Measurement of field-emission induced optical spectra

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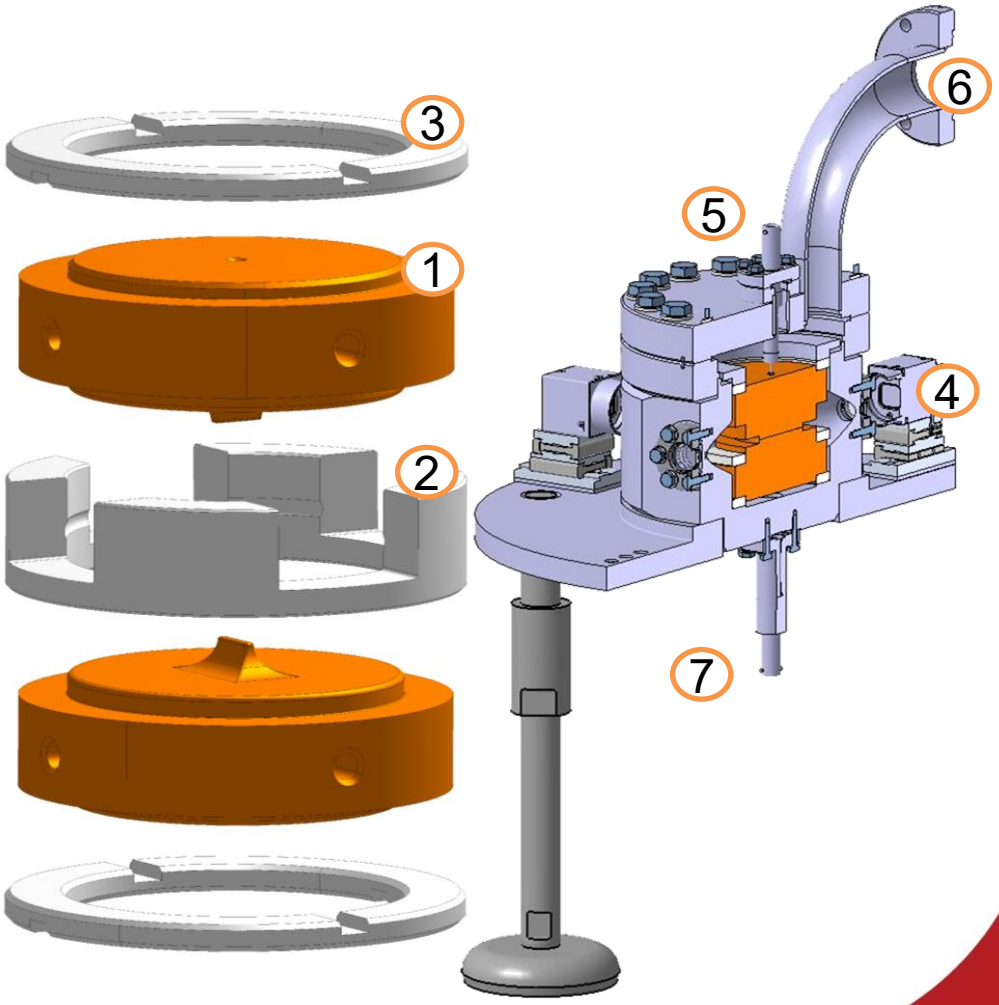
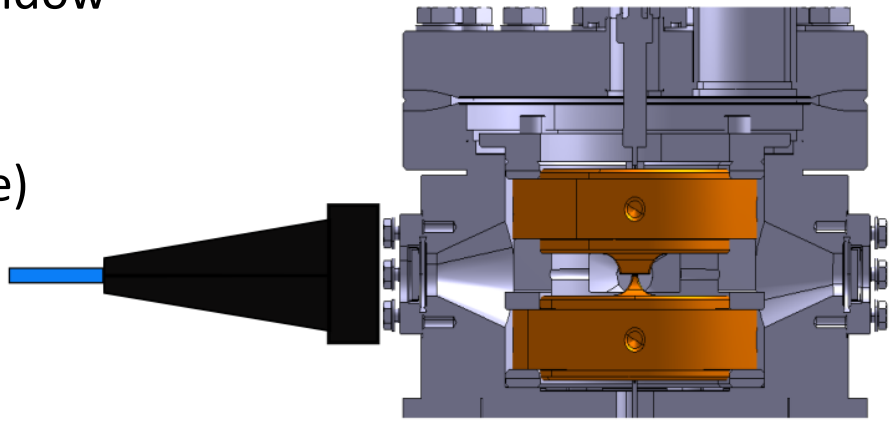
Pulsed DC Large Electrode System Chamber

