

4D Interferometer Lab

Laboratorio di Eccellenza DFA/OAS in UNIPD/INAF

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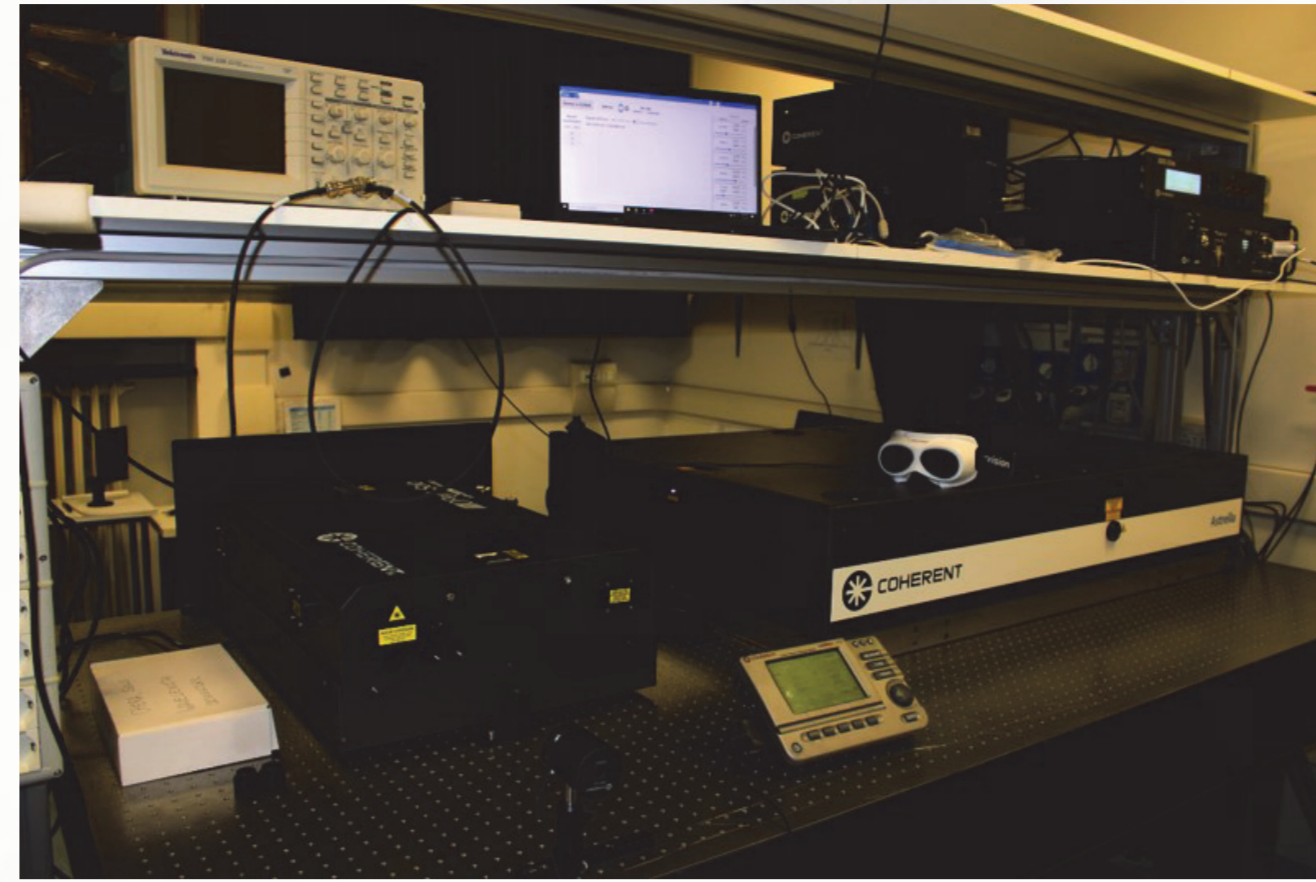
DIPARTIMENTI DI ECCELLENZA MUR 2018- 2022 PHYSICS OF THE UNIVERSE

The Department of Physics and Astronomy "G. Galilei" (DFA) is an internationally recognized leader in physics of the Universe, excelling in advanced theoretical and experimental research, teaching, and knowledge transfer. The DFA is engaged in highly competitive international research projects in fundamental and applied physics, astronomy, and astrophysics. Within this context, the DFA is launching a project titled "Physics of the Universe." This project embodies multidisciplinary research with the shared goal of understanding the Universe through the synergies of astronomy, astrophysics, cosmology, and fundamental interactions physics. The research will encompass theoretical and experimental aspects, data analysis, and technology development, also impacting technology transfer.

The main planned actions include:

- Establishing two new laboratories for the development of optics and sensors necessary for experiments and observations, both ground-based and space-based, in which the Department is involved;
- Recruiting external personnel to work in these laboratories or to support the project's objectives;
- Establishing a new master's degree program in Astrophysics and Cosmology, taught in English.

