

DKI Solar Telescope in a Nutshell

Site Information

- Location: Island of Maui, Hawai'i, summit of Haleakalā.
- Altitude: 3067 m (10,062 feet).
- Geographical coordinates:
 - 20° 42' 24" North latitude.
 - 156° 15' 23" West longitude.
- Site survey data indicate:
 - >2900 annual clear sky hours.
 - ~1000 hours with Fried parameter > 7 cm.
 - ~500 hours with Fried parameter > 12 cm at the telescope aperture.
- Sky brightness (requirement): $< 25 \cdot 10^{-6} B_{\text{Sun}}$ at 1 micron and at 1.1 solar radii.

Design

- Type: all reflective off-axis Gregorian optical design.
- Mounting: Alt/Az.
- Obstruction free (no spider, no central obscuration).
- Wavelength range: 380 nm up to 28 microns.
- Scattered-light control (requirement): $< 25 \cdot 10^{-6} B_{\text{Sun}}$ at 1 micron and at 1.1 solar radii.

Primary Mirror M1

- Clear aperture: 4 m (segment of a 12 m parent paraboloid).
- Focal length: 8 m.
- Beam: f/2 (F-number or ratio).
- Diameter of solar image in prime focus: ~75 mm.
- Plate scale in prime focus: ~25.78 arcsec/mm.
- Actively cooled (from rear side, chilled air).
- Active mirror shape control (axial, lateral actuators).

Heat Stop

The primary function of the heat stop is to act as a field stop passing only a 5 arcmin circular FOV of the Sun's full image and as such reducing the heat load from the incident ~12,000 Watts to ~300 Watts on the subsequent optics.

- Location: Prime focus.
- FOV: 5 arcmin diameter (12.19 mm diameter).
- Actively cooled (liquid coolant).

Gregorian Optical System (GOS)

- Location: Secondary (gregorian) focus.
- FOV choices:
 - 5 arcmin (Cryo-NIRSP only).
 - 2.8 arcmin (all instruments).
- Moving occulters (+/- 5 arcsec over- or under-occulting capability).
 - 2.8 arcmin FOV (all instruments).
 - 5 arcmin FOV (Cryo-NIRSP only).

Coudé Table

- Diameter: 16.5 m.
- Location of all first-light facility instruments and the Wave-Front Correction (WFC) system.
- Rotating at selectable rates to compensate image rotation.
- Orientation of the solar image on the detector (e.g. slit orientation) can be specified through a table (rotation) angle (affecting then all instruments).

Pointing

- Accuracy: <5 arcsec (blind pointing).
- Pointing limit: up to 1.5 solar radii (~8 arcmin above the solar limb) referring to the center of the FOV in the prime focus.
- Pointing exclusion zone: annular ring from 1.5 solar radii out to 25 degrees during daytime.
- Pointing offsets:
 - Maximum velocity: 360 arcsec per sec over a distance of 1.5 degrees.

- Maximum acceleration: 360 arcsec per sec².
- Supported coordinate systems for pointing (through Observatory Control System):
 - Heliocentric: Cartesian, Radial.
 - Heliographic: Stonyhurst, Carrington.
 - Helioprojective: Cartesian, Radial.

Operational and Safety Limits

- Zenith blind spot (caused by mount drive limitations):
 - Encountered twice per year around the solstices (around local noon).
 - When the DKIST encounters the zenith blind spot operations will be interrupted.
- Enclosure:
 - Opening: only when Sun has risen 7 degrees above local horizon.
 - Closing: when Sun has set 7 degrees above the local horizon.
- Maximum slew rate of enclosure and telescope azimuth track: 2 degrees per sec.
- Pointing exclusion zone: annular ring from 1.5 solar radii out to 25 degrees during daytime (to prevent that the image of the Sun is moved off the heat stop and endangering the optical support structure).

Pointing Scenarios

The DKIST supports the automated execution of discrete pointing sequences and mosaics through the Observatory Control System.

- Example 1: obtain an overall FOV exceeding the capabilities of individual instruments (a large active region, large filament or prominence).
- Example 2: perform a center-to-limb observation.
- Example 3: observe multiple active regions in sequence.
- Example 4: observe discrete areas following the solar limb all around the Sun.

Solar Rotation Tracking

- Rigid or differential.
- Remark: or as tracked by WFC (if applicable).

Observing the Corona

The DKIST has a **Lyot stop** located in a pupil plane between M2 and the secondary (gregorian) focus that is placed into the beam when the corona is observed (in the near-limb or far-limb scenario).

- Near limb: Occulting in secondary (gregorian) focus.
 - This is in a scenario where the telescope is pointed to a location above the limb but light from the solar disk is still passing through the 5 arcmin heat stop aperture in the prime focus.
 - Limb tracking available (with +/- 5 arcsec over- or under-occulting capability).
- Far-limb: Occulting in prime focus with heat stop.
 - This is in a scenario where the telescope is pointed far enough above the limb so that no light from the solar disk is passing through the 5 arcmin heat stop aperture in the prime focus. In this scenario there is no occulting in the secondary (gregorian) focus.
 - No limb tracking available.

Coronal Observations are supported by regular CO₂- and wet-washing procedures of the primary mirror M1.