

Baseline Measurements 1 --- Lab Guide

1 Overview

Over the next two weeks you will familiarize yourself with the apparatus that we will be using to collect data this semester and collect baseline data before you start stressing your cells. You will spend this week working with either the J-V (Current density-Voltage) apparatus or the EQE (External Quantum Efficiency) apparatus. **Additionally, if you are working with the J-V apparatus, you will also take data on the light spectrum from your stressing LEDs.**

2 Apparatus Walkthrough

You are beginning apparatus training this week. The **Apparatus Walkthrough** on Canvas covers how to use the apparatus. Watch the video and answer the embedded questions **before your lab section**.

3 Collaborative Coding

Learning how to program or code collaboratively is listed as one of the top skills employers of physics graduates value for many jobs. Just like any coding platform, one needs to have careful version control so as to not lose work or override work of others. Google Colab is no different than any other platform. Here are some tips to make working together smoother whenever you have team Colab notebooks.

1. Always put the team Colab notebook in the team Google Drive folder and not an individual's Google Drive folder.
2. Google Colab can run into version control issues (unlike Google Docs when people edit the notebook at the same time). To prevent version control issues, **do not have multiple people editing code in Google Colab at the same time**. Instead, one person at a time should work on the Colab notebook. To work simultaneously, you can write the markdown cell text collaboratively in a Google Document and then copy and paste it into your Colab notebook.

As a team, take a few minutes to discuss how you will manage working collaboratively on Colab notebooks this semester. Consider questions like: How will you decide who is editing the notebook at a given time? How will you make sure everyone contributes to and understands the code? Write down a brief plan in your team Google Drive folder.

4 Team Roles

As you begin working together on data collection, consider assigning roles within your team so everyone gets a chance to contribute in different ways. You can switch roles from week to week. Some examples include, but feel free to create your own:

- *Experiment director*: reads out each step of the process and makes sure things happen in the correct order
- *Data collector*: runs the data collection software and makes sure the data look as expected
- *Colab coder*: uploads the data and runs the code
- *Experiment controller*: aligns the pixels to the green dot on the EQE apparatus

5 Lab Activities

5.1 Data Management Plan

At the beginning of the lab session, discuss your data management strategy with your team. Create a Google Doc and respond to the following:

1. Explain your file directory, including the names and nesting of your folders, as well as what will be stored in each folder.
2. How are you going to rename your copied/modified data files? **Keep in mind that raw data files should never be renamed and you should never have any files with the same name in your entire directory.**

Everyone on your team should download the document as a PDF to submit on Canvas by the due date listed on Canvas. **Each member of your team must submit an identical copy of the PDF.**

5.2 Find Cell and Apparatus Assignments

All cells have been placed on the stressing stations just before the lab session starts so they can be close to the temperature they will need to be at for the measurements. You can retrieve your cell just before you are ready to take your measurements.

We want to avoid getting fingerprints on the cells and changing the light absorption, **so touch the cells only by the white circuit board or 25-pin connectors.**

5.3 Data Collection and Analysis

The rest of the lab will be spent taking baseline data and completing analysis using those data.

Look at the Apparatus Schedule to determine which apparatus (J-V or EQE) your team is working with this week and then download the corresponding Apparatus guide and Colab notebook file from Canvas.

Use the directions in the apparatus guide to collect your data. Each team member should take a measurement for at least one pixel to gain experience with the experimental tools.

Once you have finished collecting your data **make sure all data files have been uploaded to your team Google Drive folder.** Refer to the schematic posted near the apparatus for the pixel numbering convention.

Once you have completed measuring all pixels work together to complete the analysis for your baseline data using the corresponding Colab notebook. After completing the notebook, each member of your team must submit an identical copy of the .ipynb file and PDF to Canvas by the due date listed on Canvas.

Note

To convert your .ipynb to a PDF, use the [Notebook to PDF](#) online tool.

5.4 For Teams Working with EQE

Download the [EQE time log](#) and be sure to record timing for your cell and each pixel. You will record the time you remove your cell from its stressing station, the time you complete EQE measurements for each pixel, and calculate the elapsed time (Δt) between removal from the stressing station and completion of the

measurement. You will record these values for every EQE measurement this semester. Please keep this file with your raw EQE data in your team Google Drive folder.

5.5 For Teams Working with J-V: Collect Stressor LED Spectrum

Follow the [Spectrometer Guide](#) to measure the spectrum of your team's stressing LED.

Using the Stressor LED Spectrum Colab notebook from Canvas, complete the analysis for the data you collected. Each member of your team must submit an identical copy of the .ipynb file and PDF to Canvas by the due date listed on Canvas.

5.6 Store Your Cell

When you have finished your measurements, return your cell to your team's stressing station for storage. The stressing equipment will not be turned on until next week.

6 Post-lab Activities

Please complete this week's reflection by the due date listed on Canvas.