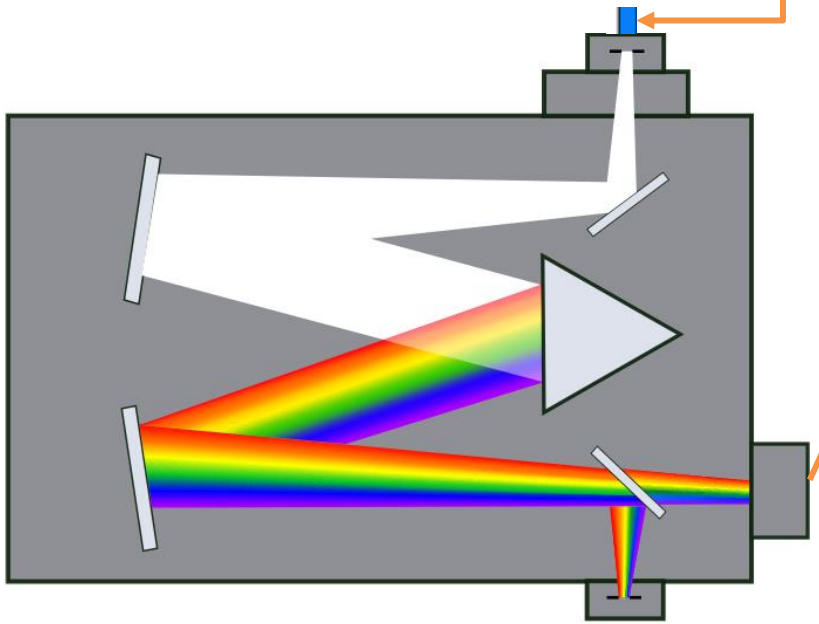
- Configuration
  1. 2 high precision machined electrodes (1µm tolerances)
  2. High tolerance ceramic spacer between electrodes providing a gap of 20µm, 40µm, 60µm, or 100µm
  3. Ceramic spacers to isolate electrodes from the chamber
  4. 4 Windows and 2 perpendicular cameras
  5. High voltage feed though
  6. Vacuum pump output (5x10^-9)
  7. Connection from the bottom electrode to ground (outside of system)

