

Instrument for the Identification of Live and Dead Bacteria

ECEN 403 - 970

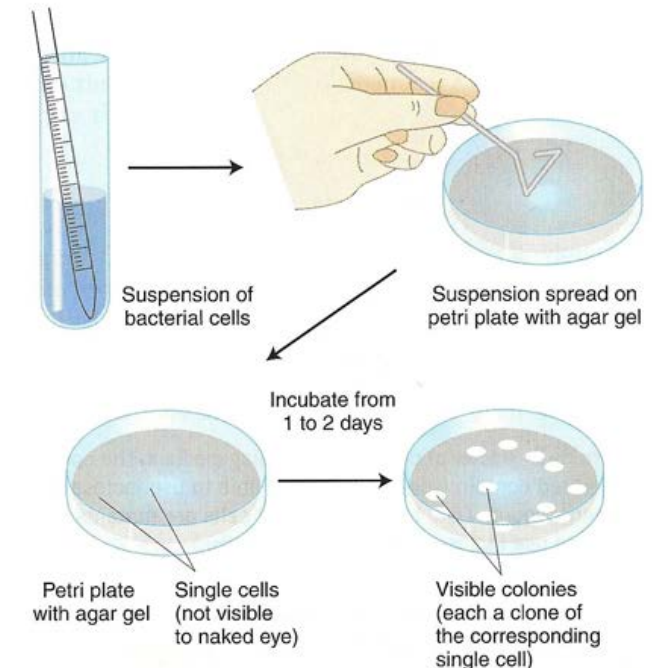
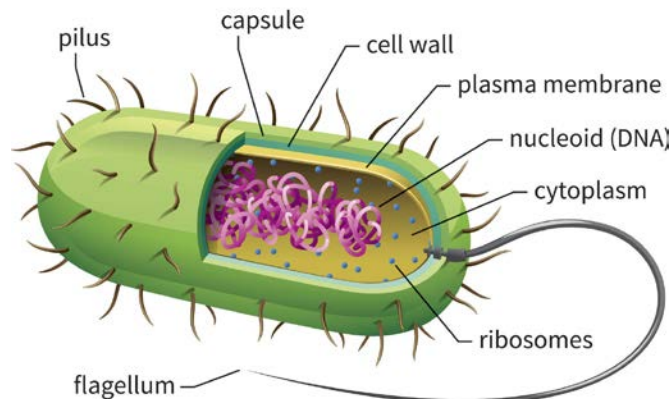
Arjun Krishnamoorthi

Team 52 (URS)

