MINIMIZING SPHERICAL ABERRATION

We saw above that increasing the f/# minimizes spherical aberrations.

For the cases where the f/# is fixed, there are other ways to minimize spherical aberrations: optimizing the shape of the lens.

A striking example is presented by a planar-convex lens: simply turning the lens around, markedly reduces the spherical aberration.

EXPLANATION: This can be understood by considering the lens as composed of 2 prisms joined at their bases.
When a ray strikes a prism, it undergoes a net deviation $\delta$.

- $\delta$ increases with the index of refraction $n$.

Since $n = n(\lambda)$, then $\delta$ depends on the wavelength of the incident light.

$n(\lambda_{\text{blue}}) > n(\lambda_{\text{red}})$ implies the deviation $\delta$ is less for red light.

- For a given prism (i.e., $n$ and $\alpha$ fixed), $\delta$ is a function of the incident angle $\theta$.

![Graph showing $\delta$ as a function of $\theta$ for $n=1.5$ and $\alpha=60^\circ$.]
Rays for which the deviation $\delta$ is minimum, traverses the prism parallel to the base.

A reinterpretation of this result, (in terms of our purpose of interpreting a lens as two prisms joined at their bases) is as follows:

The incident ray will undergo a minimum deviation when it makes, more or less, the same angle as does the emerging ray.