Instrument for the Identification of Live and Dead Bacteria

ECEN 403 – 970

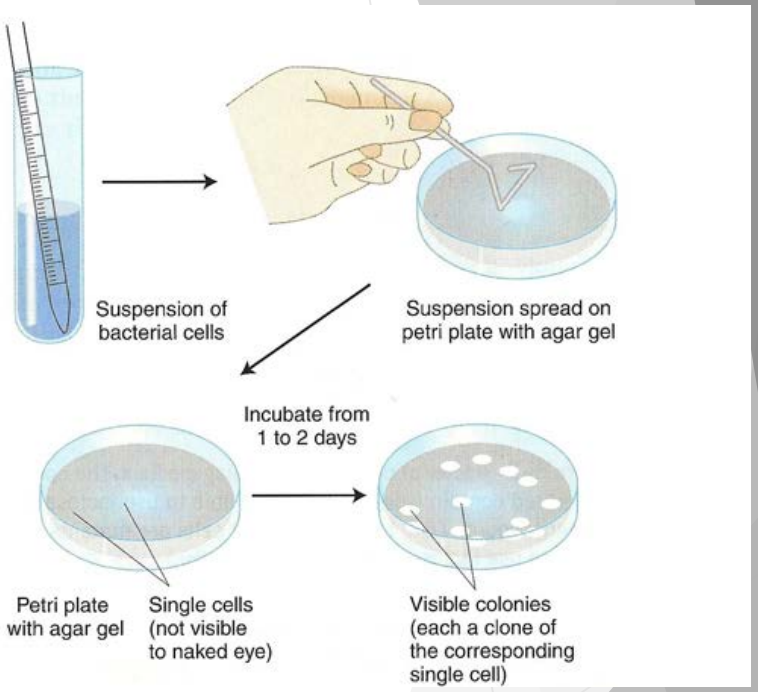
Arjun Krishnamoorthi

Team 52 (URS)

Advisor: Dr. Peter Rentzepis

Problem Statement

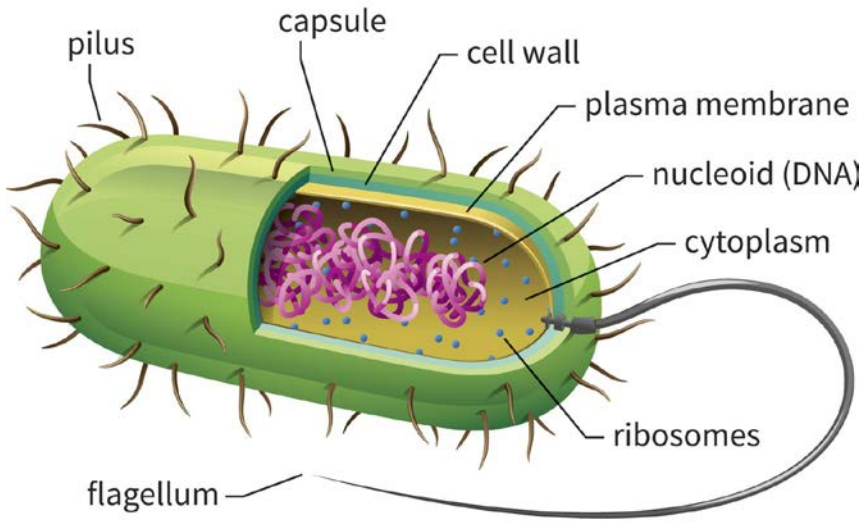
- **Bacteria are a serious threat to human life**
  - Approximately **2 million** people incur infections due to antibiotic-resistant bacteria per year
  - At least **23,000 people** die each year following such infections
  - Health care-associated infection (HAI) was noted among the **top 10 causes of death** in the United States

