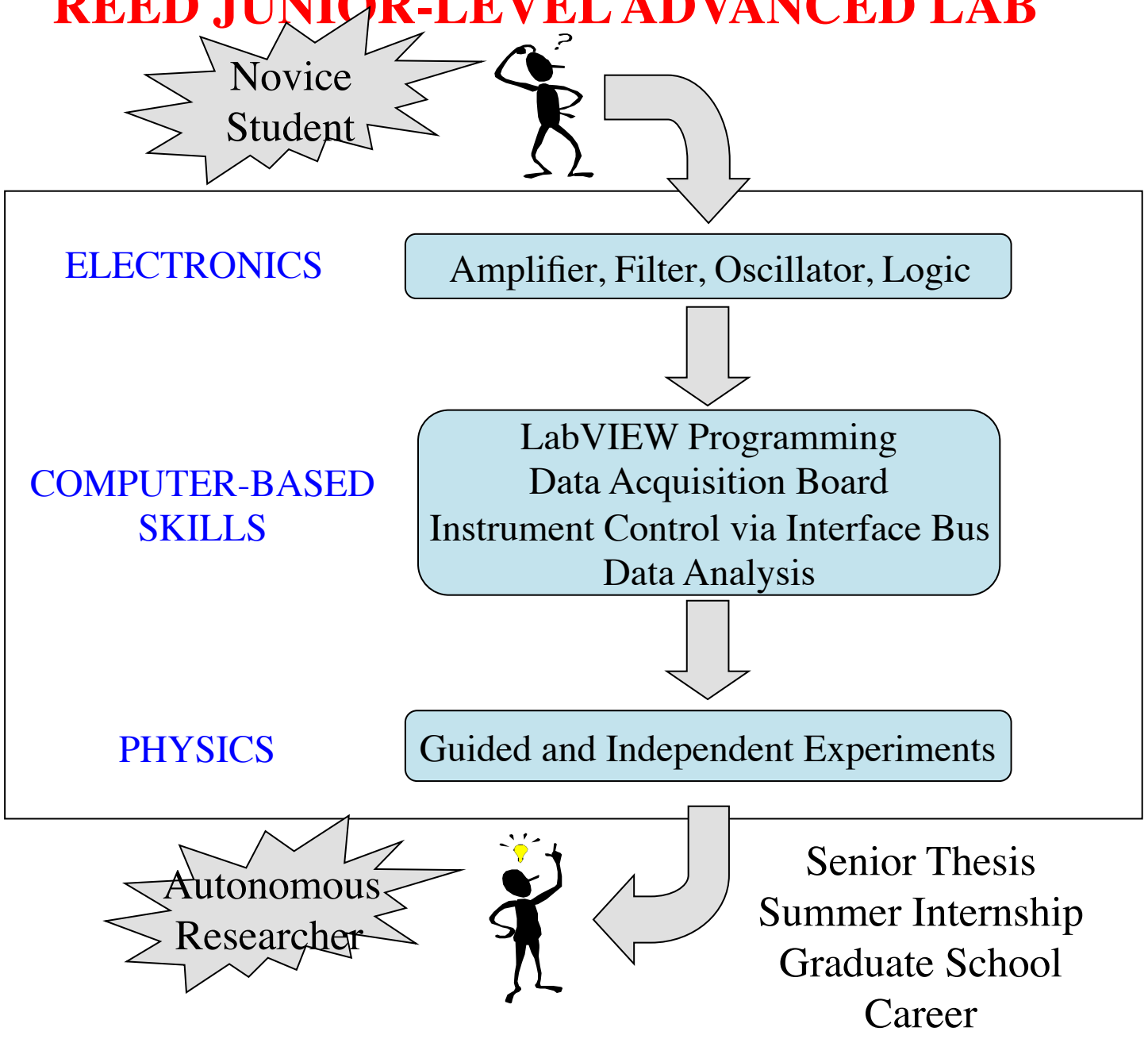
Freshman	Intro Physics with Lab	Intro Physics With Lab
Sophomore	Intro Physics	Intro Physics
Junior/Senior	Classical Mechanics Electrodynamics	Quantum Mechanics Thermal Physics

