QUICK-GUIDE: Beam Collimation & Shearing Interferometry

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The objective of this experiment is the preparation and verify a perfectly collimated plane wave by a custom beam expander using lens and a precision shearing interferometer.

SETUP:

Laser ($532nm$, $diameter = 2.0mm$) → ND Filter → Lens 1 (Bi-convex $f_1 = 50.0mm$) → Lens 2 (Plano-convex $f_2 = 300.0mm$) → Shearing Interferometer (SI254)

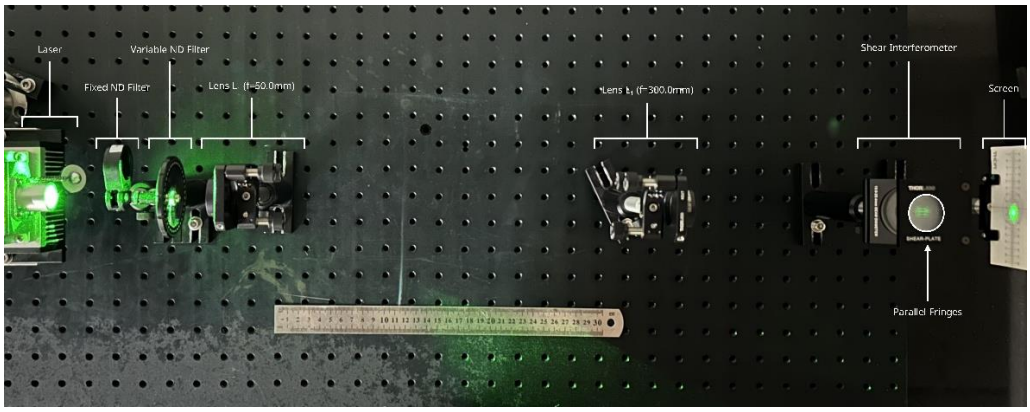

Figure 1: Experimental setup (top view)

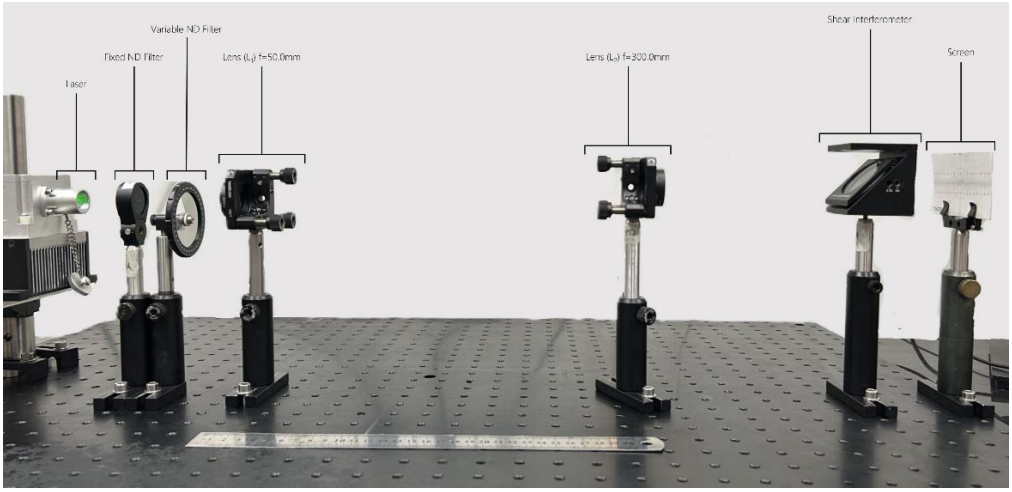

Figure 2: Experimental setup (side view)

