INCREASING LIGHT SHEET DIVERGENCE ANGLE

APPLICATION NOTE PIV-021 (A4)

One of the critical components of a PIV system is the laser light sheet. It is not uncommon for a very wide light sheet to be required. Standard cylindrical lenses offer a convenient method for expanding the laser light sheet into a sheet.

In order to increase the beam divergence angle of a PIV light sheet, a combination of cylindrical lenses may be used in succession. The collimated beam diameter (t), focal length of the lenses (f), and distance separating the lenses (s), all have an impact on the resultant light sheet divergence angle (α_2).

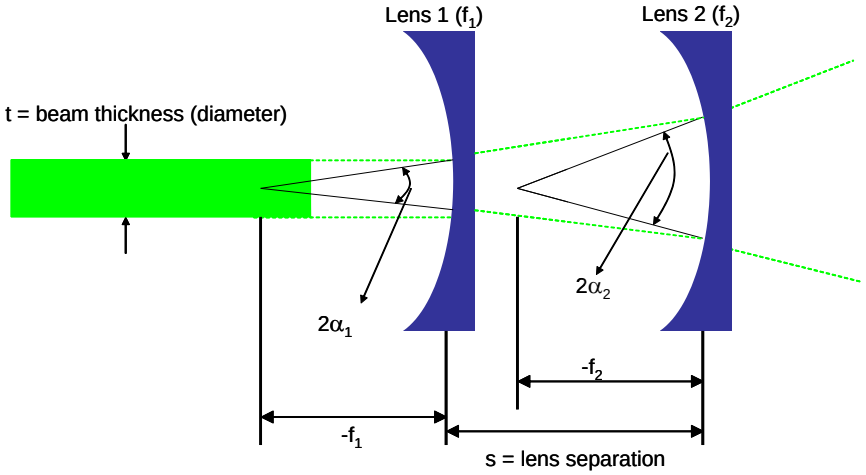

Fig. 1. Illustrated schematic of multiple cylindrical lens configuration for increase divergence angle.

The final angle of divergence is given by α_2. The following expressions can be derived from the above diagram:

$$\alpha_1 = tan^{-1}\left(\frac{1/2}{-f_1}\right) \qquad \alpha_2 = tan^{-1}\left(\frac{(s-f_1)tan(\alpha_1)}{-f_2}\right) = tan^{-1}\left(\frac{t(s-f_1)}{2f_1f_2}\right)$$

The table below gives example values for the associated parameters and the resulting angles of divergence for both cylindrical lenses in varying order (note: the separation distance, s, and beam diameter, t, used here are based on a typical 15 Hz pulsed Nd:YAG laser and TSI "bayonet-mount" light sheet optics).

t [mm]	s [mm]	f_1 [mm]	f_2 [mm]	$2\alpha_1$ [deg]	$2\alpha_2$ [deg]
6	20	–15	–25	11.3°	31.3°
6	20	–25	–15	13.7°	39.6°

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