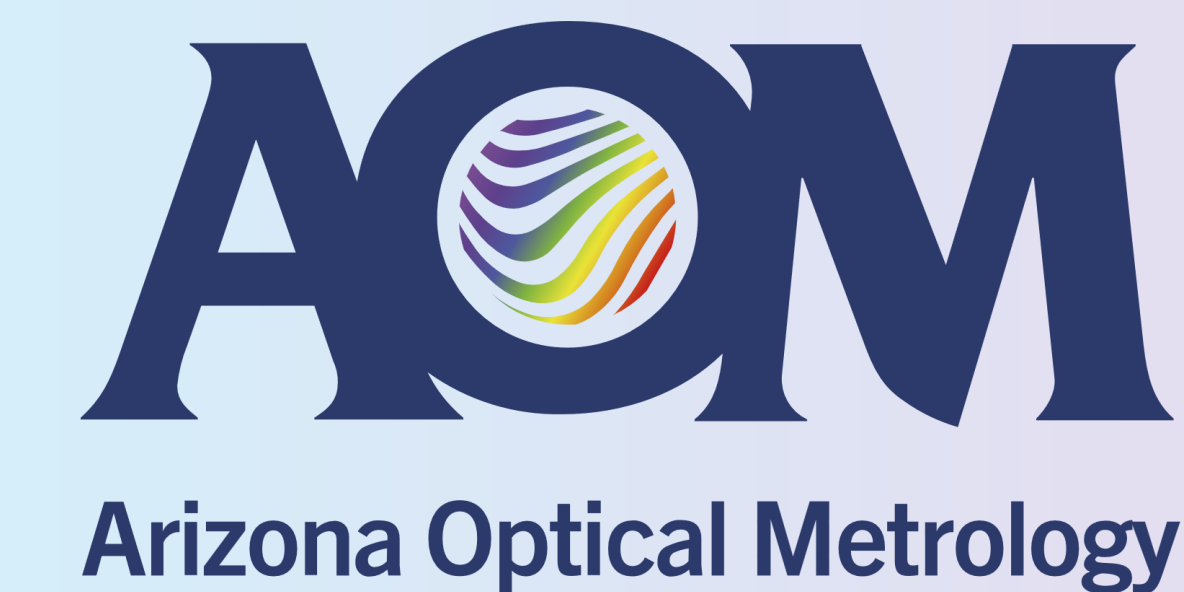


CGH Education Kit for Hands-on Learning of Optical Metrology for Complex Optics and Systems

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INTRODUCTION

Interferometry is a well-established method for measuring optical surfaces and system wavefront error. It has many advantages such as enabling precise, high-resolution, full aperture, fast snapshot topography measurements. However, for optical surface shapes like aspheres, conic sections, off-axis sections and even freeforms, a null element is required to apply interferometry effectively. A Computer-Generated Hologram (CGH) is a precisely manufactured null element that leverages diffraction through lithographically produced pattern etched or coated on a glass window.

Commercial interferometers are limited to measuring near-spherical surfaces. The Computer Generated Hologram provides the conversion for measuring nearly any surface.