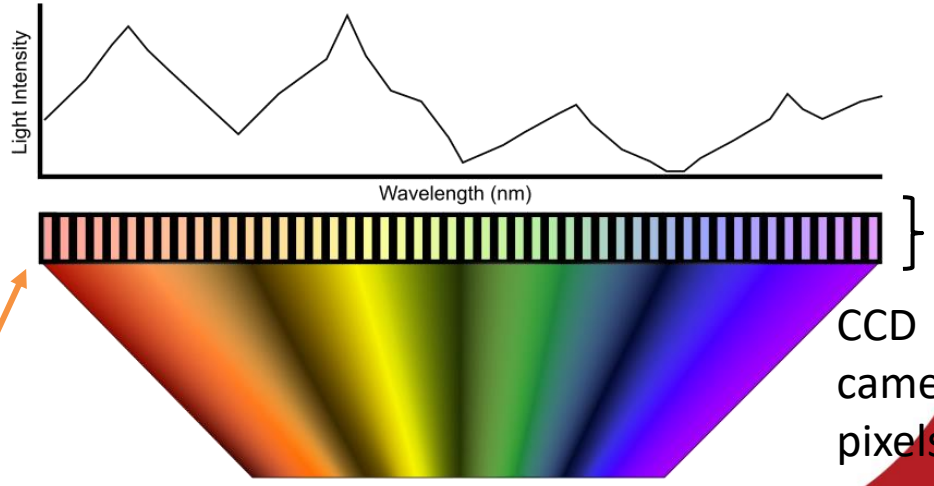


Spectrometer and Setup

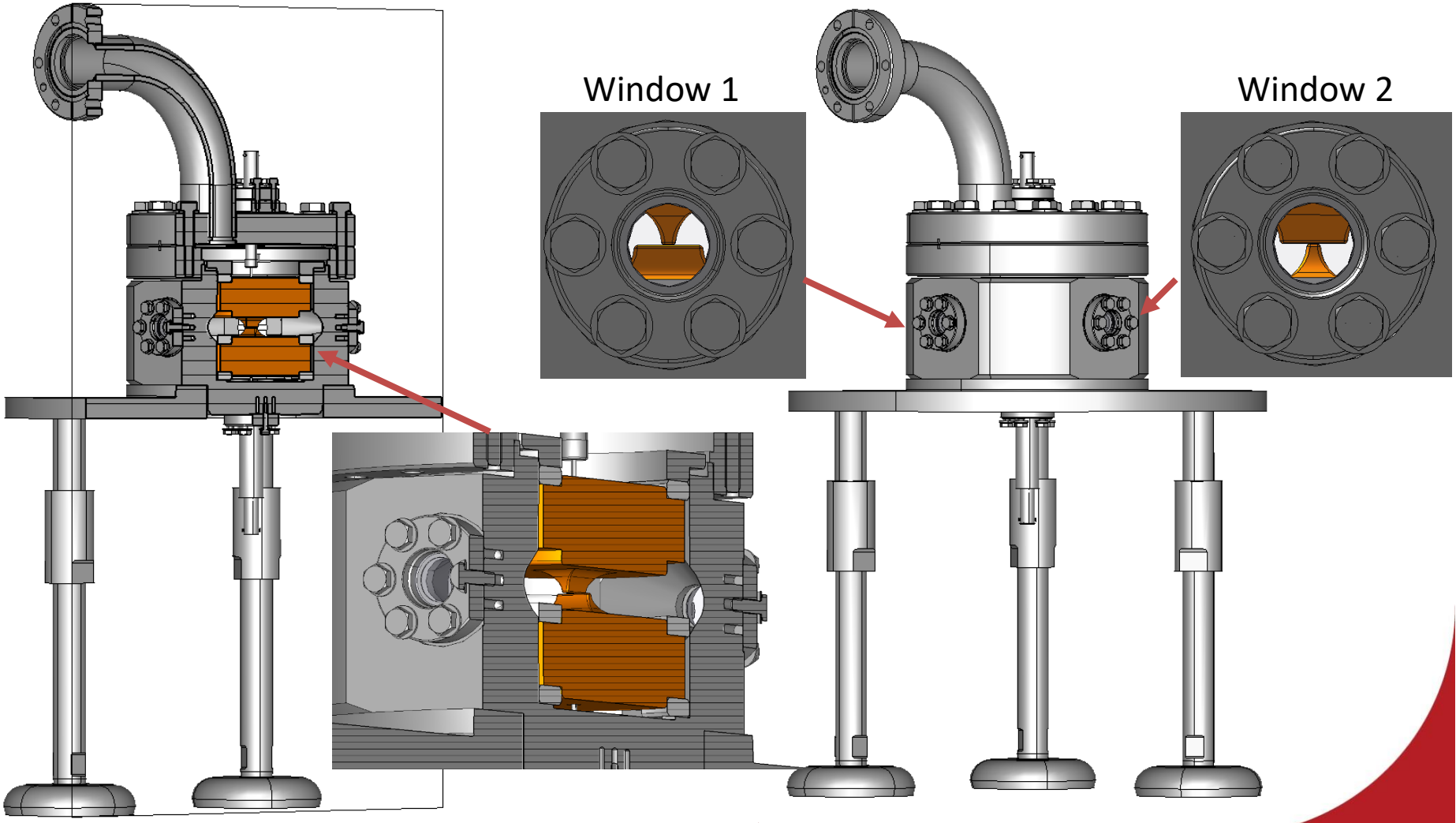
- Collimator collects light from the window
- Optical Fibre (UV or NIR)
- Spectrograph (550nm range grating)
  - Slit 2500µm (as much as possible)
- IDus CCD camera
  - Exposure time of 5 seconds