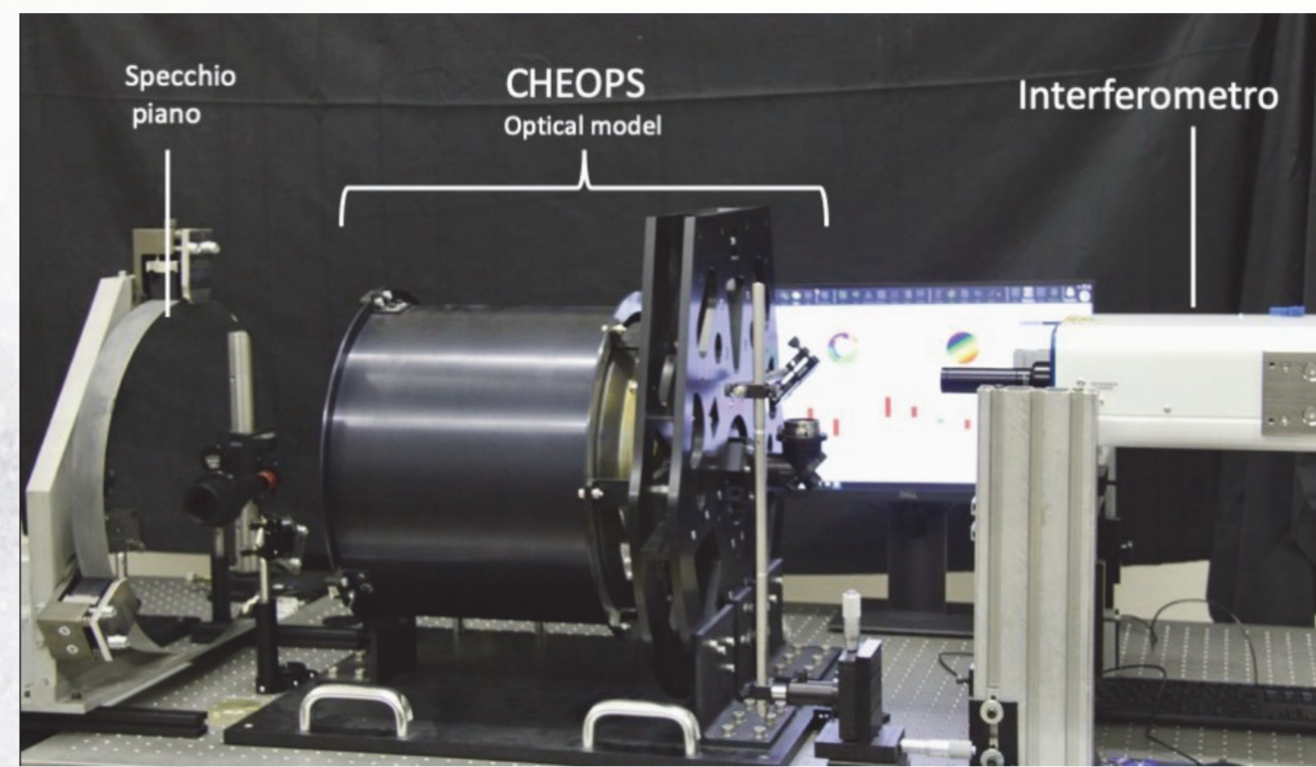
The project's main outcome will be to transform the DFA into an international hub for research and education specifically in the Physics of the Universe, in synergy with research institutions (INAF - INFN) it collaborates locally.



LABORATORIES FOR SENSORICS AND OPTICS FEMTOSECOND PULSED LASER SOURCE

The 2-component laser system consists of an ultrafast Ti:sapphire amplifier, ASTRELLA by Coherent, which pumps an Optical Parametric Amplifier (OPA), OPerA Solo by Coherent. The system can produce laser pulses with a duration of 100 fs, with frequency of 1 kHz, and a continuous wavelength range from 240 to 2600 nm. The pump beam energy at 800 nm is 5 mJ, while the output beam energy from the OPA depends on the wavelength range. The system can be used for ultrafast spectroscopy of bulk materials and nanomaterials, characterization of fast detectors and devices, or even for laser processing of thin films.

Location: Via Marzolo, Padova



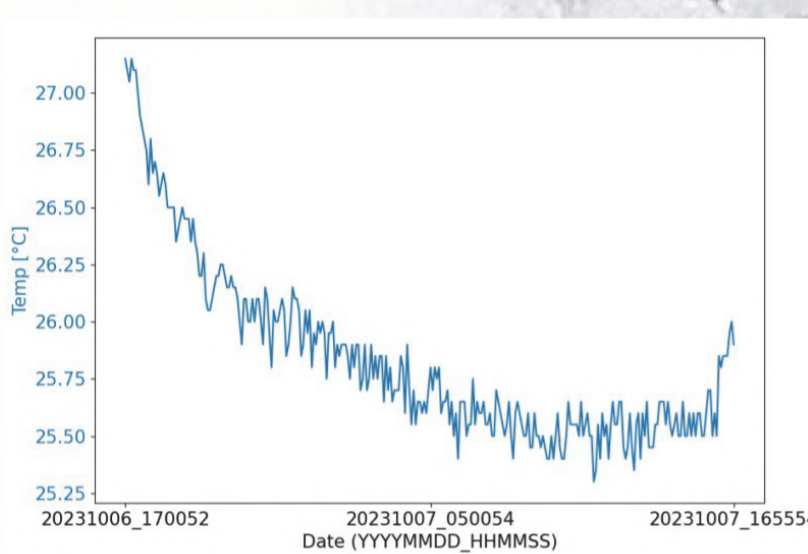
4D INTERFEROMETER PHASECAM 4030 FOR ANALYSIS OF OPTICAL ELEMENTS AND ALIGNMENT OF OPTO-MECHANICAL SYSTEMS

The interferometer is vibration-insensitive and equipped with a high-resolution sensor. It is generally characterized by its particular versatility and wide measurement dynamics. It enables the rapid acquisition of highly accurate measurements for next-generation instrumentation, suitable for both ground-based and space applications.