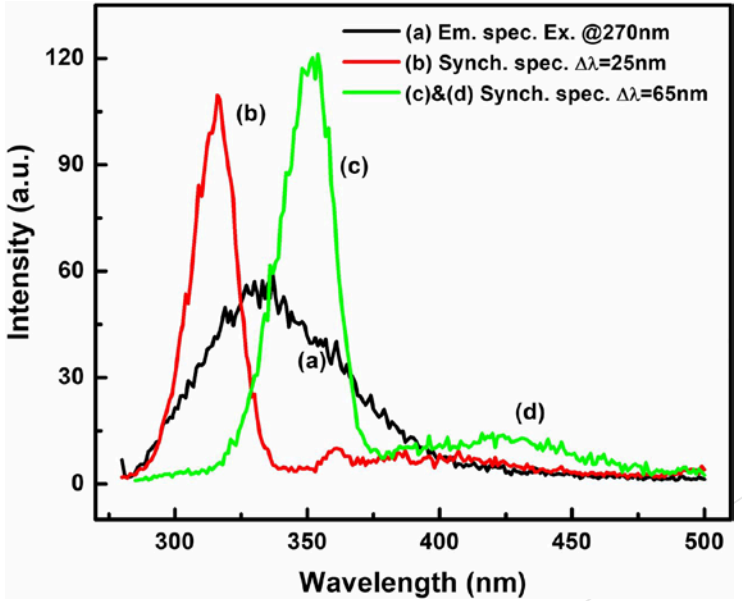


- **Current identification procedures are slow and laborious**
  - Require specialized equipment
  - Require trained personnel
  - Require extensive time **(~1 to 2 days)**

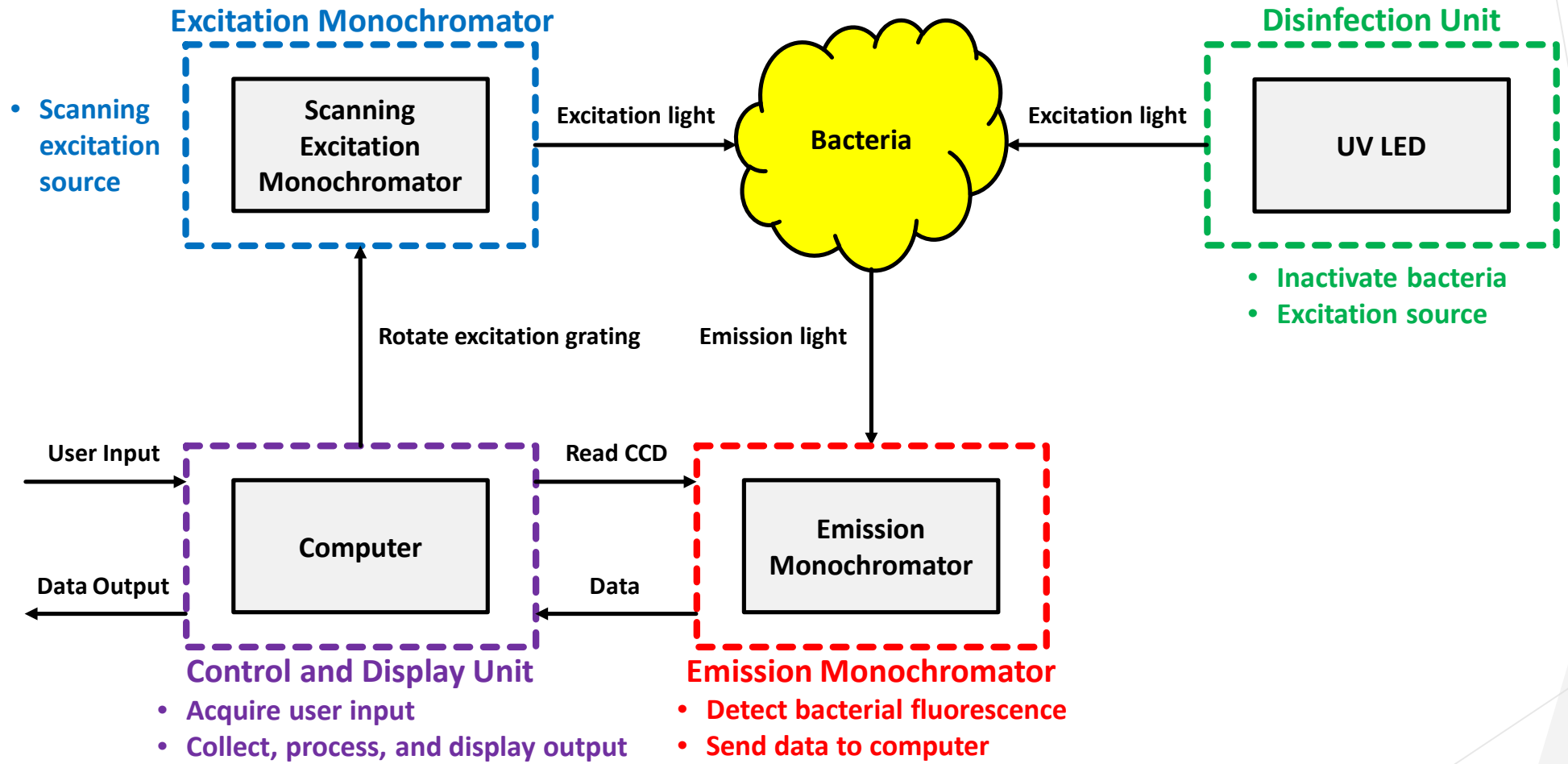
Solution

- **This research shall:**
  - Utilize **normal fluorescence** and **synchronous fluorescence spectroscopy** to detect bacteria
  - Apply **PCA** to distinguish live and dead bacteria
  - Develop a **portable prototype** for the rapid identification of live and dead bacteria



