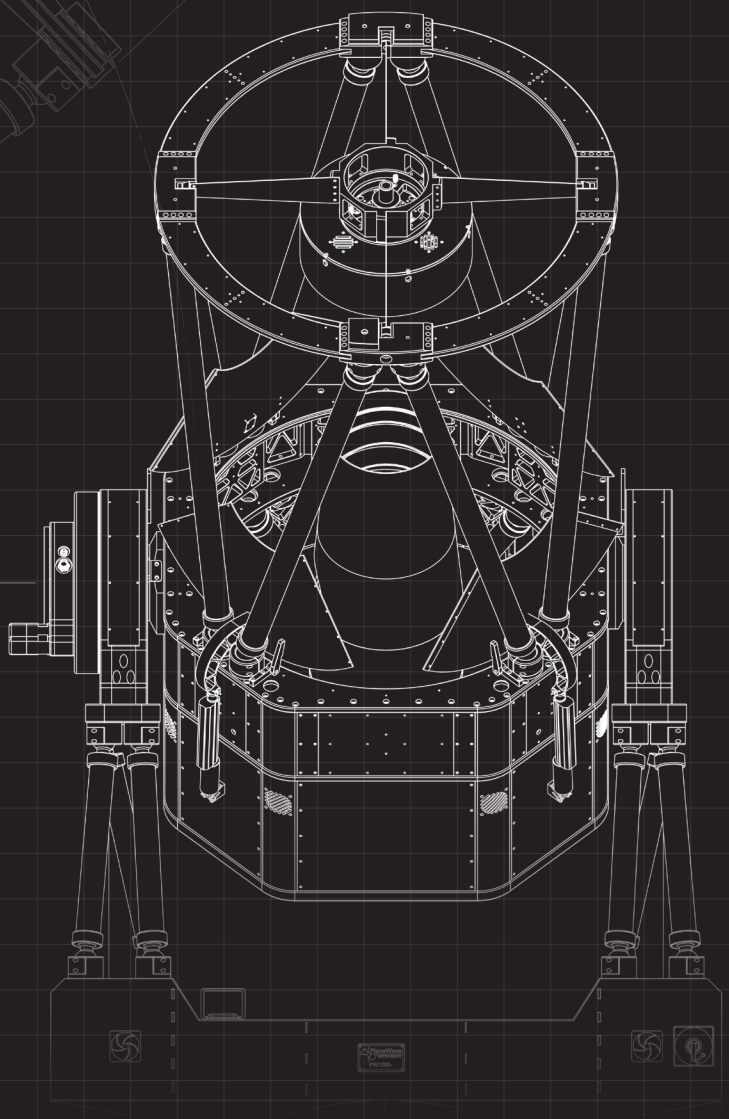
PlaneWave™ INSTRUMENTS

PRODUCT CATALOG




PlaneWave™
INSTRUMENTS

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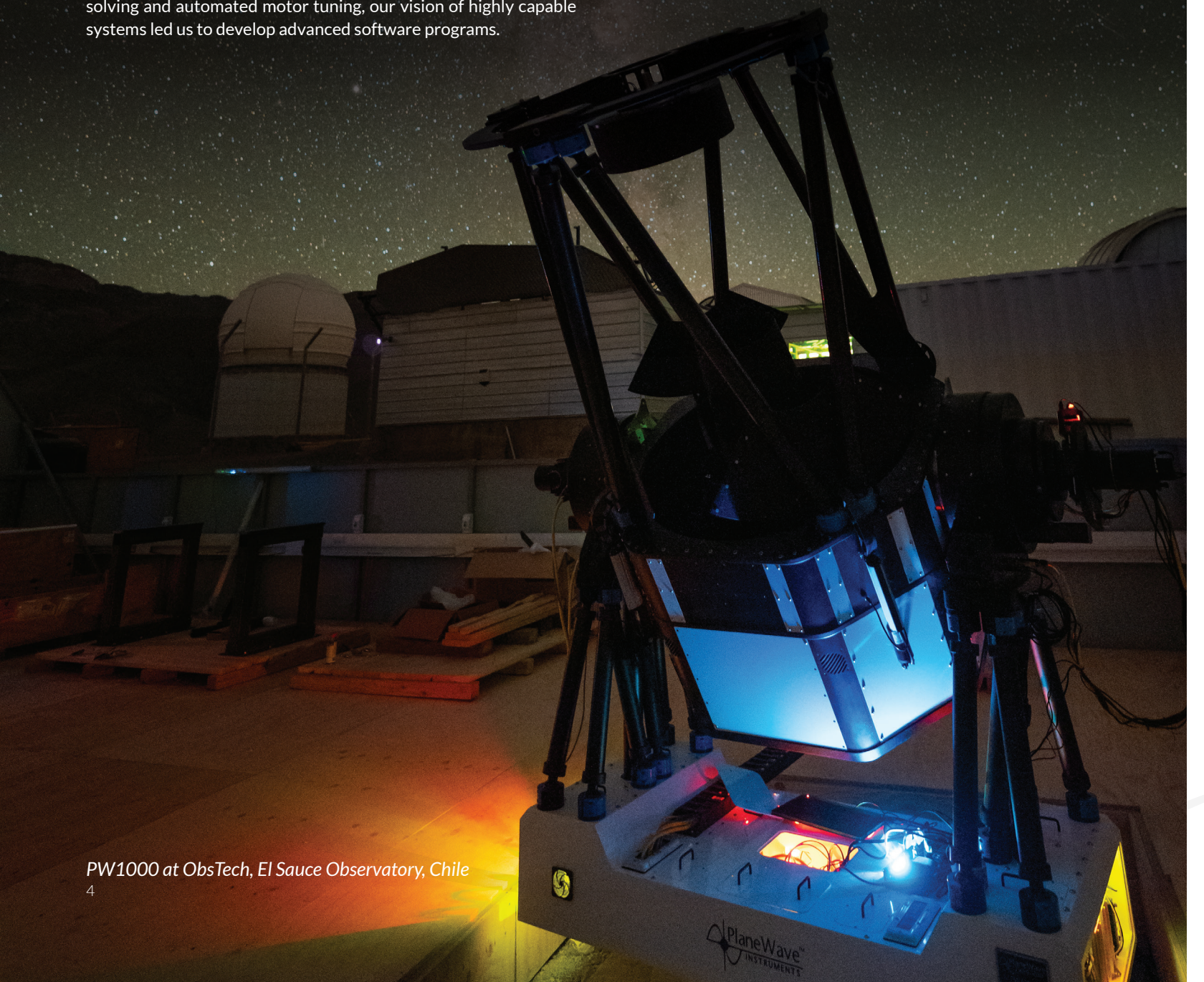
PW1000 at Palomar Observatory with the Famous 200-Inch Hale Telescope

ABOUT **PLANEWAVE**

The PlaneWave Difference

Founded in 2006 with the goal of creating the perfect telescope, US-based PlaneWave Instruments designs and manufactures observatory-class instruments for clients around the world. Our in-house optomechanical and software capabilities produce turn-key observatory systems that are used in astronomical research, astrophotography, defense missions, and more. PlaneWave's vertically integrated business model allows total control of the manufacturing, production, and testing of every product. From software-controlled autofocusing and mount modeling to plate solving and automated motor tuning, our vision of highly capable systems led us to develop advanced software programs.

PlaneWave is a global leader in advanced optomechanical systems thanks to the vision and teamwork of our dedicated staff. With a diverse group of professionals and amateur astronomers on our team, PlaneWave breaks down barriers through innovative design and manufacturing techniques. Over the years, PlaneWave has introduced product features such as on-axis encoders, direct-drive motors, and turn-key off-the-shelf large aperture observatory systems, all of which are now industry standards in the global astronomy market.



PW1000 at ObsTech, El Sauce Observatory, Chile

Our Story

When PlaneWave's CEO, Richard Hedrick, was working towards a degree in physics at El Camino College in 1990, he didn't know attending a talk by El Camino astronomy professor and professional astronomer Dr. Perry Hacking would change the course of his life forever.

Richard discovered a passion for astronomy and astrophotography in the deserts and mountains of California with a borrowed 10" telescope. When Richard had an idea to start a telescope-making class, he approached Dr. Hacking to see if he would consider teaching it and in 1991, the first telescope-making class began— a class still taught at El Camino College today. This class is where Richard, Joseph Haberman, and Jason Fournier, the future co-founders of PlaneWave, first met.

As their collaboration evolved through the early 2000s, Dr. Hacking, Richard, and his classmates decided to make the biggest amateur telescope in the world— a 42" visual-use telescope with entirely handmade optics and an eyepiece position that did not require a large ladder. When David Rowe, the engineer who would later develop the CDK telescope and become another PlaneWave co-founder, heard of their mission, he suggested a new design that would offer higher performance and the crew welcomed him to their team.

In 1995, Richard graduated from UCLA and started work at Celestron to oversee Product Development. Soon after, Jason Fournier was hired as Product Manager and Joe Haberman was hired as Master Optician. During this time, the 42" telescope optics were still being hand-figured and the group began to imagine how to design and create a telescope that did everything they wished telescopes could do. They began to dream of the pursuit of the perfect telescope.

Today, PlaneWave manufactures commercial off-the-shelf (COTS) ground-based telescopes and direct-drive tracking systems that are designed, manufactured, assembled, and tested in our Michigan and California facilities. Our team has never forgotten the dream to create the biggest and best telescopes in the world and we aim to ignite the same passion for astronomy, astrophotography, and incredible observatory systems in others that we feel every day.

Our Campus

When PlaneWave outgrew our old facilities in Rancho Dominguez, California, and Deerfield, Michigan, we envisioned becoming more than another building in a business park. PlaneWave is a unique, innovative, and exciting company and we wanted our community to be involved in our growth.

PlaneWave's campus in Adrian, Michigan, immediately impressed our team and reminded us of Thomas Edison's Menlo Park. Menlo Park, a neighborhood where Edison made major inventions, became a place for people to gather, see the work he was doing, and spend time together. We wanted to give back to the community that has welcomed us by providing a space where art, music, sports, science, and technology can grow and harmonize.

PlaneWave's 57-acre campus is stunning, located at the main entry point to our community, and was a perfect fit that gave us the necessary room to grow. We are in the process of adding new buildings, building a disc golf course, and welcoming a music theater, all in addition to the art community that already exists just yards from where we are engineering the next generation of telescopes.

In 2024, we will add an observatory to our campus and install what will be the biggest telescope in Michigan. We will be able to offer unprecedented professional and educational access as well as inspirational science programs for the public.

PlaneWave has grown immensely from a 1991 telescope-making class at El Camino College to supplying world-class telescopes to research universities and observatories around the world. We are proud of our growth and passionate about our vision for a future where our community comes together around art and science as we continue to innovate the future of observatory-class telescopes.

TESTING

At PlaneWave, our observatory system testing is more rigorous, thorough, and intentional than any of our competitors. When we set out to create the perfect telescope, we found the testing processes, systems, and software that existed did not meet our high standards. PlaneWave has continually developed and refined our testing methods, instrumentation, and analytical software to ensure harmony between product, design, and performance. We have combined traditional, industry-standard practices with our proprietary tools and methods to allow detailed verification of manufacturing and assembly requirements while maintaining an efficiency that adds to PlaneWave's product value.

Our indoor testing facilities offer a constant testing environment so we aren't limited by visibility, location, or time of year to test our telescopes. Each mirror in our optical systems undergoes an extensive process of figuring, testing, and inspection to guarantee peak performance. During mechanical production, parts and sub-assemblies are inspected and tested throughout each step of the assembly process. Most importantly, we're raising the bar by testing every element of our telescopes and mounts throughout every step of the assembly process to ensure the only thing standing between you and flawless observation is a cloudy sky.

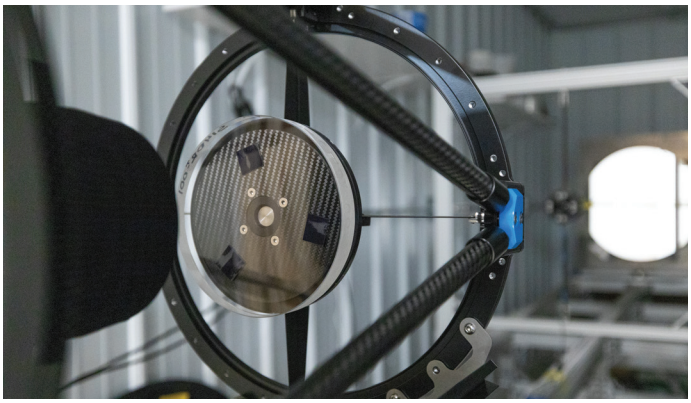
Optical Testing

PlaneWave's optical testing is inseparable from our optical production. Inside our climate and scintillation-controlled test environments, PlaneWave technicians use our proprietary metrology system to generate a detailed wavefront map for every mirror at each stage of our manufacturing process. The data is then uploaded to one of our state-of-the-art, robotic figuring machines which analyzes the fringes and shape of the mirror to correct errors and develop a surface that is ¼ of a wavelength smooth. This measurement and figuring process is repeated until each mirror meets the exacting quality required for every PlaneWave system.

While some telescope manufacturers outsource their mirror production and can only trust the test reporting from their vendor, PlaneWave maintains the ability to test each of our mirrors at every step of the fabrication process. Within the optics labs on our Michigan campus, we have built a vertical test tunnel for our largest optical systems, multiple horizontal test tunnels for our 12.5" to 24" optical systems, numerous vertical test systems for mirrors in polishing and figuring, match-plate inspection stations for convex mirror testing, and scratch inspection stations.

After final figuring, our mirrors are coated, mounted in their support cells, and retested for wavefront error to ensure that deformation has not been introduced during these processes. The importance of this step cannot be understated: the wavefront error of an unmounted optic is nearly meaningless to the performance of an assembled system and many other optical system manufacturers skip this test or remove astigmatism and other errors from their measurements. At PlaneWave, we understand that these errors can be significantly detrimental to the performance of the complete system. We do not pass mirrors or final assemblies without verifying their resulting wavefront.

In addition to testing each mirror throughout our manufacturing process, we test every one of our telescopes as a complete, finished system in one of our modern test tunnels. This ensures that each optical system is confirmed to be diffraction-limited before shipment. As our test tunnels are temperature and air-circulation controlled, we can reduce atmospheric scintillation that impacts on-sky measurements, allowing for extremely precise measurements. This enables our expert technicians to efficiently identify and correct any residual alignment errors in the complete optical system. This final optical test is the ultimate guarantee that our telescopes will yield the excellent performance that our customers have come to expect.



