

1-Meter Observatory System

The PW1000 is a complete 1-meter observatory-class telescope featuring a direct drive altitude-azimuth (Alt-Az) mounting system designed and engineered by PlaneWave. With a diffraction-limited 100mm image circle, the PW1000 is designed to excel at imaging on the largest format CCD cameras available today. Light-weighted optics are made of zero expansion fused silica materials for excellent thermal stability and

maximum throughput. The dual Nasmyth ports allow two instruments to be installed simultaneously, and a computer-controlled M3 mirror allows either instrument to be remotely selected in seconds. With direct drive motors, high resolution encoders, zero backlash and no periodic error, the PW1000 sets a new standard in 1-meter class observatory telescopes.



PW1000 Features

- Pinpoint stars over a 100mm image circle (1 degree)
- Dual Nasmyth focus ports, allowing simultaneous mounting of two instruments and easy switching between imaging and visual use.
- Direct-drive motors on each axis for smooth, fast, and virtually silent movement of the telescope
- High-resolution absolute encoders on each axis for precise positioning
- Zero backlash
- Zero periodic error
- PointXP mount modeling software
- Integrated field de-rotator / rotational field framing
- Integrated primary mirror shutter cover

Alt-Az mounts are the choice for most modern professional observatories. An Alt-Az mount is inherently more stable than an equatorial mount since there is no cantilevered mass, nor are there any large protruding counterweights to create a dangerous hazard in a public observatory. An Alt-Az telescope is also considerably more compact than its equatorial counterpart, allowing a larger telescope to fit in a smaller enclosure.

The mass required to make a rigid Alt-Az mount is substantially less, leading to substantial cost savings. Unlike German Equatorial mounts, there are no meridian flips to deal with; you can image continuously from horizon to horizon if desired. With no polar alignment required, the Alt-Az mount is far more intuitive to use than a German Equatorial mount.

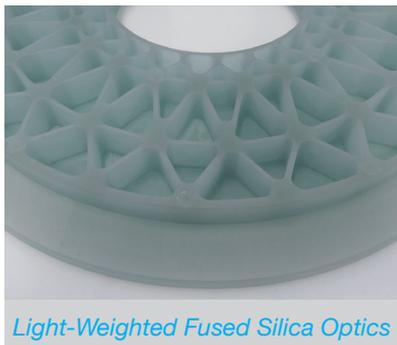
Features:

Light-Weighted Fused Silica Optics: Fused Silica has a coefficient of thermal expansion six times lower than Borosilicate (Pyrex) glass, which means that as it cools down, fused silica preserves its shape to a high degree of accuracy. This translates into consistent optical performance and unchanging focus over temperature changes.

Dual Nasmyth Focus Ports: The Nasmyth focus is along the altitude axis so the telescope does not need to be re-balanced when changing equipment. Eyepieces remain at a constant height, greatly simplifying access to the telescope for public observatories.

The computer-controlled M3 mirror allows either Nasmyth port to be selected in just a few seconds, allowing observers to easily transition between imaging and visual use, or other instrumentation.

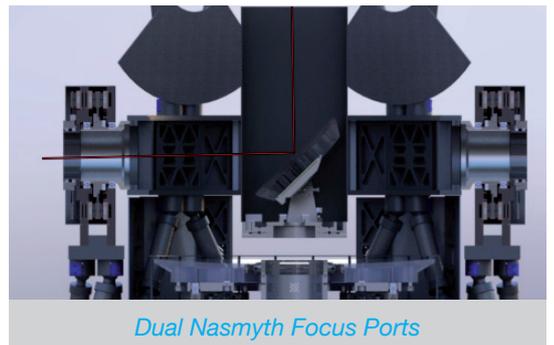
Rotating Tertiary Mirror: The PW1000 includes an integrated rotator for the tertiary mirror, with magnetic locks to position the mirror precisely at either Nasmyth focus position. The rotator can move from one port to the other in under 10 seconds.