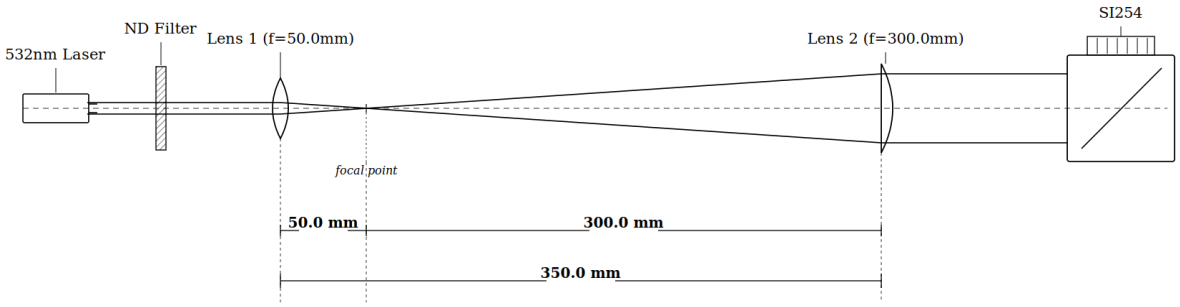

Figure 3: Setup Illustration

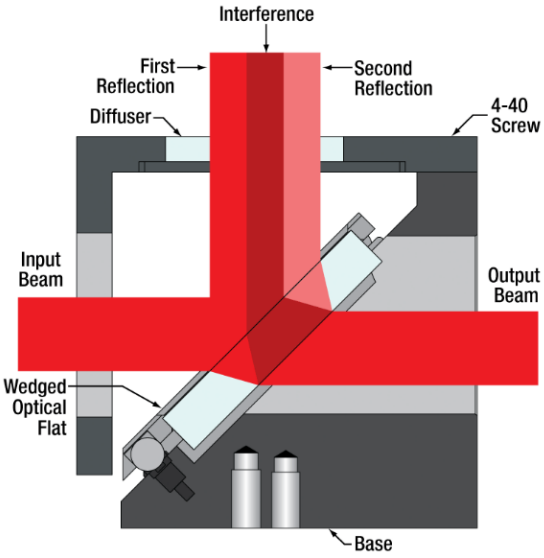

Figure 4: Shear Interferometer

EXPERIMENTAL PROCEDURE:

Step A: Build the Expander

1. Fire the naked laser down the optical axis.
2. Insert Lens 1 ($50.0mm$) to forcefully diverge the beam.
3. Place Lens 2 ($300.0mm$) on a mount exactly $350.0mm$ away from Lens 1.
4. The flat side of Lens 2 must face the incoming laser, and the curved side must face outward to minimize spherical aberration.

Step B: Read the Fringes

1. Place the SI254 Shearing Interferometer after Lens 2.
2. Magnification: $f_2/f_1 = 300/50 = \times 6$ (Expands beam to $\sim 12.0mm$).
3. Watch the frosted screen on the interferometer while slowly moving Lens 2 back and forth. Focus strictly on the bright central area where the two laser circles intersect to read your fringes.
4. Compare the dark interference fringes to the etched horizontal reference wire.

Step C: Tune to Perfection

Move Lens 2 back and forth to adjust the distance:

- (a) Fringes point UP (///): Beam is diverging. Move Lens 2 slightly AWAY from Lens 1.
- (b) Fringes point DOWN (\\\): Beam is converging. Move Lens 2 slightly CLOSER to Lens 1.
- (c) Fringes are perfectly HORIZONTAL (|||): Beam is fully collimated.

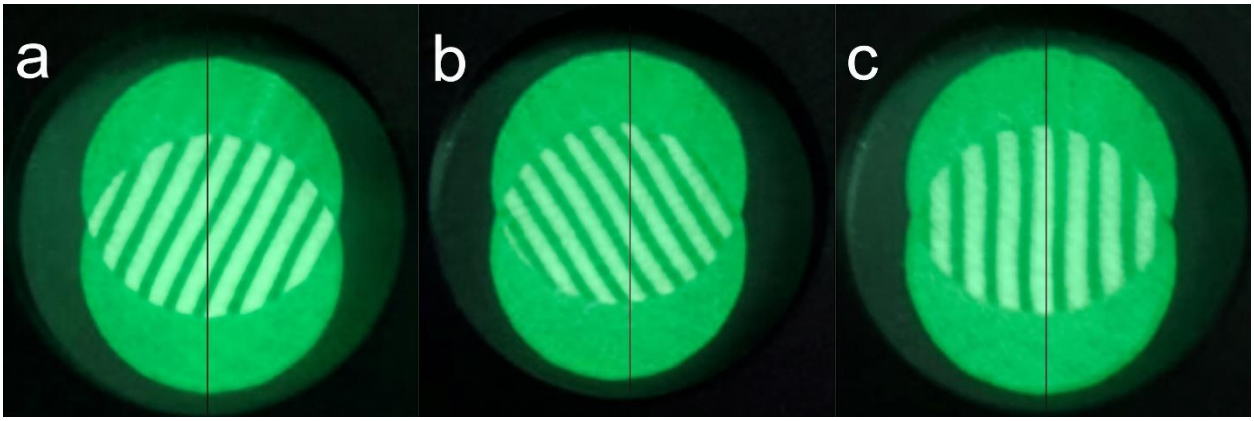

Figure 5: Fringes patterns