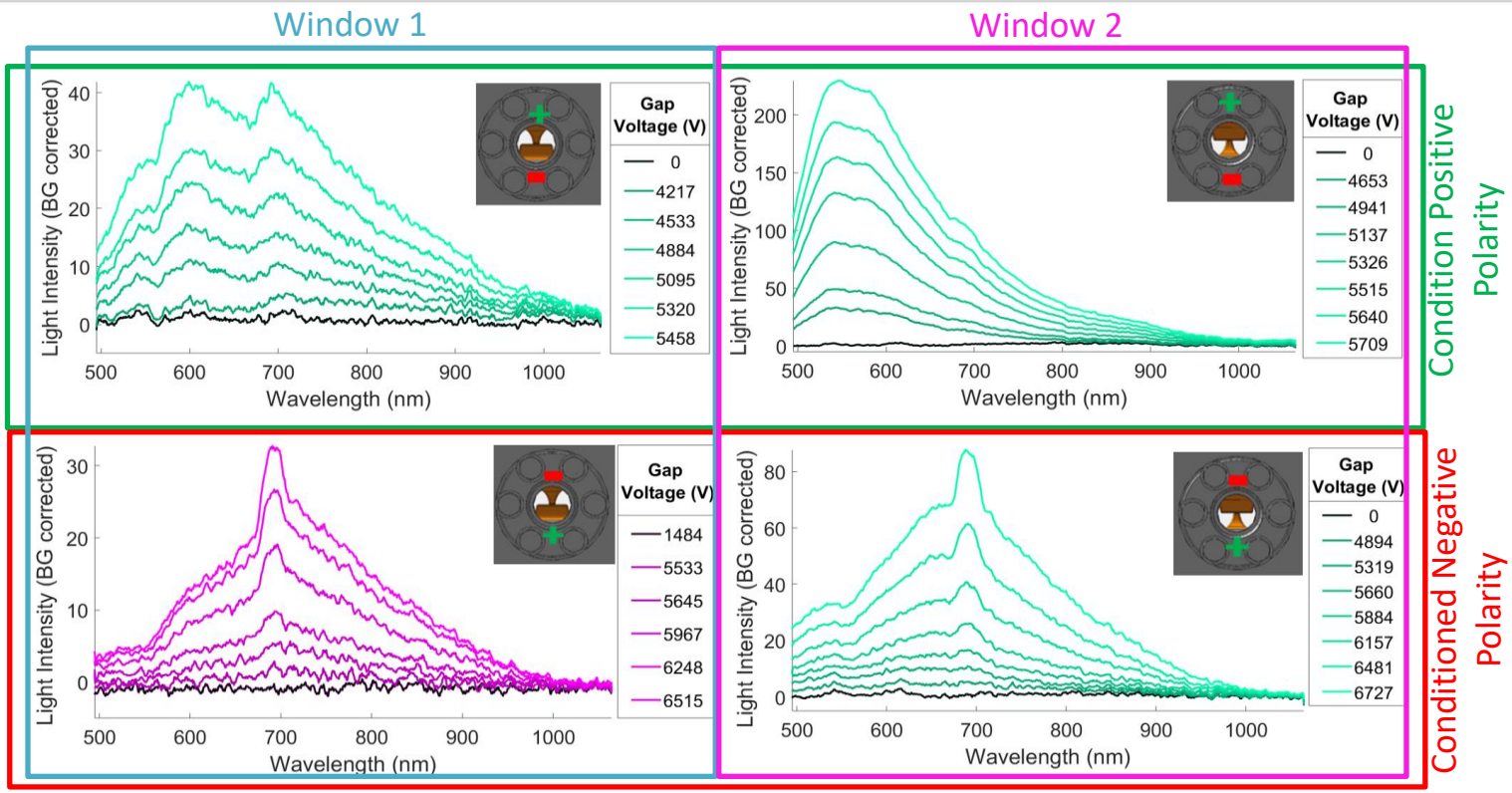




Perpendicular Windows on LES



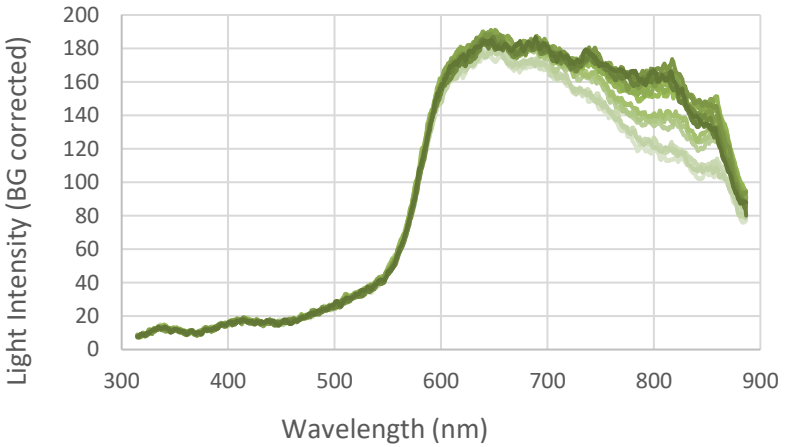
Different Position and Polarity

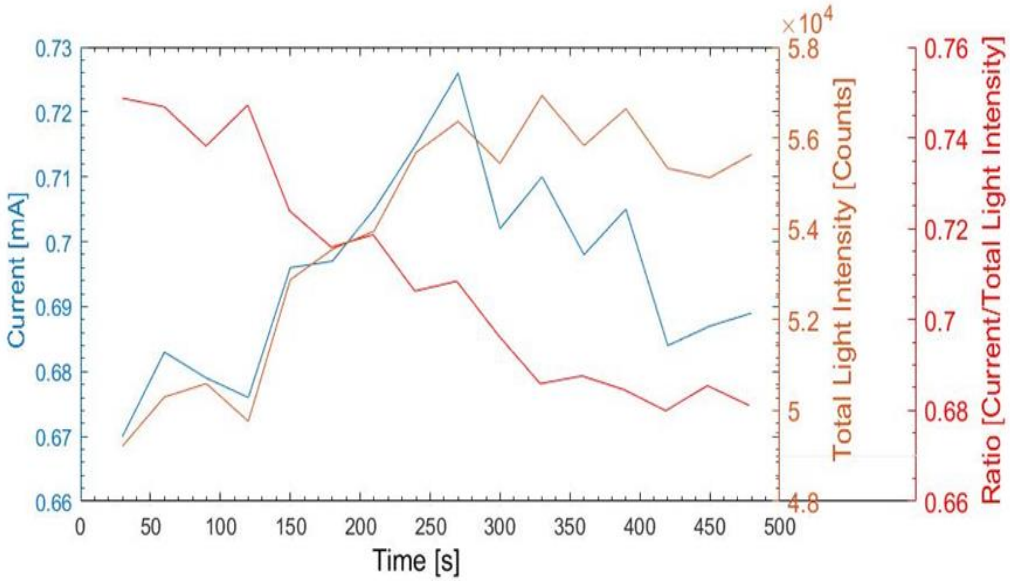


The following measurements were completed in both polarities. This was done to determine whether the spec-tra observed was a result of the optical alignment with the presumed emitting electrode. The expected result was that the spectra measured from each angle would be the same as the opposite for the different polarities. A significant result from these measurements is the result from the reverse polarity. The difference in spectra suggests that the conditioning of the electrodes plays a role in the field emission and spectra.

Light Emission and Current over Time

The supply voltage was kept at 7kV and the current and spectra were measured every 30s. It is clear from this plot that the fluctuations in spectra were between 650nm and 850nm, with the largest fluctuations between 800nm and 850nm. The fluctuations were more prominent at higher voltages and clearer due to the higher intensity of light.

