Lens Calculation

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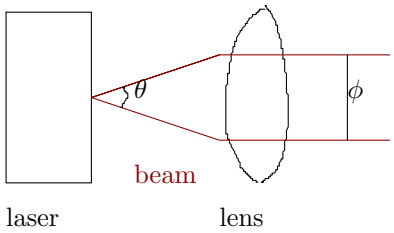

Figure 1: A schematic drawing of the laser lens system[1].

The focal length of the lens is found by[1]

$$f = \frac{\frac{\phi}{2}}{\tan\left(\frac{\theta}{2}\right)} \tag{1}$$

where f is the focal length, ϕ is the diameter of the beam, and θ is the beam divergence. The Eagleyard laser diode has a typical divergence of 21 degrees for the major axis[2]. The IO-3D-850-VLP laser has a maximum beam diameter of 2.7 mm. Then, the focal length would be,

$$f = \frac{\frac{2.7}{2}}{\tan\left(\frac{21}{2}\right)} = 7.3\text{mm} \tag{2}$$

To be well within the typical limit, setting ϕ=1 mm gives,

$$f = \frac{\frac{1}{2}}{\tan\left(\frac{21}{2}\right)} = 2.7\text{mm} \tag{3}$$

Then, the N414TM-B lens, which has a focal length of 3.3 mm is more than within the range given above and will work even in case the LD has larger than typical divergence. With this lens, the beam diameter of the major axis, ϕ becomes,

$$2f \tan\left(\frac{\theta}{2}\right) = \phi \tag{4}$$

$$\phi_{\perp} = 2(3.3)\tan\left(\frac{21}{2}\right) = 1.2\text{mm} \tag{5}$$

To correct for the elliptical beam produced from the edge emitting laser diode and have it be circular, the minor beam axis can be magnified[1]. The typical divergence of the minor axis of the Eagleyard laser diode is 8 degrees[2]. Then the beam diameter of the minor axis is,

$$\phi_{\parallel} = 2(3.3)\tan\left(\frac{8}{2}\right) = 0.5\text{mm} \tag{6}$$

The required magnification can be found by taking the ratio of the major and minor beam axes. Then,

$$\frac{\phi_{\parallel}}{\phi_{bot}} = \frac{1.2}{0.5} = 2.4 \tag{7}$$

References

[1] THORLABS, "Choosing Collimation and Ellipticity Correction Optics for Your Laser Diode". Laser Diode Tutorial. https://www.thorlabs.com/newgrouppage9.cfm?objectgroup$_id = 1832$

[2] TOPTICA eagleyard, "DATA SHEET EYP-DFB-0852-00150-1500-TOC03-0005 Revision 1.07". https://www.toptica-eagleyard.com/fileadmin/downloads/data$_sheets/EYP - DFB - 0852 - 00150 - 1500 - TOC03 - 0005.pdf$