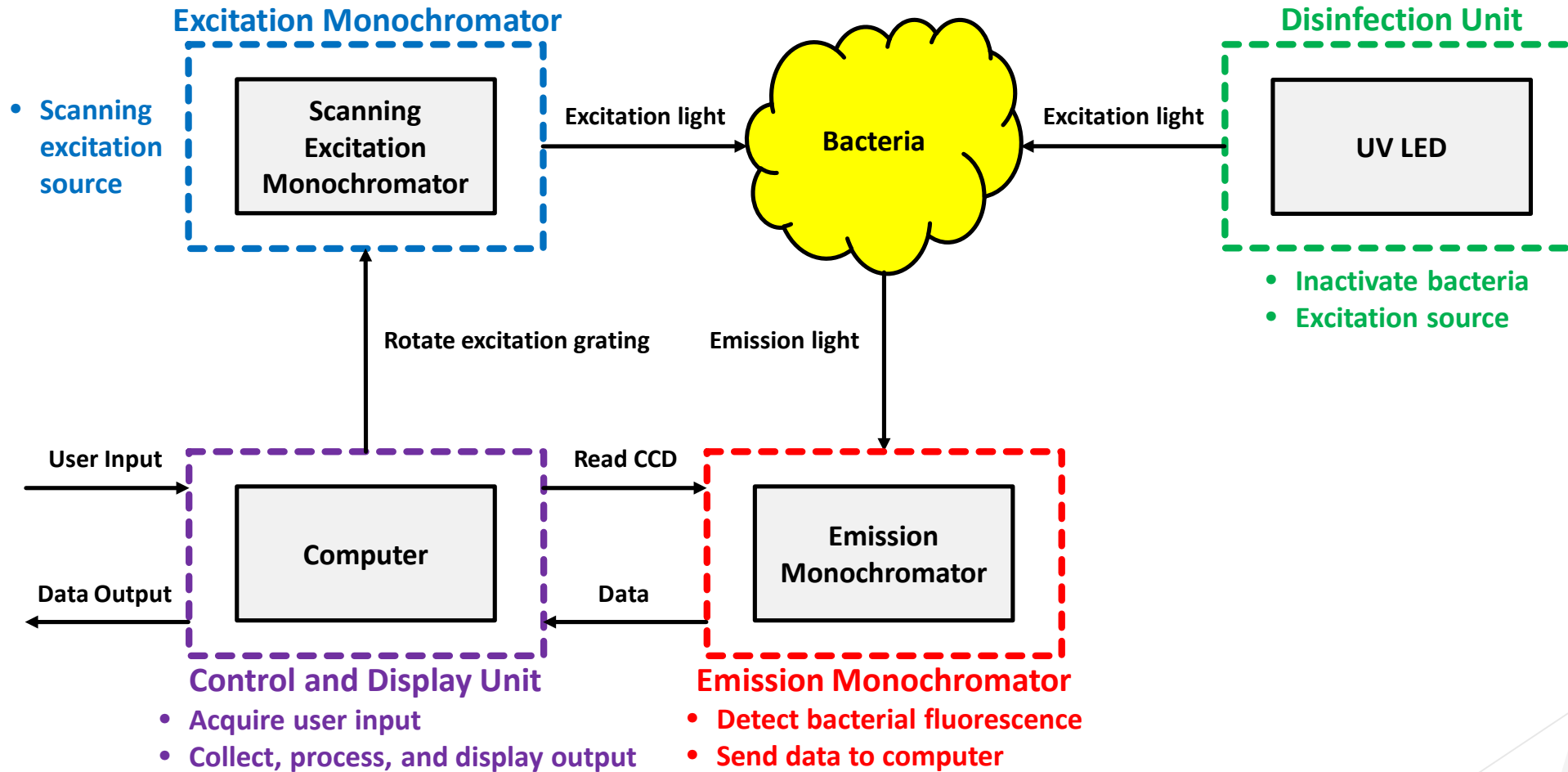
Advisor: Dr. Peter Rentzepis

Problem Statement and Goals

- ▶ Bacteria are a serious **threat** to human life
- ▶ Current identification procedures are **slow (~1 to 2 days)**
- ▶ Goals:
 - ▶ Utilize **fluorescence spectroscopy** to detect bacteria
 - ▶ Apply **PCA** to distinguish live and dead bacteria
 - ▶ Develop a **portable prototype** for rapidly identifying live and dead bacteria