Location: Vicolo dell'Osservatorio 3, Padova

LAB. CAPABILITIES

- Interferometric optical tests (mirror, lens, windows)
- DM characterization (stroke linearity, aberration control, influence function, flattening, stability)

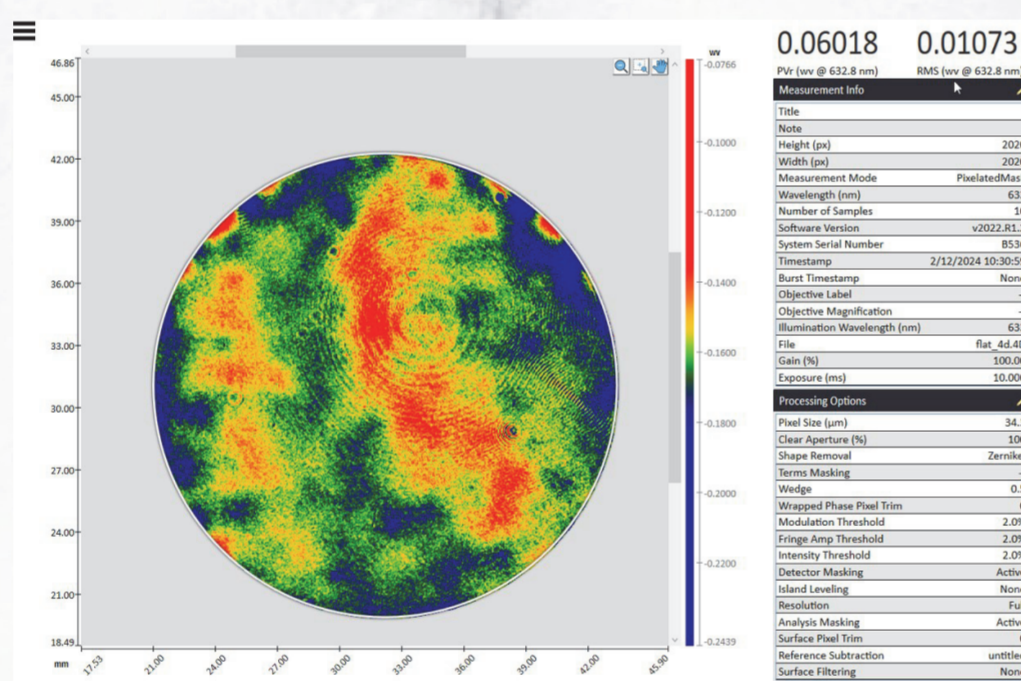
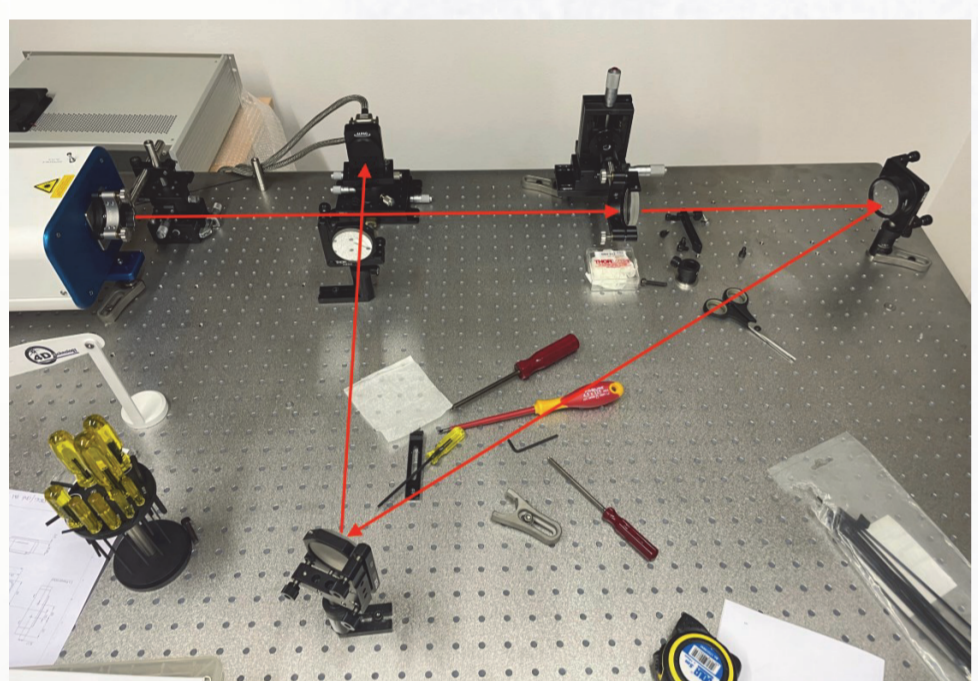


LABORATORY TEMPERATURES ALONG 24 HOURS (LEFT)
DEFORMABLE LENS & SH WAVE FRONT SENSOR (RIGHT)

