Photocathode Simulation Update

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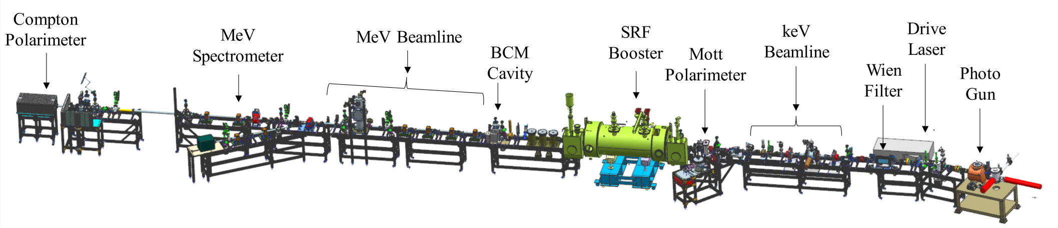
Overview

Experiment - UITF

1. Gun Installation
2. Laser Update
3. Spin Manipulation
4. Mott Polarimeter

Simulation

1. **COMSOL simulation**
2. Molflow simulation
3. IONATOR simulation

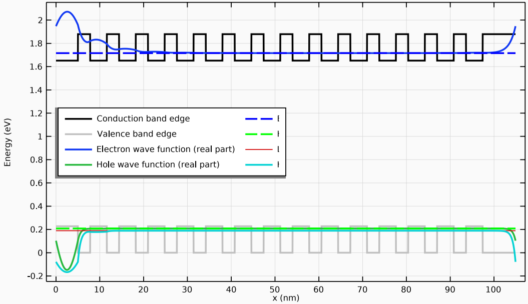


COMSOL Simulation - Quantum Confinement

Construct 1D geometry to model photo-cathode standing wave solutions

Schrodinger Equation

1. Solve the SE to find energy levels
2. Incorporate Quantum confinement effects to find energy levels
3. *Take difference between electron and holes for *effective* band gap*
4. Used in calculation of absorption coefficient



Produce E_{CB}, E_{LH}, and E_{HH} energy levels

Approach to QE/ESP results

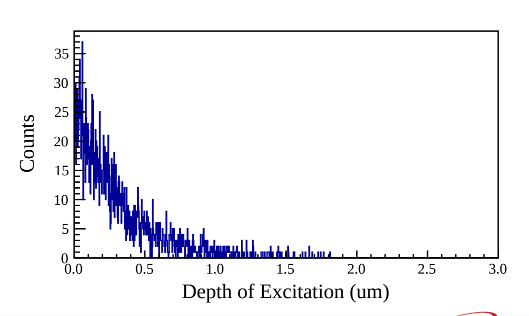
Currently not in COMSOL - *will* take previous output of energy levels

$$\epsilon(E) = AE_0^{-1.5}\left[f(\chi_0)+\frac{1}{2}\left(\frac{E_0}{E_0+\Delta_0}\right)^{1.5} f(\chi_{so})\right] \quad (1)$$

$$k \propto Im(\epsilon) \implies \alpha = \frac{4\pi k}{\lambda} \quad (2)$$

1. Equations from Adachi 1995, details omitted
2. α is can be used to calculate an absorption depth within the photo cathode

1. Monte-Carlo method to approach to generate initial electron excitation locations and energy distributions for each initial photon energy



Generating QE/ESP outputs

1. Using distributions produced previously we now simulated diffusion through the cathode
2. Once again, Monte-Carlo method introducing random momenta from excitation location
3. electrons diffuse until they undergo a scattering process or spin relaxation reaction, of which their momentum and spin are adjusted accordingly
4. Finally, once an electron reaches the band bending region it is accelerated towards the surface due to the potential difference
5. If the electron has enough energy to overcome the potential barrier, it escapes and can be counted as a escaped electron (spin is also tracked)
6. We begin by sending n photons and looking at how many electrons escape and their properties