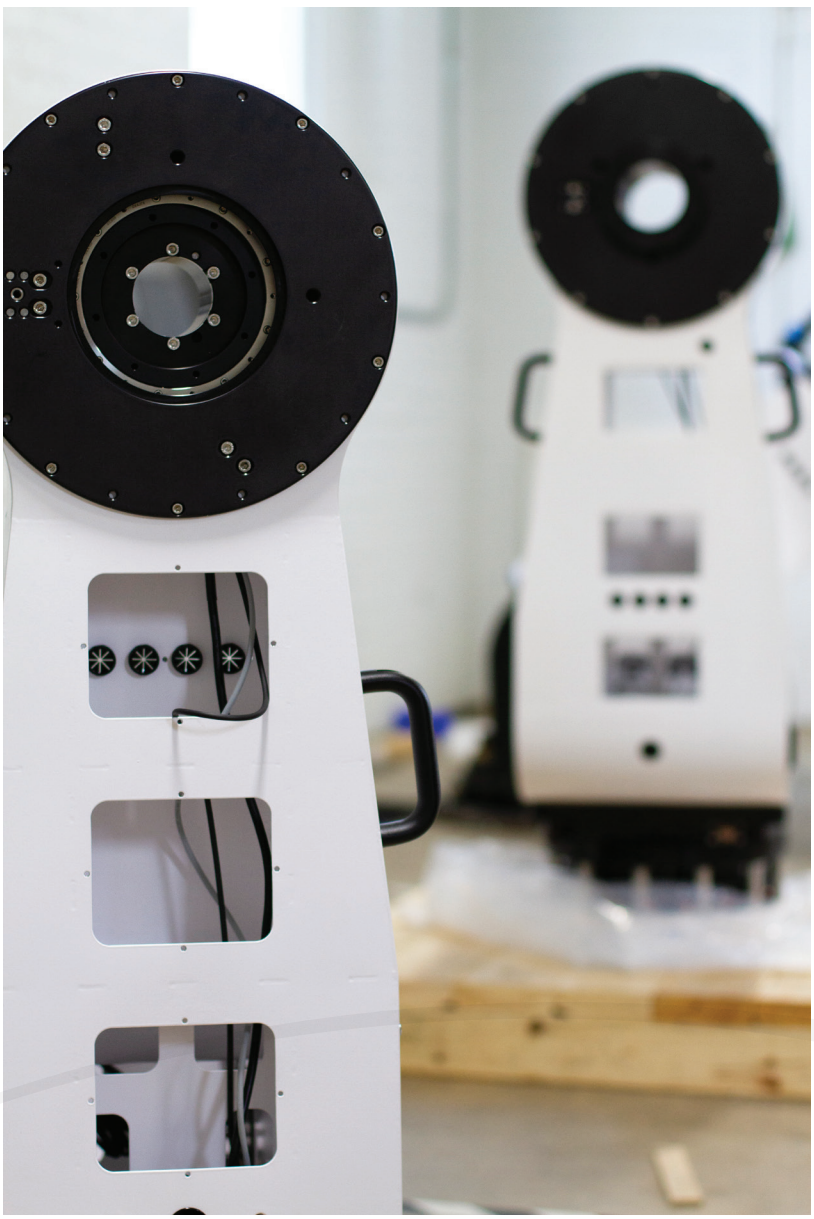
Mount / Gimbal Testing

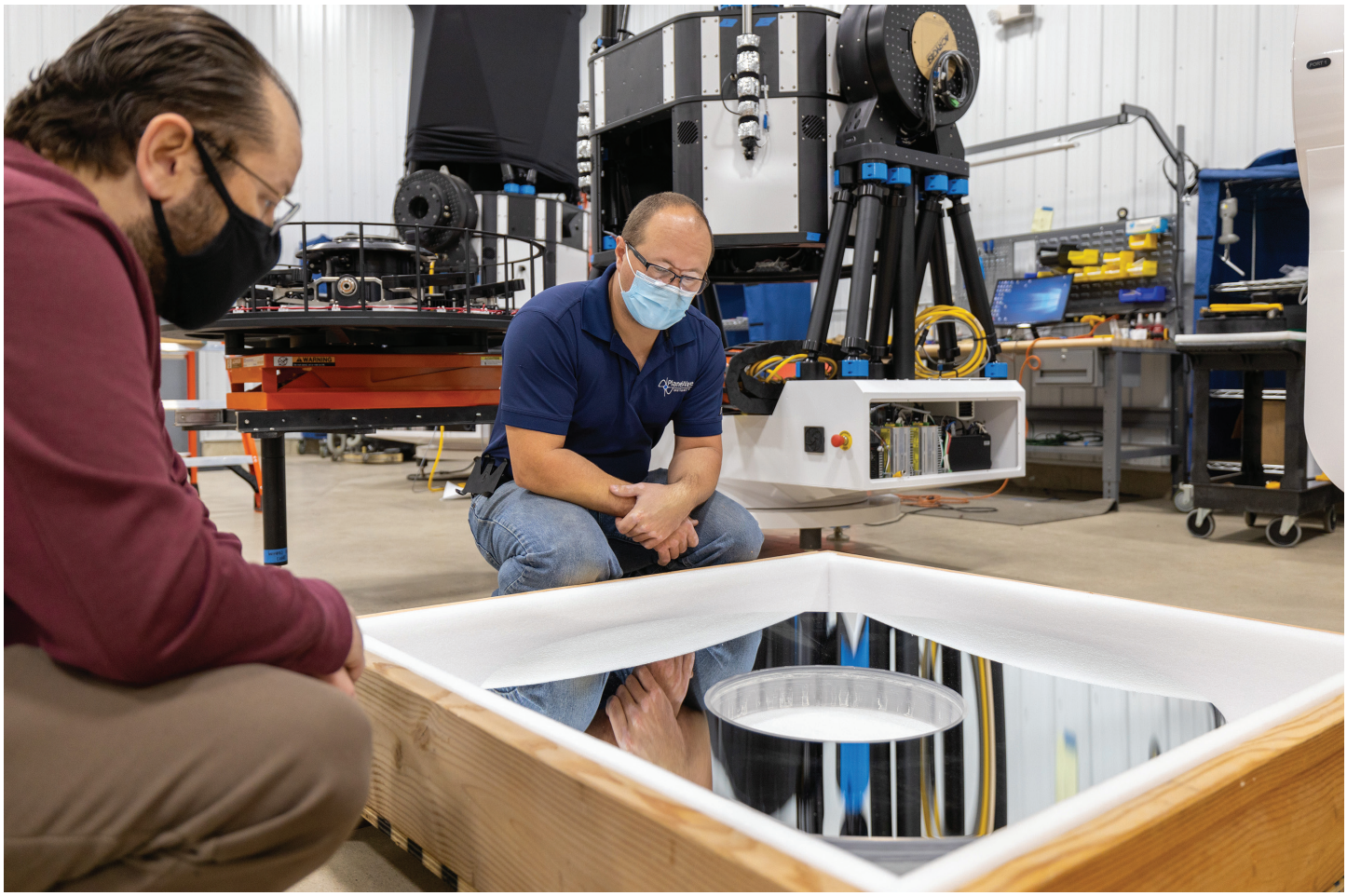
Our telescope mounts are agile direct-drive tracking systems that achieve shocking accelerations and speeds while maintaining low jitter and stable tracking, even when moving at LEO tracking rates of several degrees per second. Our mounts have been engineered for high field performance and our assembly requires rigorous testing with precise standards to ensure they function flawlessly for our customers.

PlaneWave manufactures nearly every part and component in our L-Series mounts and the larger mounts used for the CDK700, RC700, and PW1000. Machined parts are inspected both during production in our machining facilities and again upon delivery at our assembly facilities.

As the motor assembly begins, our technicians continually check for unexpected and unwanted resistance or eccentricity in the stack. Motor coils are tested for resistance and wire harnesses are checked for continuity. Then, final fit checks are performed as the motors are integrated into the mount structures and final electrical testing is conducted.

Our testing continues with extensive indoor performance testing for each mount. We run the L-350, L-500, and L-600 mounts through no less than 24 hours of automated slew testing while PlaneWave's larger gimbals for the CDK700, RC700, and PW1000 undergo an even longer process. These tests measure slew rates, currents, and resistance to capture a full spectrum of data from the axis encoders. The resulting data reveals whether the system meets our demanding jitter and tracking accuracy standards. If a motor under performs against any criteria, it is rebuilt and testing renews from the very beginning. It is the best way to be certain our mounts will meet or exceed your expectations.





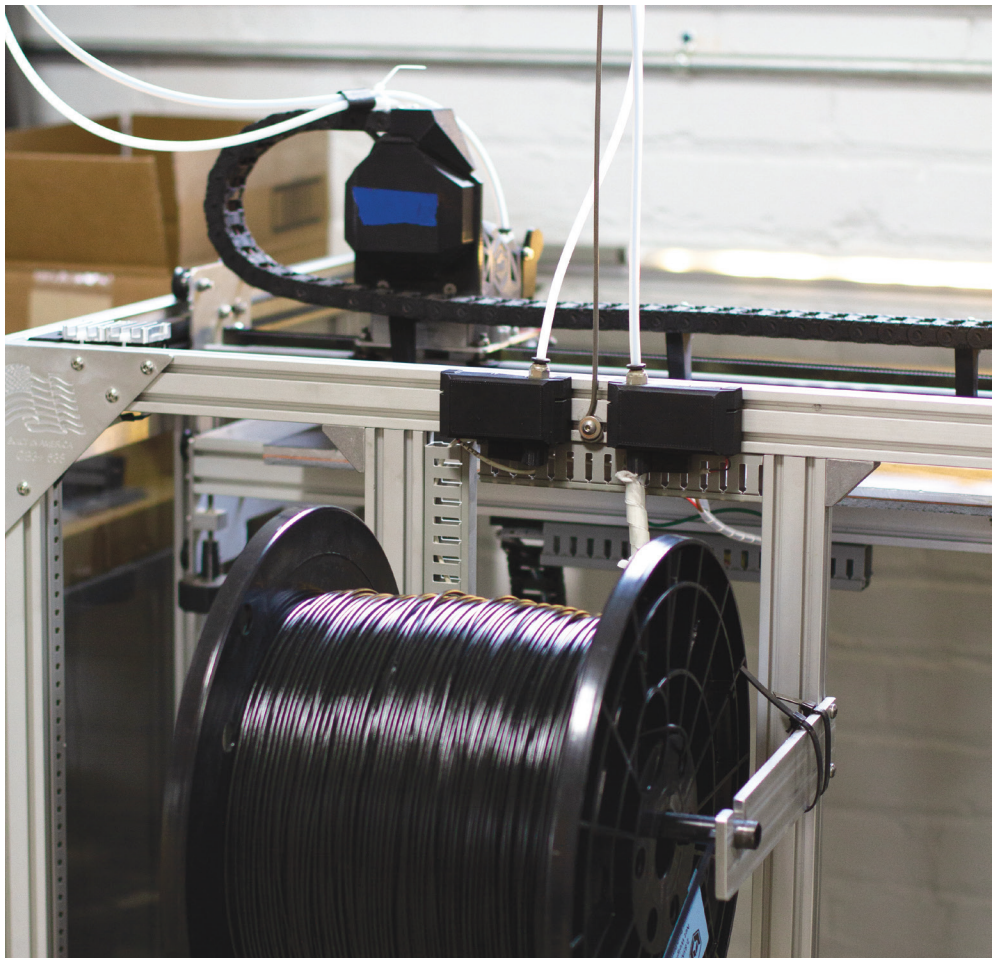
WHY PLANEWAVE

KEY TECHNOLOGIES

+ PlaneWave has developed state-of-the-art optical manufacturing and testing facilities. From individual mirrors to complete optical systems, we ensure that each of our products is of the highest quality.
+ We have developed extensive motion control algorithms, astrometric analysis software, pointing analysis and correction software, and control system architectures that significantly enhance the performance of our gimbal systems.
+ PlaneWave's vertical integration includes in-house design and manufacturing of our gimbals, motors, optics, and OTAs. This allows for minimized cost and maximized performance through design optimization of each system component.

IN-HOUSE MECHANICAL CAPABILITIES

+ PlaneWave is a leader in developing products that are innovative, high-quality, and designed to be scalable for volume manufacturing.
+ Our team of engineers and production technicians use SolidWorks, custom software tools, state-of-the-art CNC, and 3D printing to design and produce our products.
+ PlaneWave is built on vertical integration- we operate our own machining facility for total product and quality control.
+ From new product development to custom design, our team is well-suited to meet the rapidly evolving requirements of our customers.

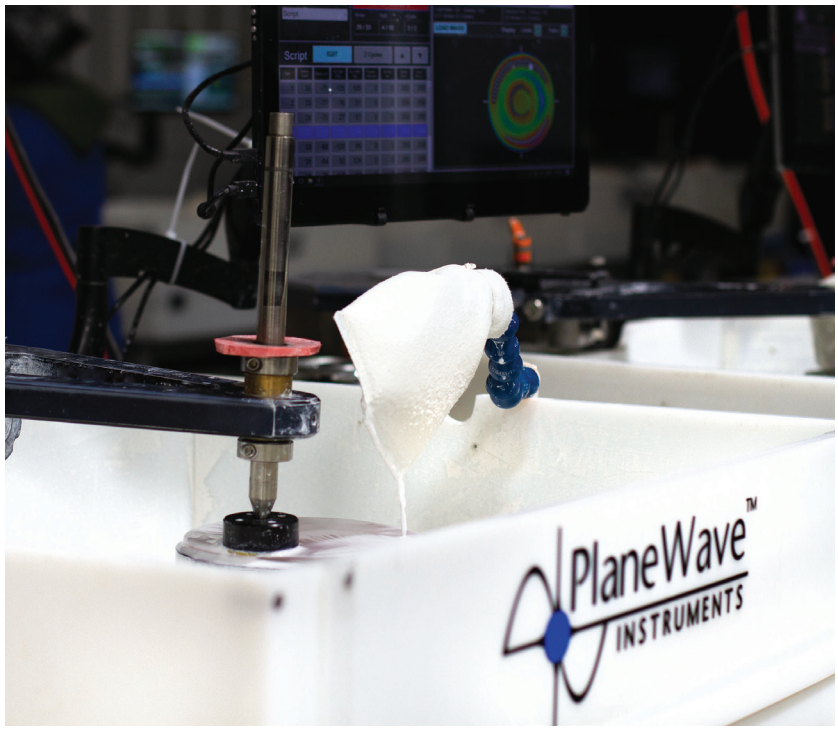


MARKET SEGMENTS

ASTRONOMY

OPTICAL COMMUNICATION

SPACE DOMAIN AWARENESS



COTS MODIFICATIONS

PlaneWave products have been designed to meet the needs of a variety of markets and applications. For applications that are not fully or perfectly addressed by our standard COTS offerings, we offer a variety of optional modifications:

OPTICAL COATINGS:

Whether mirror or lens coatings, PlaneWave works with several coating vendors that offer both varieties of off-the-shelf formulas and the ability to deliver fully custom coatings to specification.

LENS SUBSTRATES:

For highly demanding applications using our CDKs in wavelengths well outside of the visible spectrum, we offer lens-substrate selections optimized for UV or IR.

MECHANICAL ENHANCEMENTS:

- Upper truss hard shrouds for when our traditional spandex shrouds for the front cage are not enough
- Breadboard interfaces for instrumentation
- Customized baffles and light shields

PLANEWAVE SERVICE LIFECYCLE

PRE-SALE SUPPORT

From commercial applications to research observatories, PlaneWave's sales team has decades of experience helping clients solve their complex equipment needs.

AFTER-SALE SUPPORT

PlaneWave is here to help ensure your equipment is running smoothly for decades to come through technical support, on-site installation, service agreements, and extended warranties.

IN-HOUSE OPTICAL PROCESSES

+ Our in-house CNC mirror generation, polishing, figuring, and coating chamber processes are overseen by our experienced team.
+ PlaneWave technicians use our proprietary optical metrology systems to generate a precision surface wavefront map for every mirror and complete system and at each stage of the manufacturing process.
+ Our state-of-the-art, robotic sub-aperture figuring machines smooth and correct any errors present in the mirror surface.
+ After final figuring, our mirrors are coated, inspected, mounted in their support cells, and retested to ensure that no surface aberrations have been introduced during coating or assembly.

INSTALLATION

PlaneWave teams are available to install equipment almost anywhere in the world and to provide on-site client training.

SERVICE AGREEMENTS

Looking for ways to optimize your equipment year after year? PlaneWave offers a variety of service agreements to help maintain your system, with both remote support services and site-visits.

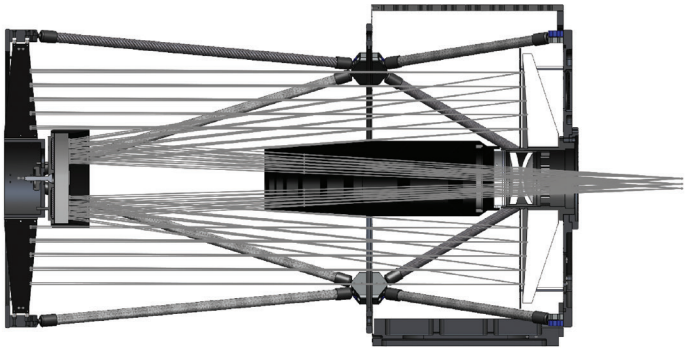
EXTENDED WARRANTY

For projects where predicting operating costs over time is crucial, PlaneWave offers extended warranty packages.

OPTICAL **DESIGN**

Corrected Dall-Kirkham (CDK)

PlaneWave's Corrected Dall-Kirkham telescope is based on an innovative optical design developed by Dave Rowe. The goal of the design is to make an affordable astrographic telescope with a large enough imaging plane to take advantage of the large format CCD/sCMOS cameras of today. Most telescope images degrade as you move off-axis from either coma, off-axis astigmatism, or field curvature. The CDK design suffers from none of these problems. The CDK is coma free, has no off-axis astigmatism, and has a flat field. The design is a simple and elegant solution to the problems posed above. The CDK consists of three components: an ellipsoidal primary mirror, a spherical secondary mirror, and a lens group. All these components are optimized to work in concert in order to create superb pinpoint stars across the entire 52- to 100-mm image plane.



Ritchey-Chrétien (RC)

Our PlaneWave Instruments Ritchey-Chrétien telescopes use only a primary and secondary mirror with reflective coatings. This can be useful when making observations primarily on-axis and wide-field imaging is not a concern.

Infrared Dall-Kirkham (IRDK)

Our IRDK telescopes include a Dall-Kirkham optical design with coatings that are optimized to transmit in infrared or ultraviolet wavelengths. There are no refractive lenses, only reflective components to the design. For IR application, reflective coatings are a protected gold that give better than 98% reflectivity from .65 micron (650 nm) to 5 micron (5000 nm). This design is ideal for infrared astronomy or LIDAR applications. UV-optimized coatings can be provided as well.