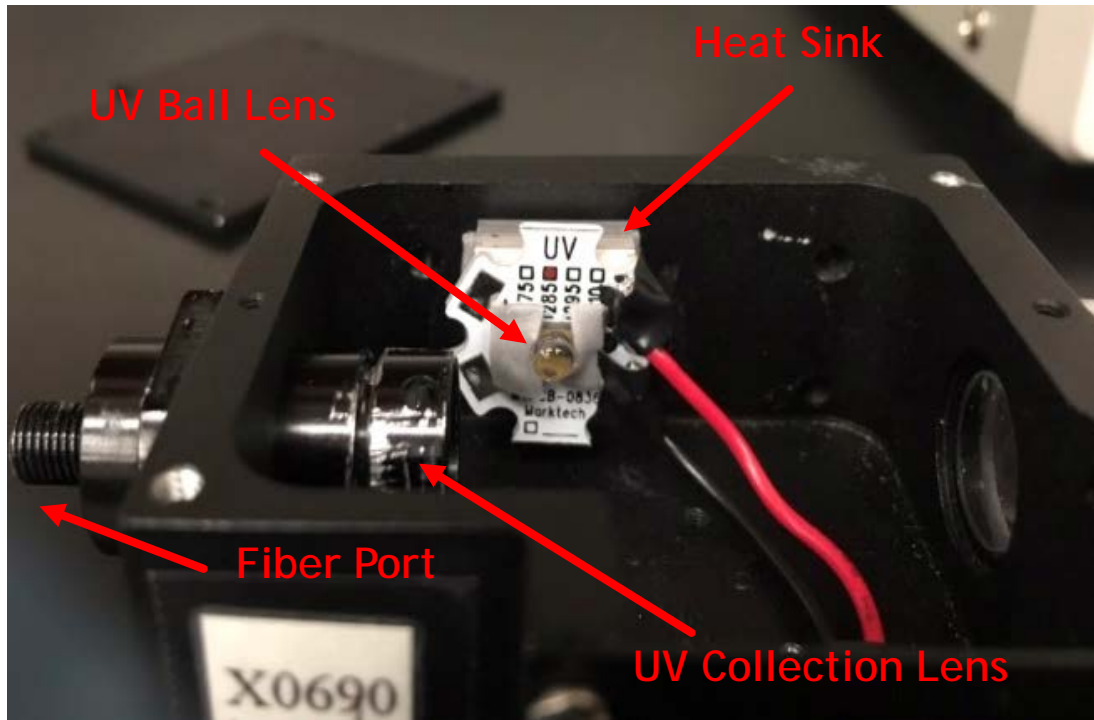
System Overview



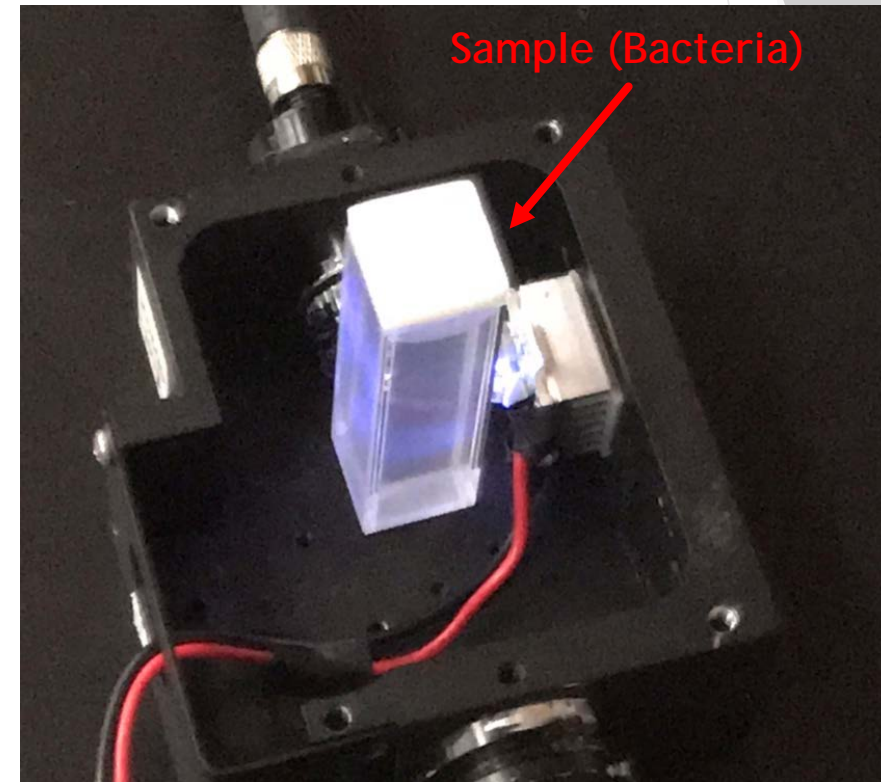
Disinfection Unit Subsystem

Accomplishments since the last presentation <4> hours	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"> • Enclosure selected • UVC LED (285 nm) acquired, mounted, and wired through soldered connections • Focusing and collection optics aligned • Coupled with emission monochromator through fiber optic port 	<ul style="list-style-type: none"> • Design and machine cover for unit • Investigate using additional LEDs to increase fluorescence intensity

Disinfection Unit Subsystem



Configuration of disinfection unit.

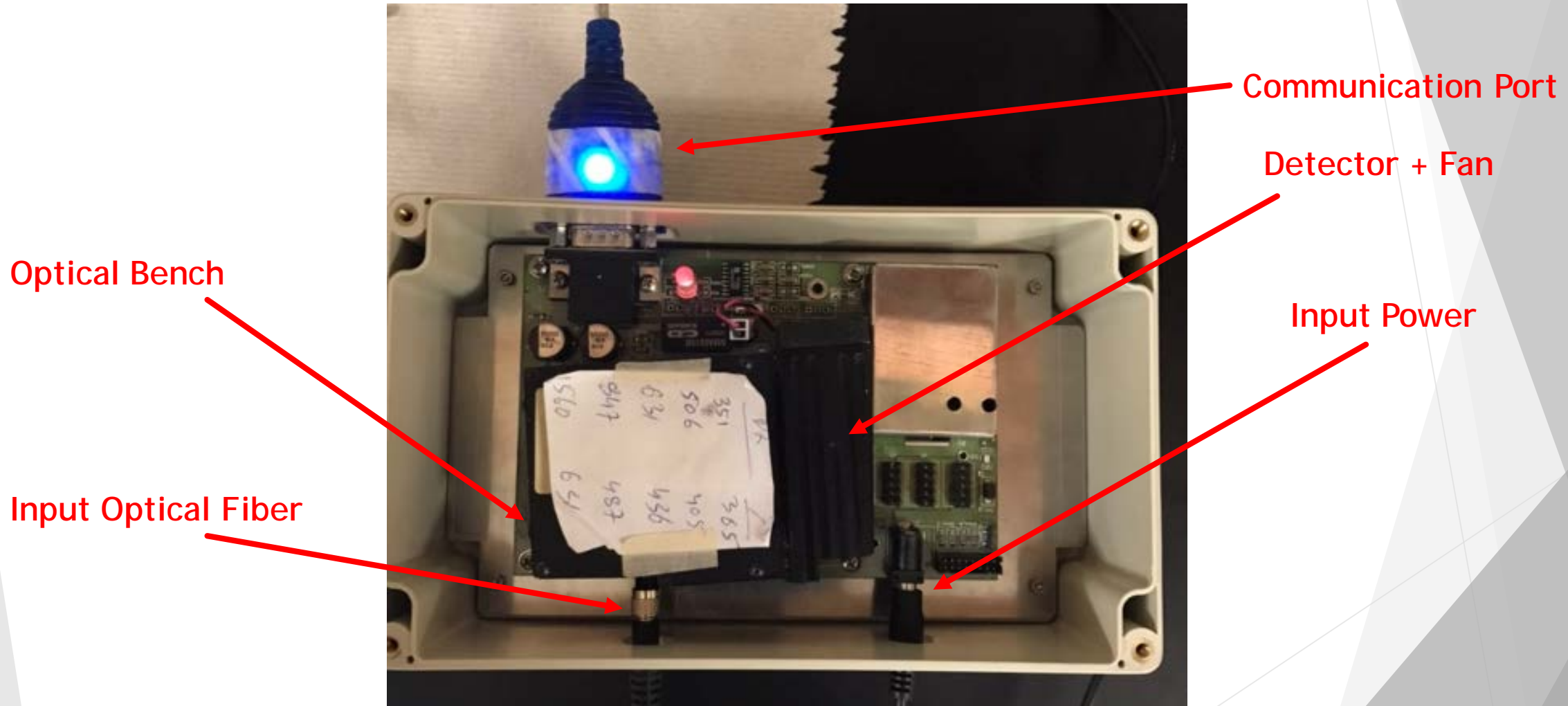


Excitation and disinfection setup.