Lab Course with Guided and Independent Projects

GOAL: TEACH BASIC RESEARCH SKILLS

PHYSICAL UNDERSTANDING	Apply Classroom Theory Background Literature Searches Consultation With Experts Adequate Level of Precision Range of an Approximation Suppression of Competing Effects
DATA-TAKING SKILLS	Electronics Computer-Assisted Data Acquisition Optics Vacuum Technology Data Analysis Techniques Design of Sophisticated Instrumentation Patience Consistency Checking
RESPONSIBILITY TO THE COMMUNITY	Outside Interest In Results Benefit Of Peer Review Honest, Timely, Concise Report of Results

REED JUNIOR-LEVEL ADVANCED LAB



SPRING-SEMESTER PHYSICS EXPERIMENTS

Guided Experiments:

- Optical Bandgap of Semiconductor (Monochromator)
- Doppler-Free Saturated Absorption Spectroscopy (Laser Diode)
- Temperature Dependence of Diode's Saturation Current (Cryostat)
- Isotope Shift of Balmer Series in Hydrogen (Spectrometer)
- Mass of Cosmic Ray Muon (Fast-Timing Electronics)
- Fabrication of Fullerenes (Materials Fabrication)
- Proof of Existence of Photons (Single-Photon Detection)

SPRING-SEMESTER PHYSICS EXPERIMENTS

Independent Projects:

- High-Temperature Superconductor
- Chaotic Electrical Circuit
- Raman Spectroscopy
- Quantized Conductance in Nanowire
- Quantum-Dot Photoluminescence
- Period of Jupiter's Moons
- Optical Tweezers

FUNDING ADVANCED LAB DEVELOPMENT

Institutional Sources:

- Departmental Budget Line-Item
- Development Office
- Alumni Donations
- Local Industry Donations

External Sources:

- Foundations (e.g., Keck)
- NSF (Broader Impact, Dissemination)

HOT TOPICS IN ADVANCED LAB DEVELOPMENT

Quantum Optics Experiments:

Existence of Photon
Single-Photon Interference
Entanglement and Quantum Eraser
Bell's Inequality

Computer-Based Data Acquisition:

LabVIEW
MATLAB
Arduino

Low-Cost Electronics:

Field Programmable Gate Array (FPGA)
Microelectromechanical Systems (MEMS)
Wireless Communication

ADVANCED LABORATORY PHYSICS ASSOCIATION (ALPhA)

Purpose:

Promote Advanced Experimental Physics Instruction

Organization:

- Founded 2007
- 250 College and University Advanced Laboratory Developers
- Web Page – advlab.org
- $30 Membership Fee

Programs:

- Laboratory Immersions
- Conference on Laboratory Instruction Beyond the First Year (BFY)
- Discounted Equipment

LABORATORY IMMERSIONS PROGRAM

Purpose:

Advanced Lab Faculty and Staff Development

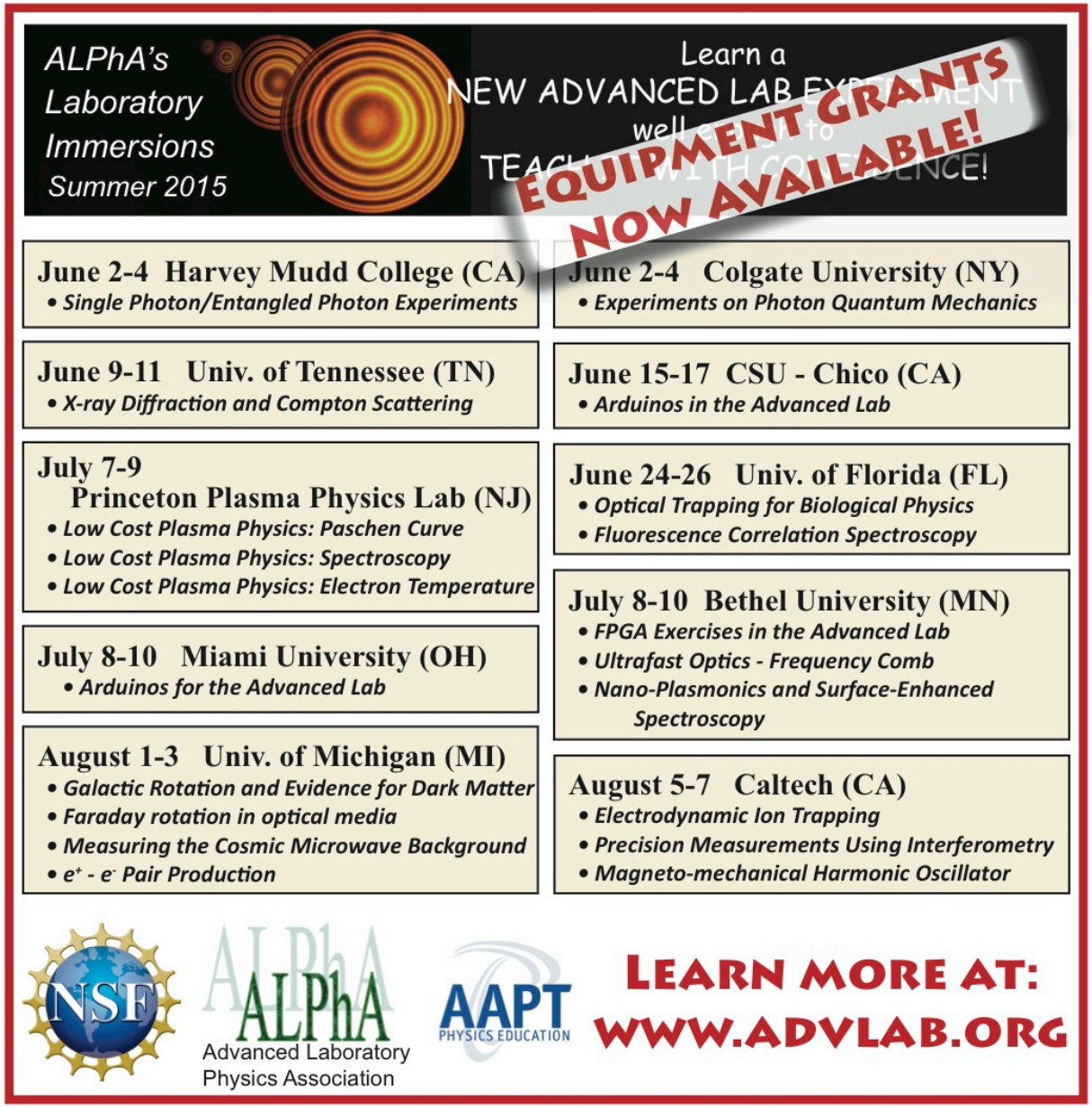
Format:

- Taught at Volunteer Mentor's Institution
- Two- or Three-Day Training on One Advanced Lab Experiment
- Cost – $350 Registration (includes meals) plus Travel Expenses

Note:

Mentor Can Use For Dissemination Component of NSF Grant

LABORATORY IMMERSIONS PROGRAM



BFY CONFERENCE

Purpose:

Community Building for Advanced Lab Developers

Format:

- 2.5-Day Conference Once Every Three Years
- Limited to 150 Participants
- 12 40-Minute Workshops on Different Advanced Lab Experiments
- Plenaries and Breakout Sessions on Advanced Lab Topics
- Poster Session
- $199 Registration Fee, Includes All Meals

BFY CONFERENCE

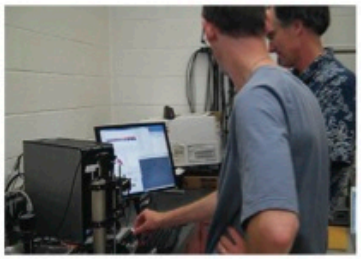
The Second Conference on

Laboratory Instruction Beyond the First Year of College

University of Maryland

July 22 - 24, 2015

WWW.ADVLAB.ORG



DISCOUNTED EQUIPMENT

Purpose:

Support Implementation of Laboratory Immersions Experiments

Quantum Optics Experiments = Most Popular Immersion:

- Single-Photon Detectors are Most Expensive Component
- ALPhA Sells Detectors for $1430 Each (About Half Retail Price)
- Total Experiment Cost is about $20k

DISCOUNTED EQUIPMENT

Jonathan F. Reichert Foundation ALPhA Immersions Support:

For Immersion Attendee,
up to 40% of Cost of Immersion Experiment Equipment
($7,500 Maximum)