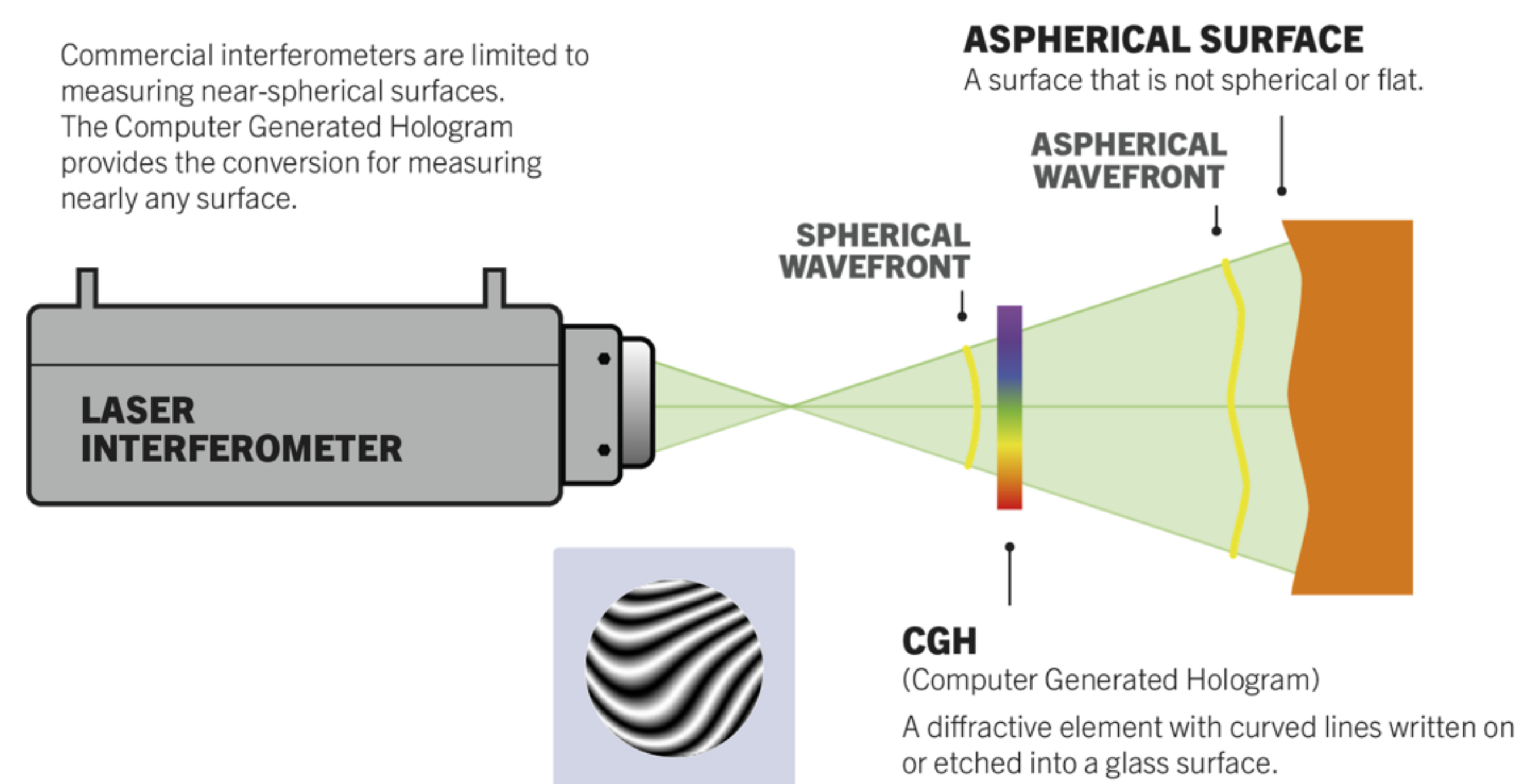


Fig. 1 Interferometric test layout of aspheric optical surface enabled by CGH null element

A growing number of applications that utilize high-performance optics, along with technical advances in CGH capabilities, have created a significant demand for CGH metrology.



Fig. 2 CGHs are used for surface measurement, alignment, and final verification of a wide variety of optical components and systems. Applications include the world's largest lenses for the Rubin Observatory (LSST) (top left), the primary mirror segments for the James Webb Space Telescope (top right), high-volume complex lenses for next-generation AR/VR headsets (bottom left), and freeform mirrors needed for high performance systems that fit within tight mechanical constraints (bottom right).

EDUCATION KIT

A CGH Education Kit was developed by AOM to build understanding and provide hands-on experience for a variety of applications of CGH metrology. The challenge with CGH training and even basic understanding is often tied to the lack of physical examples of CGH and matching test optic.