Astrographs (DeltaRho)

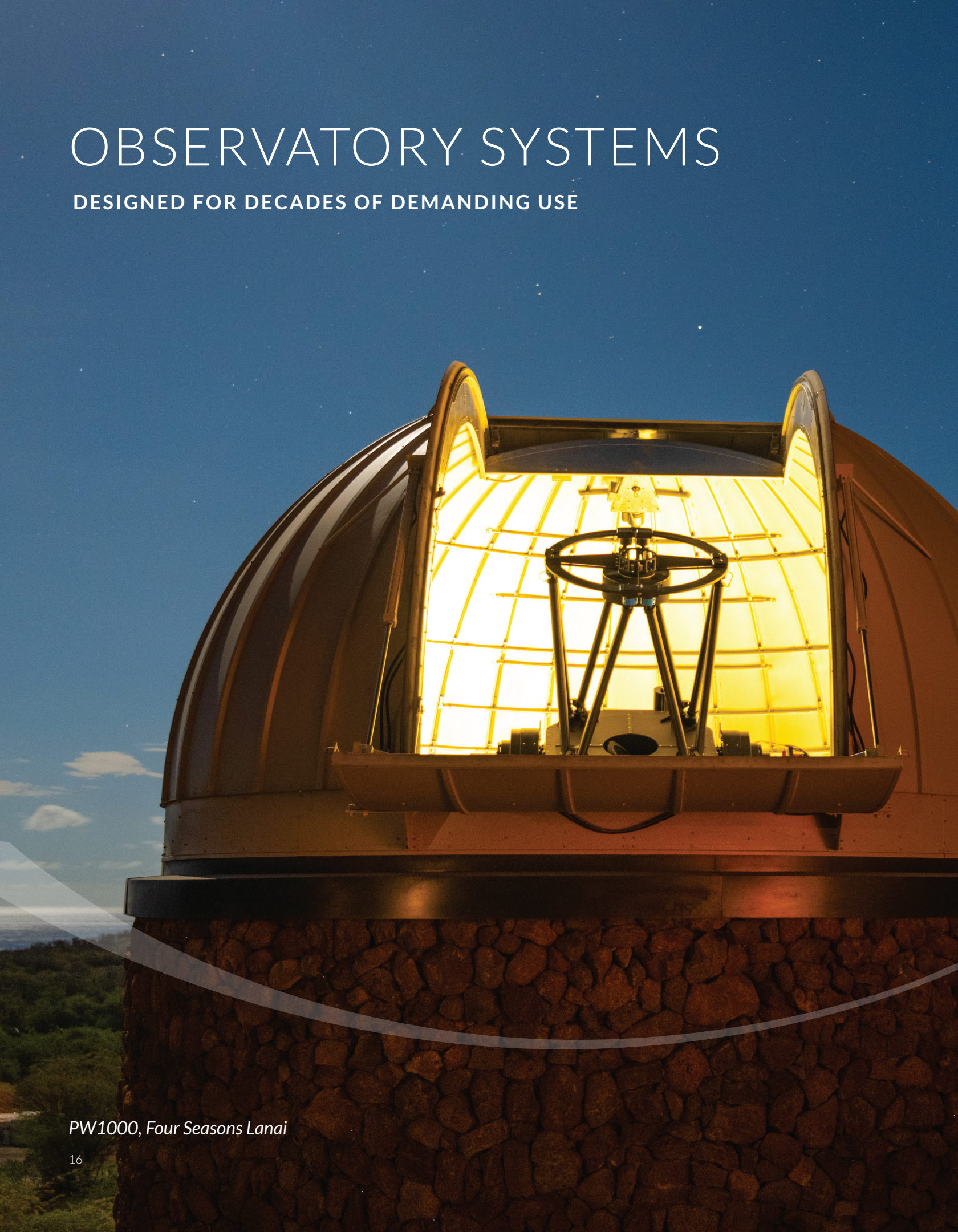
With the goal of providing stunning images, astrograph telescopes are known for their wide field of view and fast focal ratios to collect a significant amount of light in a short period of time. This is why our PlaneWave team has developed the DeltaRho lineup of astrographs to meet the needs of advanced imaging applications. Such applications demand systems that can keep up, and the DeltaRho is designed and made for uncompromising performance as a fast, wide-field optical system. Inspired by the challenges of Space Domain Awareness (SDA), astronomical research surveys, and demanding astrophotographers, our engineers developed an elegant, new optical design that meets PlaneWave's standards for imaging performance and ease-of-use. The DeltaRho offers Cassegrain focus at a focal ratio of f/3. Born from our heritage and insight as one of the world's leading designers and manufacturers of high-performance telescopes, we believe you will find the innovation, resolution, and contrast of the DeltaRho just as amazing as its speed and field of view.

Kevin Morefield, CDK14

ObsTech, El Sauce Observatory, Chile

OBSERVATORY SYSTEMS

DESIGNED FOR DECADES OF DEMANDING USE



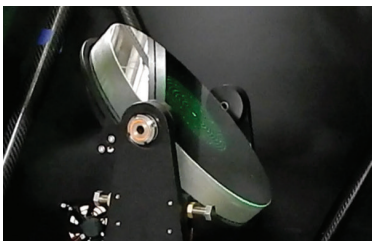
PW1000, Four Seasons Lanai


PlaneWave™
INSTRUMENTS

ALT-AZ OBSERVATORY SYSTEM **FEATURES**

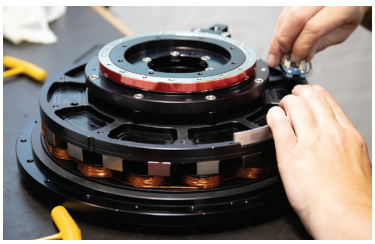
Nasmyth Focus

Dual Nasmyth Focus along the altitude axis eliminates balancing issues as you change out equipment. Eyepieces remain at a constant wheelchair-accessible height (for ADA compliance), greatly simplifying access to the telescope for public observatories. This feature is supported by our rotator and focuser options, which de-rotate the field and allow for long exposure alt-az tracking, and allow precise focusing.



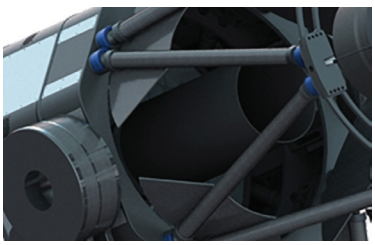
Rotating Tertiary System

The CDK700 includes an integrated rotator for the tertiary mirror, with magnetic locks to position the mirror precisely for either Nasmyth focus position. The rotator can move from one port to the other in under 10 seconds, allowing observers to easily transition between imaging and visual use.



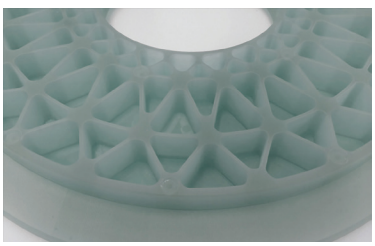
Direct-Drive Motors and Encoders

Direct-drive motors mean there are no gears to cause 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 or have any backlash at all, but the mount will be able to counter against wind gusts. 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

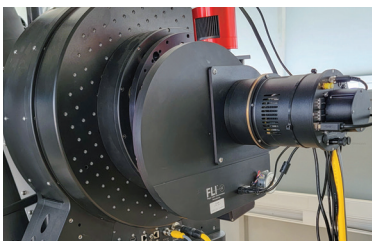
This feature protects the primary mirror from unwanted dust and moisture with this integrated four-shutter automated system, fully controllable with PlaneWave Interface (PWI) software.



Lightweight Fused Silica Optics

RC700 and PW1000

Fused silica (quartz) has a coefficient of thermal expansion six times lower than borosilicate (Pyrex) glass, which means that while 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.



Field De-Rotator

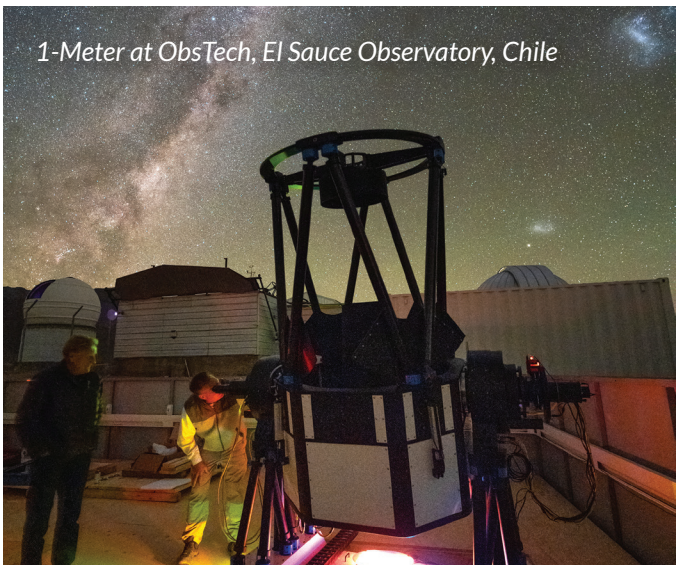
Alt-az telescopes needing to capture exposures that are free from field rotation require a method to de-rotate the imaging equipment about the optical axis. Our PWI software calculates field rotation rates based upon where the telescope is pointing and applies the necessary de-rotation to the imaging train for pinpoint images that are free from field rotation. Our PWI software communicates with PlaneWave in-house manufactured rotators for optimal on-sky performance. These rotators include our IRF90 Rotating Focuser, Series-5 Rotator, and Direct-Drive Rotator pre-installed on the PW1000.

CDK600, New Mexico

PW1000

OPTICAL DESIGNS AVAILABLE:

CDK f/6.6 **RC** f/10



Optical System

Aperture	1000 mm (39.37 in)
Focal Length	6000 mm
Focal ratio	f/6
Central Obstruction	47% of the Primary Mirror Diameter
Back Focus from De-Rotator	373 mm (14.7 in)
Weight	2600 lbs (1180 kg)
OTA Tube	Dual truss structure with Nasmyth focus ports
Dimensions	135" H x 72" W x 45"
Focus Position	Dual Nasmyth focus ports
Image Scale	29 microns per arcsecond at f/6
Optimal Field of View	100 mm (1.0 degrees)

Mechanical Structure

Fork Assembly	Space Frame Steel Truss
Fork Base	Welded stainless steel torsion box
Azimuth Bearing	Dual 11.125-in tapered roller bearings
Altitude Bearing	Three 9.5-in, 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

System Performance

Pointing Accuracy	Better than 10-arcsecond RMS with PointXP Model
Pointing Precision	2 arcseconds
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 35 mm off-axis over 1 hour of tracking (18 arcseconds)

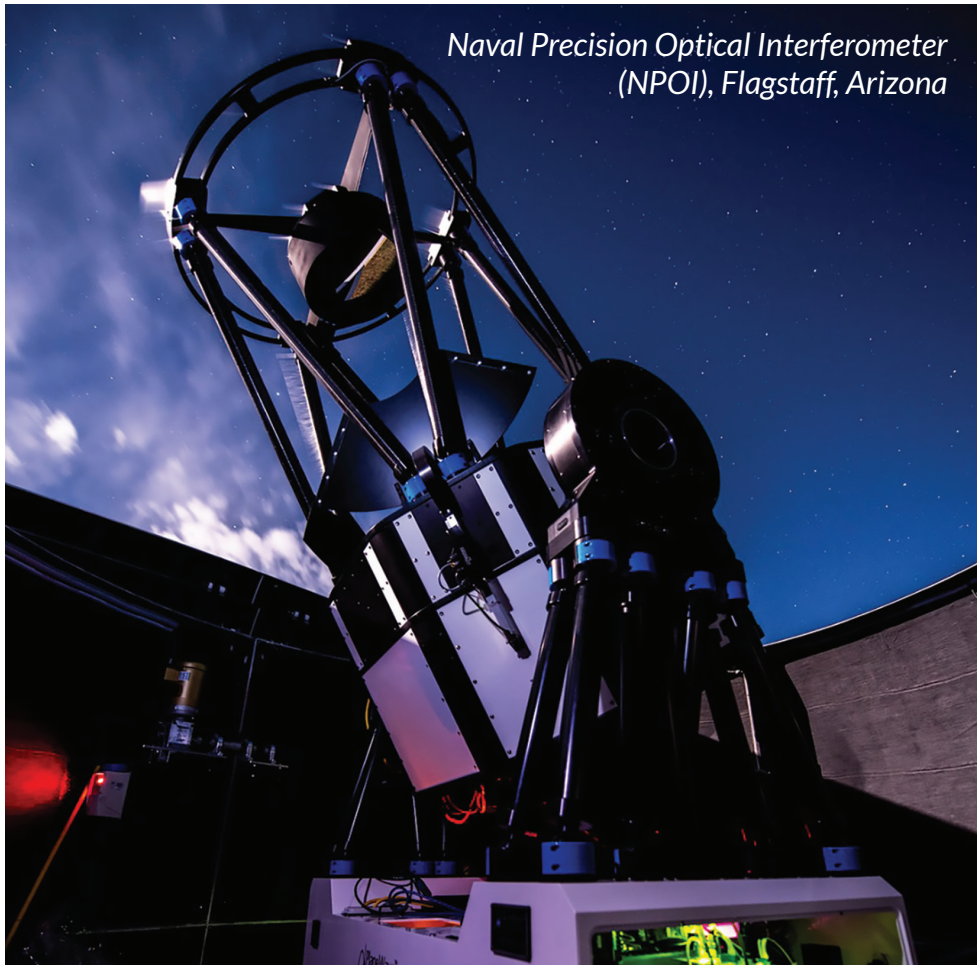
Software

PlaneWave Interface (PWI) Software Included	Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.

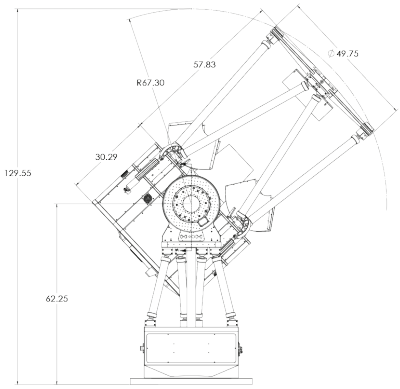
1-Meter Observatory Telescope System

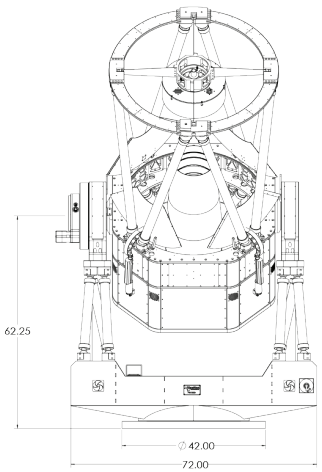
The PW1000 is a complete observatory class telescope and direct-drive alt-azimuth mounting system, designed and engineered by PlaneWave. With a 100 mm image circle, the PW1000 is designed to excel at imaging on large format CCD cameras. The optical system utilizes a Nasmyth focus through both altitude bearings allowing your camera or eyepiece to remain at a fixed height while holding heavy instruments without needing to rebalance the optical tube assembly.

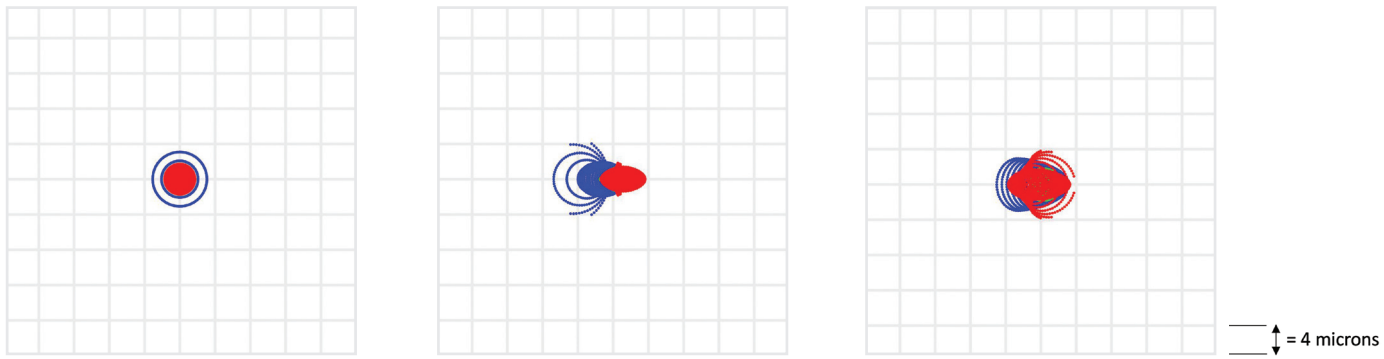
Instrumentation can be installed on both sides of the fork mount and easily accessed using the included rotating tertiary mirror system. With direct-drive motors, dual camera/eyepiece capabilities, high resolution encoders, and zero backlash or periodic error, the PW1000 sets a new standard for 1-meter observatory telescopes.



