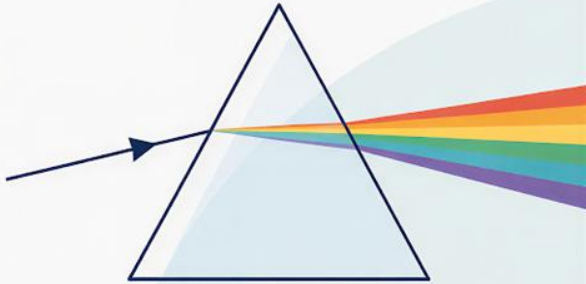
Laser Setup and Beam Alignment

Lab Session | Assist Lect. ISMAEL A. GHNEI | AL-Hadara College





Practical Roadmap | خطة العمل

Safety Rules | السلامة

Strict lab exclusion and certified protective eyewear protocol.

Alignment Tools | الأدوات

Thermal paper, fluorescent cards, and visible tracer lasers.

Mirror Mounts | الحوامل

Kinematic mounts for horizontal yaw and vertical pitch control.

Two-Mirror Walk | التوجيه

Decoupling position and angle using two steering mirrors.

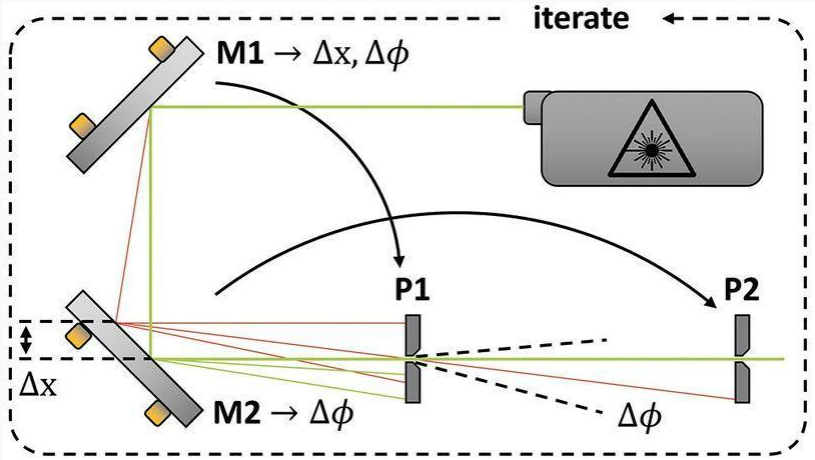
Calculations | الحسابات

Beam divergence, spot diameter, and attenuation power density.

Verification | المعايرة

Centering through dual irises to ensure collinear propagation.

Laser Safety Protocol



Safety is mandatory during alignment (بروتوكول السلامة الليزرية).
Exclude non-trained personnel from the optical area. Always perform initial alignment at the lowest possible power setting, or simulate the path with an auxiliary low-power visible guide laser.

Hazard Control & PPE | إجراءات الحماية

Personnel & Area Signs | التحكم بالمنطقة:

Post clear warning notices at all lab entrances during alignment. Never allow unauthorized individuals inside. Remove reflective jewelry, watches, and badges that could create hazardous stray reflections from high-intensity beams.

Protective Eyewear | نظارات الحماية:

Wear certified laser safety eyewear designed specifically for the laser wavelength. Utilize dedicated alignment goggles when allowed, which attenuate beam energy to a visible yet safe level without blinding the operator.

Invisible Beam Tools | أدوات الكشف

Thermal Burn Cards | الورق الحراري

Heat-sensitive paper darkens upon infrared laser exposure, instantly revealing beam shape and burn symmetry.