Light-Weighted Fused Silica Optics



Direct drive motors and encoders



Dual Nasmyth Focus Ports

Direct drive motors and encoders: Direct Drive motors and absolute on-axis encoders eliminate the need for reduction gears, thereby eliminating backlash and periodic error. With high-resolution encoders providing the feedback for the direct drive motors, not only will the telescope track without periodic error and backlash, the mount will also counter wind gusts with precise servo feedback. The direct drive motors can move the telescope at incredible speeds for tracking satellites or just to minimize target acquisition time.

Automated Primary Mirror Shutter: Protects the primary mirror from unwanted dust and moisture with this integrated four shutter automated system, fully controllable with PlaneWave's PWI software.



Rotating Tertiary Mirror

Proven Technology of the CDK700

The PW1000 uses the same proven technology as the CDK700. Many CDK700s are deployed around the world at various institutions such as: Caltech, Harvard, Penn State, University of New South Wales, Simon Frasier University, University of Montana and University of Hamburg, and many more.

The CDK (Corrected Dall-Kirkham) Optical Design is an innovative solution for unsurpassed scientific investigation, visual observing and astro-imaging at an affordable price. It has excellent performance with large format CCD cameras, far exceeding the off-axis performance of most commercial telescope designs, including the uncorrected Ritchey-Chrétien.

Our design produces a flat, coma-free and astigmatic-free field of view. Since the secondary mirror is spherical, centering is very forgiving, making it easy to align the telescope optics for optimum performance. The end result at the image plane is no off-axis coma, no

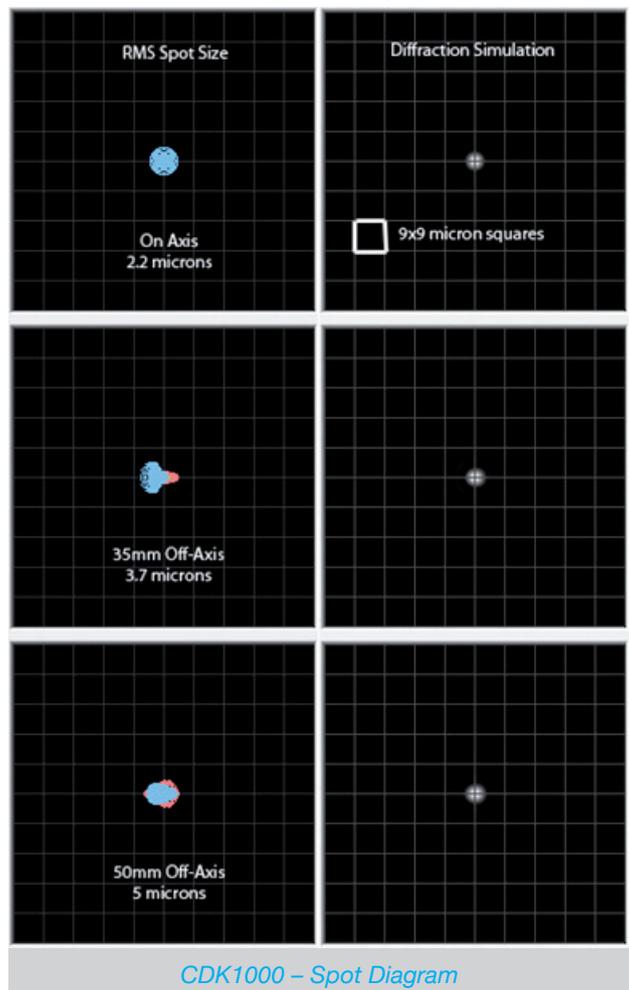
off-axis astigmatism, and a perfectly flat field to the edge of a 100mm image circle. The stars will be pin-points from the center to the corner of the field of view.



