Assignment 6a

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June 9, 2021

1 Overview

The objective is to plot the light intensity emitted by electrons in a tubelight
w.r.t position after the tubelight has reached steady state.

Light is emitted when atoms in the tubelight get excited by electrons.
These electrons are accelerated by the uniform electric field and in each
time step, an average of N electrons are introduced from the cathode.

2 Position, Displacement and Velocity

We begin by dividing the tube to n sections and M electrons introduced
in each section. We run the simulation for nk turns. If the electron has
velocity beyond u_o, then p is the probability that it collides with an atom
and excites it, which in turn emits light.

We create three arrays for computing and storing the above three variables.

- Position xx

- Displacement dx

- Velocity u

We then accumulate the information for the simulation. We do it in three
other arrays

- Intensity I

- Position X

- Velocity V

Next we find the position of electrons where it is greater than zero for
further computation.

```
ii=where(xx>0);
```

After having done that, we proceed to compute the velocity and displacement given by the following equations.

$$dx_i = u_i \Delta t + \frac{1}{2} a (\Delta t)^2 = u_i + 0.5 \tag{1}$$

The equations for advancing other variables are:

$$x_i = x_i + dx_i$$

$$u_i = u_i + 1$$

We then change all variables to zero if their position is greater than n. Also, we find the energized electrons using the following code

```
ll=where(rand(len(kk[0]))<=p);
kl=kk[ll];
```

We reset the velocities to zero since they suffer an inelastic collision and change the position of these electrons as well. Since these electrons energized the atoms which then relaxed and emitted a photon, we update the intensity array as follows

```
I.extend(xx[kl].tolist())
```

We then introduce M new electrons and initialize their position to 1 in the empty slots in the position array or in a new slot. Taking all the existing electrons, we add their positions and velocities into the simulation arrays.

3 Plots

We plot the simulations for two types of probability distribution, the first being a Gaussian distribution and the second being a Quadratic distribution.

The first plot is the intensity plot, which we plot using `hist` function.
The next plot is the the number of electrons w.r.t position in steady state.
The plots of electron phase spaces are as follows
The plots of intensity map as bands are as follows

4 Conclusion

The code for the assignment van be referred to in the other file. Also, the plots for specified values of
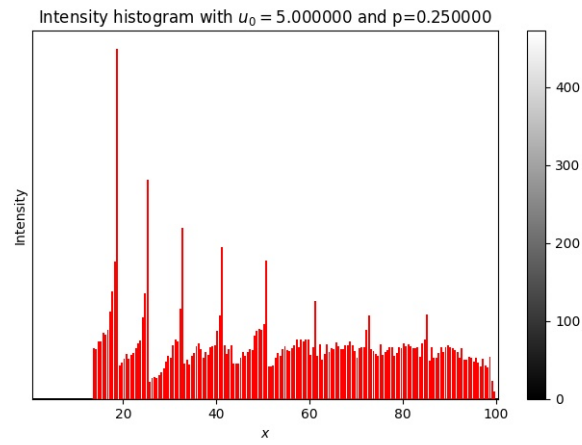
Figure 1: Intensity plot for gaussian probability
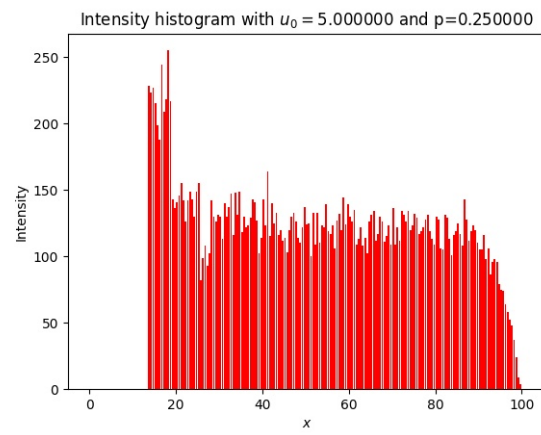

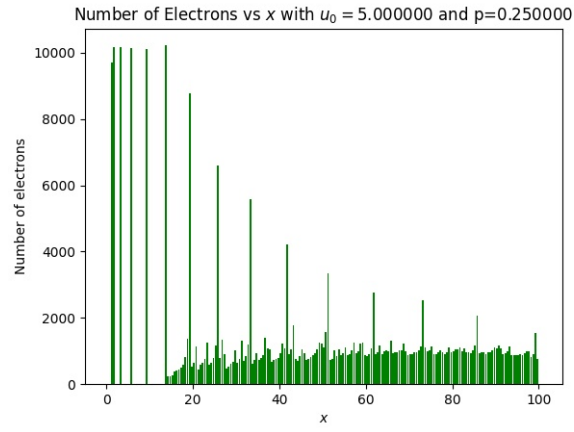Figure 2: Intensity plot for quadratic probability