Naval Precision Optical Interferometer (NPOI), Flagstaff, Arizona







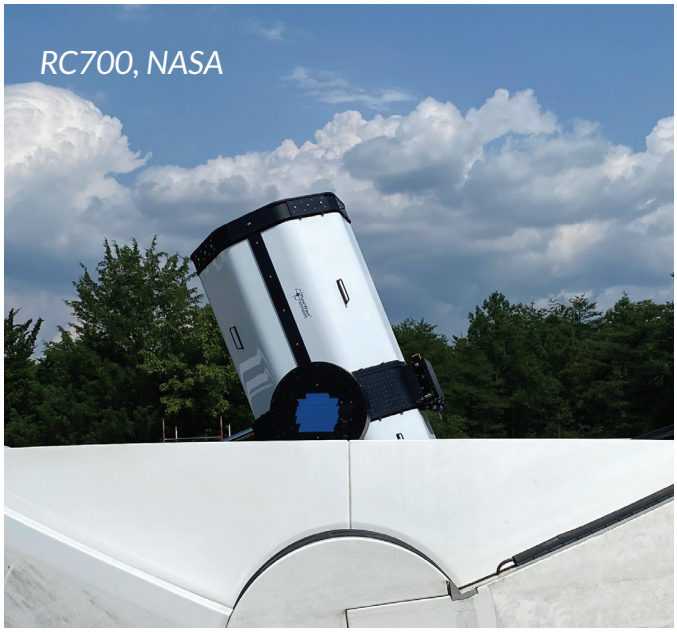
Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 1.061 microns

Distance Off-Axis = 35.026 mm
RMS Spot Size (radius) = 1.805 microns

Distance Off-Axis = 49.920 mm
RMS Spot Size (radius) = 2.097 microns

RC700

Shown with optional DeltaRho 350 optical tube and robotic piggyback mount



Optical System

Aperture	700 mm (27.56 in)
Focal Length	8,410 mm
Focal Ratio	f/12
Central Obstruction	<30% of primary Mirror
Back Focus from Mounting Surface	317 mm (12.48 in)
Weight	2,500 lbs (1134 kg)
Optical Tube	Dual truss structure with Nasmyth Focus
Dimensions	92.25"H x 52" W x 36" D
Focus Position	Nasmyth Focus

Mechanical Structure

Fork Assembly	Space-frame for maximum stiffness
Optical Tube	Dual truss structure with Nasmyth Focus *Shown with optional upper truss hard shroud*

System Performance

Pointing Accuracy (all-sky RMS)	10-arcsecond RMS with PointXP Model
Pointing Precision	2 arcseconds at sidereal velocity
Open Loop Tracking Accuracy	<0.2 arcseconds over a 10-second period at sidereal velocity
Azimuth Range of Motion	660 degrees
Altitude Range of Motion	10 – 90 degrees

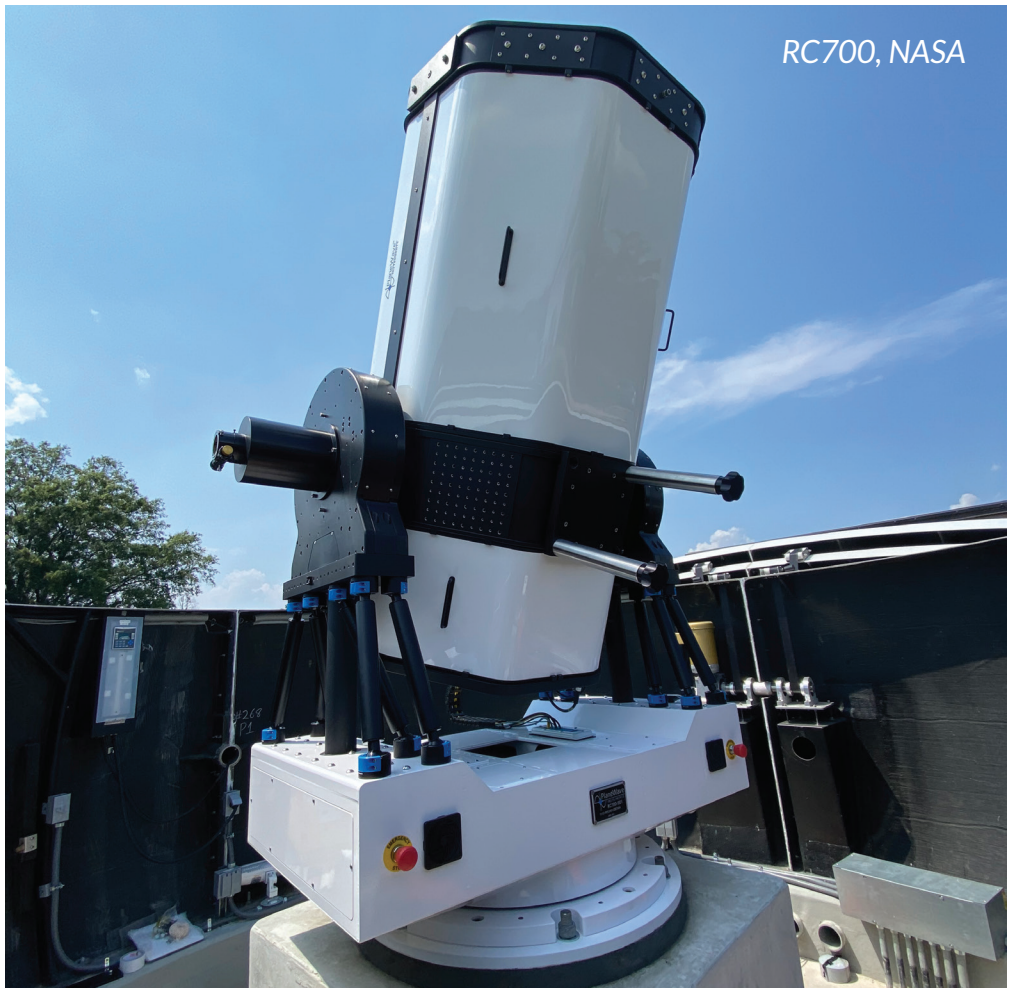
Software

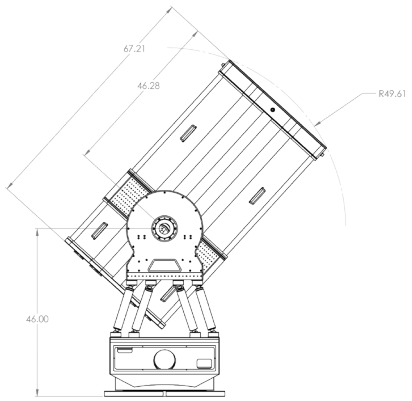
PlaneWave Interface (PWI) Software Included	Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.

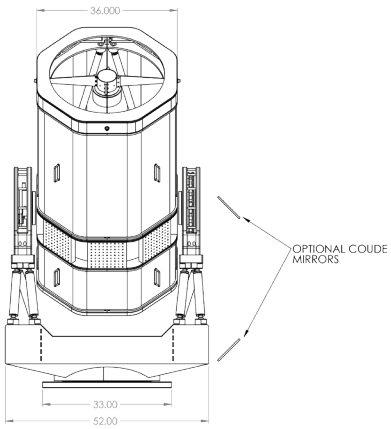
0.7-Meter Observatory Telescope System

The RC700 is a complete observatory class telescope and direct-drive alt-azimuth mounting system, designed and engineered by PlaneWave. With a 70 mm image circle, the RC700 is designed to excel at imaging on large format CCD cameras. The optical system utilizes a Nasmyth focus through both altitude bearings allowing your camera or eyepiece to remain at a fixed height while holding heavy instruments without needing to rebalance the optical tube assembly.

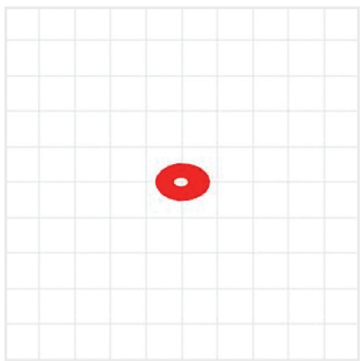
Instrumentation can be installed on both sides of the fork mount and easily accessed using the included rotating tertiary mirror system. With direct-drive motors, high resolution encoders, and zero backlash or periodic error, the RC700 sets a new standard for 0.7-meter class telescopes meant for high-resolution imaging and free-space optical communication.



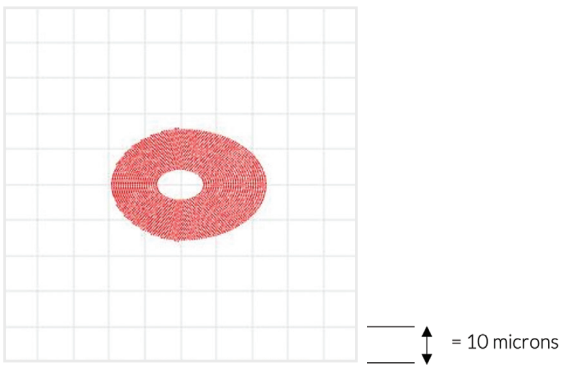




Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 0.015 microns



Distance Off-Axis = 11.744 mm
RMS Spot Size (radius) = 4.725 microns



Distance Off-Axis = 20.551 mm
RMS Spot Size (radius) = 14.063 microns

CDK700

Optical System

Aperture	700 mm (27.56 in)
Focal Length	4540 mm
Focal ratio	f/6.5
Central Obstruction	47% of primary mirror
Back Focus from Mounting Surface	309 mm (12.2 in)
Weight	1,200 lbs (544 kg)
Optical Tube	Dual truss structure with Nasmyth Focus
Dimensions	93.73" H x 43.25" W x 39" D
Focus Position	Nasmyth Focus
Image Scale	22 microns per arcsecond
Optimal Field of View	70 mm (0.68 degrees)

Mechanical Structure

Fork Assembly	Single piece U-shaped fork arm assembly for maximum stiffness
Azimuth Bearing	20-in diameter thrust bearing
Altitude Bearing	2 x 8.5 in OD ball bearings
Optical Tube	Dual truss structure with Nasmyth Focus

CDK700, Great Basin National Park

System Performance

Pointing Accuracy	10-arcsecond RMS with PointXP Model
Pointing Precision	2 arcseconds
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 35 mm off-axis over 1 hour of tracking (18 arcseconds)

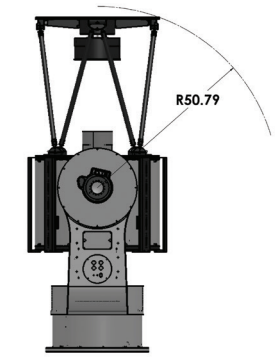
Software

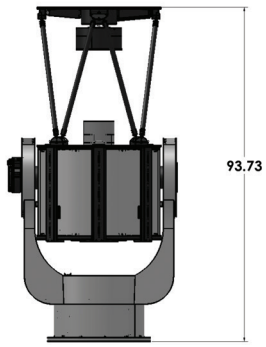
PlaneWave Interface (PWI) Software Included	Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.

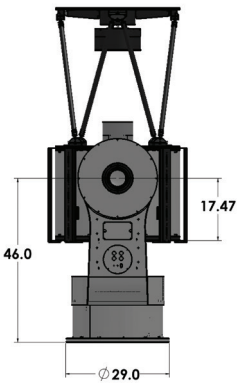
0.7-METER OBSERVATORY TELESCOPE SYSTEM

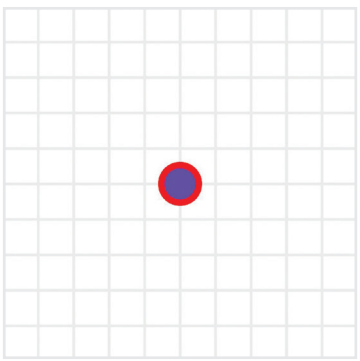
The CDK700 is a complete observatory class telescope and direct-drive alt-azimuth mounting system, designed and engineered by PlaneWave. With a 70 mm image circle, the CDK700 is designed to excel at imaging on large format CCD cameras. The optical system utilizes a Nasmyth focus through both altitude bearings allowing your camera or eyepiece to remain at a fixed height while holding heavy instruments without needing to rebalance the optical tube assembly.

Instrumentation can be installed on both sides of the fork mount and easily accessed using the included rotating tertiary mirror system. With direct-drive motors, high resolution encoders, and zero backlash or periodic error, the CDK700 set *the standard* for commercially produced research telescopes.

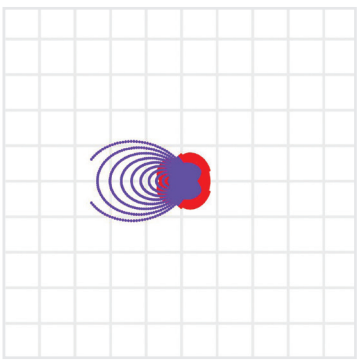




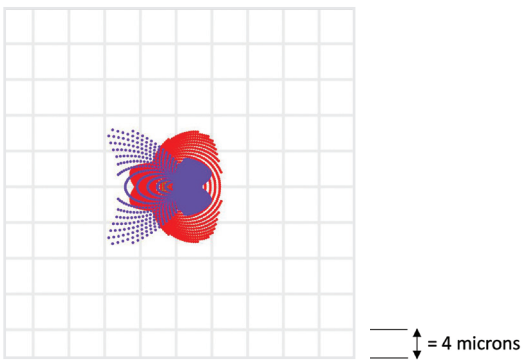




Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 1.163 microns

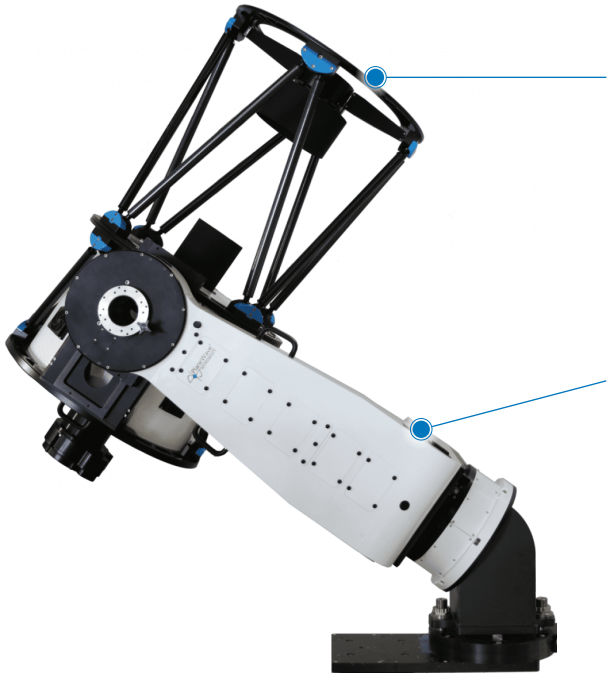


Distance Off-Axis = 21.420 mm
RMS Spot Size (radius) = 1.958 microns



Distance Off-Axis = 39.794 mm
RMS Spot Size (radius) = 2.916 microns

CDK600



CDK24

24-inch (0.61 m) f/6.5 Corrected Dall-Kirkham Astrograph. The telescope has a dual-truss design with three cooling fans for the back of the primary mirror and four fans for the front surface of the primary mirror.

See page 44 for more information.

