Appendix A

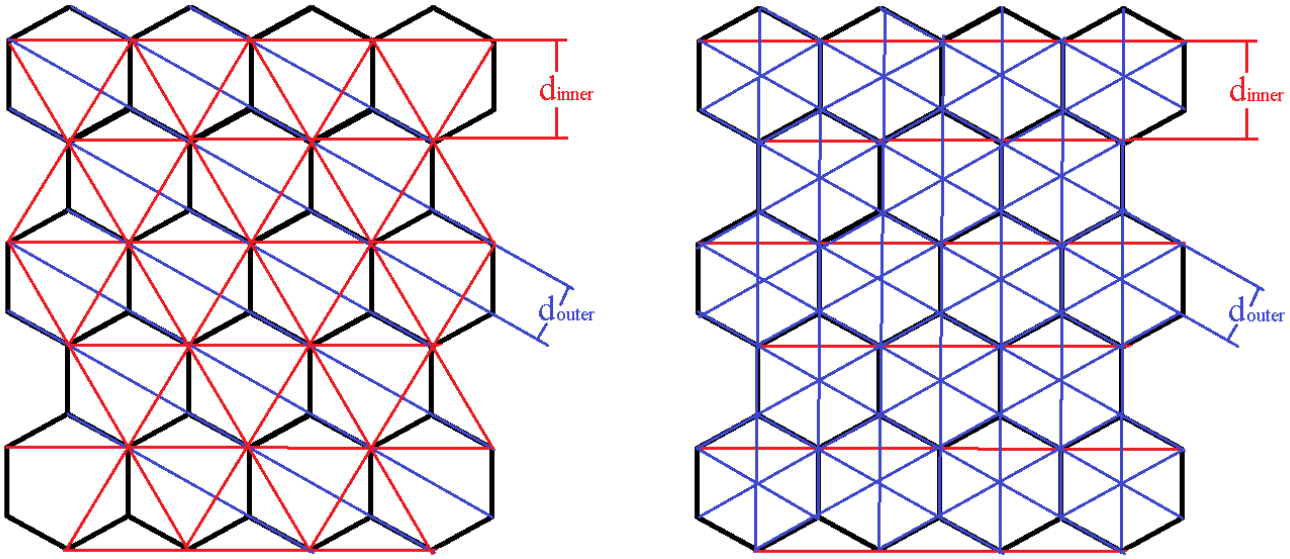

Figure 4: This is an exaggeration of the hexagonal crystalline structure of carbon in the graphite form. The red lines represent one diffraction grating and the blue represent the other. There are many orientations that yield the two distances in an organized pattern. The left shows the multiple orientations for diffraction leading to the inner ring. The right shows the patterns leading to the outer ring.

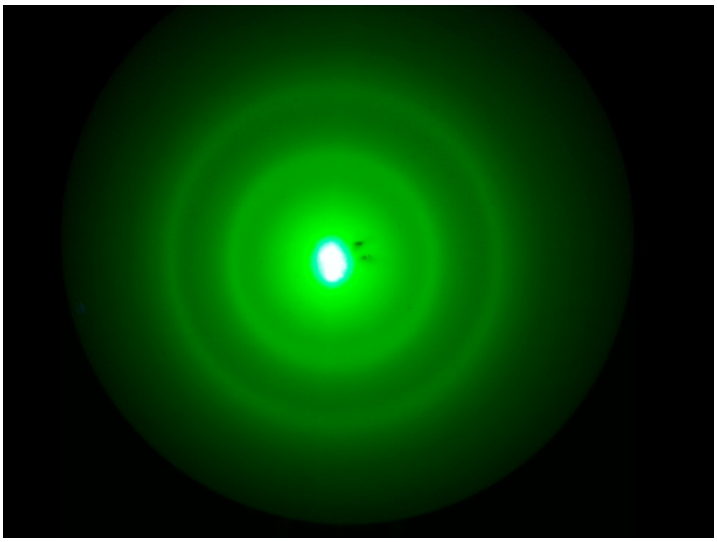

Figure 5: This is a photograph taken of the diffraction pattern during the experiment. The unobstructed electron beam is much brighter than the rings outside. Note the two distinct rings corresponding to two separate distances between carbon atoms in the graphite structure.