Five CDK700 telescopes at the Caltech/MINERVA installation on Mount Hopkins, Arizona

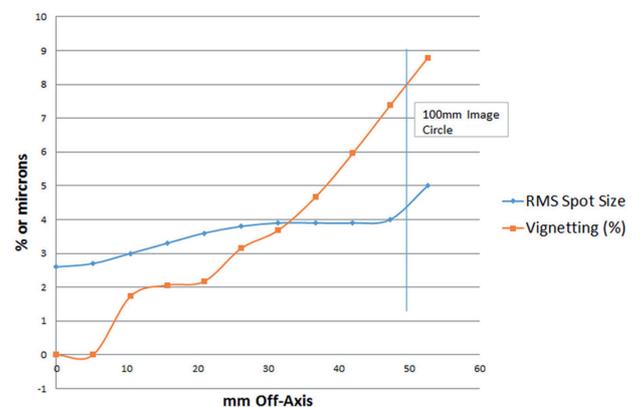
OPTICAL SYSTEM

Optical Design	Corrected Dall-Kirkham (CDK)
Aperture	1000 mm (39.37inch)
Focal Length	6000 mm
Focal ratio	f/6
Central Obstruction	47% of the Primary Mirror Diameter
Back Focus	373mm (14.7 inches) from Mounting Surface of de-rotator
Weight	2600 lbs
Optical Tube	Dual truss structure with Nasmyth focus ports
Optical Performance	3.7 micron RMS spots [35mm on-axis] (400 to 900nm) 5.0 micron RMS spots [50mm off-axis] (400 to 900nm)
Dimensions	135" H x 72" W x 45"
Optimal Field of View	100mm (1.0 degrees)
Focus Position	Dual Nasmyth Focus Ports
Image Scale	29 microns per arcsecond at F/6



MECHANICAL STRUCTURE

Fork Assembly	Space Frame Steel Truss
Fork Base	Welded stainless steel torsion box
Azimuth Bearing	Dual 11.125 inch tapered roller bearings
Altitude Bearing	Three 9.5 inch 4 way loaded ball bearings (two pre-loaded on motor side and one on non motor side)
Optical Tube	Dual truss structure with Nasmyth focus
Instrument Payload	300 lbs (150 ft-lbs) - mounted on the field de-rotator plate



MOTION CONTROL

Motor Control	Industrial grade Parker brushless motor control system and built in electronics
Motor	Azimuth and Altitude: Direct Drive 3 Phase Axial-Flux Torque Motor
Encoder	Azimuth and Altitude: Absolute encoder with a resolution of 0.078 arcseconds (16.5 million counts per revolution)
Motor Torque	Greater than 200 ft-lbs of peak torque
Drive Electronics	Controls the altitude and azimuth motors and encoders, 2 direct drive de-rotators with absolute encoders, 4 fans zones, 3 dew heater zones, two focusers, an array of temperature sensors, M3 port selector, primary mirror covers and magnetic axis deceleration
Telescope Control Software	Incorporates PointXP mount modeling software and All Sky PlateSolve both by Dave Rowe. Also included is automatic focusing, dew heater control, primary mirror cover control, dome control and all ASCOM compatible. Linux and Windows compatible.

SYSTEM PERFORMANCE

Pointing Accuracy	Better than 10 arcsecond RMS with PointXP Model
Pointing Precision	2 arcsecond
Tracking Accuracy	<1 arcsecond error over 10 minute period
System Natural Frequency	10 Hz or greater
Field De-Rotator Accuracy	< 3 microns of peak to peak error at 35mm off-axis over 1 hour of tracking (18 arc sec)



Automated Primary Mirror Shutter

PRIMARY MIRROR

Radius of Curvature	6260 mm (246.46 inches)
Optical Diameter	1000 mm (39.4 inch)
Outer Diameter	1020mm (40.157inch)
Core Diameter	360.7 mm (14.2 inches)
Material	Fused Silica
Primary Thickness	85 mm (3.3 inches)
Primary Weight	122 lbs. (54% light weighted)
Cell	18 point

SECONDARY MIRROR

Radius of curvature	5740 mm (226 inches)
Optical Diameter	450 mm (17.7 inches)
Material	Fused Silica
Secondary Weight	27.2 lbs

TERTIARY MIRROR

Optical Major Diameter	404 mm (15.9 inches)
Optical Minor Diameter	286 mm (11.3 inches)
Material	Fused Silica
M3 Thickness	65 mm (2.6 inches)

NOTE: All specifications and dimensions are subject to change.

