Using a differential equations package to emulate the path of different electron energies through the proposed sequence of fields, a discrepancy was found between the theoretical analysis and the simulation. The force equations did not show a time delay in the Wien filter due to a lack of fringe fields. To simulate this, an ‘artificial’ potential is constructed based on the vertical positions of the electrons entering the Wien filter. When they cross the potential line, the electrons speed is modified by this equation from Martin’s paper.

Where q is charge of electron, E is electric field strength, m is mass, v0 is average velocity of electrons, is the relative y position from the electron of v0 velocity.

If the forces in the Wien filter are turned off and only the velocity modifications are made as the electron enters and exits where there Wien filter is suppose to be, then the program emulates exactly what the analysis predicts; the electrons arrive at the end point with relatively good accuracy. Further testing will need to be done in order to determine the final pulse width using this calculation.

If the velocity delay described above is turned off, and the forces in the filter are turned back on the filter still has a focusing effect. The deflection that the unbalanced forces cause also has a focusing effect. When the electron enters the last to B-fields at an angle, the extra distance traveled is , where is the deflection angle and r is the radius of motion in the B-field. Recall that r=mv/qB.

So the extra path taken by an electron with speed is

The simulation showed that this focusing effect was accurate to a pulse width of 3e-8 m for one electron of where . Using Martin’s equation below

The equation is reduced to

Let’s set . If there was no delay, the faster electron would be ahead by . This would result in a spread of

For the example, ,

This is a bit larger than the simulation but that may be from inaccuracy in the step size.

My next step is to tune the electric field to take into account both the potential delay and the deflection delay to correctly represent the physical situation.