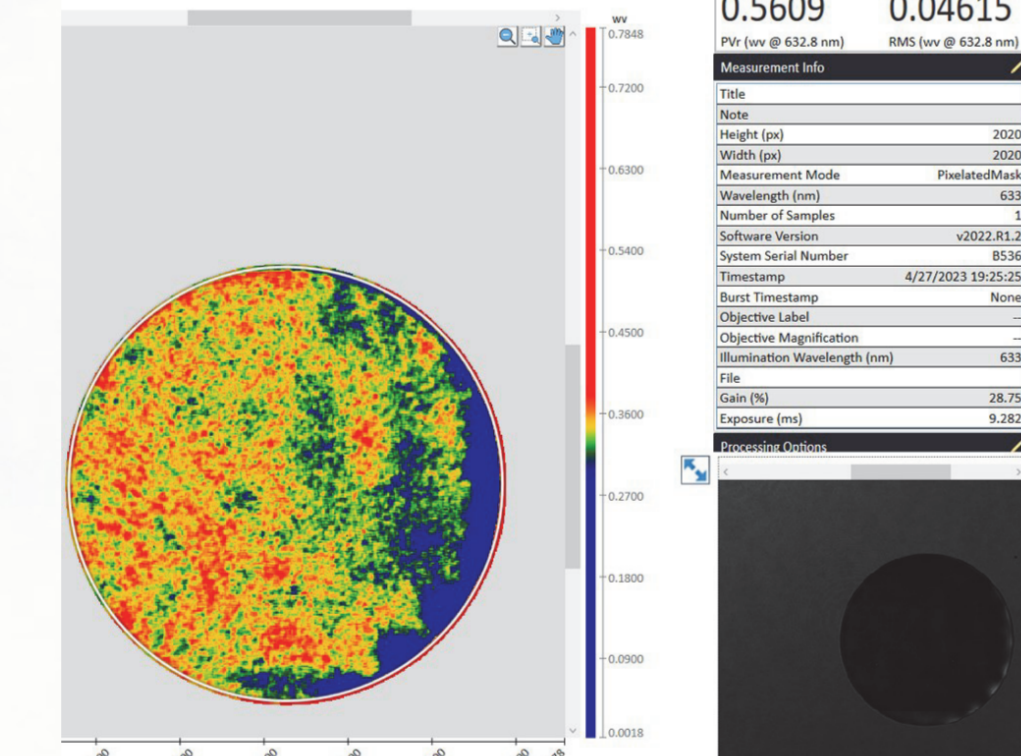
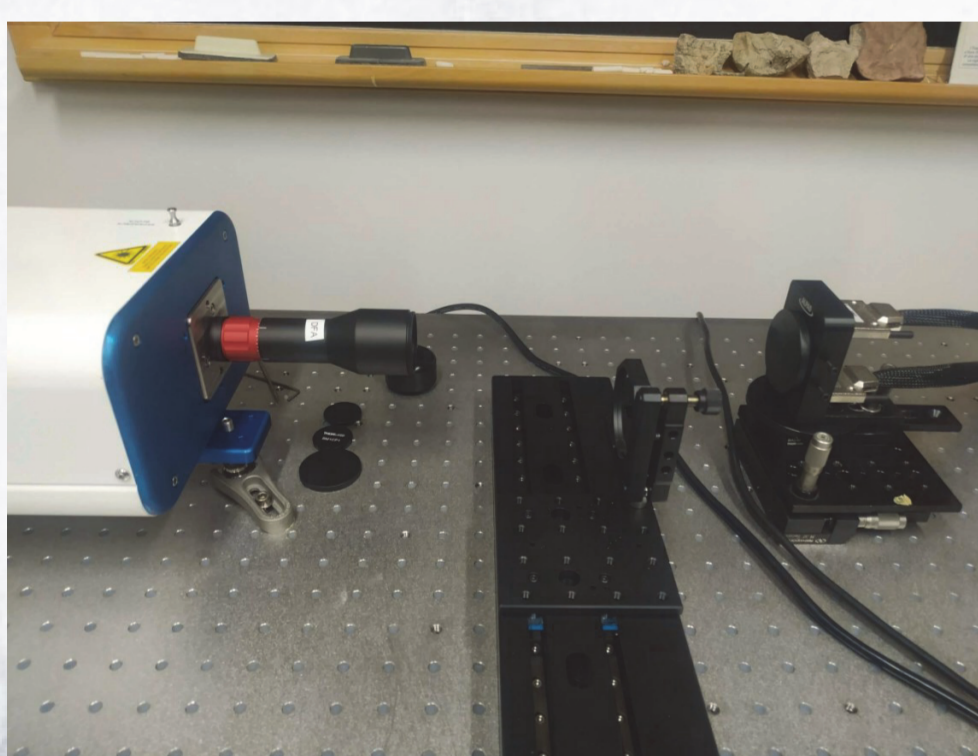
TEST OF AOL1825 DEFORMABLE LENS CL.APERT. 25,5 MM (INGOT)