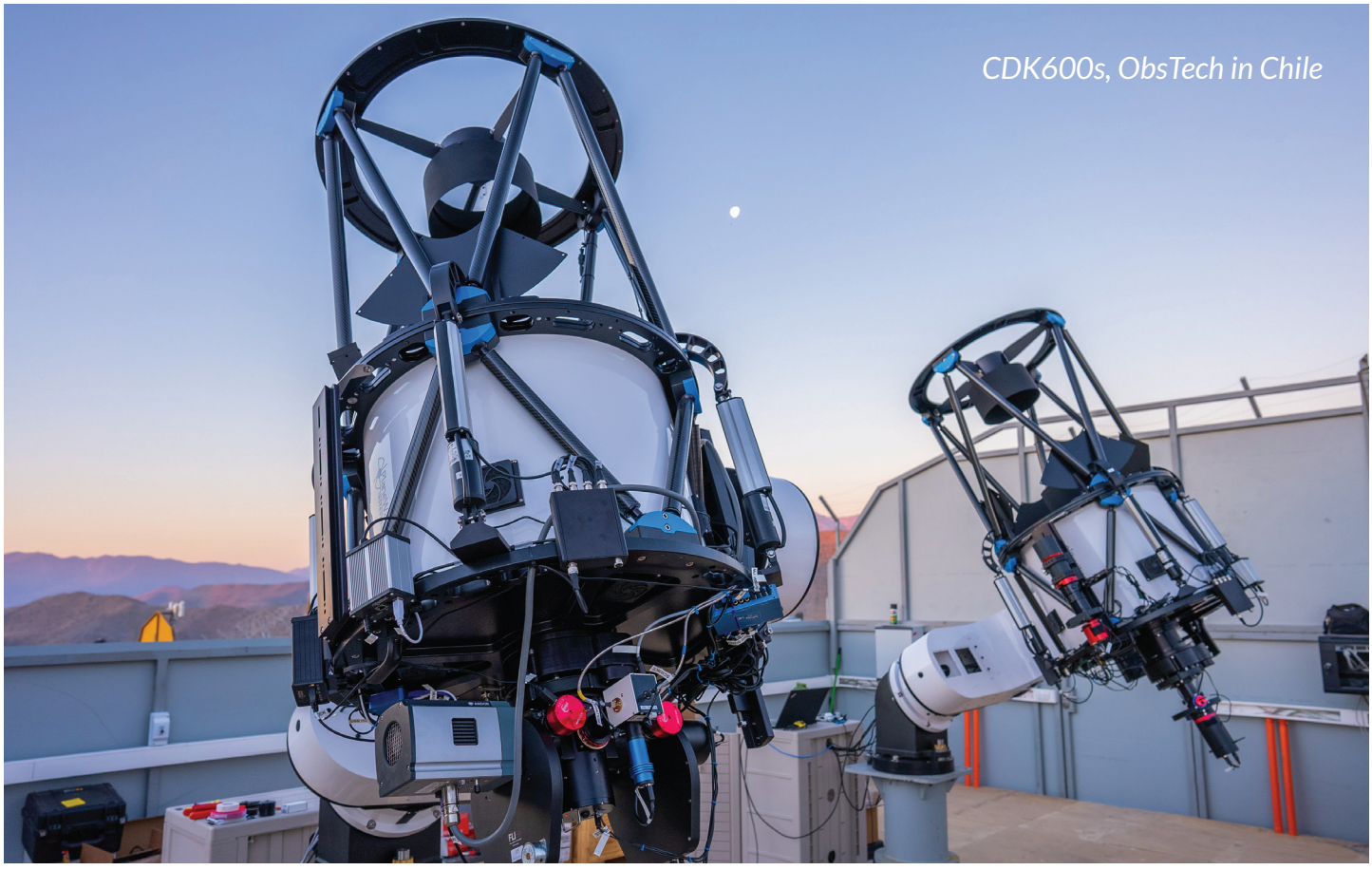
L-600 Direct-Drive Mount

300 lbs (136 kg) loading capacity. Incredible slew speed, dual-mounting options, Azimuth Dovetail Balance System, through-the-mount cabling, direct-drive motors, encoders, and much more.

See page 52 for more information.

PlaneWave Interface (PWI) Software Included

Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.



CDK600s, ObsTech in Chile

CDK500

CDK20

20-inch (0.51 m) f/6.8 or f/7.77 Corrected Dall-Kirkham Astrograph. Has a dual carbon-fiber truss design with three cooling fans.

See page 42 for more information.

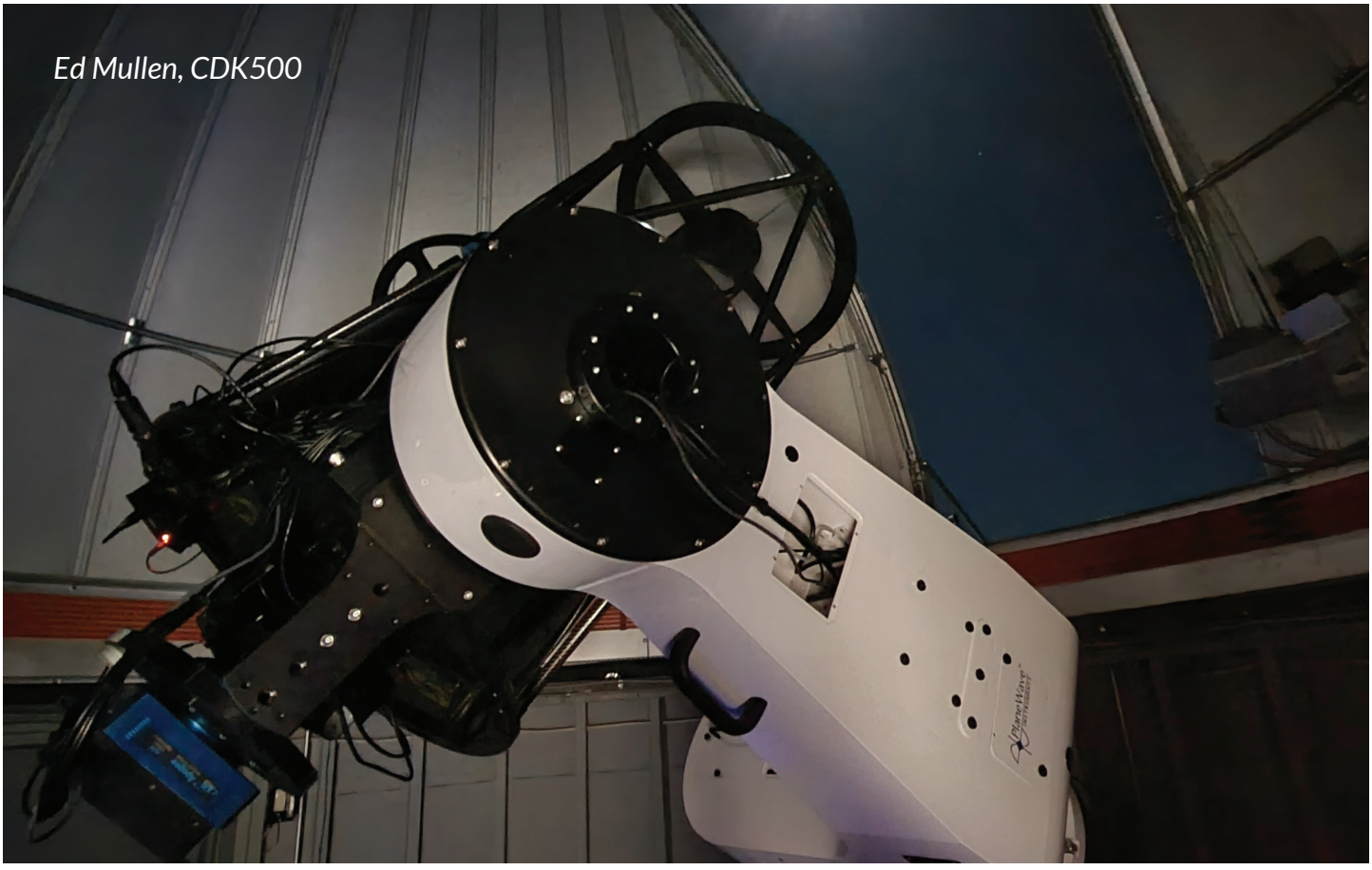
L-500 Direct-Drive Mount

200 lbs (91 kg) loading capacity. Incredible slew speed, dual-mounting options, Azimuth Dovetail Balance System, through-the-mount cabling, direct-drive motors, encoders, and much more.

See page 51 for more information.

PlaneWave Interface (PWI) Software Included

Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.



Ed Mullen, CDK500

CDK400

CDK17

17-inch (0.43 m) f/6.8 Corrected Dall-Kirkham Astrograph. The telescope has a dual carbon-fiber truss design, with three cooling fans, and four fans blowing across the boundary layer of the mirror's surface.

See page 40 for more information.

L-500 Direct-Drive Mount

200 lbs (91 kg) loading capacity. Incredible slew speed, dual-mounting options, Azimuth Dovetail Balance System, through-the-mount cabling, direct-drive motors, encoders, and much more.

See page 51 for more information.

PlaneWave Interface (PWI) Software Included

Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.

CDK350

CDK14

14-inch (0.35 m) f/7.2 Corrected Dall-Kirkham Astrograph. The telescope features dual carbon-fiber truss design, three cooling fans, and removable primary mirror and backplate.

See page 38 for more information.

L-350 Direct-Drive Mount

100 lbs (45 kg) loading capacity. Incredible slew speed, dual-mounting options, Azimuth Dovetail Balance System, through-the-mount cabling, direct-drive motors, encoders, and much more.

See page 50 for more information.

PlaneWave Interface (PWI) Software Included

Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.

CDK300

CDK12.5

12.5-inch f/8 Corrected Dall-Kirkham Astrograph. The telescope features a carbon-fiber optical tube assembly for rigidity and fast cooling and simple secondary mirror collimation thanks to the fixed primary mirror.

See page 36 for more information.

L-350 Direct-Drive Mount

100 lbs (45 kg) loading capacity. Incredible slew speed, dual-mounting options, Azimuth Dovetail Balance System, through-the-mount cabling, direct-drive motors, encoders, and much more.

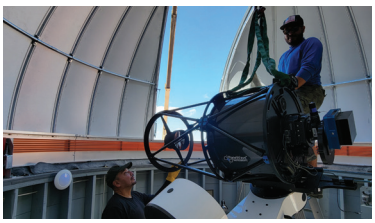
See page 50 for more information.

PlaneWave Interface (PWI) Software Included

Featuring plate solving, mount control, mount modeling, focusing, environmental sensing, and more.

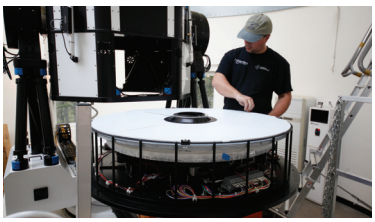
CDK400, Deep Sky Chile

RECOMMENDED OBSERVATORY SYSTEM **SERVICES**



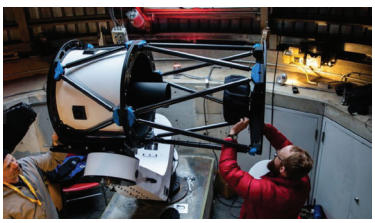
Installation

PlaneWave teams are available to install equipment almost anywhere in the world and to provide on-site client training.



Service Agreements

Looking for ways to optimize your equipment year after year? PlaneWave offers a variety of service agreements to help maintain your system with both remote support services and site visits.



Extended Warranty

For projects where predicting operating costs over time is crucial, PlaneWave offers extended warranty packages.

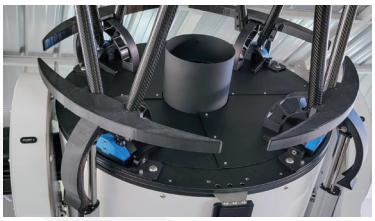
OPTIONAL OBSERVATORY ACCESSORIES

CDK24 and CDK700 Primary Mirror Shutter

Protect the primary mirror of your CDK24 or CDK700 from unwanted dust and moisture with the PlaneWave Primary Mirror Shutter. The four-vane shutter design can be controlled remotely with our Mirror Cover Control Software (PWShutter) which can be downloaded free from our website.

Fabric Light Shroud

This is a spandex fabric light shroud that blocks out stray light and minimizes dust on the primary mirror. Available for the CDK14, CDK17, CDK20, CDK24, and CDK700.



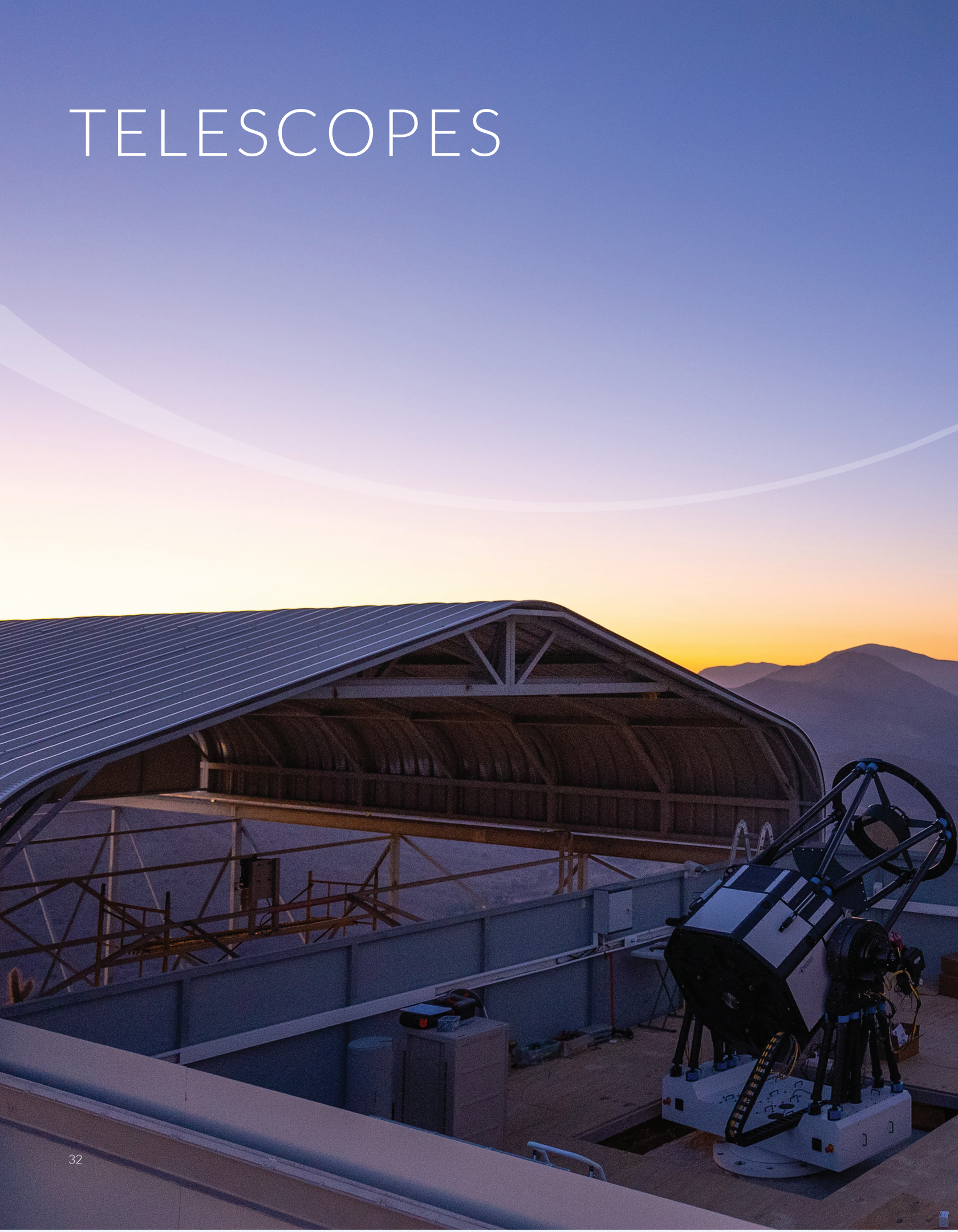
Telescope Shroud Spacer

The shroud spacers allow PlaneWave fabric shrouds to be installed as well as motorized mirror covers. The spacers allow the mirror covers to safely open and close with the fabric shroud installed.

We routinely develop new accessories, contact us for more observatory accessory options.