Appendix B

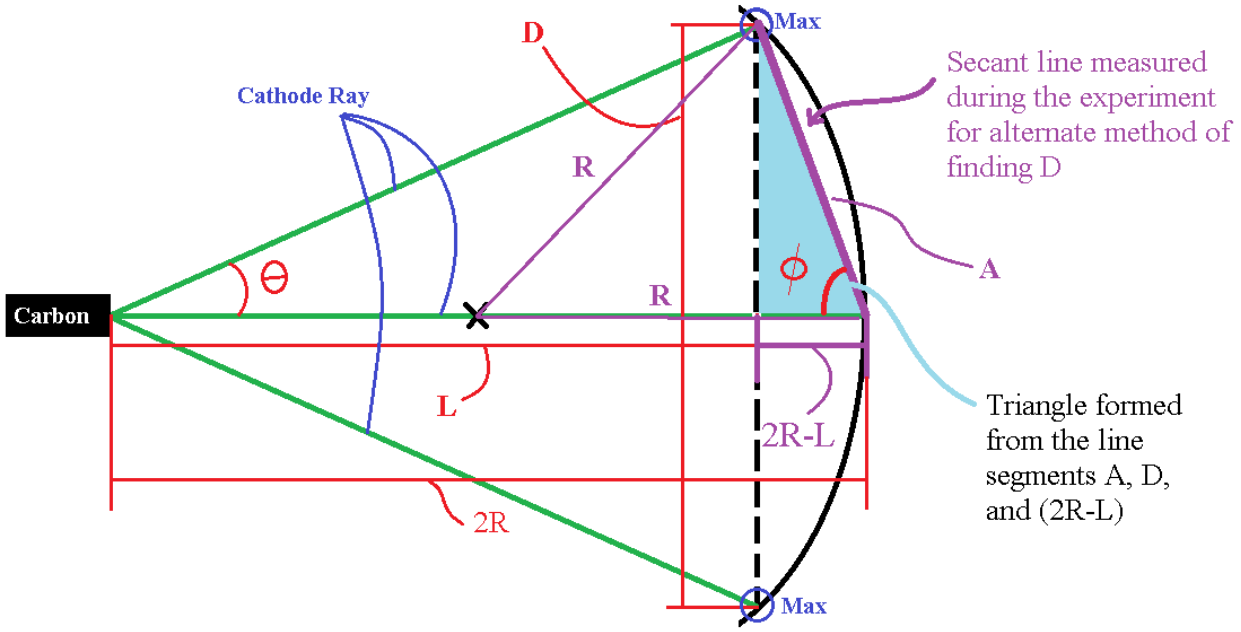

Figure 6: This is a more detailed version of Figure 1. The purple line, A, is the secant line measured from the unobstructed wave at the center, to the diffraction maximum. Using trigonometry, we can find the leg of the triangle equal to half the distance D.

Letting R be the radius of the electron diffraction tube and A be the measured secant line, the law of cosines can be rearranged to

$$\phi = \cos^{-1}\left(\frac{A}{2R}\right) \qquad (12)$$

With ϕ, we can find an expression for D in terms of A such that

$$D = 2A\sin\phi \qquad (13)$$

Substituting equation (12) for ϕ in equation (13), we find our alternative method for finding D

$$D = 2A\sin\left(\cos^{-1}\left(\frac{A}{2R}\right)\right) \qquad (14)$$

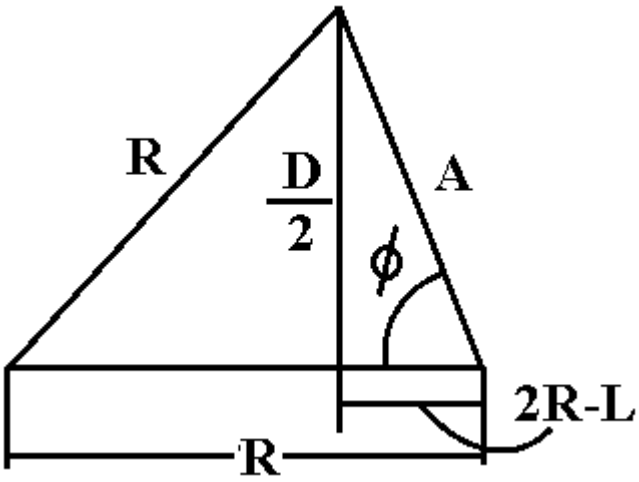

Figure 7: A diagram of the purple triangle found in Figure 6. The radius, R, is a known value and A is measured.

Appendix C

Diameter Method			
V	V^(-1/2)	D Inner (mm)	D Outer (mm)
1745.119	0.023937979	40.46	68.03
2105.48	0.021793372	38.48	64.58
2429.4	0.020288526	35.89	58.31
2781.663	0.018960411	33.30	55.86
3044.848	0.018122462	32.72	53.20
3376.866	0.017208503	31.56	50.46
3729.129	0.016375565	30.64	49.82
4036.853	0.015739051	28.49	48.13
4376.969	0.015115178	27.10	45.40
4640.154	0.014680262	26.99	44.57
4939.78	0.014228077	26.98	43.31

Table 1: This is a table of the data collected by the diameter method. The values for D inner, and D outer were measured directly.

Secant Method			
V	V^(-1/2)	D Inner (mm)	D Outer (mm)
1745.119	0.023937979	40.46	68.03
2105.48	0.021793372	38.48	64.58
2429.4	0.020288526	35.89	58.31
2781.663	0.018960411	33.30	55.86
3044.848	0.018122462	32.72	53.20
3376.866	0.017208503	31.56	50.46
3729.129	0.016375565	30.64	49.82
4036.853	0.015739051	28.49	48.13
4376.969	0.015115178	27.10	45.40
4640.154	0.014680262	26.99	44.57
4939.78	0.014228077	26.98	43.31

Table 2: This is a table of the data collected by the secant method. The values for D inner and D outer are calculated from the secant line in Figure 6

After plotting the data found in Table 1 and Table 2, a linear regression was applied to find the error in the slope, δm_s. This accounted for the error in the graphed values ${V_a}^{-1/2}$, D_{inner}, and D_{outer}. To find the error in the distance between atoms, d, we used the following equation

$$\frac{\delta d}{|d|} = \sqrt{\left(\frac{\delta m_s}{|m_s|}\right)^2 + \left(\frac{\delta L}{|L|}\right)^2 + \left(\frac{\delta h}{|h|}\right)^2 + \left(\frac{\delta m}{|m|}\right)^2 + \left(\frac{\delta e}{|e|}\right)^2} \tag{15}$$

This gave us the fractional uncertainty in the values of d we calculated for each method. To increase the accuracy of our results we used a weighted average.

$$d_{wav} = \frac{\sum w_i d_i}{\sum w_i} \tag{16}$$

Where w_i is the weight expressed by

$$w_i = \frac{1}{{\sigma_i}^2} \tag{17}$$

and σ_i is the uncertainty corresponding to each d value.