SIMULATION OF WAVES AND SHOCKS
Summer 2003 Midterm Report by: Mark Miles
Advisors: Moysey Brio & Colm Dineen

Before my research began, it was important for me to become familiar with the 2D Vector-Maxwell Simulator. I performed various tests, practicing writing new environments and modifying old ones. During this phase of my research, I was able to determine certain functions in the Vector-Maxwell software that was not operational, or at least, not operating as expected. For example, I discovered that it was not yet possible to change the z-position of the source of a light wave. Once I became proficient enough, I was given my first real assignment.

It was hypothesized that when light was excited into a disk with an imperfection, the light would eventually leave the disk through the imperfection. We tested two different environments. One had a disk with a small piece missing on its edge. The other had a disk with an extra piece added to the edge. After several attempts, the original hypothesis appeared to be incorrect. Light seemed to leave the disk at every point of the disk's surface, regardless of the imperfection.

It was then my duty to find reports on microdisk cavity lasers. A microdisk cavity laser is a small disk, often composed of GaAs, which is then injected with light from a laser. In my research, I found that in these microdisks, something called a whispering gallery mode is set up. A whispering gallery mode occurs when light is excited into a disk, and after a period of time (dependent on the size of the disk and the frequency of the wavelength), the light starts to travel around the disk in a uniform ring.

Once I concluded my research on microdisk cavity lasers, I started a new project. I attempted to create a whispering gallery mode in a disk of GaAs with a diameter of five microns. I first tried to excite the wave directly in the disk, setting the pinpoint source off center to force it to ricochet within the disk. Eventually, after a series of slight modifications, I was able to produce what appeared to be a whispering gallery mode.

Unfortunately, the frequency that the simulator was displaying was much smaller than it should have been. It was unknown whether this discrepancy was due to the fact the light was excited directly in the disk, or whether there was some bug in the simulator.

We then started the experiment with a line source outside the disk, allowing the light to filter into the disk. This time, the frequency seemed more correct; however, a whispering gallery mode could not be set up.

Now, we have the line source back inside the disk, and we are still attempting to find a whispering gallery mode. The frequency seems to be where it should be, but a mode has not been set up yet. We are continuing our experiments, but have yet to duplicate the findings in the reports.