PW1000, Palomar Observatory

TELESCOPES



ObsTech, El Sauce Observatory, Chile

DELTARHO **350**

Optical Systems

Aperture	350 mm (13.78 in)
Focal Length	1050 mm (41.34 in)
Focal ratio	f/3
Central Obstruction	56% by diameter
Back Focus from Mounting Surface	5.6 in (142.24 mm). This distance includes refraction from filters.
Weight	46 lbs (21 kg)
OTA Length	23 in (584 mm)
Optical Performance (Spot Diameter)	4.8-micron RMS on-axis 5.6-micron RMS at 23 mm off-axis 6.4-micron RMS at 30 mm off-axis
Telescope Cage	Carbon fiber truss poles with carbon fiber shroud
Optimal Field of View	60 mm Image Circle

Primary Mirror

Optical Diameter	13.78 in (350 mm)
Outer Diameter	14.5 in (468.3 mm)
Shape	Prolate Ellipsoid
Material	Fused Silica (quartz)
Coating	Enhanced Aluminum - 96%
Alignment	Permanently aligned at factory

Secondary Mirror

Diameter	7.48 in (190 mm)
Shape	Spherical
Material	Fused Silica (quartz)
Coating	Enhanced Aluminum - 96%

Lens Group

Diameter	110 mm (4.33 in)
Number of lenses	Three
Coating	Broadband AR Coatings (less than .5% reflected from 400 to 700 nm)

SUGGESTED **ACCESSORIES**

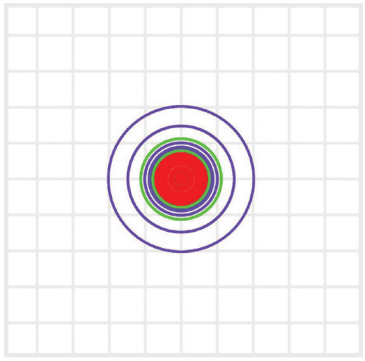
L-350 MOUNT

SERIES-5 ROTATOR

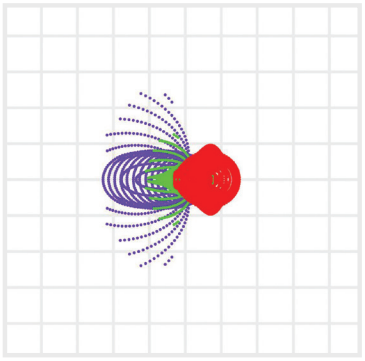
SERIES-5 FOCUSER

SERIES-5 CONTROLLER

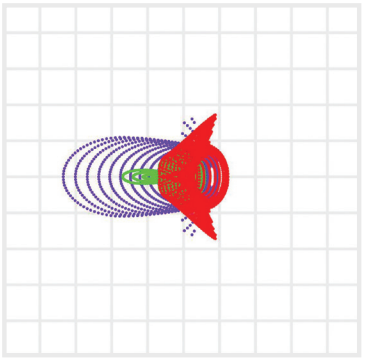
SPOT DIAGRAM DELTARHO 350



Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 2.386 microns



Distance Off-Axis = 23.051 mm
RMS Spot Size (radius) = 2.830 microns



Distance Off-Axis = 29.630 mm
RMS Spot Size (radius) = 3.225 microns

Lagoon Nebula, 24 Minutes of Total Exposure Time, LRGB

View more images in our gallery at: **PlaneWave.com/gallery**

CDK/IRDK**12.5**

OPTICAL DESIGNS AVAILABLE:

CDK f/8 **IRDK** f/8

Optical Systems

Aperture	12.5 in (318 mm)
Focal Length	100.04 in (2541 mm)
Focal ratio	f/8
Central Obstruction	42% of the Primary Mirror Diameter
Back Focus from Mounting Surface	10.445 in (265 mm)
Back Focus from Racked-in Focuser	7.2 in (183 mm)
OTA Length	31 in (787 mm)
Optical Tube	Carbon Fiber
Weight (includes manual-focuser and dovetail)	46 lbs (20.9 kg)
Weight (includes electronic-focuser and dovetail)	48.5 lbs (22 kg)
Optical Performance* (Spot Diameter)	2.8-micron RMS on-axis 3.8-micron RMS at 11 mm off-axis 8.0-micron RMS at 21 mm off-axis
Optimal Field of View*	52 mm Image Circle

Primary Mirror

Optical Diameter	12.5 in (318 mm)
Outer Diameter	13 in (330 mm)
Shape*	Prolate Ellipsoid
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%
Alignment	Permanently aligned at factory

Secondary Mirror

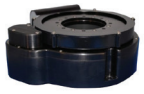
Diameter	4.65 in (118 mm)
Shape	Spherical
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%

**Noted specifications and spot diagrams are for CDK only*

SUGGESTED **ACCESSORIES**

L-350 MOUNT

DELTA-T HEATER

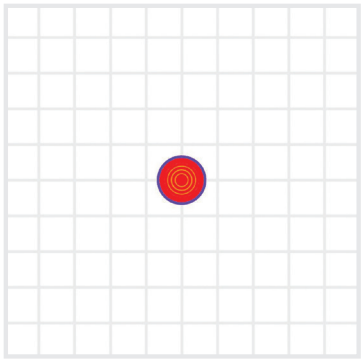


IRF90 – INTEGRATED ROTATING FOCUSER

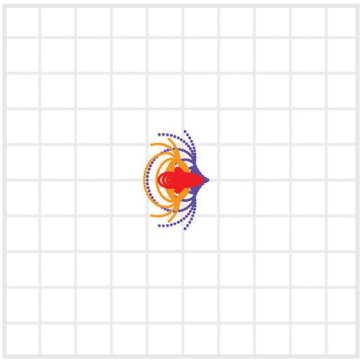
ELECTRONIC FOCUS ACCESSORY KIT

OPTICAL REDUCERS 0.66X

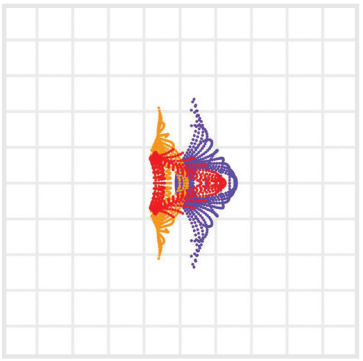
SPOT DIAGRAM CDK12.5



Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 1.426 microns



Distance Off-Axis = 11.098 mm
RMS Spot Size (radius) = 1.892 microns



Distance Off-Axis = 20.998 mm
RMS Spot Size (radius) = 4.040 microns

View more images in our gallery at: **PlaneWave.com/gallery**

CDK/IRDK**14**

OPTICAL DESIGNS AVAILABLE:

CDK f/7.2 **IRDK** f/7.2

Optical Systems

Aperture	14 in (356 mm)
Focal Length	2563 mm (101 in)
Focal ratio	f/7.2
Central Obstruction	23.5% by surface area; 48.5% by diameter
Back Focus from Mounting Surface	11.09 in (282 mm)
Weight	48 lbs (22 kg)
OTA Length	35 in (889 mm)
Optical Performance* (Spot Diameter)	0.9-micron RMS on-axis 4.0-micron RMS at 26 mm off-axis 6.2-micron RMS at 35 mm off-axis
Upper Cage	Carbon Fiber Truss
Lower Cage	Carbon Fiber Truss and Light Shroud
Optimal Field of View*	52 mm Image Circle

Primary Mirror

Optical Diameter	14 in (355.6 mm)
Outer Diameter	14.5 in (468.3 mm)
Shape*	Prolate Ellipsoid
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%
Alignment	Permanently aligned at factory

Secondary Mirror

Diameter	6.5 in (165 mm)
Shape	Spherical
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%

**Noted specifications and spot diagrams are for CDK only*

SUGGESTED **ACCESSORIES**

L-350 MOUNT

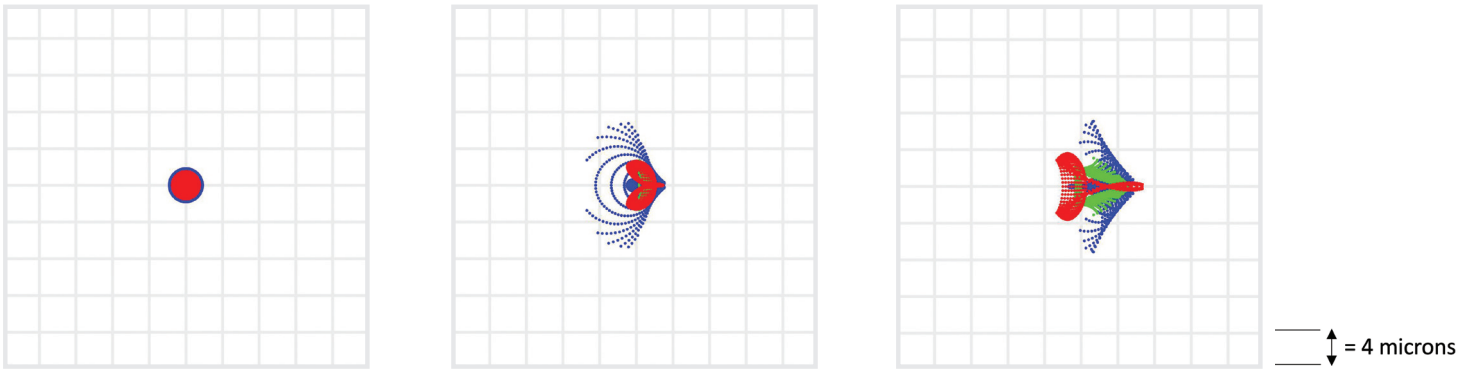
DELTA-T HEATER

IRF90 – INTEGRATED ROTATING FOCUSER

ELECTRONIC FOCUS ACCESSORY KIT

OPTICAL REDUCERS 0.66X

SPOT DIAGRAM CDK14



Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 0.923 microns

Distance Off-Axis = 26.012 mm
RMS Spot Size (radius) = 2.017 microns

Distance Off-Axis = 34.930 mm
RMS Spot Size (radius) = 3.139 microns

View more images in our gallery at: **PlaneWave.com/gallery**

CDK/IRDK**17**

OPTICAL DESIGNS AVAILABLE:

CDK f/6.8 **IRDK** f/6.8

Optical Systems

Aperture	17 in (432 mm)
Focal Length	2939 mm (115.71 in)
Focal ratio	f/6.8
Central Obstruction	23.7% by surface area; 48.6% of the primary mirror diameter
Back Focus from Mounting Surface	10.32 in (262.33 mm)
Back Focus from Racked-in Focuser	7.24 in (184 mm)
Weight	106 lbs (48 kg)
OTA Length	42 in (1067 mm)
Optical Performance* (Spot Diameter)	0.9-micron RMS on-axis 3.8-micron RMS at 21 mm off-axis 5.0-micron at 35 mm off-axis
Upper Cage	Carbon Fiber Truss
Lower Cage	Carbon Fiber Truss with Light Shroud
Optimal Field of View	70 mm Image Circle

Primary Mirror

Optical Diameter	17 in (432 mm)
Outer Diameter	17.5 in (445 mm)
Shape	Prolate Ellipsoid
Material	Fused Silica (quartz)
Coating	Enhanced Aluminum - 96%
Alignment	Permanently aligned at factory

Secondary Mirror

Diameter	190 mm (7.48 in)
Shape	Spherical
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%

**Noted specifications and spot diagrams are for CDK only*

SUGGESTED **ACCESSORIES**

L-500 MOUNT

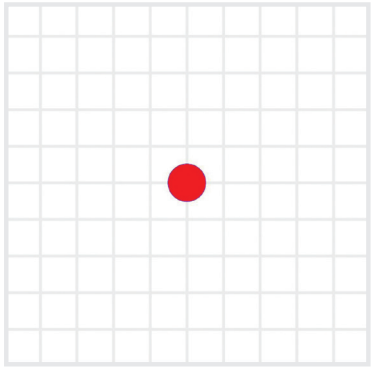
DELTA-T HEATER

IRF90 – INTEGRATED ROTATING FOCUSER

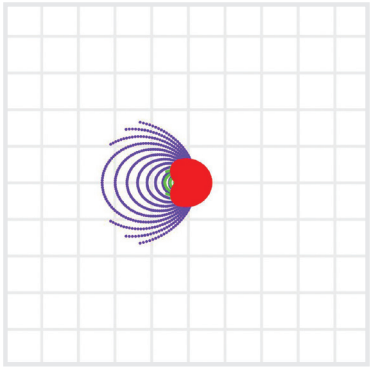
ELECTRONIC FOCUS ACCESSORY KIT

OPTICAL REDUCERS 0.66X

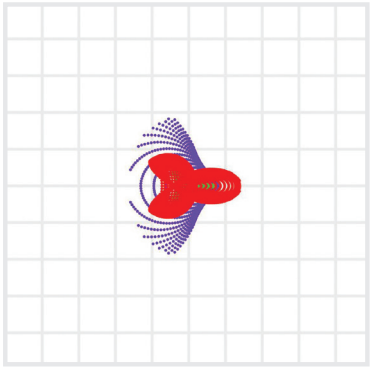
SPOT DIAGRAM CDK17



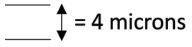
Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 0.888 microns



Distance Off-Axis = 20.548 mm
RMS Spot Size (radius) = 1.877 microns



Distance Off-Axis = 35.015 mm
RMS Spot Size (radius) = 2.496 microns



View more images in our gallery at: **PlaneWave.com/gallery**

CDK/IRDK**20**

OPTICAL DESIGNS AVAILABLE:

CDK
f/6.8

CDK
f/7.77 LONG BF

IRDK
f/6.8

Optical Systems

Aperture	20 in (508 mm)
Focal Length	3454 mm (135.98 in) or 3947 mm (155.4 in)
Focal ratio	f/6.8 or f/7.77
Central Obstruction	39% of the Primary Mirror Diameter
Back Focus from Mounting Surface	f/6.8 — 8.81 in (223 mm) f/7.77 — 10.6 in (269.24 mm)
Weight	140 lbs (63.5 kg)
OTA Length	47 in (1,194 mm)
Optimal Field of View*	52 mm Image Circle

Primary Mirror

Optical Diameter	20 in (508 mm)
Outer Diameter	20.5 in (521 mm)
Shape*	Prolate Ellipsoid
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%
Alignment	Permanently aligned at factory

Secondary Mirror

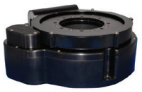
Diameter	7.5 in (191 mm)
Shape	Spherical
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%

**Noted specifications and spot diagrams are for CDK only*

SUGGESTED **ACCESSORIES**

L-500 MOUNT

DELTA-T HEATER



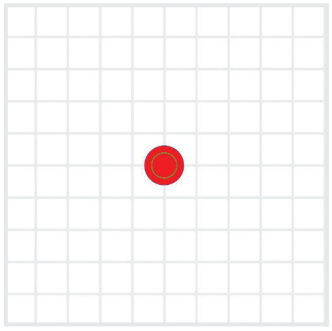
IRF90 – INTEGRATED ROTATING FOCUSER

ELECTRONIC FOCUS ACCESSORY KIT

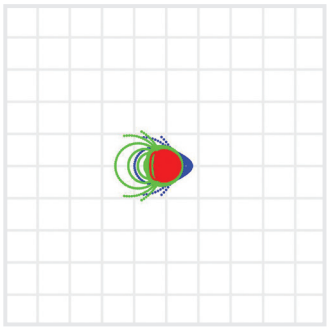
OPTICAL REDUCERS 0.66X

SPOT DIAGRAM CDK20

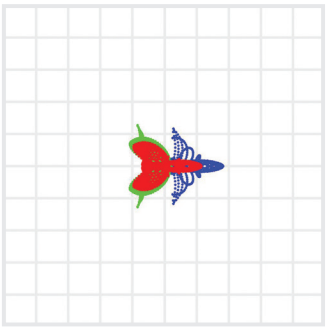
f/6.8



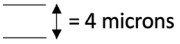
Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 1.479 microns



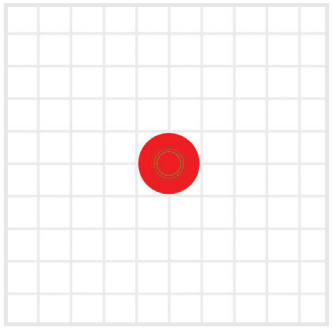
Distance Off-Axis = 12.063 mm
RMS Spot Size (radius) = 1.923 microns



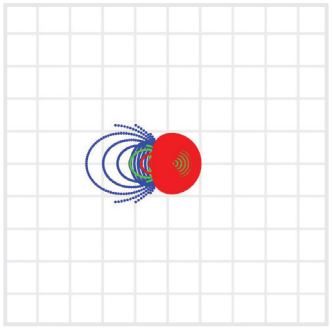
Distance Off-Axis = 21.029 mm
RMS Spot Size (radius) = 3.005 microns



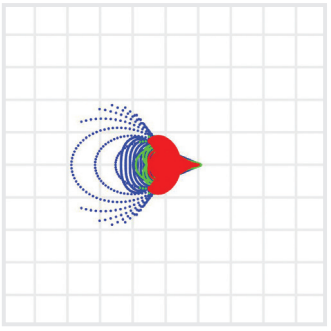
f/7.77



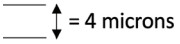
Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 1.472 microns