Emission Monochromator Subsystem

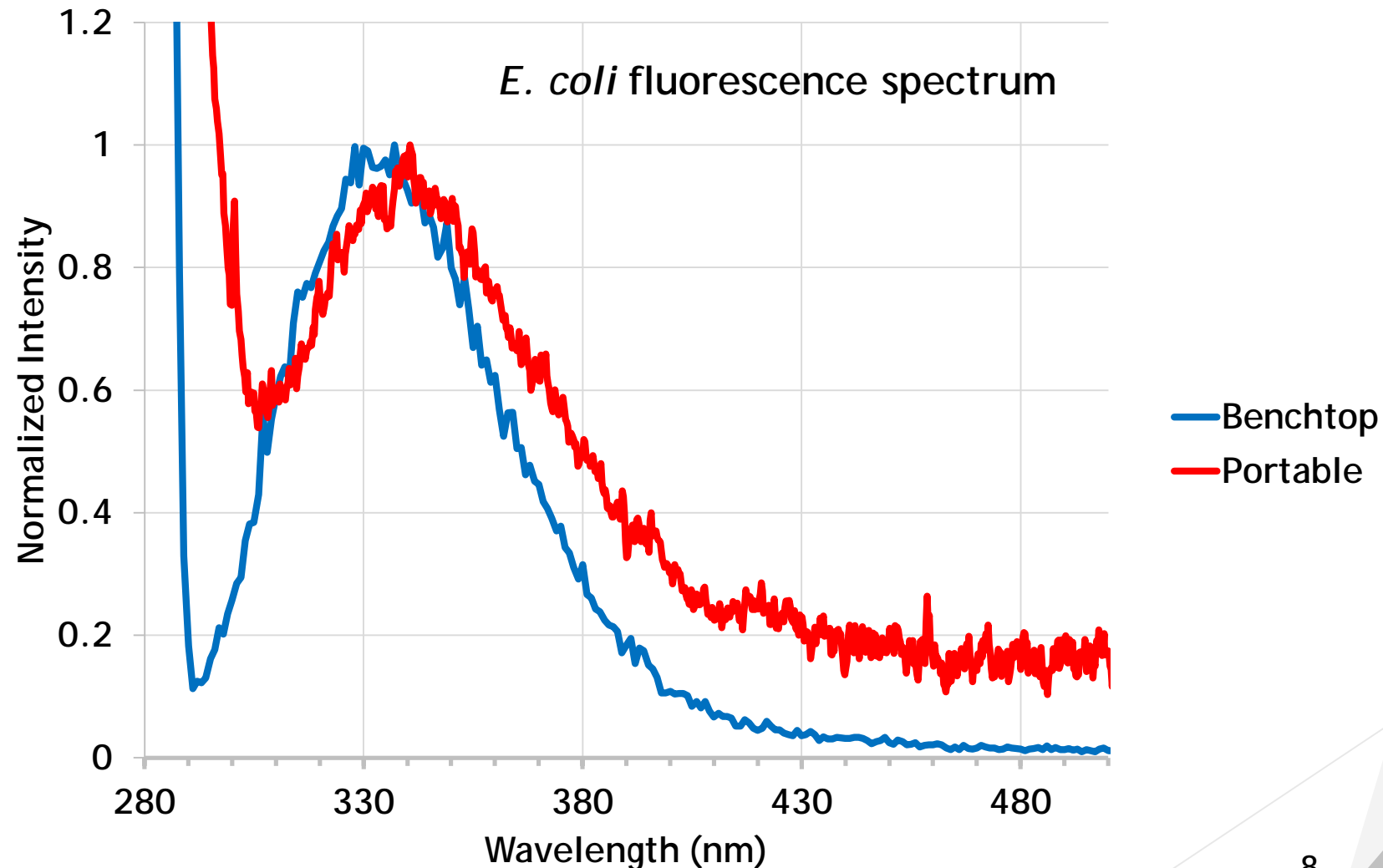
Accomplishments since the last presentation <8> hours	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"> • Emission monochromator selected (B&W Tek) • Emission monochromator calibrated, aligned, and optimized for UV region • Mounting plate machined for electronics project box • UV sensitivity validated by detecting bacteria fluorescence 	<ul style="list-style-type: none"> • Continue increasing sensitivity to lower integration time • Reduce noise in recorded spectra • Resolve any machining issues • Begin testing subsystem with excitation monochromator (for next semester)