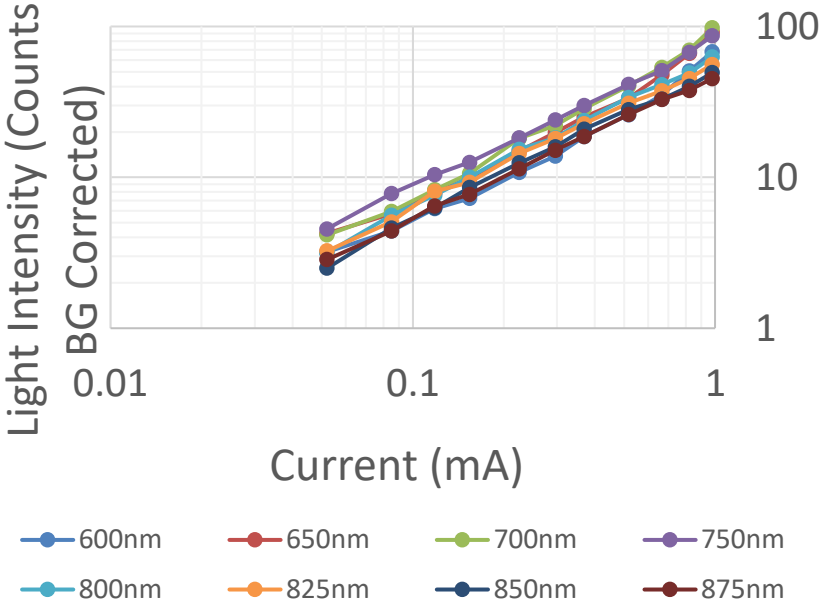


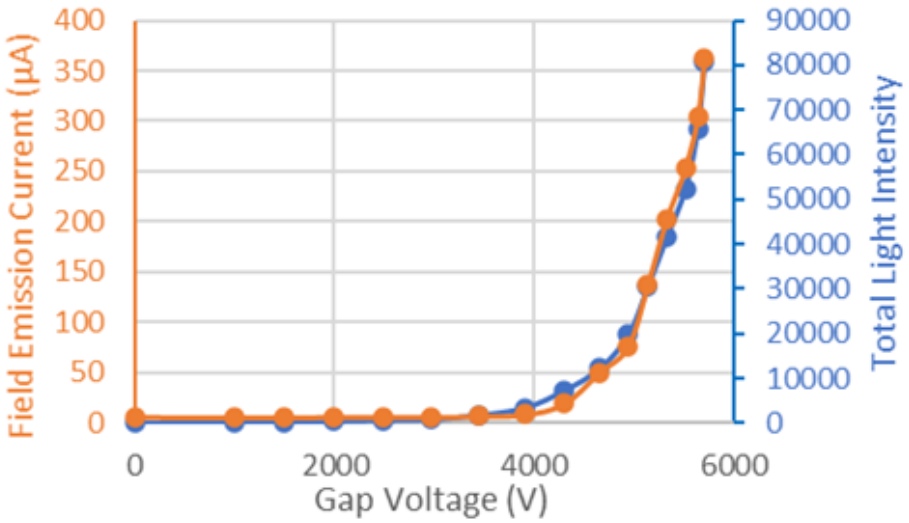


"Total light intensity" is the light intensity at every measured wavelength summed together. These results did give a clear relationship between the light intensity and current measured with respect to time. As the current fluctuated the light intensity appeared to follow the same changes in terms of increasing and decreasing by similar proportions.

Current and Voltage vs Light Intensity

The current was measured in parallel with all results as the supply voltage was increased. This shows a clear correlation between the current and spectra light intensity at different wavelengths. The gap power also had a linear correlation with light intensity; therefore, it is not possible to specify which is directly related to the cause of the light.





Looking for light emission correlation with the Fowler Nordheim Theorem. Light intensity when plotted with respect to voltage gives a plot that resembles the emission plot.