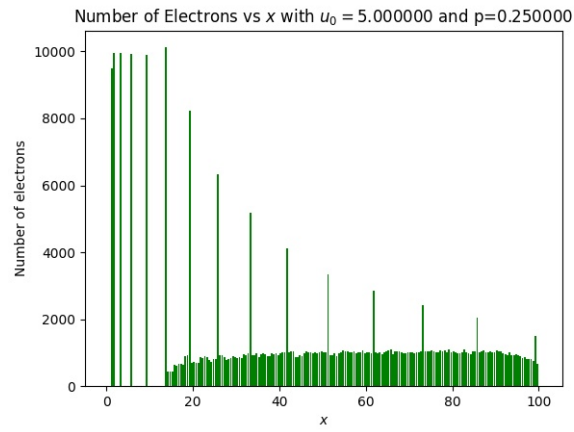Figure 3: No. of electrons for gaussian probability

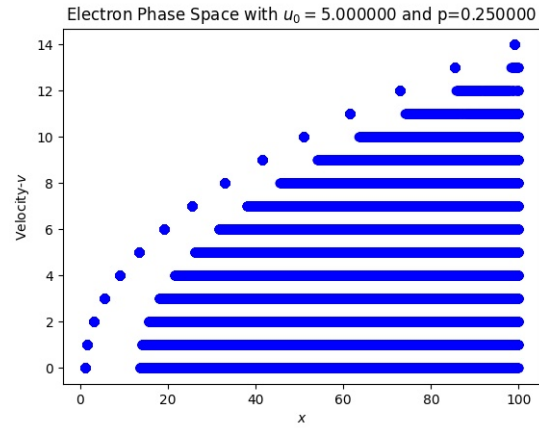Figure 4: No. of electrons for quadratic probability

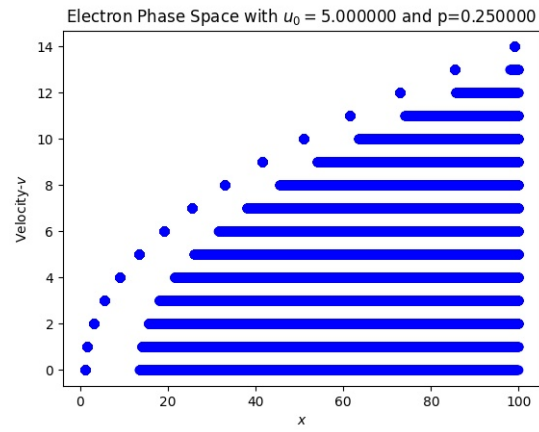Figure 5: Electron phase plot for gaussian probability

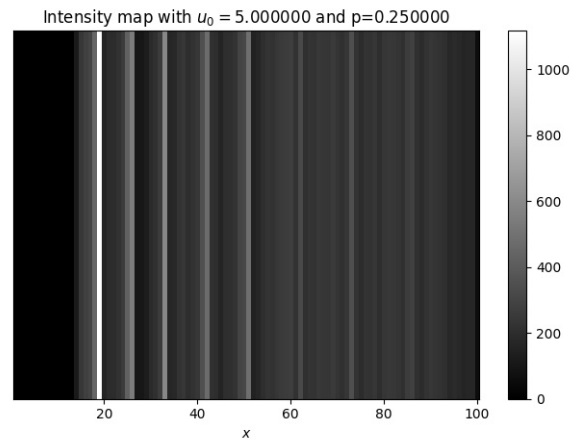Figure 6: Electron Phase plot for quadratic probability
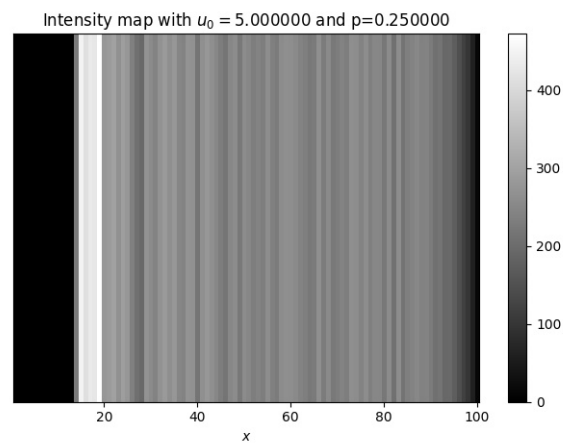
Figure 7: Intensity map plot for gaussian probability

Figure 8: Intensity map plot for quadratic probability