Emission Monochromator Subsystem



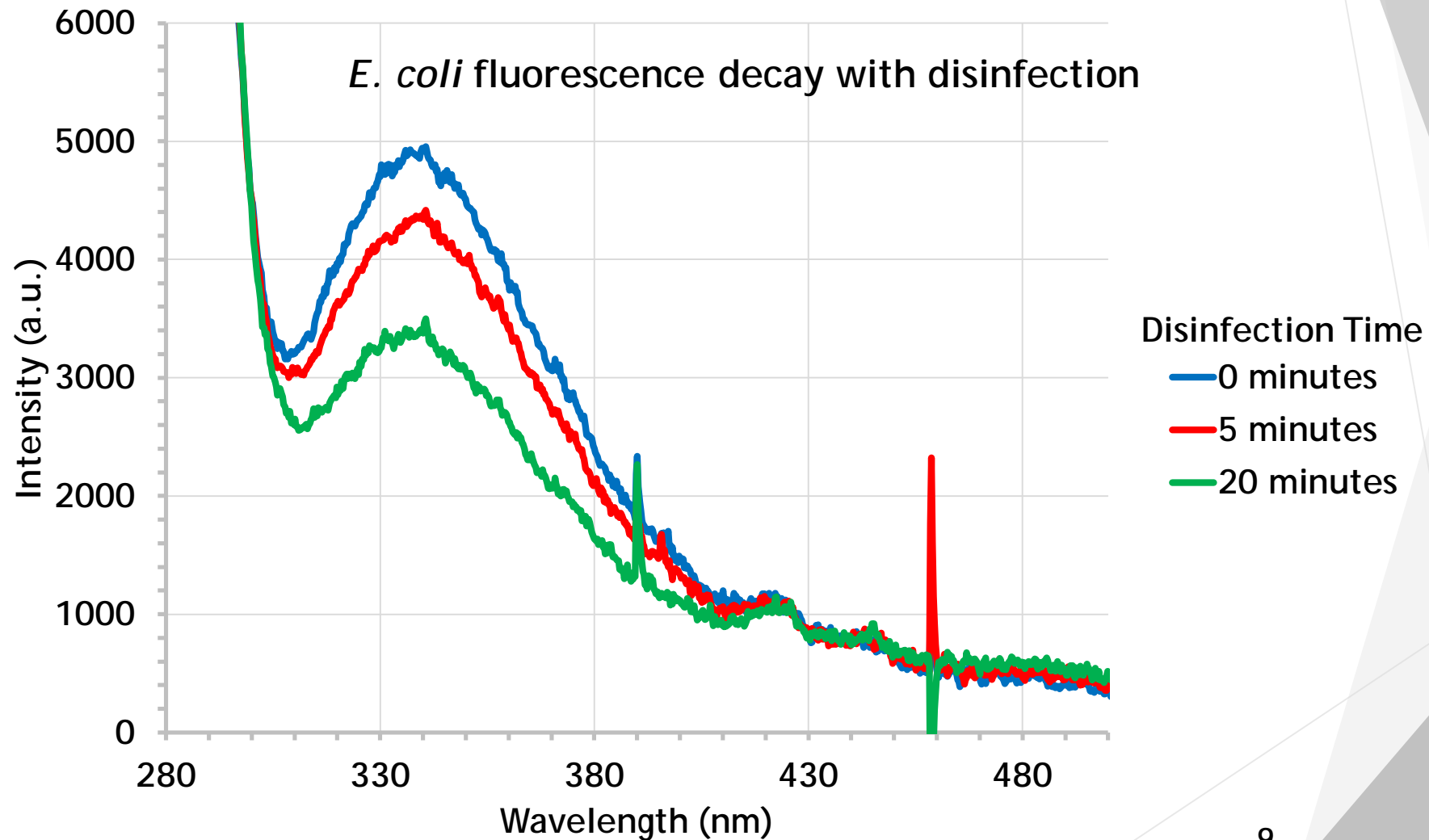
Configuration of emission monochromator.

Emission Monochromator Subsystem



Validation of UV sensitivity with bacteria (*E. coli*).

