lab #4

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1 tabulation of data

Note that the uncertainty in all measurements is $\delta = .0005m$ unless otherwise noted.

1.1 different radii of the lens

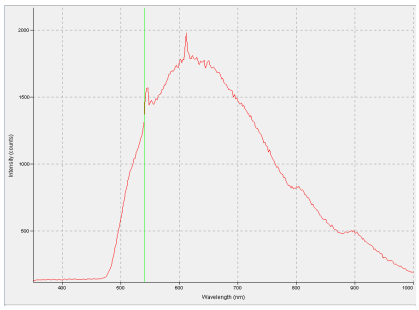
The detentions of the masks in meters and there focal positions (yellow light). For this our object was located at .1235m and our lens was at .693m

R_i	R_o	R_{ave}	δR_{ave}	image
.013	.018	.0155	.0025	1.0765
.018	.0225	.02025	.00225	1.0720
.0225	.0295	.026	.0035	1.0660
.02875	.03425	.0315	.00275	1.0575
.035	.0395	.03725	.00225	1.0500
.039	.042	.0405	.0015	1.0415
.0415	.0455	.0435	.002	1.0340
.0445	.0495	.047	.0025	1.0270
.0495	.053	.05125	.00175	1.0180
.05325	.0565	.054875	.001625	1.0130
.05625	.05875	.0575	.00125	1.0010

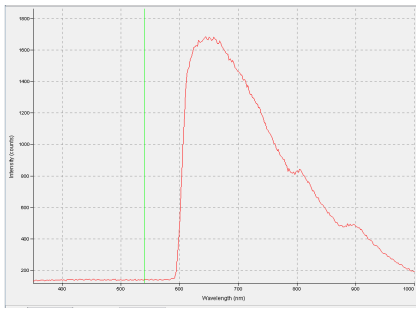
1.2 chromatic aberration

Firstly we have our spectra for the different filters:

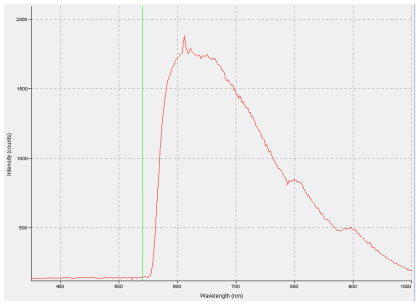
yellow



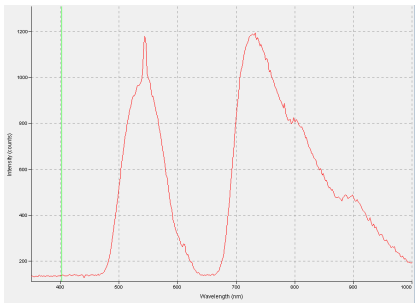
red



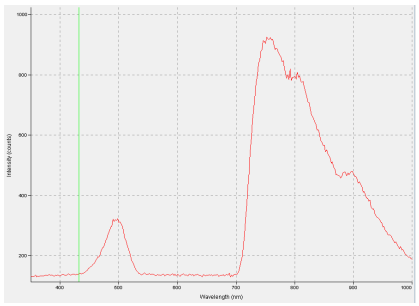
orange



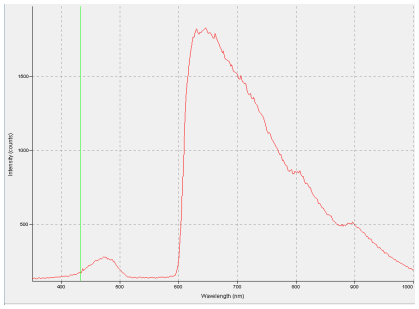
green



blue



violet



For this our object was located at .1235m and our lens was at .8055m. The uncertainty in the wavelength is high since they are very spread out so $\delta\lambda = 15nm$

color	image (m)	wavelength (nm)
yellow	1.1965	625
red	1.1985	650
orange	1.1985	615
green	1.1915	550
blue	1.187	500
violet	1.186	475