Phosphor Cards | بطاقات الفسفور

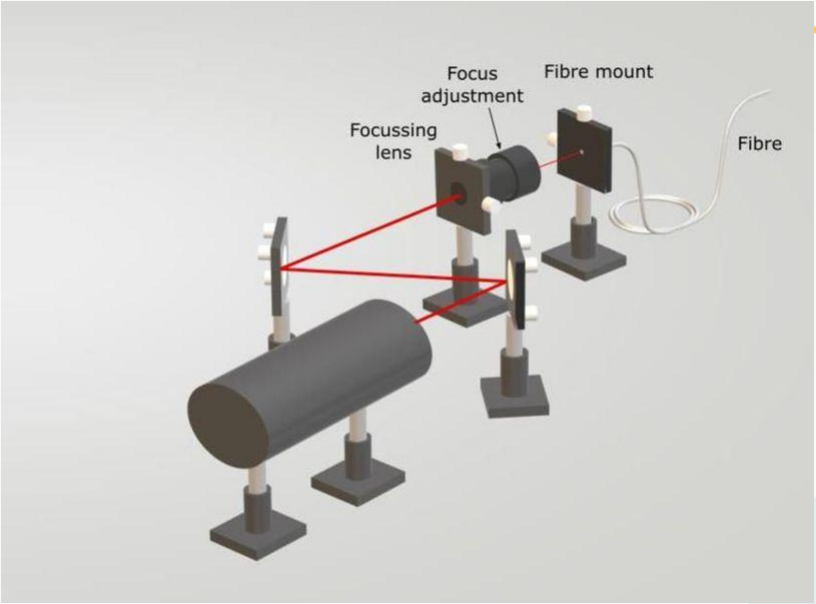
Coated plates emit visible fluorescence when hit by UV or IR beams; recharged periodically with UV lamps.

Viewing Scopes | الكاميرات الرقمية

CCD/CMOS sensor scopes and display monitors convert invisible radiation into real-time visible coordinates.

Kinematic Mirror Mounts

Precision kinematic mounts enable accurate angular tilt (حوامل المرايا الحركية). Fine-pitch thumbscrews independently control horizontal swivel (yaw) and vertical tilt (pitch), altering beam propagation direction while maintaining stable optical center coordinates.



Two-Mirror Steering
نظام المرآتين |



Steering a laser along a defined optical axis requires two mirrors to control 4 degrees of freedom (x, y offset and pitch, yaw angles). Mirror 1 steers the beam position onto Mirror 2, while Mirror 2 establishes the final collinear launch angle toward the target.

Alignment Sequence | خطوات المحاذاة

1

Position Reference Irises | تثبيت الفتحات

Fix Iris 1 close to Mirror 2 (Near) and Iris 2 far down the intended optical axis (Far) at identical height.

2

Adjust Mirror 1 for Iris 1 | ضبط المرآة1

Turn Mirror 1 tilt knobs to center the laser beam cleanly through the aperture of Iris 1.

3

Adjust Mirror 2 for Iris 2 | ضبط المرآة2

Turn Mirror 2 tilt knobs to steer the beam directly through the center of distant Iris 2.

4

Iterate to Convergence | المعايرة التكرارية

Close both irises gradually and repeat Steps 2 and 3 until the beam passes both pinholes simultaneously.

Dual Iris Verification



Dual pinholes define an unambiguous spatial vector in 3D laboratory space (معايرة المحور البصري). Closing iris apertures reveals clipping halos. If the spot is off-center at Iris 2, small corrections on Mirror 1 followed by Mirror 2 align the beam with zero angular tilt.

Industrial & Clinical Delivery

Aesthetic articulated arms and industrial CNC gantries use 3 or more steering mirrors (أنظمة التوصيل الضوئي). Misalignment causes severe beam clipping, power loss at the focal handpiece, and distorted oval spots. Regular kinematic calibration ensures perfect beam delivery.



Troubleshooting | استكشاف الأخطاء

Beam Clipping | قص الحزمة

Occurs when the beam clips aperture rims or mirror edges, causing diffraction rings and power attenuation. Re-center sequentially.

Thermal Drift | الانزياح الحراري

Cavity warm-up causes pointing instability. Allow the laser source to reach thermal equilibrium for 15 minutes before calibration.

Back Reflection | الانعكاس العكسي

Specular reflections returning into the laser cavity cause power fluctuations. Always tilt alignment cards slightly off normal.

100,000x

Power Attenuation Factor for Safe Lab Alignment

Lab Session Completed | نهاية الجلسة العملية

AL-Hadara University College | Dept. of Aesthetic & Laser Technology