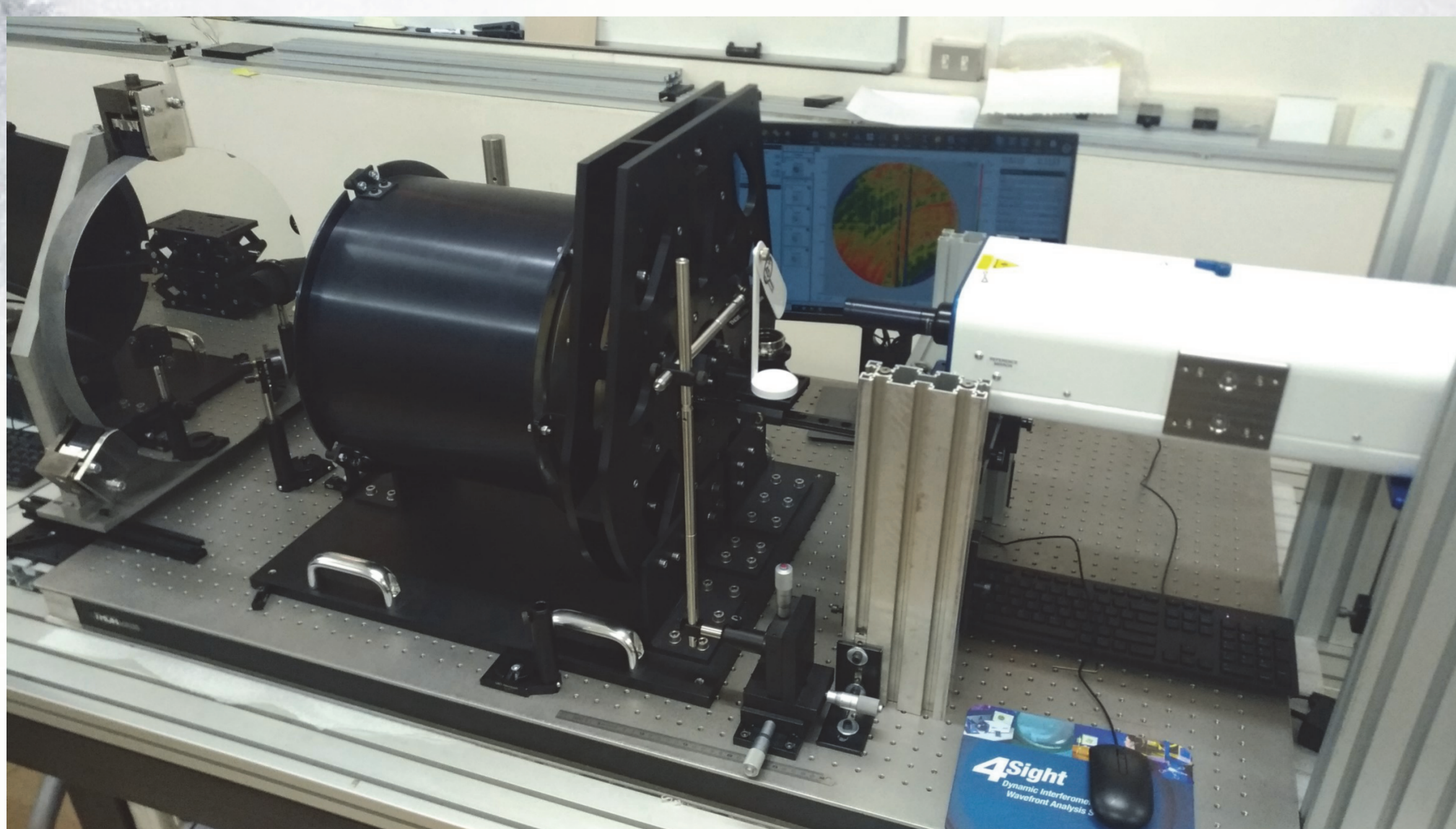
ALPAO DM97-15 PUPIL DIAM. 13.5 MM



ALPAO DM97-25 PUPIL DIAM. 22,5 MM



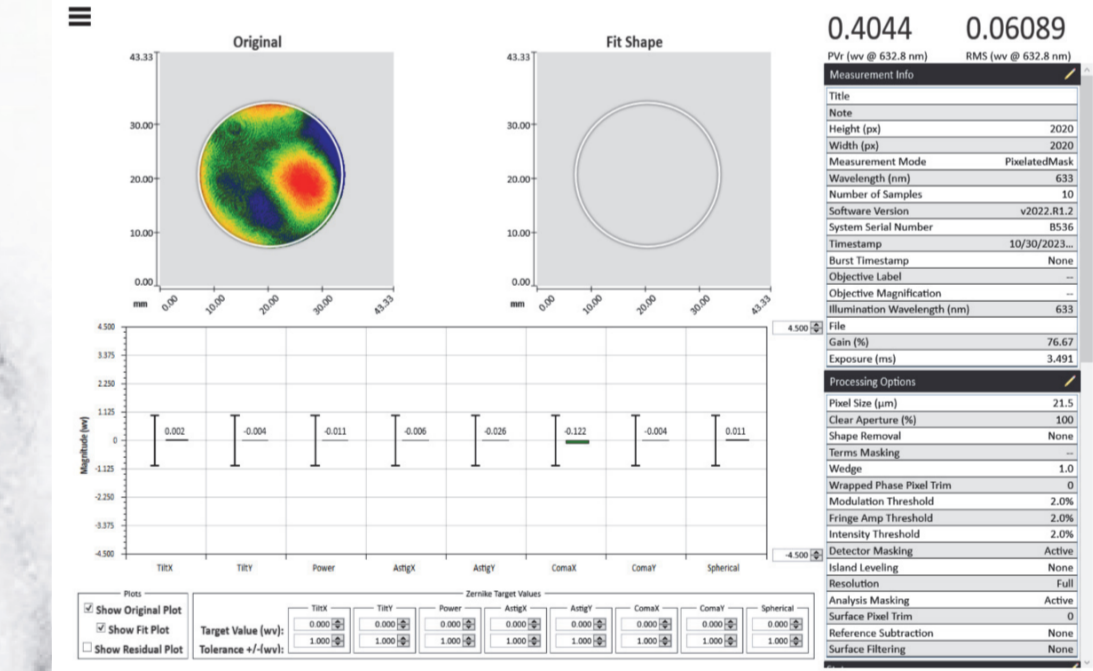
TESTING CHEOPS OPTICAL PROTOTYPE



LAB. UTILITIES

- Optical bench 2000x1000x300mm +wheels +PDU +Passive air leveling vibration isolators
 - Diverger lens EFL80 mm λ10
 - Custom Beam expander
 - Achromatic Beam expander 5x & 10x
 - 2x AOL1816 Deformable lens 18 actuators Clear Aperture 16mm (Dynamic Optics srl)
 - SH-wavefront sensor
 - Reference flat and spherical λ/20
 - Thorlabs LTS300C 300mm motorized translation stage
 - PLICO software control station
- A framework for Adaptive Optics laboratory experiments, instruments control under Python
doi://10.13009/AO4ELT7-2023-042
- 4D 4Sight Focus software control
 - Lab temperature & humidity monitoring
 - All under remote control