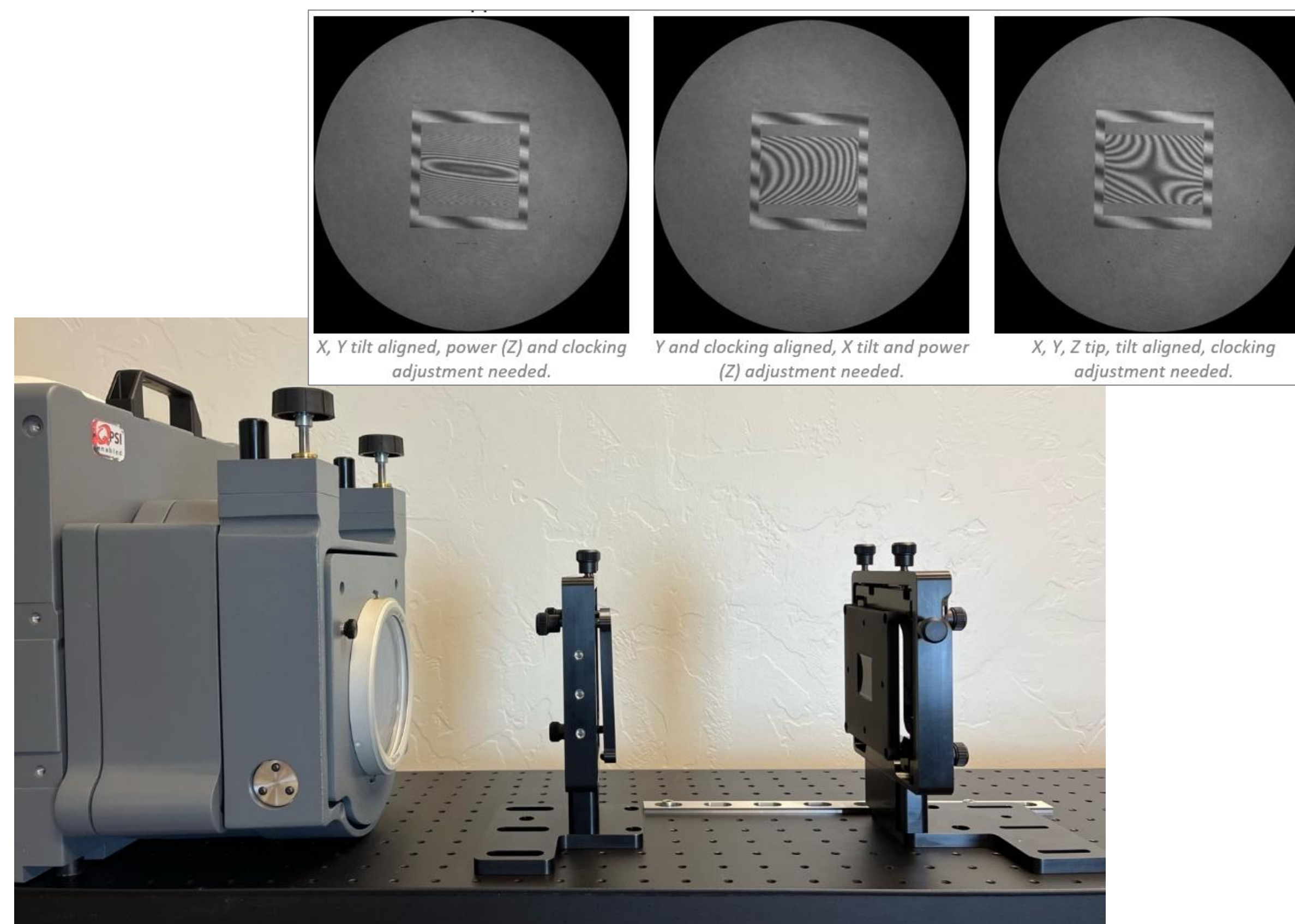


Fig. 3 Interferometric test setup of cylinder surface figure measurement using a Fizeau interferometer with plane-wave input to cylinder CGH and concave cylinder test optic (bottom) and resulting fringe pattern with various alignment modes of the cylinder to CGH.

Combined with a standard commercial interferometer, the CGH Education Kit includes everything a user needs to create multiple CGH test setups and explore concepts in alignment and diffraction.