Emission Monochromator Subsystem

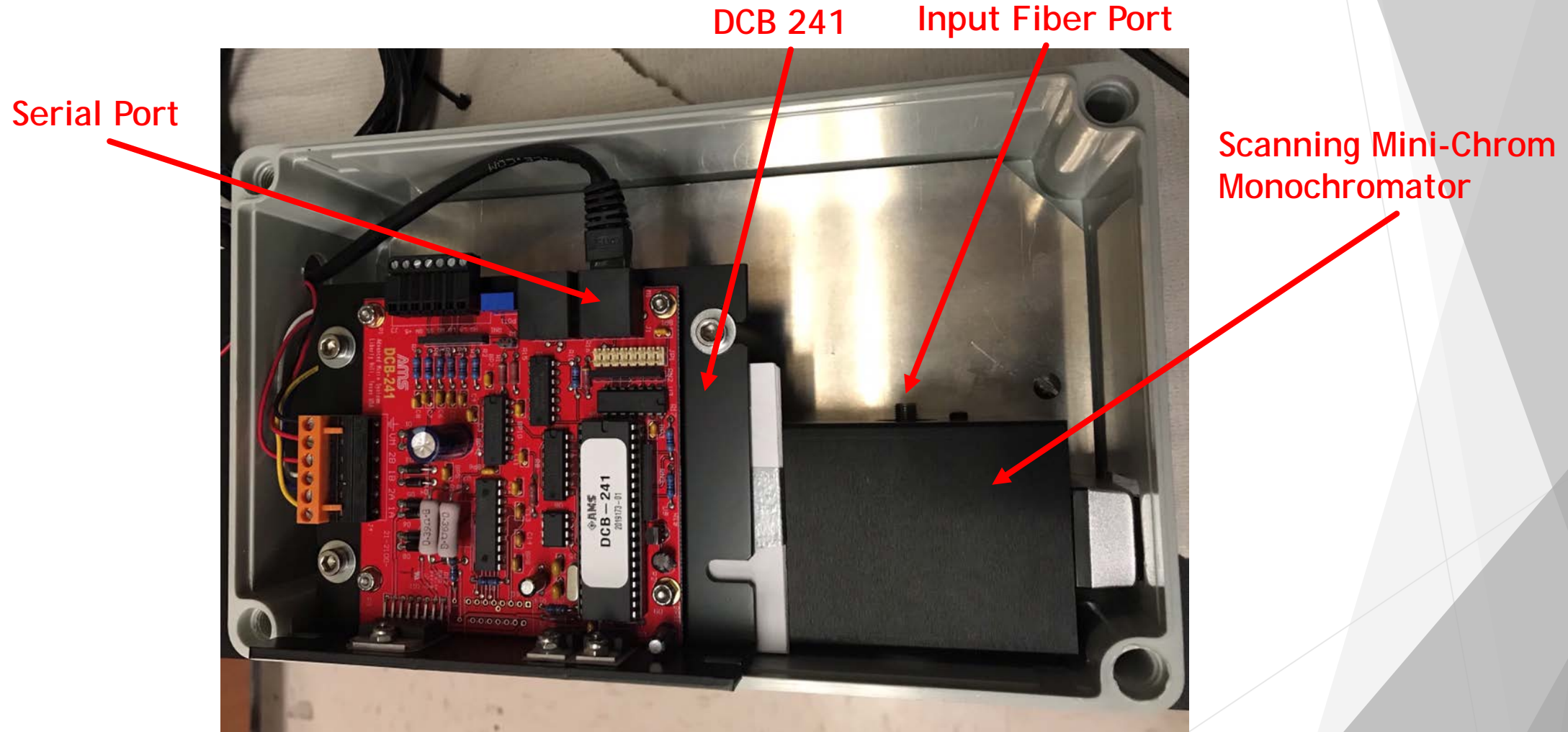


Validation of disinfection unit with bacteria (*E. coli*).

Excitation Monochromator Subsystem

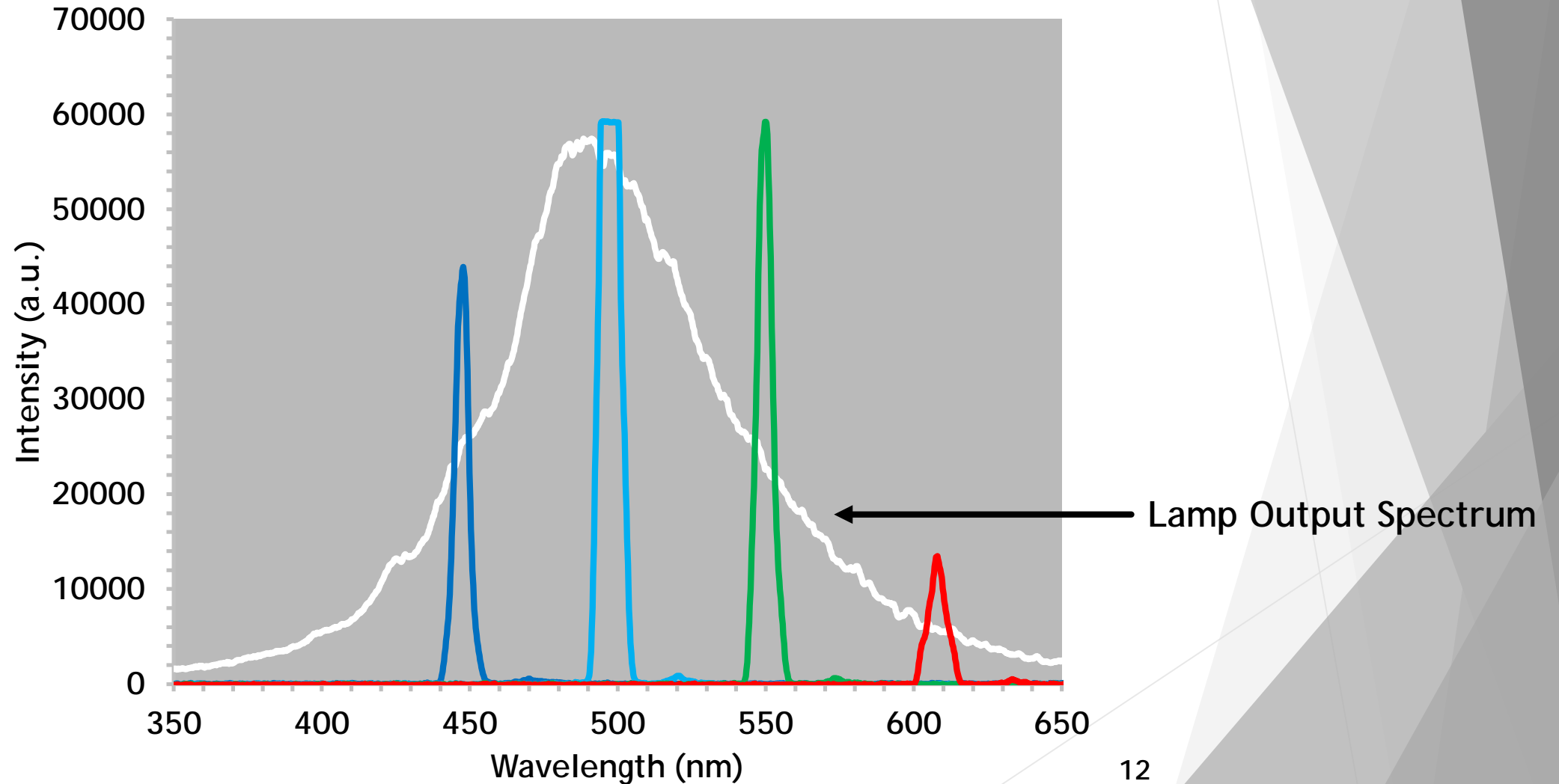
Accomplishments since the last presentation <8> hours	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none"> • Scanning monochromator selected (Mini-Chrom) • Stepper motor controller and driver selected (DCB 241) • High-power UVC LED selected (280 nm) • Mounting plate machined for electronics project box • Scanning capability validated with tungsten halogen lamp 	<ul style="list-style-type: none"> • Manage heat dissipation with UVC LED • Mount UVC LED on heat sink with soldered connections • Resolve any machining issues • Begin testing subsystem as excitation source (for next semester)

Excitation Monochromator Subsystem



Configuration of excitation monochromator.