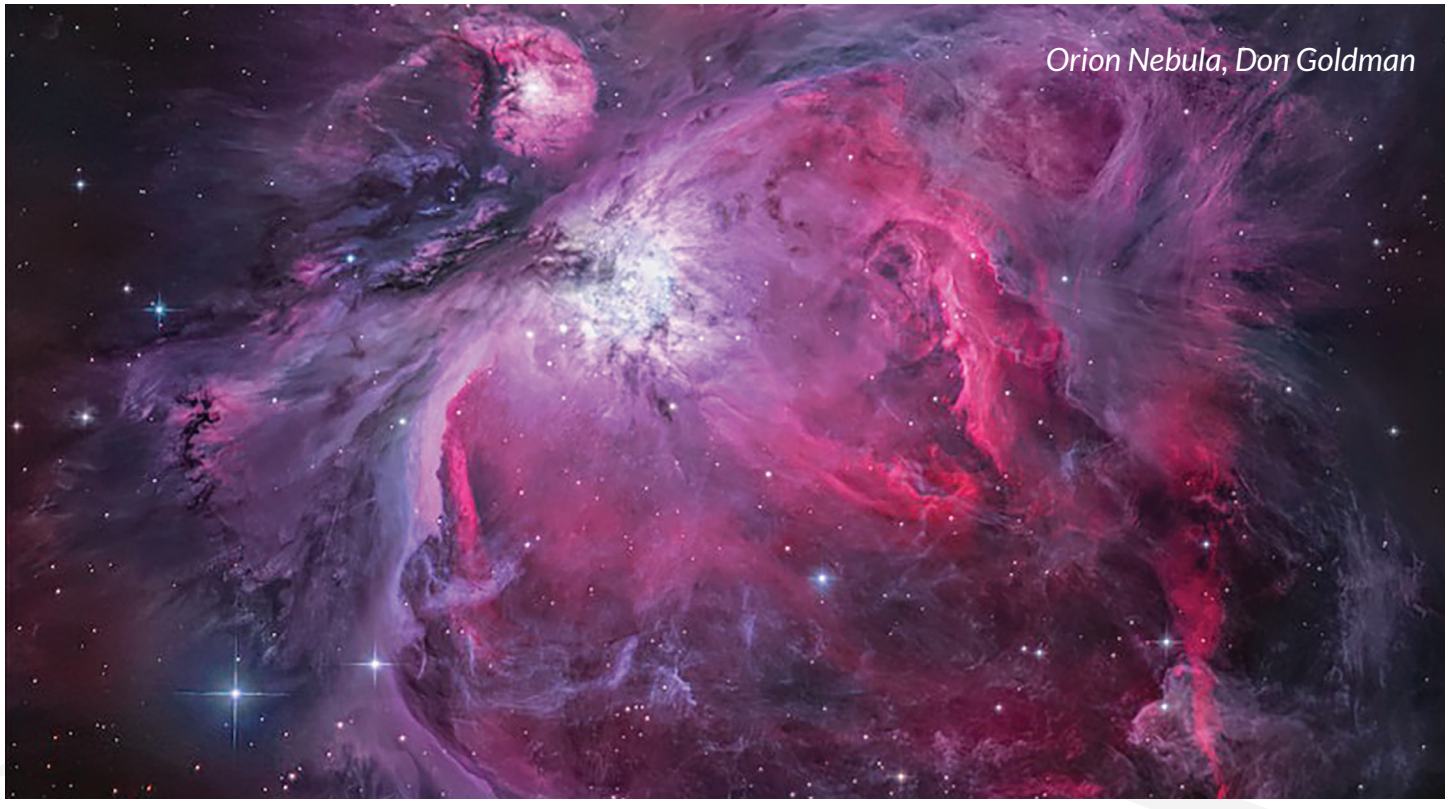


Distance Off-Axis = 13.805 mm
RMS Spot Size (radius) = 2.050 microns



Distance Off-Axis = 25.946 mm
RMS Spot Size (radius) = 2.595 microns





View more images in our gallery at: **PlaneWave.com/gallery**

CDK/RC/IRDK**24**

OPTICAL DESIGNS AVAILABLE:

CDK f/6.5 **RC** f/10.6 **IRDK** f/6.5

Optical Systems

Aperture	24 in (610 mm)
Focal Length	CDK: 3962 mm, RC: 6469 mm
Focal ratio	CDK: f/6.5, RC: f/10.6
Central Obstruction	CDK: 47%, RC: 30% by diameter
Back Focus from Mounting Surface	CDK: 14.1 in (358 mm), RC: 10.3 in (261.8 mm)
Weight	240 lbs (108.9 kg)
OTA Length	56 in (1,422 mm)
Optical Performance* (Spot Diameter)	1.2-micron RMS on-axis 4.0-micron RMS at 26 mm off-axis 4.8-micron at 35 mm off-axis
Upper Cage	Carbon Fiber Truss
Lower Cage	Carbon Fiber Truss with Aluminum Light Shroud
Optimal Field of View	70 mm Image Circle (CDK only)

Primary Mirror

Optical Diameter	24 in (610 mm)
Outer Diameter	24.5 in (622 mm)
Shape*	CDK: Prolate Ellipse, RC: Hyperbolic
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%
Alignment	Permanently aligned at factory

Secondary Mirror

Diameter	9.45 in (240 mm)
Shape	CDK: Spherical, RC: Hyperbolic
Material	Fused Silica (quartz)
Coating*	Enhanced Aluminum - 96%

**Note specifications are for CDK and RC only*

SUGGESTED **ACCESSORIES**

L-600 MOUNT

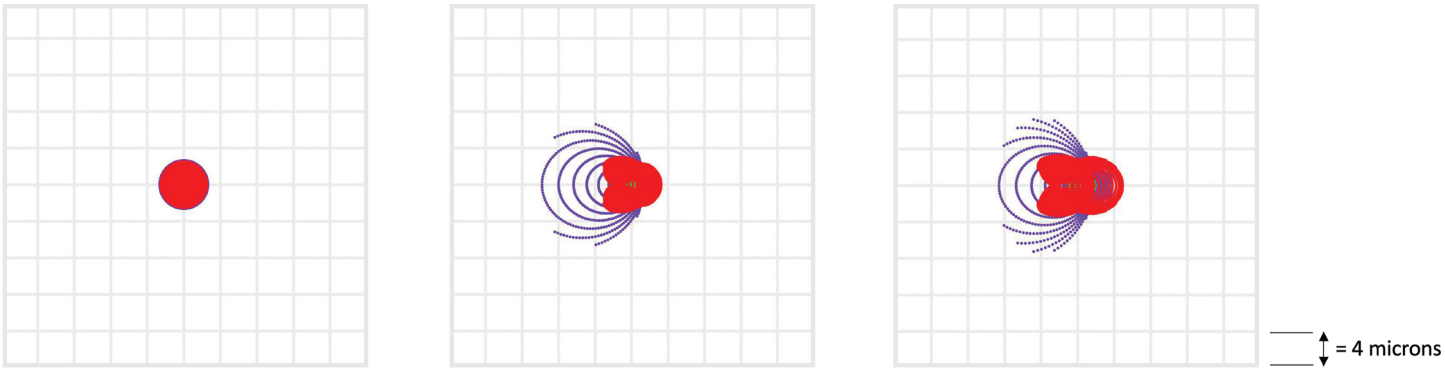
DELTA-T HEATER

IRF90 – INTEGRATED ROTATING FOCUSER

ELECTRONIC FOCUS ACCESSORY KIT

OPTICAL REDUCERS 0.66X

SPOT DIAGRAM CDK24



Distance Off-Axis = 0 mm
RMS Spot Size (radius) = 1.242 microns

Distance Off-Axis = 26.048 mm
RMS Spot Size (radius) = 2.027 microns

Distance Off-Axis = 35.117 mm
RMS Spot Size (radius) = 2.394 microns

View more images in our gallery at: **PlaneWave.com/gallery**

TELESCOPE **FEATURES**

Cooling Fans

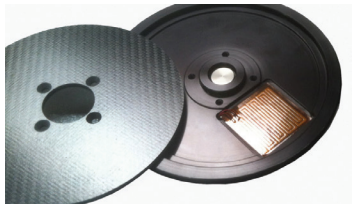
Three cooling fans on the backplate pull air through the telescope and by the primary mirror (on some CDKs also three additional fans on the side of the optical tube blow air across the primary to ensure a boundary layer of air does not distort images). These fans help the telescope reach thermal equilibrium quickly, further reducing any distortion in images due to temperature variations. They are controlled by a switch on the optical tube, or via PWI3 software with the optional Electronic Focus Accessory (EFA Kit).

Carbon Fiber Truss Design

Minimizes thermal expansion which causes focus shift as temperature changes during an imaging session. Carbon fiber also reaches ambient temperatures quickly and is extremely lightweight and rigid to help ensure excellent imaging data is produced.

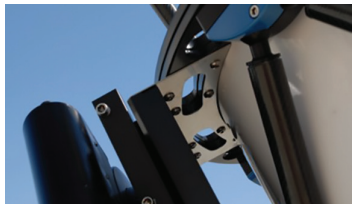
Fused Silica Optics

Fused silica (quartz) 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 as temperature changes.



Delta-T Ready

For added dew prevention, the CDKs are internally wired with polyimide film heater pads and temperature sensors, ready to be controlled with the optional Delta-T controller via PWI 3 software.



Dovetail Expansion Joint

Allows for the difference in thermal expansion between carbon fiber and aluminum. The expansion joint allows the aluminum dovetail to expand and contract without stressing the carbon fiber lower truss. This results in images that are not distorted due to expansion, or contraction of the optical tube materials.

3D Printed Baffles

PlaneWave uses digital 3D printing technology to produce lightweight baffle tubes. 3D printers add successive layers of material to construct a baffle system with precision-positioned internal stray light baffles to minimize vignetting and maximize image contrast. Quality baffling makes an incredible difference in overall image quality, so we ensured an optimal design was created for our telescopes.

Fixed Primary Mirrors

The primary mirror is factory aligned and permanently collimated to the mechanical axis of the telescope at the factory. This removes image tilt at the focal plane due to misalignment of the mechanical and optical axes. This makes collimating the telescope dramatically easier, as only the secondary mirror needs collimating.

OTA **ACCESSORIES**

Series-5 Focuser and Rotator

The goal was to create a faster, stronger focuser and rotator system that had a thinner profile than the IRF90. Our new stackable Series-5 Focuser and Rotator have achieved just that for users of our CDK700 and smaller telescopes. Both the focuser and rotator offer a clear aperture of five inches and are designed to stack for users that require derotation. For those only needing focusing capabilities, the new focuser also occupies less backfocus, which means more room for imaging train components.

Hedrick Focuser

When using the Hedrick Focuser with the optional EFA kit, you can remotely control the focuser using the included PWI control PC software. You can download the PWI software from the Downloads page on our website. Using MaximDL in conjunction with the focuser, allows you to quickly and accurately find the best focus position in a matter of minutes.

IRF90 – Integrated Rotating Focuser

The IRF90 is a large capacity integrated focuser and rotator. The focuser is capable of lifting 40 lbs (18 kg) with a range 30 mm (30000 microns). The rotator has a 90 mm aperture with a range of 365 degrees with hardstops to eliminate any chance of cord wrap. The IRF90 is compatible with the CDK14, CDK17, CDK20, CDK24, and CDK700.

Electronic Focus Accessory (EFA) Kit

The EFA control box can be mounted to the backplate of any PlaneWave telescope OTA (12.5 through 24 inches). The EFA Kit plugs into the temperature sensors and fan control systems that are built into each telescope. A Hand Control is provided to control an optional focuser or rotator when standing at the eyepiece. The EFA kit comes with PWI3, a software package that controls all EFA functions from a PC. Cables and adapters are provided to attach the EFA kit to a PC. The EFA kit is ASCOM compatible.

Delta-T Heater

The Delta-T controller is an optional accessory for dew prevention on CDK12.5 through CDK24 OTAs and the CDK700 system. CDK12.5 to CDK24 and CDK700 telescopes come with primary and secondary mirror dew heating pads (CDK700 adds tertiary mirror heating), which are ready to accept the Delta-T controller. Controlled via PWI3 software for CDK12.5 through CDK24 OTAs (PWI2 for the CDK700).

Optical Reducers 0.6x and 0.7x

With the range of high-end and high-power optical reducers, PlaneWave is offering a unique ability for all telescope sizes to adopt the telescope to the needs of the customer or the site. Just adding these Optical Reducer lenses make every CDK a different telescope for a completely different application while maintaining the original optical configuration and changing from f/6.8 to f/4.5 without any loss in collimation is as easy as changing to another camera.

Fabric Light Shroud

This is a spandex fabric light shroud that blocks out stray light and minimizes dust on the primary mirror. Available for the CDK14, CDK17, CDK20, CDK24, and CDK700.

MOUNTS & GIMBALS


PlaneWave™
INSTRUMENTS

L-350 DIRECT-DRIVE MOUNT

Mount System

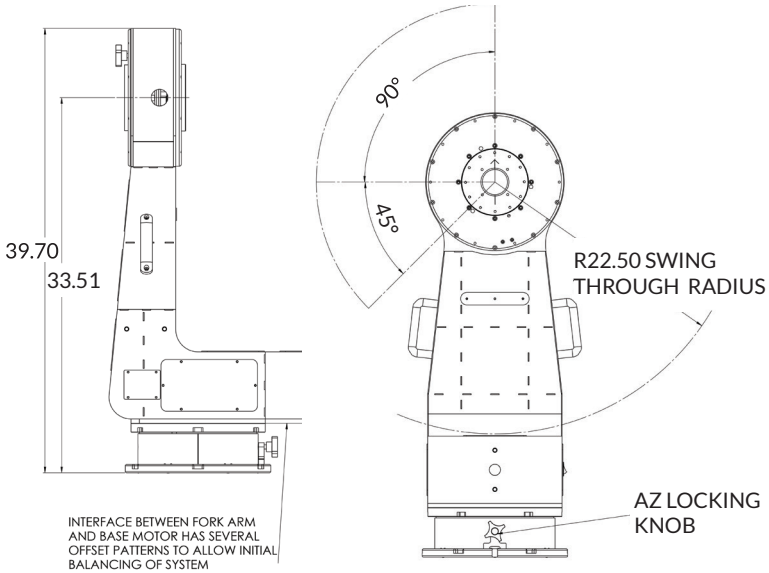
Type	Alt-Azimuth / Equatorial Direct-Drive Mount
Weight	110 lbs (50 kg)
Max. Load Capacity	100 lbs (45 kg)
Latitude range	0 to 90 degrees, Northern and Southern hemispheres
Cable management	Equipment cables can be wired through mount

Motion Control

Motor Control	Industrial grade brushless motor control system and built in electronics
Motor – Azimuth and Altitude	Direct-Drive 3 Phase Axial-Flux Torque Motors
Encoder – Azimuth and Altitude	152 mm stainless steel encoder ring with reader built into the azimuth and altitude axes. 18,880,000 counts per revolution (0.069-arcsecond resolution).
Motor Torque	Approximately 20 ft-lbs continuous; 50 ft-lbs peak
Drive Electronics	Industrial grade, off-the-shelf brushless motor drives for each axis with custom designed interface card
Telescope Control Software	Uses PWI4. Incorporates PointXP mount modeling software by Dave Rowe. All ASCOM compatible.

Control System

Control Electronics	PlaneWave Interface dual axis telescope control
User Interface	PlaneWave Interface 4 (PWI4) Control Software with integrated PointXP mount modeling software
Homing Sensors	Home position sensors are included allowing the mount to find its home position on power up
Slew Rate	20 degrees per second (standard); 50 degrees per second (maximum), both axes
Power Requirement	Accepts 120 to 240 VAC. Supplied with 120 VAC 15A IEC Type B Regulated Power Adapter.



System Performance

Pointing Accuracy	<10-arcsecond RMS with PointXP Model
Pointing Precision	2 arcseconds at sidereal velocity
Tracking Accuracy	0.3 arcseconds over a 5-minute period at sidereal velocity
System Natural Frequency	10 Hz or greater

L-500 DIRECT-DRIVE MOUNT

Mount System

Type	Alt-Azimuth / Equatorial Direct-Drive Mount
Weight	257 lbs (100 kg)
Max. Load Capacity	200 lbs (91 kg)
Latitude range	0 to 90 degrees, Northern and Southern hemispheres
Cable management	Equipment cables can be wired through mount

Motion Control

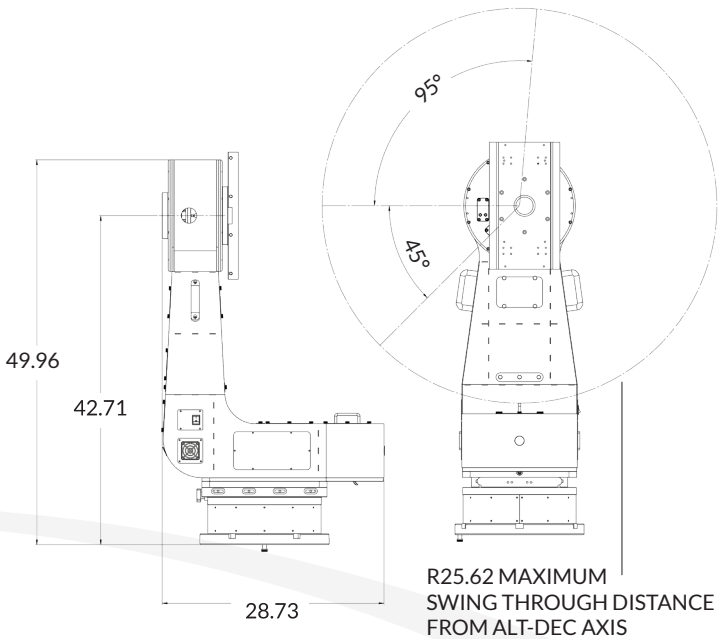
Motor Control	Industrial grade brushless motor control system and built in electronics
Motor – Azimuth and Altitude	Direct-Drive 3 Phase Axial-Flux Torque Motors
Encoder – Azimuth and Altitude	152 mm stainless steel encoder ring with reader built into the azimuth and altitude axes. 18,880,000 counts per revolution (0.069-arcsecond resolution).
Motor Torque	Approximately 20 ft-lbs continuous; 50 ft-lbs peak
Drive Electronics	Industrial grade, off-the-shelf brushless motor drives for each axis with custom designed interface card
Telescope Control Software	Uses PWI4. Incorporates PointXP mount modeling software by Dave Rowe. All ASCOM compatible.

