Name: _____ **Period:** _____ **Due Date:** _____

Lab Partners: _____

DETERMINING THE DIVERGENCE OF A HeNe LASER

Purpose: To determine the point of origin of the light emitted by our HeNe lasers. We will use this result to correct our calculations in later parts of this lab. The theory of Diffraction does not require that our laser exhibit perfect collimation (parallel rays). For simplicity, however, we will be study diffraction and interpret the results using the assumption that the light is perfectly collimated. Most laser beams spread out slightly and so are divergent, to some degree.

Our lasers are well collimated (divergence = $\theta \approx 1$ - 2 milliradians), but not extraordinarily so. They are slightly divergent. With some effort we could insert additional optical devices into the beams to collimate them further.

Fraunhofer diffraction in its purest form requires a monochromatic light source: our laser comes pretty close**;** a coherent light source: again our laser comes pretty close**;** and a collimated light source: this is where our laser lets us down just a little. We can apply a mathematical correction factor, a geometric magnification adjustment, to correct for this when it become important to do so. At that point we will need to know the divergence of the beam.

Our first step toward correcting for divergence of the laser beam is to measure the amount of divergence. The next goal is to find the apparent origin of the diverging beam. This point is usually some distance behind the actual laser itself. Measure the diameter (mm) of the beam at various distances from the front of the laser housing and determine the point of origin of the beam relative to the front end of the housing. Create a graph of the beam's diameter (m) vs distance (m) and extrapolate to find the point of origin, i.e. the location where the beam diameter is zero. (*Make sure all distances are greater than 2 m from the front of the laser housing*.)

Distance from the front	**Diameter**	**Distance from the front**	**Diameter**
_____ m	_____ mm	_____ m	_____ mm
_____ m	_____ mm	_____ m	_____ mm
_____ m	_____ mm	_____ m	_____ mm
_____ m	_____ mm	_____ m	_____ mm

According to the graph, the point of origin is _____ m behind the front of the laser housing

When we report distances throughout the remainder of this lab, we will always report distance from the point of origin whenever the distance to the laser is called for. The difference between distance from the front of the laser and distance from the point of origin becomes less important as the distance increases.

Beam Divergence = Beam Diameter / Distance from the point of origin = m = _____ milliradians

The point of origin is only an apparent location. The laser beam does not originate at a single point in space. Divergence arises because the lasing tube has a finite width and a finite length. There are curved surfaces on the internal exit mirror and the external surface of the exit window. These curved surfaces help to minimize divergence but to not eliminate it.