CGH Education Kit

- (5) 2-inch CGHs with magnetic ball-mount interface
- (2) FP3 fine alignment stages
- (2) Cylinder test optics
- Asphere test optic
- Alignment targets plate
- Laser pointer
- Detailed instruction guide

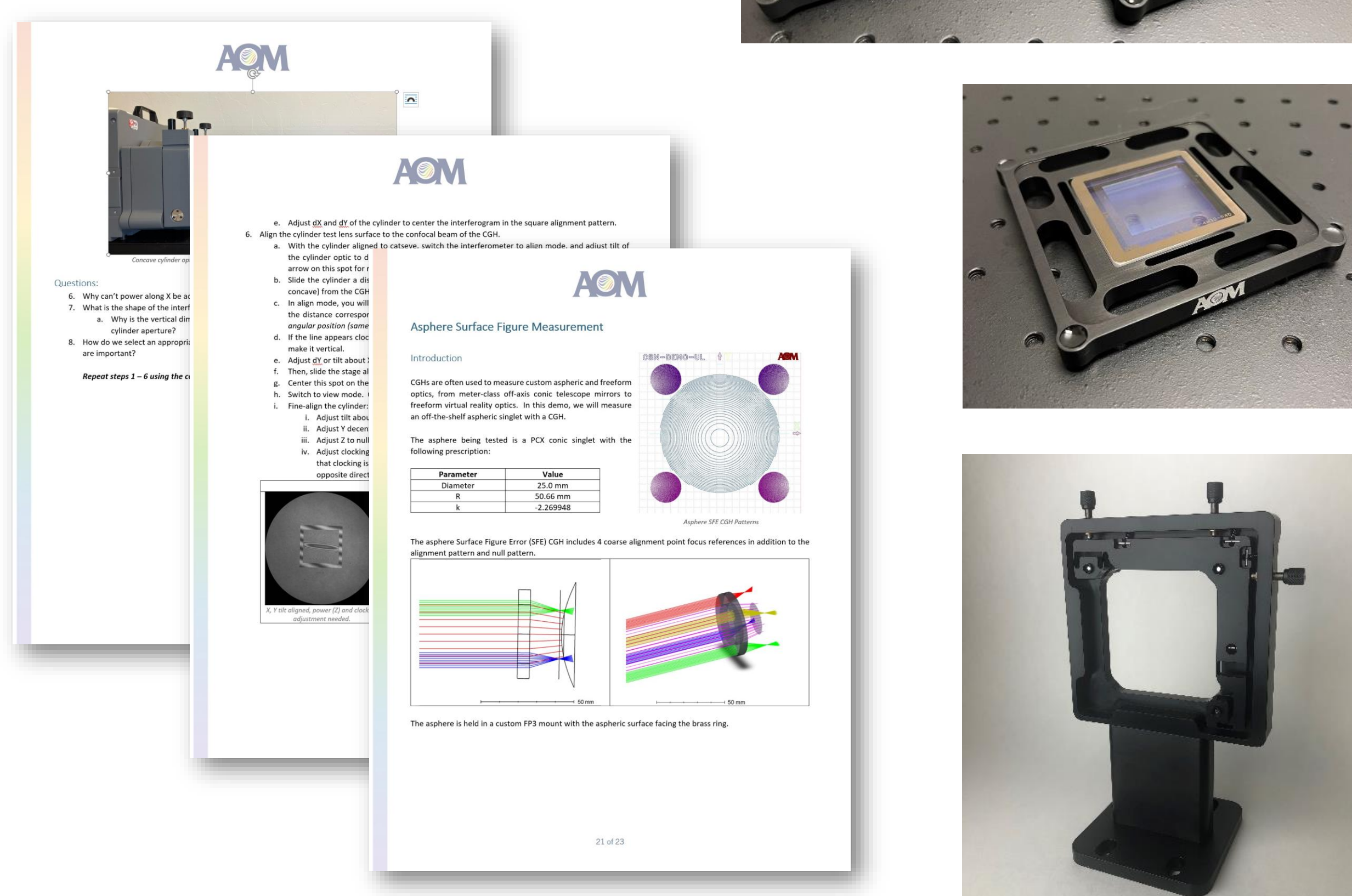


Fig. 4 CGH Education Kit comprehensive instructions walk the user through multiple interferometric test setups (left) and complete set of hardware including test optics, CGH, alignment stages (right)

GOALS

A range of ease-of-use features are available that break the paradigm of CGH application of the past. The CGH education kit gives optics students and educators the tools to develop tests and improve understanding of a critical optical engineering and fabrication skill.