Control System

Control Electronics	PlaneWave Interface dual axis telescope control
User Interface	PlaneWave Interface 4 (PWI4) Control Software with integrated PointXP mount modeling software
Homing Sensors	Home position sensors are included allowing the mount to find its home position on power up
Slew Rate	20 degrees per second (standard); 50 degrees per second (maximum), both axes
Power Requirement	Accepts 120 to 240 VAC. Supplied with 120 VAC 15A IEC Type B Regulated Power Adapter.

System Performance

Pointing Accuracy	<10-arcsecond RMS with PointXP Model
Pointing Precision	2 arcseconds at sidereal velocity
Tracking Accuracy	0.3 arcseconds over a 5-minute period at sidereal velocity
System Natural Frequency	10 Hz or greater



L-600 DIRECT-DRIVE MOUNT

Mount System

Type	Alt-Azimuth / Equatorial Direct-Drive Mount
Weight	338 lbs (153 kg)
Max. Load Capacity	300 lbs (136 kg)
Latitude range	0 to 90 degrees, Northern and Southern hemispheres
Cable management	Equipment cables can be wired through mount

Motion Control

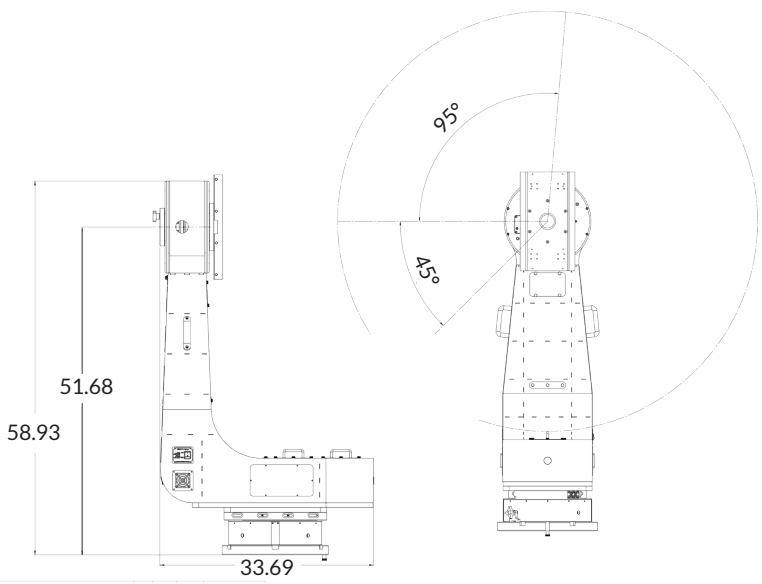
Motor Control	Industrial grade brushless motor control system and built in electronics
Motor – Azimuth and Altitude	Direct-Drive 3 Phase Axial-Flux Torque Motors
Encoder – Azimuth and Altitude	152 mm stainless steel encoder ring with reader built into the azimuth and altitude axes. 18,880,000 counts per revolution (0.069-arcsecond resolution).
Motor Torque	Approximately 20 ft-lbs continuous; 50 ft-lbs peak
Drive Electronics	Industrial grade, off-the-shelf brushless motor drives for each axis with custom designed interface card
Telescope Control Software	Uses PWI4. Incorporates PointXP mount modeling software by Dave Rowe. All ASCOM compatible.

Control System

Control Electronics	PlaneWave Interface dual axis telescope control
User Interface	PlaneWave Interface 4 (PWI4) Control Software with integrated PointXP mount modeling software
Homing Sensors	Home position sensors are included allowing the mount to find its home position on power up
Slew Rate	20 degrees per second (standard); 50 degrees per second (maximum), both axes
Power Requirement	Accepts 120 to 240 VAC. Supplied with 120 VAC 15A IEC Type B Regulated Power Adapter.

System Performance

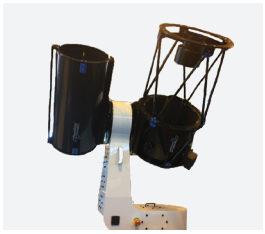
Pointing Accuracy	<10-arcsecond RMS with PointXP Model
Pointing Precision	2 arcseconds at sidereal velocity
Tracking Accuracy	0.3 arcseconds over a 5-minute period at sidereal velocity
System Natural Frequency	10 Hz or greater



SPECIAL FEATURES

Incredible Slew Speeds

The direct-drive motors can move the telescope at speeds up to 50 degrees per second for tracking satellites, high-cadence surveys, or to minimize target acquisition time.

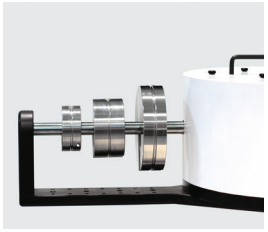


Dual Mounting System

PlaneWave style mounting bracket to hold CDK17/20 onto inside of fork arm with additional option of mounting a scope on the outside of the fork arm. *Optional dovetail clamp required.*

Through-the-Mount Cabling

Access panels in the fork arm and azimuth axis allow for camera equipment cabling through the inside of the mount.

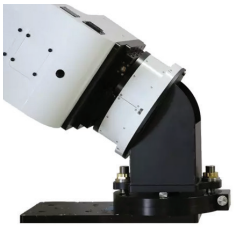


Azimuth Dovetail Balance System

For precise center of gravity balance whether in alt-az or equatorial configuration.

Direct-Drive Motors and Encoders

No gears to cause 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 or have any backlash at all, but the mount will be able to counter against wind gusts.



OPTIONAL: **POLAR WEDGES**

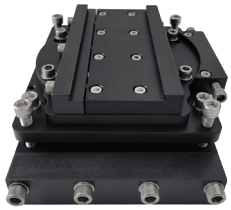
Available for all latitudes

For precise polar alignment adjustment, add our EQ-wedge to your L-Series direct-drive mount. Each wedge is made for your specific latitude and has an alignment range of +/- 3 degrees.

CDK600 at The University of Colorado Boulder

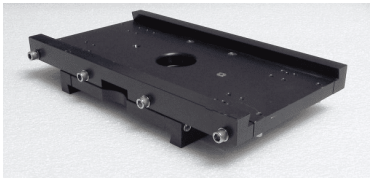
View more installation images in our gallery at: **PlaneWave.com/gallery**

L-MOUNT **ACCESSORIES**



Two-Axis Adjustable Saddle

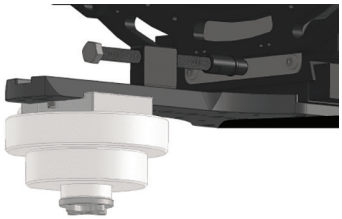
Add to the versatility of your L-Series mount with this two-axis adjustable saddle to co-align two optical tubes. This dovetail accepts Losmandy D-style plates and secures to the L-Series declination/altitude axis. Fits L-350, L-500, and L-600 mounts.



Telescope Dovetail Saddles

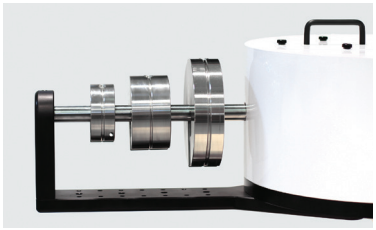
The #600182 Keller EZ Saddle accepts Losmandy D-style dovetail rails such as the CDK12.5 and CDK14. This saddle comes standard with the L-350 mount and can also be attached to the outside arm of any L-Series mount for dual-mounted OTA configurations.

The #200919 wide saddle comes standard with L-500 and L-600 mounts for securing CDK17, CDK20, or CDK24 telescopes.



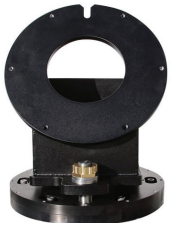
Ascend – Mount Balancing Accessory for L-Series Mounts

Now one person can easily balance a CDK on the L-Series mounts using the Ascend accessory. The Ascend can attach to either the front or rear of the #200919 dovetail clamp and precisely slide the CDK forward or back for accurate balance. Ascend uses a long pushrod to safely balance in the mount's declination/altitude axis with the turn of a bolt.



L-350/L-500/L-600 Right Ascension Balance Accessory

Add to the versatility of your mount with this external Right Ascension axis balance accessory. Balance of the mount is important for optimal direct-drive motor performance and with this accessory users have the ability to fine tune the adjustments. *Some counterweights included.



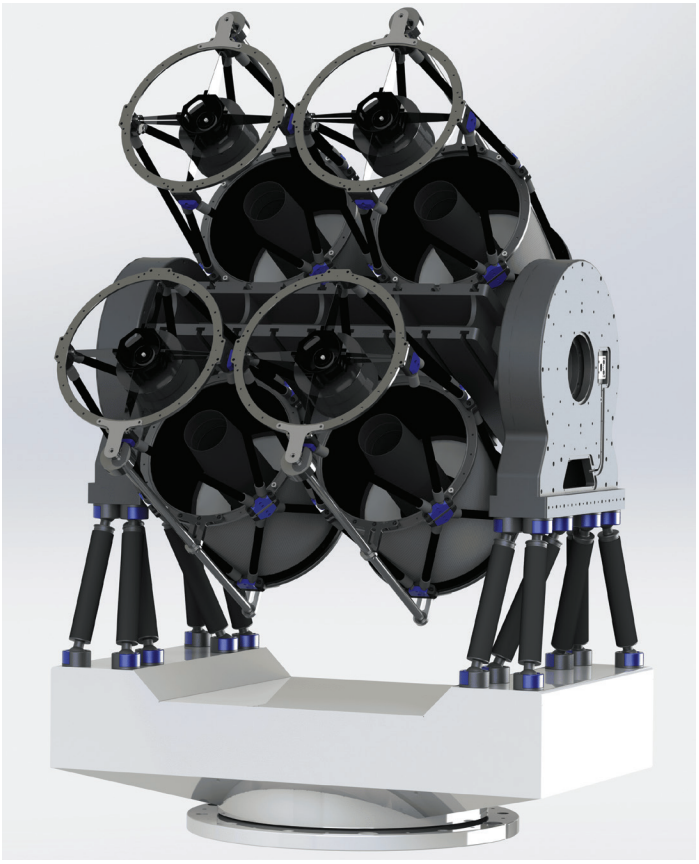
L-350/L-500/L-600 Equatorial Wedge

Add to the versatility of your direct-drive mount with PlaneWave's Equatorial Wedge for precise polar alignment adjustment. Each wedge is made for your specific latitude and has an alignment range of +/- 3 degrees. Uses oversized fine thread adjustment screws and brass tightening nuts for a fine latitude adjustment.

Portable Rolling Pier

With the Portable Rolling Pier, you can now use your L-Series mount every clear night without having to leave it set up exposed to the harsh elements. The Rolling Pier allows you to roll your L-Series mount and telescope under the stars quickly and easily using the attached steering T-handle. Using auto-mount modeling in PWI software, your L-Mount can be ready to start imaging in just minutes.

700 AND 1000 SERIES GIMBAL



High-Capacity Gimbals

PlaneWave is proud to introduce our next stage in an already wildly successful lineup of mounts and gimbals. The 700 and 1000 series gimbals are utilized in our CDK700, RC700 and PW1000 observatory system telescopes and have extensive heritage in both performance and reliability. Configurable for specific customer goals, this new line of gimbals is ready to meet the most stringent applications. Available with additional ruggedization and weatherization, power input options, Coudé path compatible, and slip rings for continuous azimuth rotation.

For further details or to discuss options and specific applications, contact our team.

Specifications 700 Series

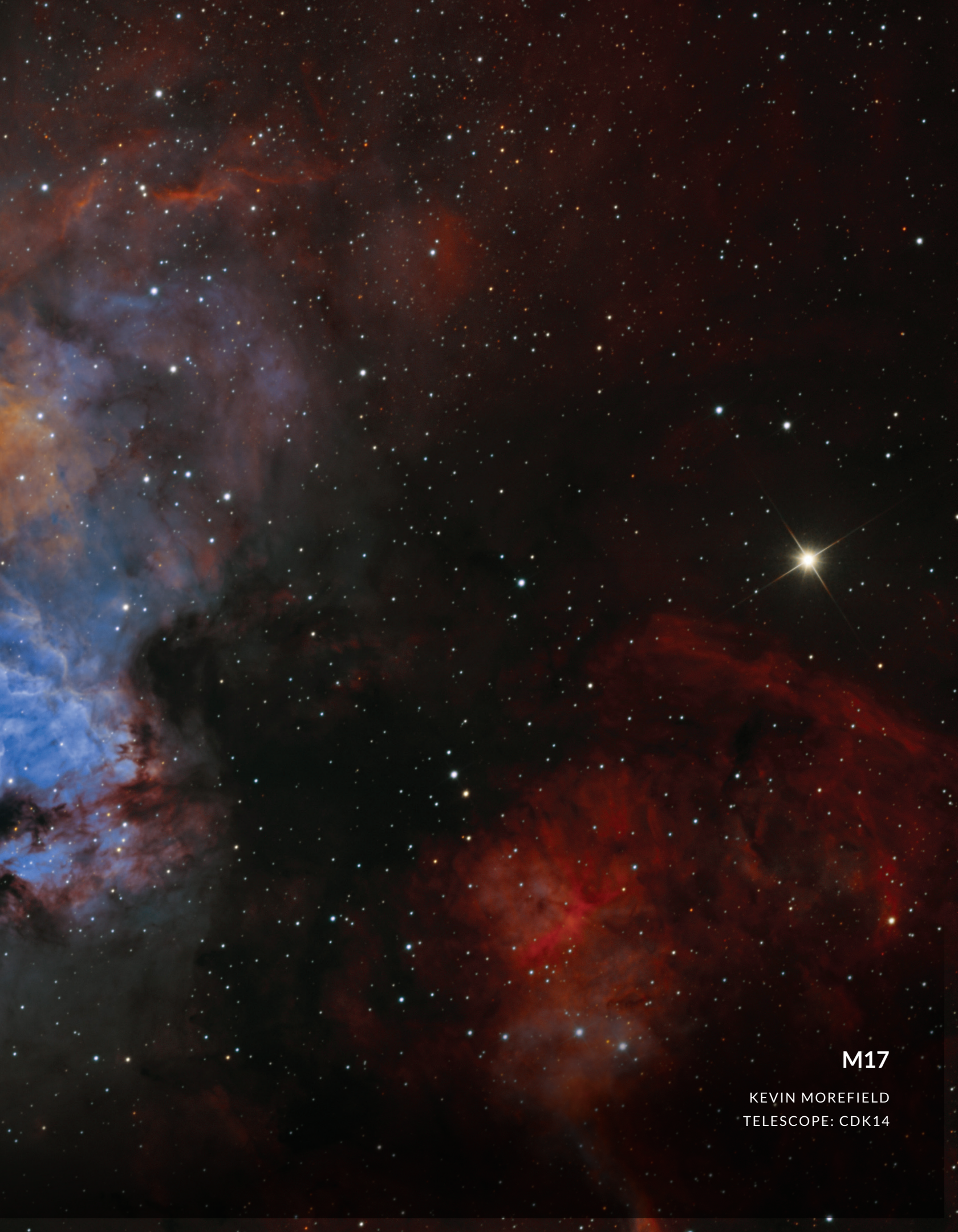
Max. Load Capacity	800 lbs load capacity with 170 foot-pounds of torque (AZ)
Motor	High-torque direct-drive motors - no gears, zero backlash, zero periodic error, zero maintenance
Encoder	26-bit axis encoders; GPS/PTP synchronized encoder time-stamping
Tracking Accuracy	Tracking speeds > 10 degrees/second
Slew Rate	Slew speeds > 50 degrees/second
Power Requirement	115VAC 15A input: no need for 3-phase power

Specifications 1000 Series

Max. Load Capacity	1200 lbs load capacity with over 200 foot-pounds of torque (AZ)
Motor	High-torque direct-drive motors - no gears, zero backlash, zero periodic error, zero maintenance
Encoder	26-bit axis encoders; GPS/PTP synchronized encoder time-stamping
Tracking Accuracy	Tracking speeds > 10 degrees/second
Slew Rate	Slew speeds > 50 degrees/second
Power Requirement	115VAC 15A input: no need for 3-phase power

Statue of Liberty

MARTIN PUGH
TELESCOPE: CDK17



M17

KEVIN MOREFIELD

TELESCOPE: CDK14

PlaneWave™ INSTRUMENTS

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