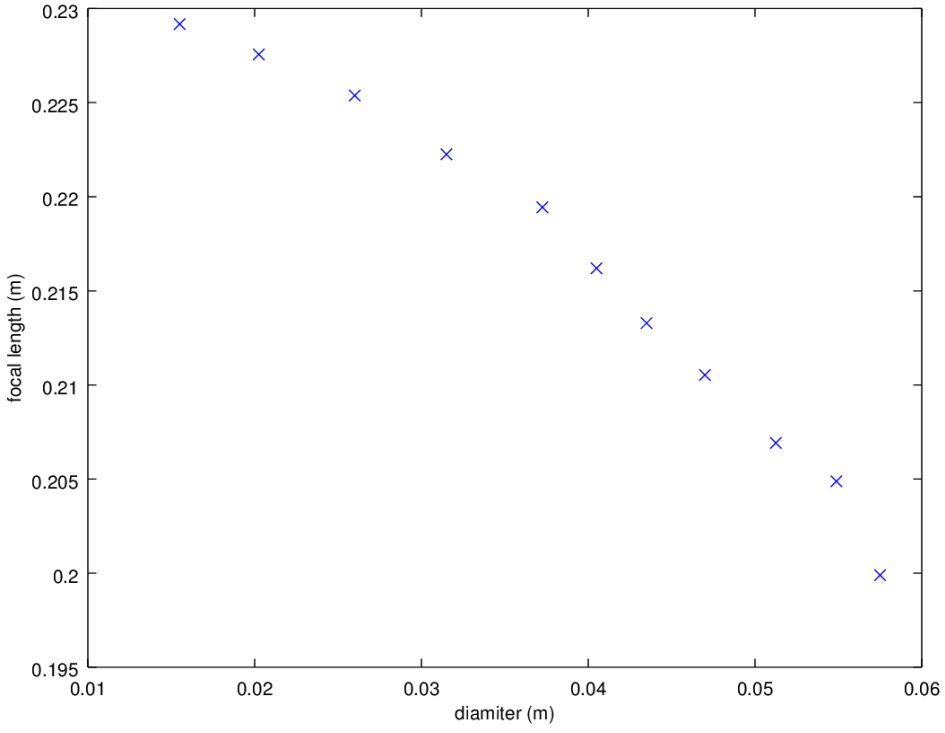
1.3 sagital and tangential aberration

For this our object was located at .1235m and our lens was at .92m.

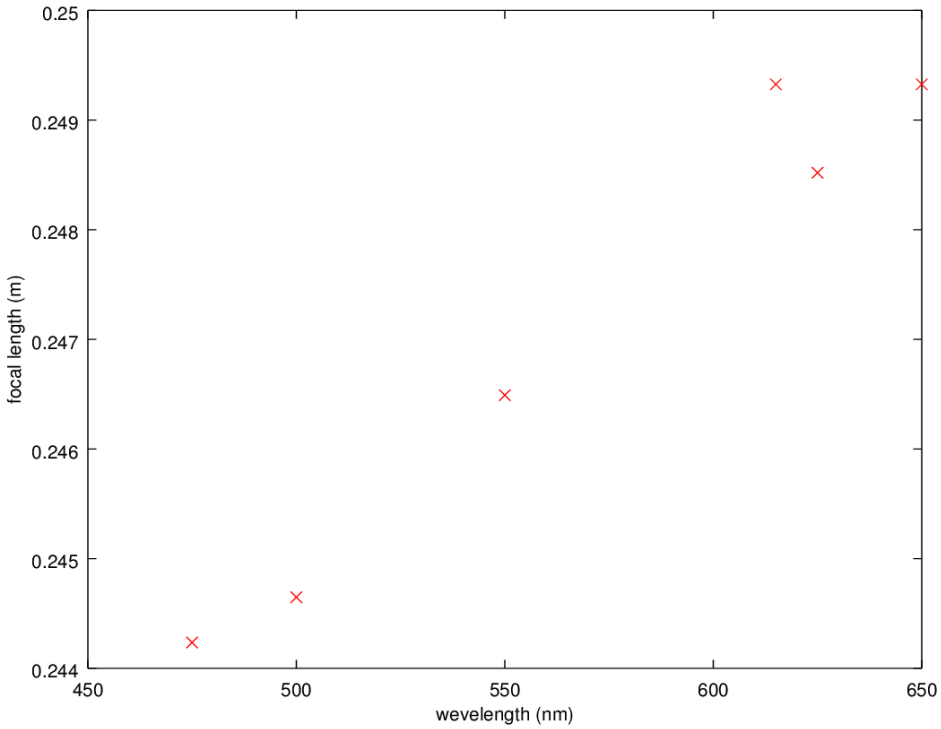
angle	sagital image (m)	tangential image (m)
-35	1.151	1.334
-30	1.204	1.3565
-25	1.269	1.364
-20	1.312	1.379
-15	1.353	1.386
-10	1.3775	1.397
10	1.376	1.395
15	1.351	1.386
20	1.315	1.3675
25	1.268	1.3565
30	1.201	1.328
35	1.155	1.323