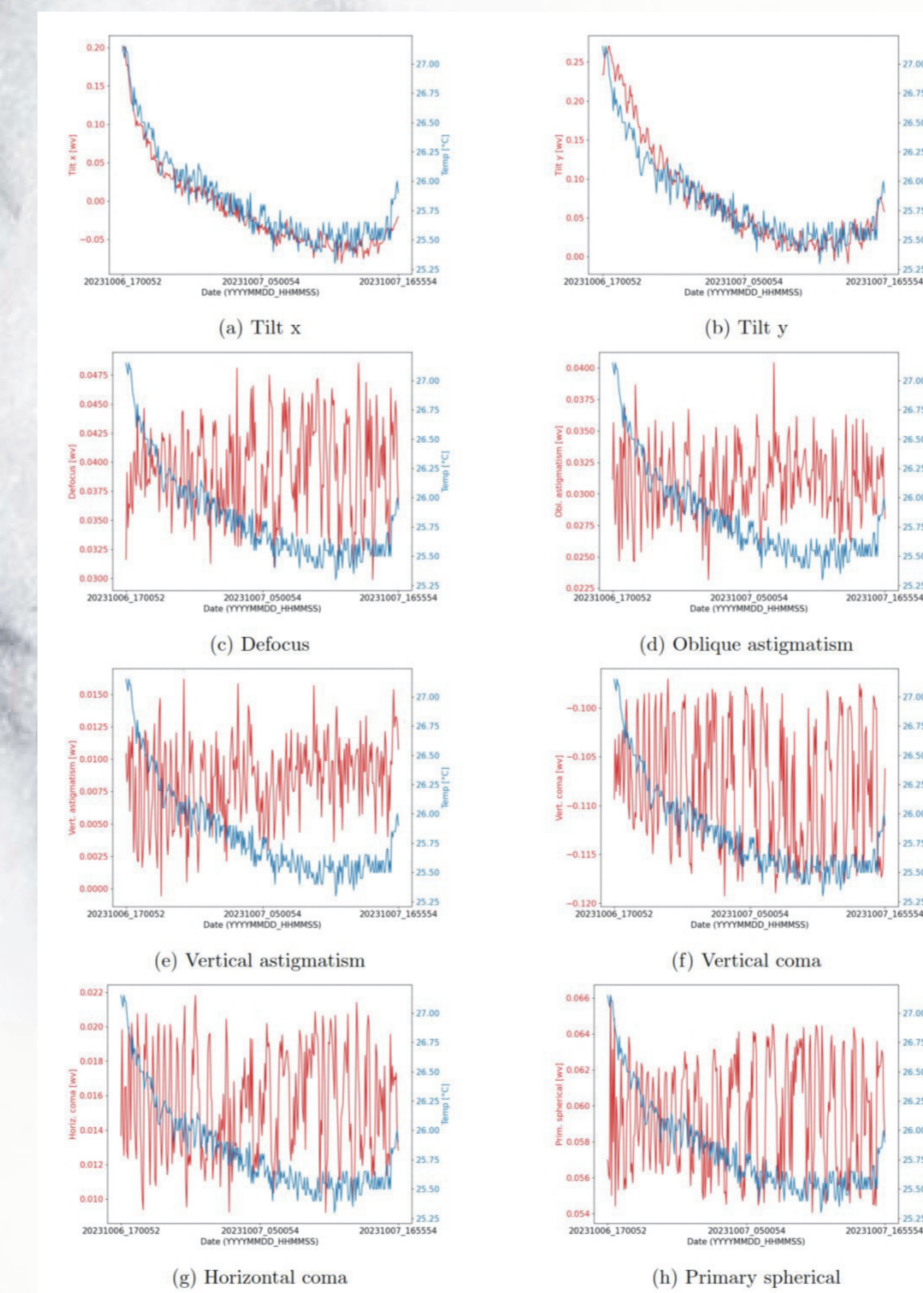
ALPAO DM292- PUPIL DIAM. 26,5 MM



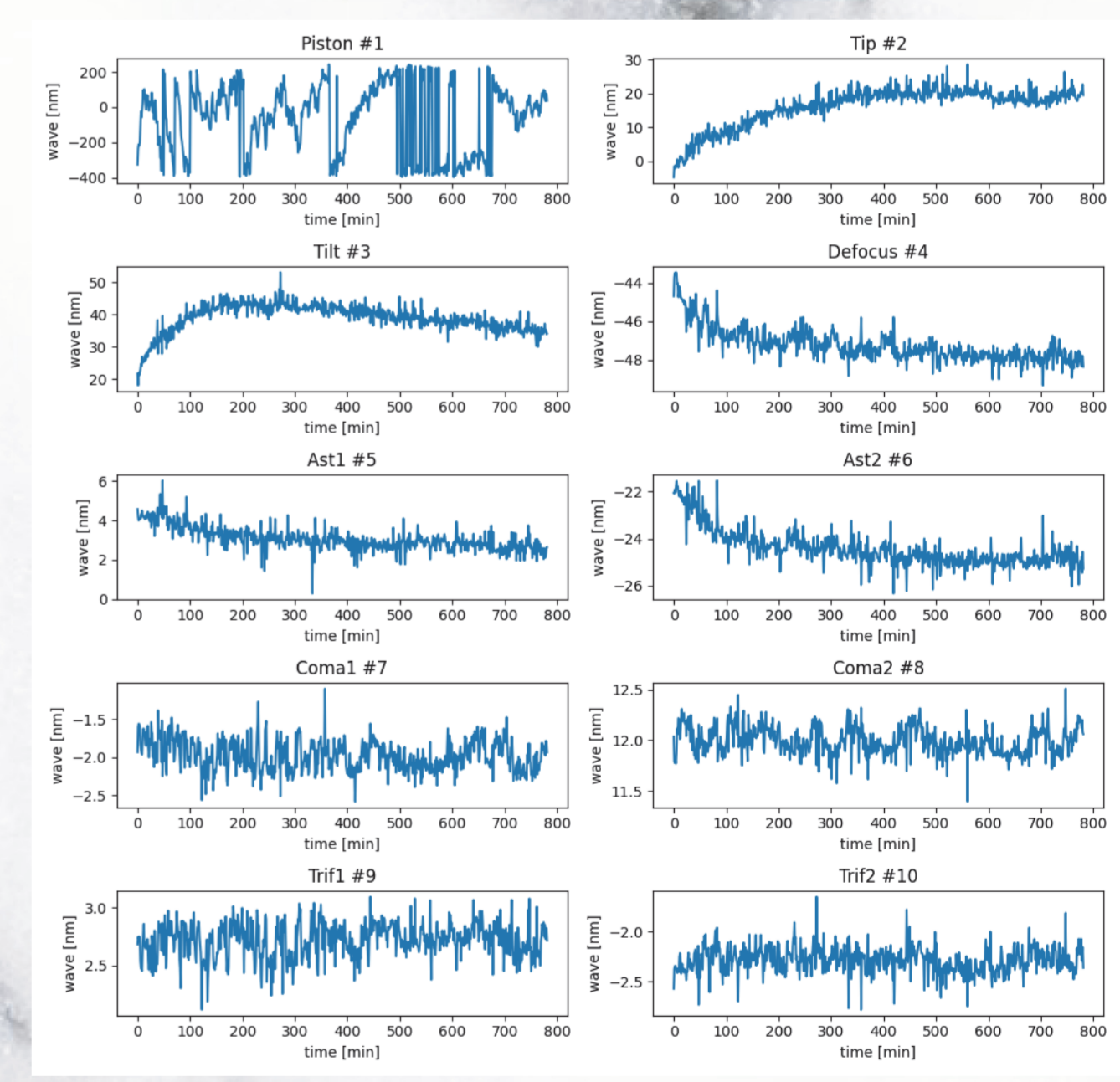
NICHOLAS FRISO BACHELOR'S DEGREE IN ASTRONOMY 2022 THESIS: CHARACTERIZATION OF A DEFORMABLE MIRROR FOR ASTRONOMICAL APPLICATIONS
[HTTPS://HDL.HANDLE.NET/20.500.12608/61025](https://hdl.handle.net/20.500.12608/61025)

STABILITY TESTS

CUSTOM BEAM EXPANDER



DM-292



High Performance Dynamic Twyman Green Interferometer

Instantaneous Acquisition
The PhaseCam 4030 is a compact, lightweight dynamic test interferometer with simple, intuitive operation. The system is designed for measuring optical components such as flat mirrors and collimators. The PhaseCam 4030 incorporates Dynamic Interferometry technology using a single camera, high-speed optical phase sensor that makes wavefront measurements in less than 30 microseconds over 5000 times faster than a temporal phase shifting interferometer. Because acquisition time is so short, the PhaseCam can be used under almost any conditions, even for measuring moving parts, without vibration isolation. Vibration immunity makes the PhaseCam ideal for use on the production floor, in clean rooms and in environmental test chambers. It can even measure moving parts such as deformable or scattering mirrors, spinning disks, or vibrating membranes.

Complete Measurement System
The PhaseCam 4030 is a turnkey instrument that includes the interferometer, 4Sight Focus advanced wavefront analysis software and a high-speed computer system. Samples with any reflectivity from 1% to 100% can be measured with a simple adjustment. Its stabilized HeNe laser 632.8 nm provides excellent coherence length and wavelength stability.