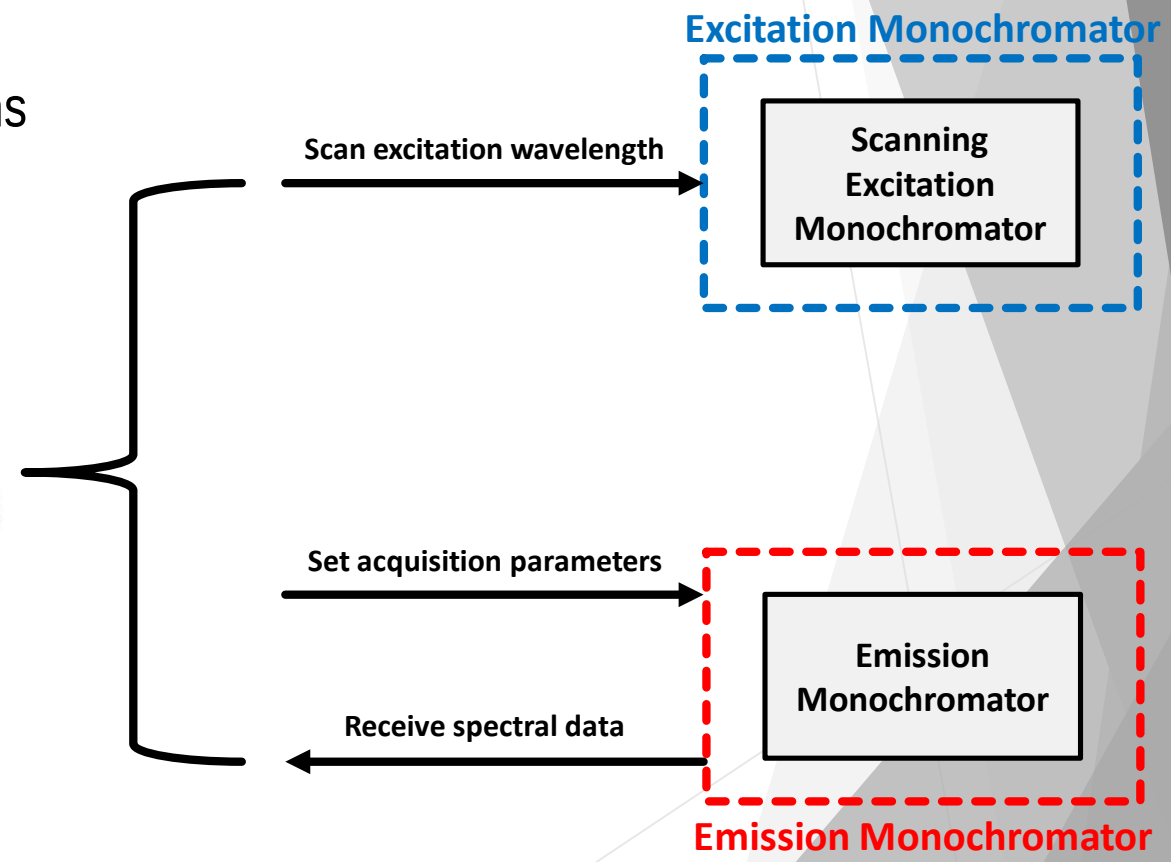


System Overview



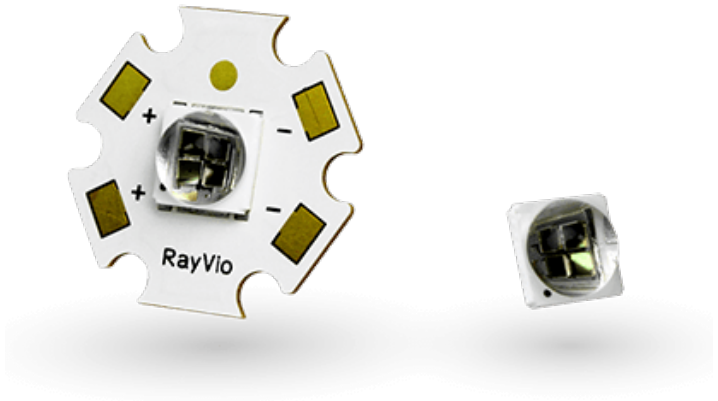
Control and Display Unit Subsystem

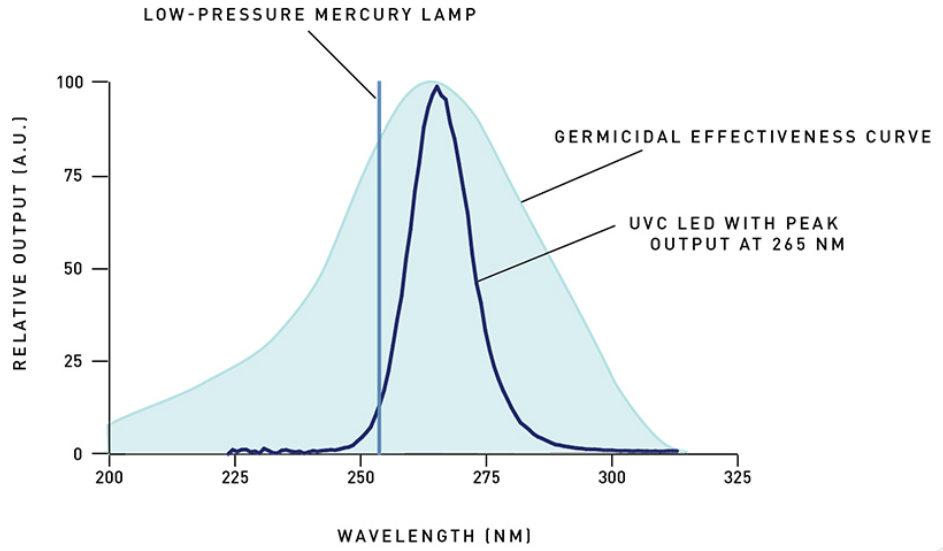
- **Onboard, compact laptop executing MATLAB GUI**
  - Interfaces with user
  - Communicates with other subsystems



Disinfection Unit Subsystem

- **High-power UV LED**
- **Dual-function module**
  - Disinfection source for inactivating bacteria
  - Excitation source for normal fluorescence

