Homework #1, Due by email, Monday October 7th

1. Consider an integral of form

Where both A and are real functions, and assume that A(u) is only large near u=0. By expanding as a Taylor series, should how the wavepacket changes position as a function of t. Note: this is a simplified version of the group velocity and what you are using is a simplified form of the stationary phase approximation which is where ray diagrams come from.

2. Consider two electrons with energy E and E+dE where dE=1eV, emitted at the same time from the source and initially with the same phase. They now travel down the column from the source some distance D. As an estimate, if the phase difference between the two electrons is π/2 at D consider that they are incoherent. Using first the **non-relativistic** equations for the wavelength, plot the smallest distance D for them to be incoherent for energies of 100eV to 1MeV. Then plot this for the **relativistic** equations for the wavelength.

3. Assuming a fully incoherent condensor aperture, derive the transverse coherence in the plane of the sample as the distance where the coherence between two points in the plane of the sample becomes half of what it is for the same point. (Yes, I did mean the same point, think carefully.)