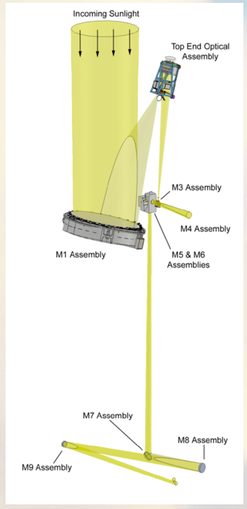
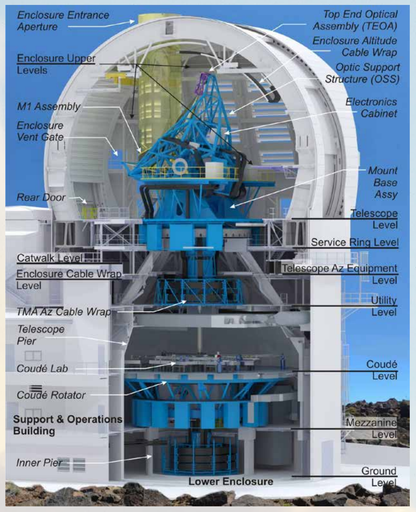
BRINGING PERFECT VISION TO THE DANIEL K. INOUYE SOLAR TELESCOPE

DKIST
DANIEL K. INOUYE SOLAR TELESCOPE

This off-axis, 4-meter Gregorian telescope is designed to image the Sun in near-ultraviolet (UV), visible, and infrared (IR) wavelengths. The telescope is currently under construction in Maui and, once completed, will deliver the highest spatial resolution solar images ever seen.

Current understanding of solar phenomena is limited by the resolution of observational data. Physicists understand that critical processes occur on relatively small scales but have previously been unable to resolve the fundamental scale of solar structures. Through the use of adaptive optics, the DKIST will offer the first chance to directly observe solar magnetic field interactions at their intrinsic spatial scale. One of the biggest challenges facing the DKIST adaptive optics is that the brightest region of the solar atmosphere is best observed at visible wavelengths. Providing diffraction limited images at 500 nm requires the DKIST adaptive optics to have very high spatial and temporal bandwidths, resulting in a system that is comparable to high-performance AO systems on 8-meter class night-time telescopes. Our cooperation with our industry partner, Northrop Grumman's Adaptive Optics Associates – Xinetics (AOX), resulted in the delivery of a precision deformable mirror (DM), driver system, and integrated active cooling system on cost and on schedule. **This DM is the heart of DKIST's mission-critical AO system without which the telescope cannot achieve some of its most scientifically important performance requirements.**

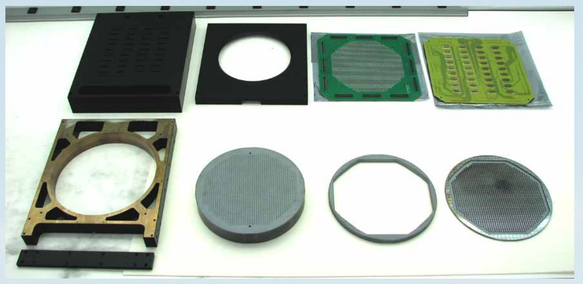




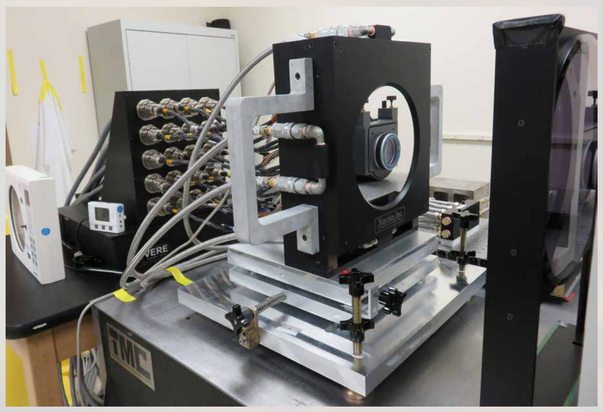
A 4-meter diameter, off-axis primary mirror makes DKIST the largest solar telescope in the world with a generous Coudé-path bench.

DKIST advances the state of the art for solar observations through:

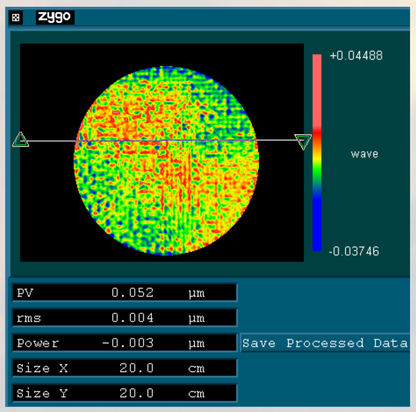
- **High Spatial and Temporal Resolution**
  - DKIST's diffraction limit will resolve spatial scales ~30 km in the visible
  - Resolution of mean free path and pressure scale height in the near-IR (0.1")
- **Precision Polarimetry at high spatial resolution**
  - Polarization sensitivity of 10^{-5}
  - Polarization accuracy of $5x10^{-4}$
- **Increased Photon Flux**
  - Feature variability limits exposure time, especially at small spatial scales
  - Coronal observations are usually photon starved
- **Excellent Stray Light Control**
  - Necessary for high-sensitivity polarimetry
  - Coronal imaging



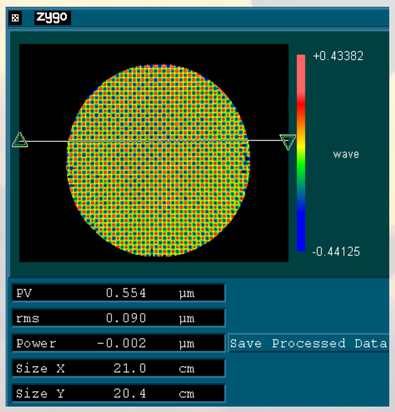
AOX, the leading supplier of precision DMs, produced the DKIST DM using our proven lead magnesium niobate electro-ceramic actuators. The DKIST AO system requirements resulted in a unique, thermally-controlled 1600 channel DM with an actuator pitch of 4.7 x 4.9 mm, 5 microns of available stroke and an interactuator stroke limit of 2 microns. At full solar illumination the thermal system controls facesheet temperature from +0 to -2 °C from ambient. AOX is proud to be a member of the DKIST team.



The DKIST DM undergoing Factor Acceptance Testing at AOX's Devens, MA, facility. The active cooling plumbing is visible in this picture.



DM flattened to 4 nm (RMS) with a measured surface roughness of less than 7 Angstroms.



Waffle test demonstrating 100% actuator functionality at delivery.

Luke Johnson, Erik Johansson
Wavefront Correction Group
National Solar Observatory
Daniel K. Inouye Solar Telescope
http://dkist.nso.edu/

NSO
National Solar Observatory

Photo courtesy of Jay Lee

Northrop Grumman / AOA Xinetics
Advanced Optics & Silicon Carbide

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