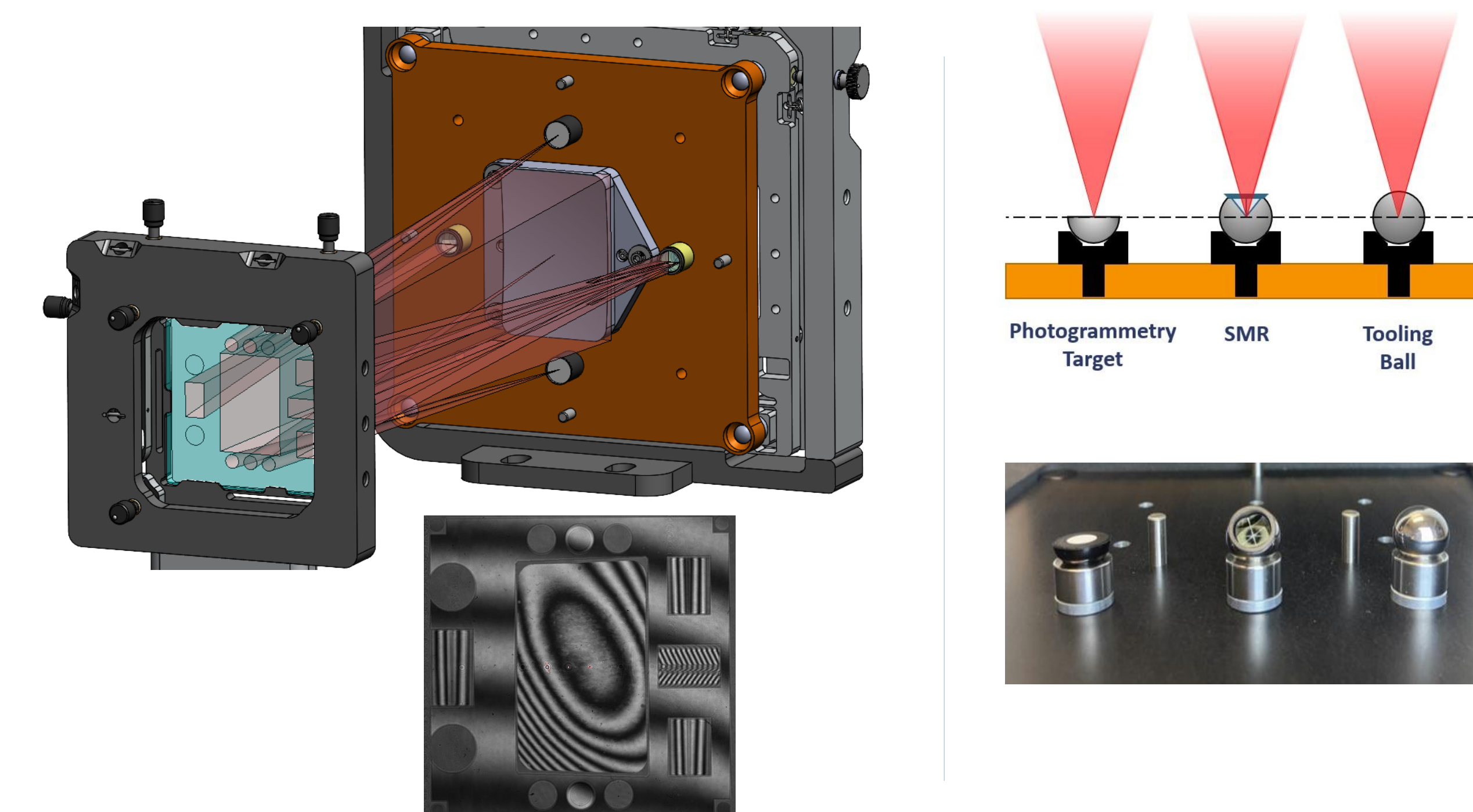


Fig. 5 Alignment patterns designed and fabricated at the same time as the test null pattern created precise optical reference points that can be paired with various targets (right) to create a complete easy to use CGH test setup (left).

AOM is making CGH Education Kits available *at no cost* to optics education programs around the world. The inaugural kit was delivered to The University of Arizona's Wyant College of Optical Sciences for deployment in the OPT1513 Optical Fabrication and Testing Lab and Lecture courses starting in the fall '22 semester.