Excitation Monochromator Subsystem

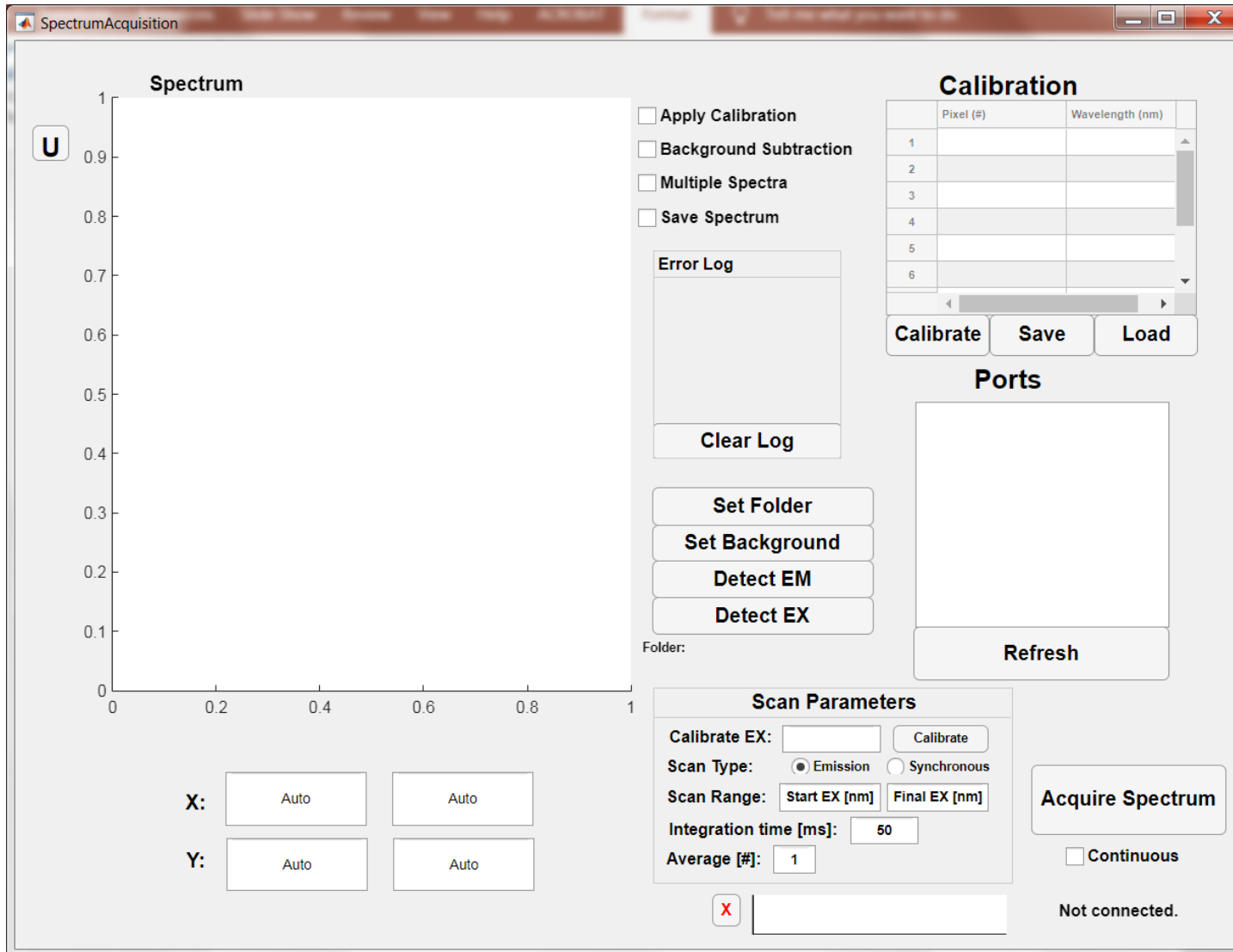


Validation of scanning capabilities with tungsten halogen lamp.