2 analysis

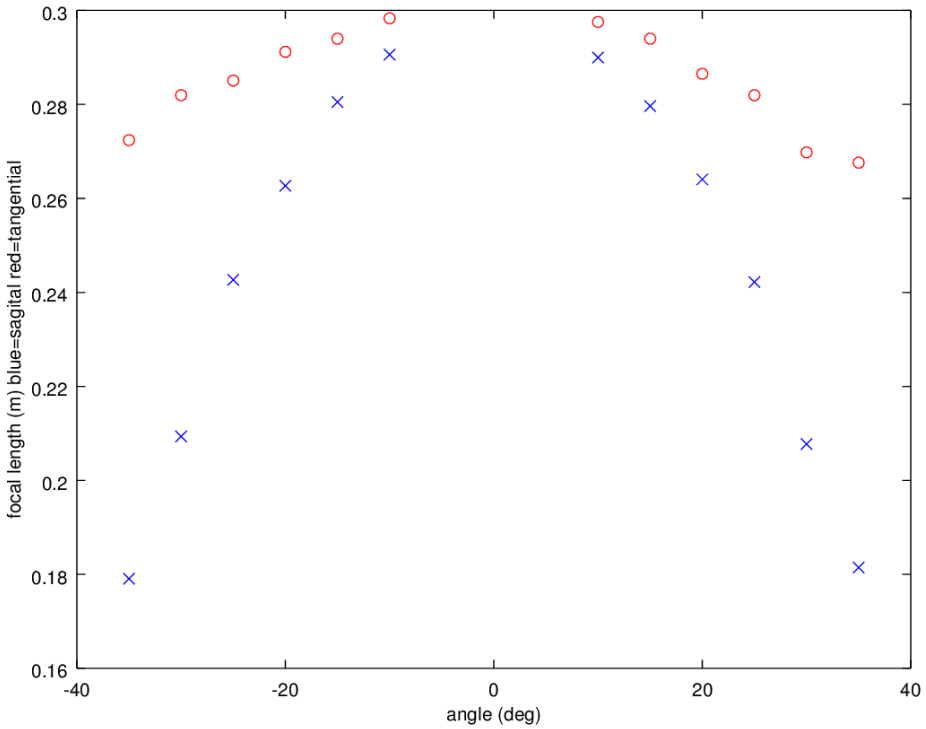
Here we see a significant inverse relationship between the focal length and the diameter of the mask.



This is the focal length for various colors.



This is a plot of the sagital and tangential focal lengths vs the angle of rotation.



3 additional discussion

The spherical aberration we observed seams to be consistent with the inverse relationship described in the book. The rays passing through the higher radius regions seem to be bent in more, as expected.

Since glass has a higher reflective index for smaller wavelength light we would expect that the lens (who's effect is proportional to the reflective index) would be stronger for smaller wavelengths. This is the result shown in the above graph.