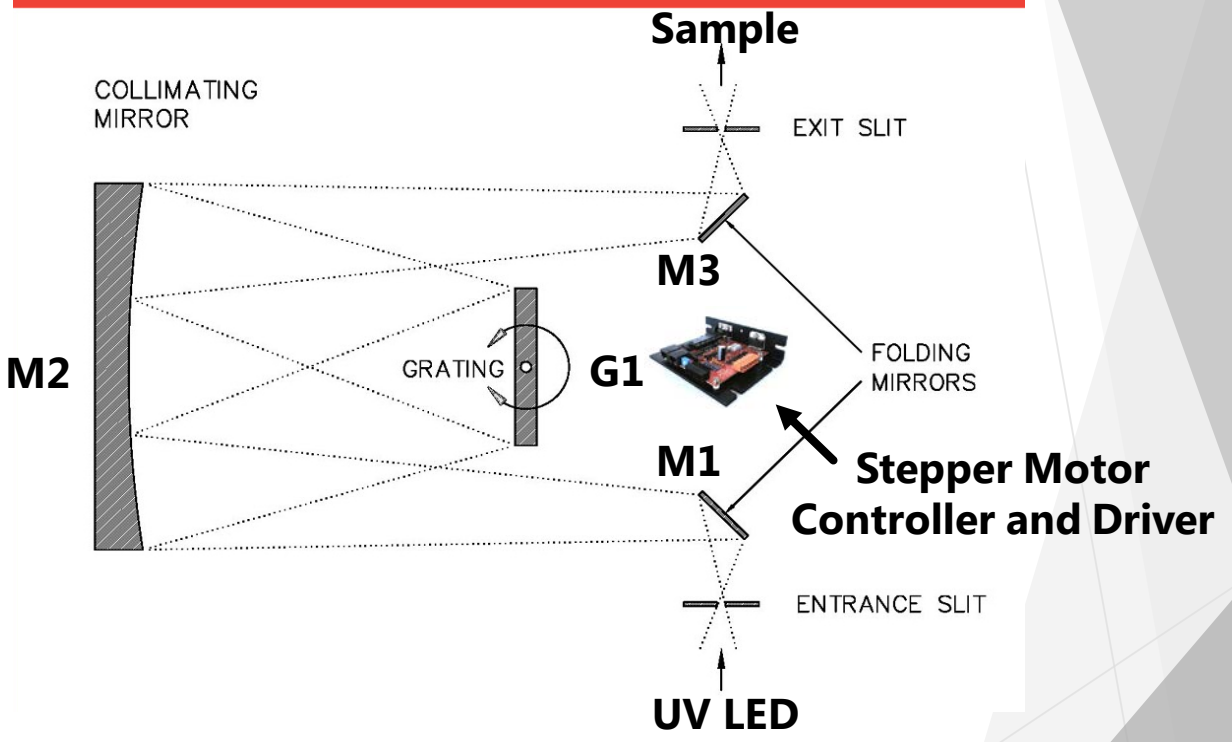




Excitation Monochromator Subsystem

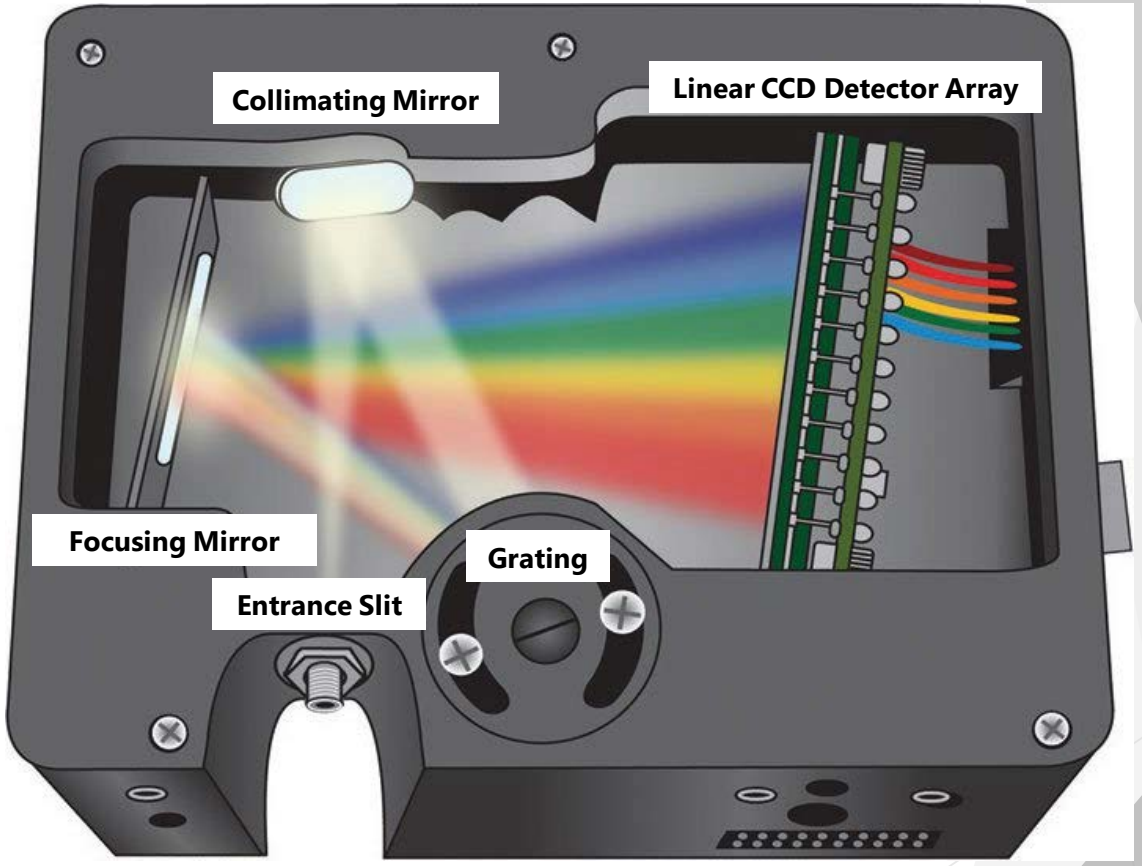
- **Optical bench**
  - Optimized for UV region
  - Scanning capability for synchronous fluorescence
  - Optical fiber ports
- **Light source**
  - High-power UV LED
- **Controller and Driver**
  - Rotate grating

Optical Diagram



Emission Monochromator Subsystem

- **Optical bench**
  - Optimized for UV region
  - Input optical fiber port
- **Detector**
  - Linear CCD detector array
  - High UV sensitivity
- **Control electronics**
  - Interface with computer



Execution and Validation Plan

- **Currently:** Have outlined needs for each subsystem, selected and received parts, and begun designing and machining enclosures for subsystems

	October 11th	October 18th	October 25th	November 1st	November 8th
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
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
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
Emission Monochromator	Optimize sensitivity characteristics of subsystem	Design enclosure for subsystem	Machine enclosure for subsystem	Validate usage with disinfection unit	Validate usage with excitation monochromator

Execution

Validation

Thank You!

Questions?