Application Note

AN005: Intra-Cavity Adaptive Optics (ICAO) Testing of MEMS DM

Introduction

Intra-Cavity Adaptive Optic (ICAO) tests were conducted to determine the utility of HR-coated MEMS mirrors in compensating for intra-cavity laser aberrations and thus improve HEL laser output. These first tests were conducted with open-loop focus and spherical aberration control on the DM by manually controlling DM actuator voltages using AgilOptics' HVDD software. To conduct the tests, an AgilOptics 32-actuator DM was integrated into a high-power Solid-State Laser (SSL) cavity as a replacement for the rear cavity mirror. The test setup is shown in **Figure 1**. The setup included diagnostics for measuring far field beam size (beam detector screen and video camera) and output beam power (calorimeter).

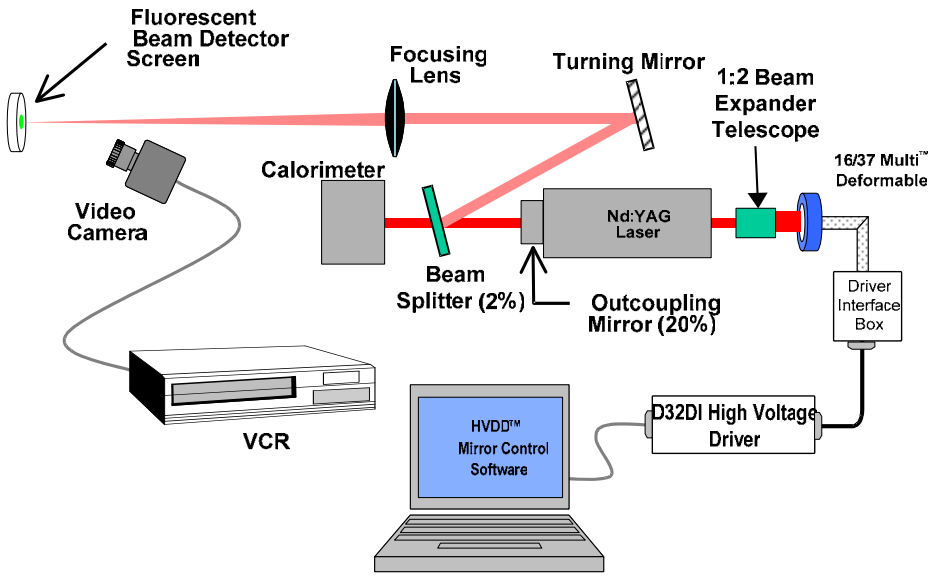
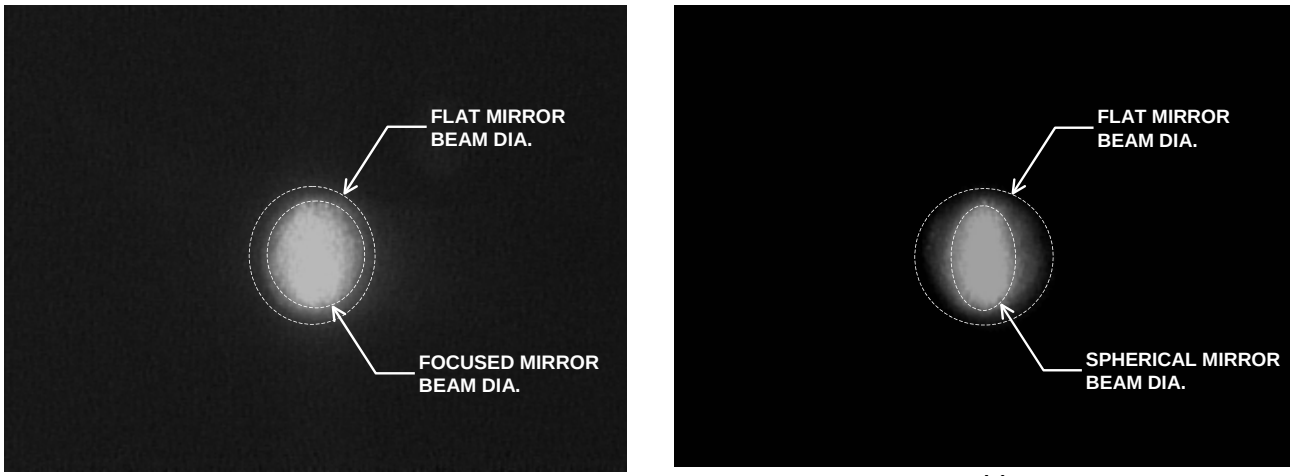


Figure 1 Setup for ICAO testing

Results

Test results adjusting the DM to compensate for focus and spherical aberration in the cavity are depicted in **Figure 2**. The beam diameter change for the focus test results is shown in **Figure 2 a)**, producing a beam area reduction of 38.9%, a beam energy reduction of 25.7%, and an irradiance increase of 21.6%. The beam diameter change for the spherical aberration test results is shown in **Figure 2 b)**, producing a beam area reduction of 50.2%, a beam energy reduction of 53.3%, and an irradiance decrease of 6.25%. These results were obtained without any attempt to optimize the test configuration. As laser gain was increased, at the end of the tests, the mirror eventually failed. The failed mirror is pictured in **Figure 3**. Examining this photograph suggests that the mirror failed due to high peak irradiance and mirror de-centering in the laser cavity.



a) b)

Figure 2 ICAO output far field beam diameter reduction with **a)** focus control and **b)** spherical aberration control

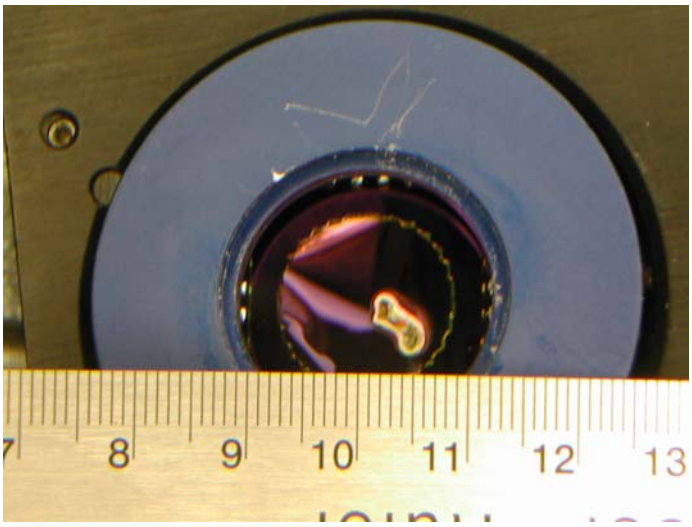


Figure 3 Mirror damaged during ICAO experiments due to high peak irradiance.

What Can Deformable Mirrors Do?

- Correct Optical Aberrations
- Laser Beam Shaping
- Optical Image Enhancement

Deformable mirrors are revolutionizing laser and optical systems by replacing static components with dynamic optics. Deformable mirrors (DM) are adaptive optics with dynamic faces able to optimize or change the characteristics of reflected light for a specific application. With time-varying control, a DM can focus a beam at several different points at different times or it can replace a lens in an optical system. Deformable Mirrors can improve optical images in telescopes, cameras, and other imaging systems.

For further information and discussion about how deformable mirrors work and how they will solve your optical problems see the manuals for HVDD, Clarifi, and the application notes available on the Web.

http://www.agiloptics.com/AppNotes.htm

http://www.agiloptics.com/downloads.htm