

## APPENDIX 1. ESTIMATE OF $\sigma_{lc}$

The distribution of  $\sigma_{lc}$  was characterized using an empirical fit to the contour diagram in Figure 2c. The following rules define a set of contours of constant  $\sigma_{lc}$ , and there is linear interpolation between all unmatched contours:

- 1) 0.623  $\mu\text{m}$  contour linearly connects (16.0  $\mu\text{m}$ , 0°) and (13.0  $\mu\text{m}$ , 90°)
- 2) 0.399  $\mu\text{m}$  contour linearly connects (16.75  $\mu\text{m}$ , 0°) and (15.5  $\mu\text{m}$ , 90°)
- 3) 1.4  $\mu\text{m}$  linearly contour connects (2.5  $\mu\text{m}$ , 90°) to (9.6  $\mu\text{m}$ , 10°), then extending along 10° until it intersects 0.623  $\mu\text{m}$  contour from rule 1
- 4) 0.623  $\mu\text{m}$  contour at +10° from 1.4  $\mu\text{m}$  contour from rule 3
- 5) 1.4  $\mu\text{m}$  contour at  $\phi = \cos^{-1}(\text{lesser of } 1.0, 0.66+0.0345\ l)$
- 6) 0.623  $\mu\text{m}$  contour at  $\phi = \cos^{-1}(\text{lesser of } 1.0, 0.66+0.0345\ l) - 10^\circ$

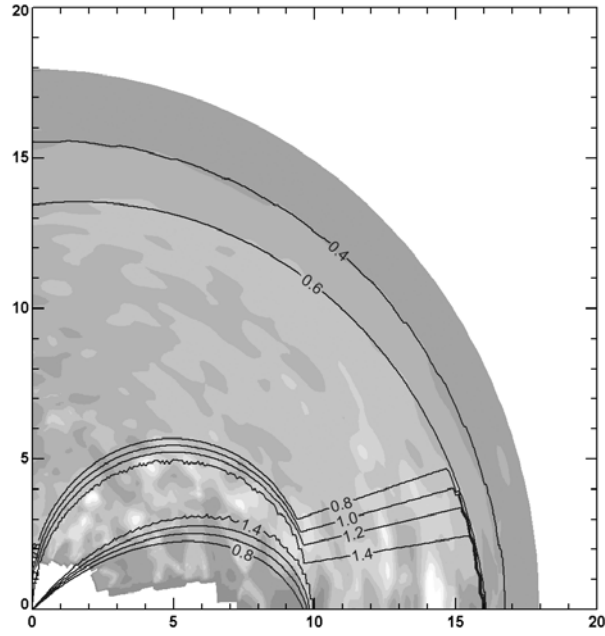
The value of 0.623  $\mu\text{m}$  is the approximate mean  $\sigma_{lc}$  value in the main body of the diagram. In regions with high variability in  $\sigma_{lc}$ , higher values were taken as being more likely to be valid and thus represented in this model, as they tend to be based on more data points. Changes in contour values and positions will alter  $\chi^2_v$  results, but the fact that the current analysis produces values near 1.0 suggests that this model is adequately scaled. The resulting contours are shown in Appendix Figure 1, and the model is implemented in the following C++ code.

```
/* SigmaLc
   Given a length and an angle, returns the estimated uncertainty in
   its projection to the c axis.
   Input: length (in microns), phi (in degrees)
*/
double SigmaLc(double length, double phi)
{
    double upperBound = 16.0-2.8*phi/90.0;
    if (length > upperBound) {
        double farBound = 16.75-1.25*phi/90;
        if (length > farBound) return(0.399);
        else {
            return(0.623-0.223*(length-upperBound)/(farBound - upperBound));
        }
    }
}
```

```

    }
}
double upcos = (length > 9.85) ? 0.985 : length*0.1;
double phip = acos(upcos)*180.0/PI;
if (phi >= phip+10.0) return(0.623);
if (phi >= phip) return(1.4-0.767*(phi-phip)/10.);
double locos = (0.66 + 0.0345*length);
if (locos > 1.0) locos = 1.0;
double phiq = acos(locos)*180.0/PI;
if (phi > phiq) return(1.4);
if (phi <= phiq-10.0) return(0.623);
return(1.4-0.777*(phiq-phi)/10.0);
}

```



**APPENDIX FIGURE 1:** Polar contour plot of  $\sigma_{lc}$  model used for this work. Contours of constant estimated  $\sigma_{lc}$  are superimposed on grayscale contours of measured  $\sigma_{lc}$  (Fig. 2c). Contour interval =  $0.2 \mu\text{m}$ .