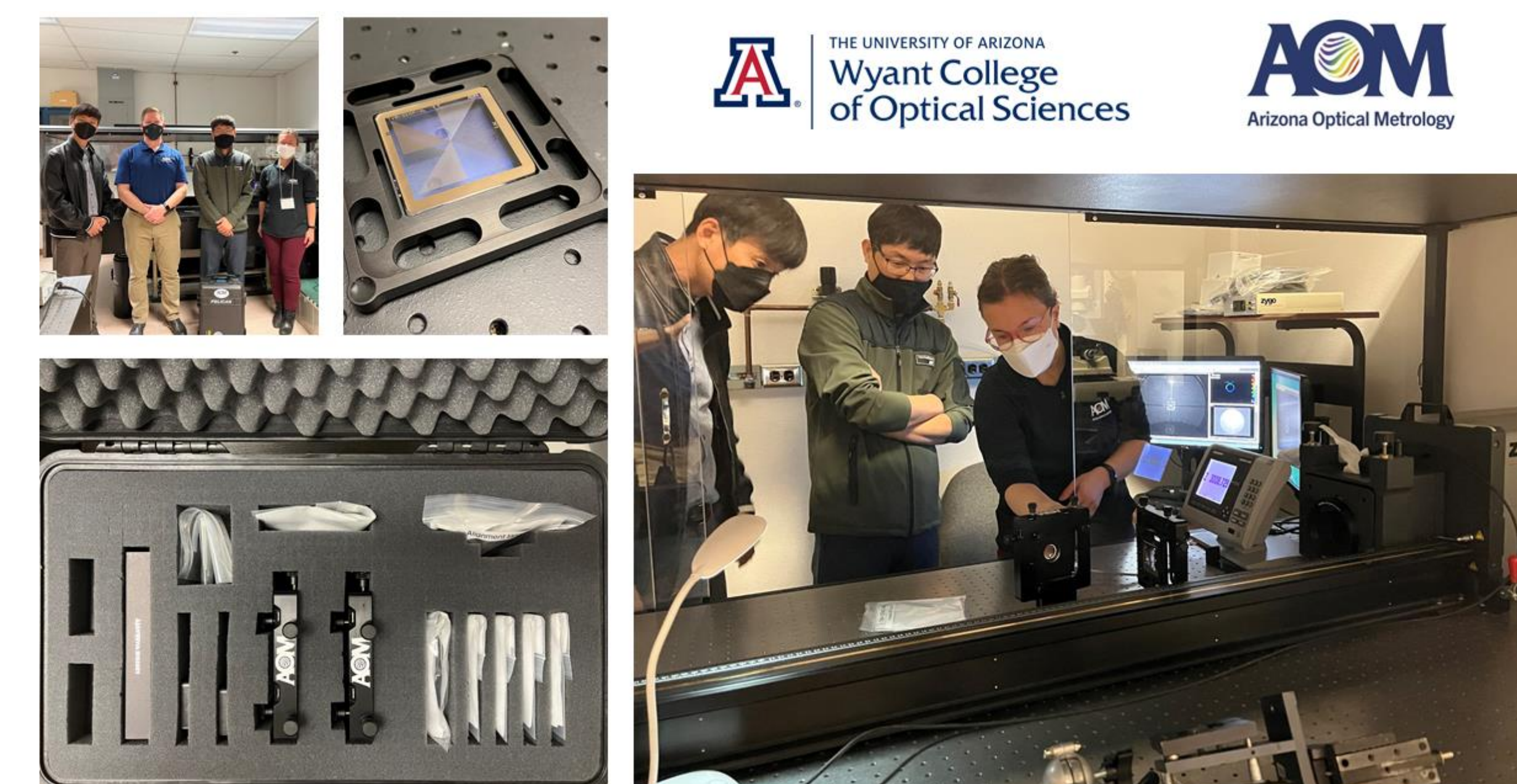


Fig. 6 Delivery and training of the first CGH education kit at the Wyant College of Optical Sciences interferometry lab

CONCLUSIONS

The CGH Education Kit was developed with optical engineering and fabrication education institutes in mind. Students aiming for nearly any level in their optics career, from technician to engineer, can benefit from the hands-on experience of setting up and aligning interferometric tests using CGHs.