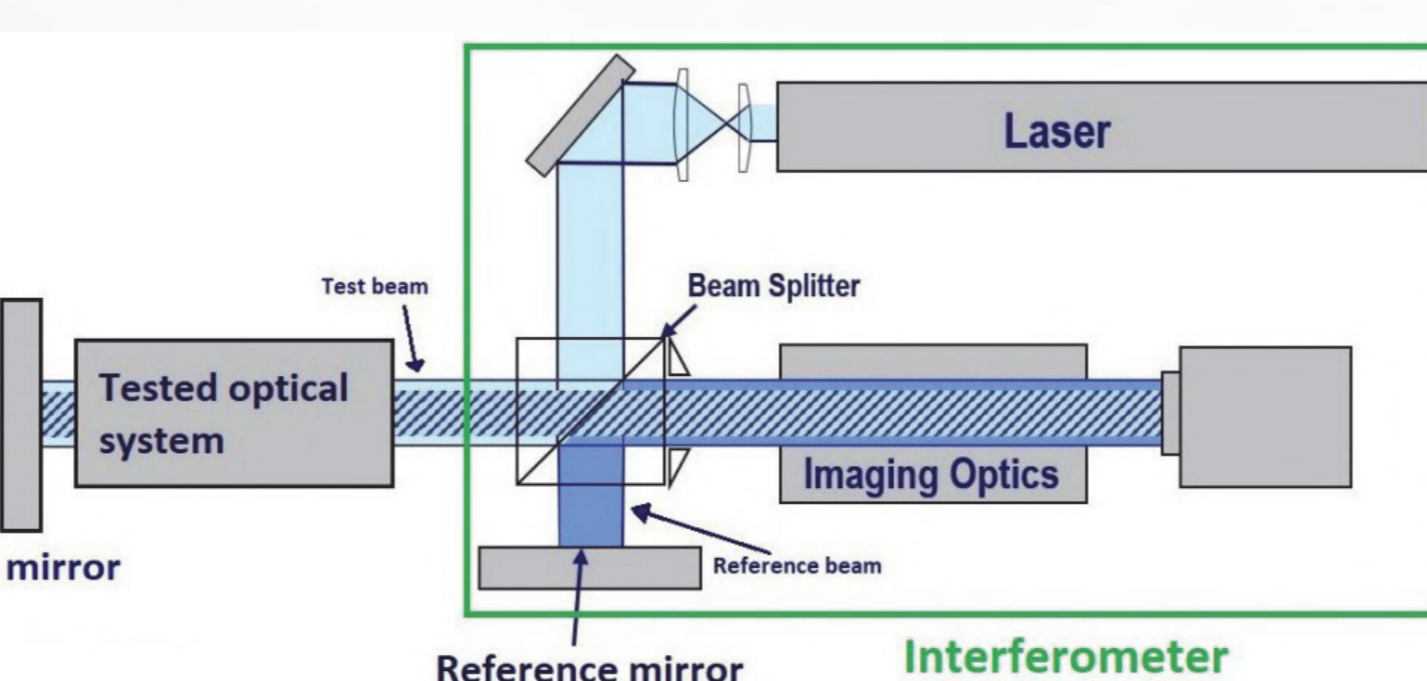
Industry Leading Analysis, Standard
4Sight Focus wavefront acquisition and analysis software utilizes a user-friendly interface with unparalleled simplicity, analysis features and graphical displays. The 4Sight Focus 64-bit acquisition engine produces rapid analysis and display of single, averaged or burst measurements. Continuous data acquisition and real-time camera flat fields provide real-time visual feedback for simplifying optical system or beam train alignment. The user-friendly interface makes data comparison, manipulation, masking, reference subtraction, flattening and center removal simple to perform. Zernike, geometric and diffraction analyses are standard. Comprehensive data sharing capabilities let you read, write, and save most file types, including Zernike, Matlab, Vision, Metaphase, VIPS and Cxley.

FEATURES

- Vibration insensitive dynamic operation
- 30 µsec data acquisition time
- 4MP camera
- Outstanding 64-bit data analysis and visualization software
- 4Sight Focus software
- Master-class telescope optics
- Quality verification of optical components
- Vacuum and environmental chamber testing
- Production floor quality control
- Optical testing of moving parts



TWYMAN-GREEN INTERFEROMETER (CREDIT 4D TECHNOLOGY)



Specifications

Configuration	Model 4030
Detector/Imager	Vibration insensitive dynamic Twyman-Green interferometer
Acquisition Mode	Single camera, high speed optical phase sensor
Laser Source	Stabilized HeNe @ 632.8 nm
Typical Laser Power	12 mW
Measurement Cycle Length	~ 30 µs
Beam Diameter	72 mm collimated beam
Optics	4Sight Focus advanced wavefront analysis software
Polarization	Circular
Focus Range	472.0 mm (variable application dependent)
Aperture	16 mm, 100 µm pitch
Pixel Magnification	134 µm (500 line pairs)
Ring Contrast	100% (variable application dependent)
Camera	4MP, 12 bit, 30 FPS
Field of View	100 mm (variable application dependent)
Data Arch	4Sight Focus Analysis Software
Operating System	Windows 10
System Software	4Sight Focus Analysis Software
Interference phase shifting data acquisition	Interference phase shifting data acquisition
Reference generation, acquisition, data averaging, masking	Reference generation, acquisition, data averaging, masking
2D and 3D surface maps	2D and 3D surface maps
4096 data format supported, images supported	4096 data format supported, images supported
Analysis of multiple sub-apertures	Analysis of multiple sub-apertures
1024x1024 line pairs resolution, 5000 line pairs	1024x1024 line pairs resolution, 5000 line pairs
Weight	13.4 kg (29.5 lbs)
Physical Dimensions	63.1 x 21.1 x 11.4 cm (24.8 x 8.3 x 4.5 in)
Power consumption	12.5 W (max) with computer
Temperature Range	Operation: 18°C to 30°C (65°F to 86°F) Non-conditioning Storage: -10°C to 100°C (14°F to 212°F)
System Software	4Sight Focus Analysis Software
Acquisition Rate	1 to 10 frames/sec (see video & interferogram examples)
Minimum Exposure	100 ns
System Reliability	1 Year, 100%
ISO 9001	ISO 9001
Warranty	One year, limited, on-site system installation and operator training.

4D Technology
An Onto Innovation Subsidiary