Control and Display Unit Subsystem

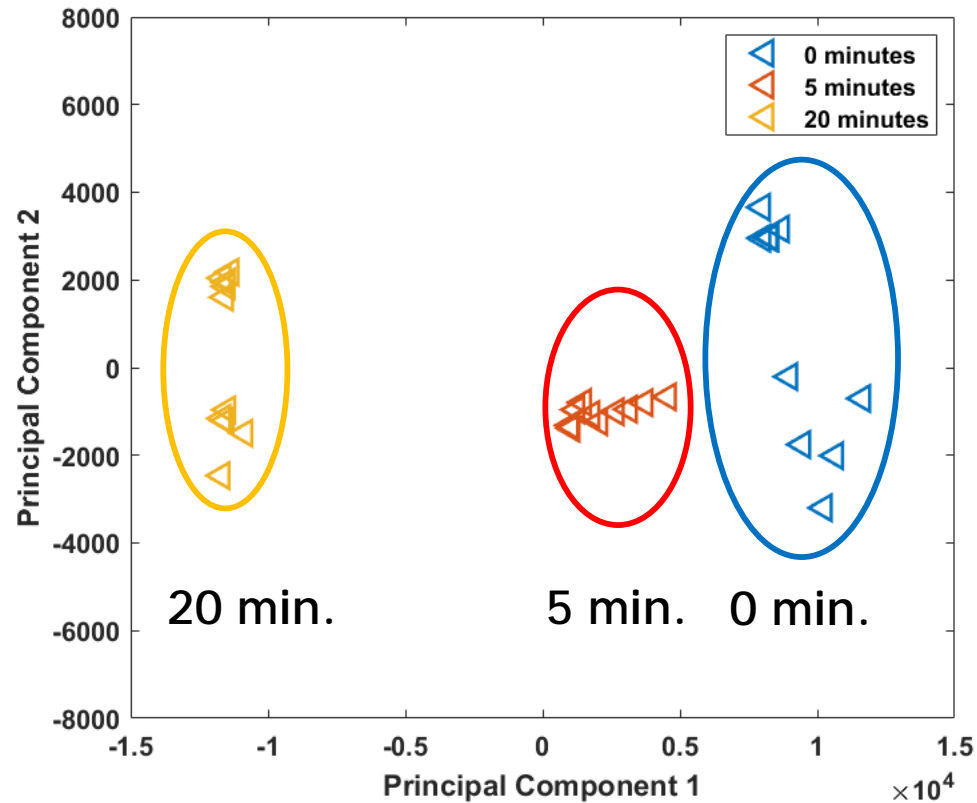
Accomplishments since the last presentation <8> hours	Ongoing progress/problems and plans until the next presentation
<ul style="list-style-type: none">• MATLAB GUI created through App Designer• Serial communication through USB port validated for both monochromators• PCA implemented through Statistics and Machine Learning Toolbox	<ul style="list-style-type: none">• Create simple GUI for processing data• Optimize communication speed (baud rate, data compression, etc.)• Optimize PCA parameters• Continue debugging code

Control and Display Unit Subsystem

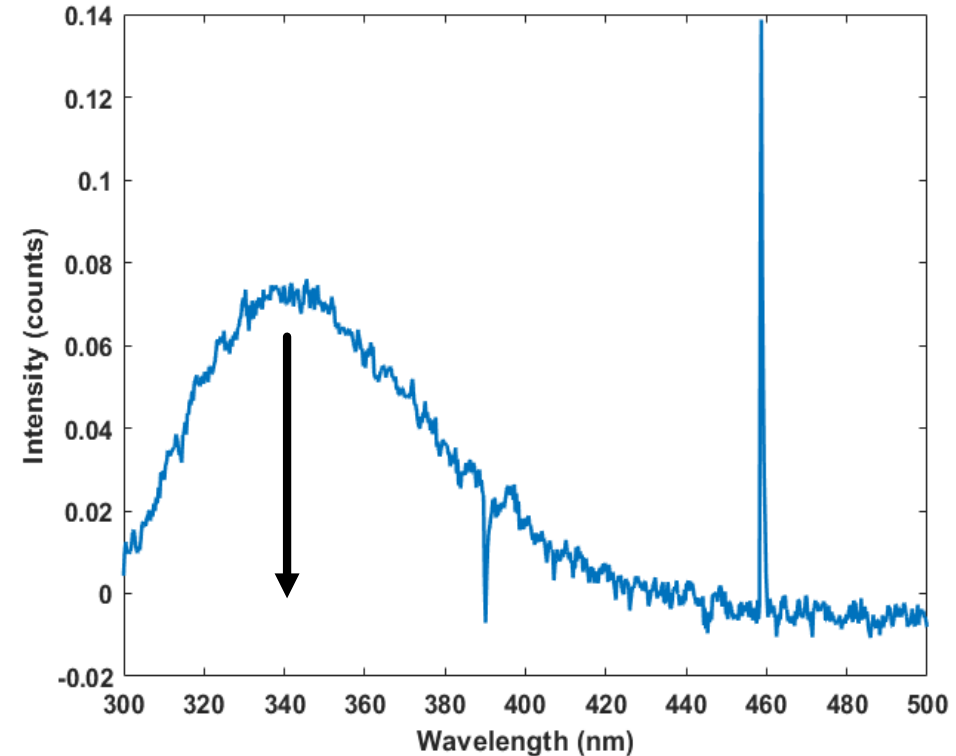


MATLAB GUI for communicating with excitation and emission monochromators.

Control and Display Unit Subsystem



PCA Score Plot



PCA Principal Component 1 Plot

Execution and Validation Plan

- **Currently:** Have completed practically all execution steps on schedule, validated all major subsystem functionalities, and begun integration of all subsystems

	October 11th	October 18th	October 25th	November 1st	November 8th	Execution
Control and Display Unit	Develop MATLAB code for communicating with emission monochromator	Develop MATLAB code for communicating with excitation monochromator	Develop MATLAB code for processing data (plotting, PCA, etc.)	Develop simple GUI for interfacing with all subsystems	Validate GUI communication and processing requirements	Validation
Disinfection Unit	Select UV LED and optical fiber for subsystem	Design enclosure for subsystem	Machine enclosure for subsystem	Validate disinfection and excitation functions of subsystem	Couple with emission monochromator	Completed (Execution)
Excitation Monochromator	Select UV LED and microcontroller for subsystem	Design enclosure for subsystem	Machine enclosure for subsystem	Validate scanning capability of subsystem	Couple with emission monochromator	Completed (Validation)
Emission Monochromator	Optimize sensitivity characteristics of subsystem	Design enclosure for subsystem	Machine enclosure for subsystem	Validate usage with disinfection unit	Couple with excitation monochromator	Incomplete

Thank You!

Questions?