WIYN 3.5-Meter Frequently Asked Questions

After reading this FAQ, what if I have additional questions about the WIYN telescope?

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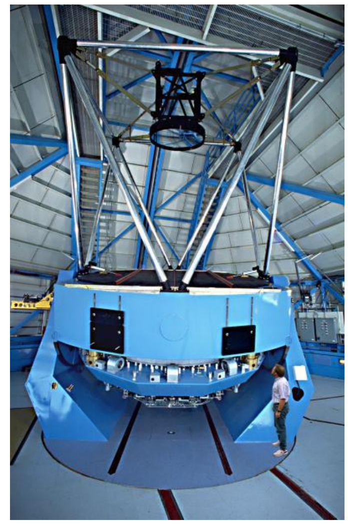
What is the general description of the WIYN 3.5-meter Telescope?



The WIYN 3.5-meter telescope is an f/6.3 Ritchey–Chrétien (RC) design. The light-weighted primary mirror is made of borosilicate glass with thermal management and active shape control used to maintain the optical figure at 0.024 waves rms. The secondary and tertiary mirrors are light-weighted ULE®. The telescope rides in an altitude-azimuth (alt-az) mounting and carries Cassegrain-type instruments at various focal locations. There are also optical fiber feeds to instrument laboratories on the ground floor below the telescope.

Where are the WIYN focal positions?

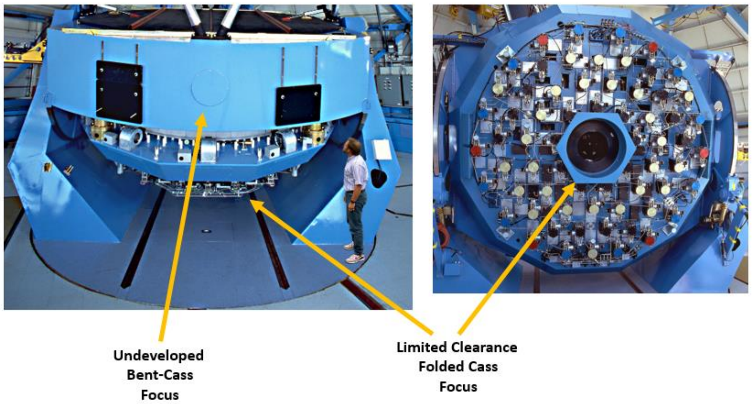
Five focal positions can carry instruments or fiber optic couplers. These include one traditional Cassegrain focus and four locations around the mirror cell structure that are selected by a central 45^{o} tertiary mirror. The four selectable foci include two Nasmyth stations, one at each end of the altitude axis, and two Bent-Cassegrain foci located on the mirror cell at stations that are 90^{o} around from the altitude axis. One Nasmyth focus is dedicated to the WIYN One Degree Imager (ODI). The second Nasmyth port carries various interchangeable instruments and fiber optic couplers and the necessary observing support equipment for guiding and image conditioning.

Use of the second Nasmyth port would provide access to existing field conditioning and guider instrumentation, but likely would also require time shared access to the telescope beam with other facility and PI instruments. This could lead to frequent, disruptive, and time-consuming instrument “swaps” and be contrary to the EPDS operational goal of rapid, stable, and repeatable access to the telescope. Therefore, use of the Nasmyth port is strongly discouraged.

The Bent-Cass positions are “undeveloped” in that there is only an instrument mounting flange available at these locations. The range of motion of the telescope in altitude is from the zenith to near the horizon on only one side of the azimuth yoke. Therefore, one Bent-Cass port is “up” and has no floor clearance issues. The other Bent-Cass port is “down” and may have floor clearance considerations.

The traditional Cassegrain focus at the aft end of the telescope is also available. This focus port is called the Folded Cass because an instrument must typically be folded back into the telescope to avoid mechanical clearance conflicts with the azimuth yoke. The Folded Cass port also has undeveloped status.

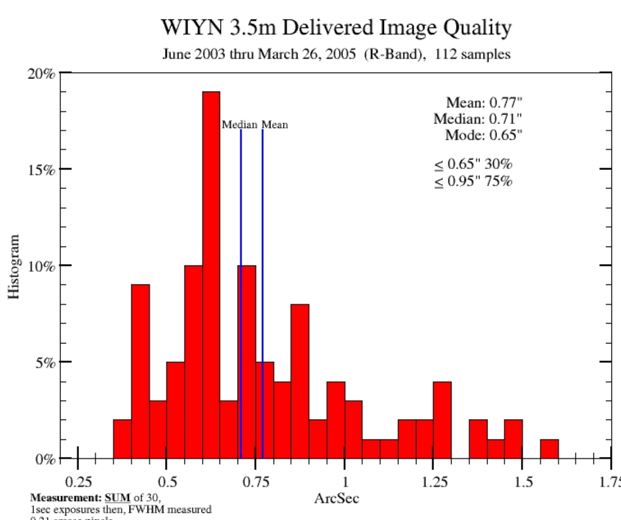
The unused focal positions offer the opportunity for dedicated installation of a new EPDS instrument or its fiber optic feed head. The upper Bent-Cass port is probably the preferred location. However, most of the existing Nasmyth observing support capabilities must also be reproduced as part of the new instrument development. These include, but are not limited to, a target acquisition camera, field rotation compensation, atmospheric spectral dispersion compensation, focus drift sensing, fine image motion stabilization, larger scale image tracking and focus control feedback to the telescope, and dedicated calibration light sources.



What are the imaging characteristics of the WIYN telescope?

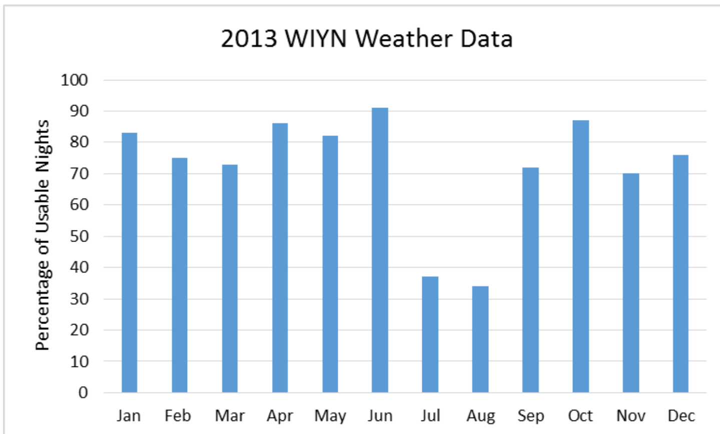
The 3.5-meter WIYN is located on the southwest ridge of the Kitt Peak summit at a site noted for having some of the best atmospheric seeing conditions on the mountain. The facility's attention to thermal design is intended to preserve the inherent excellent image quality of the site. Central to that design is capture and controlled disposal of waste heat from telescope instrumentation, electronics, and support equipment. *New instrumentation should anticipate the need for waste heat capture and removal using either the observatory's waste heat disposal system or a separate instrument specific system.*

The combined atmospheric seeing and imaging properties of the WIYN 3.5-meter are summarized in the following figure



What are the weather and observing characteristics of the WIYN site?

Clouds/Moisture. Kitt Peak does participate in the Southwest's pattern of active summer weather (Monsoon Season). The WIYN observatory can experience 50% weather related lost observing time in late July and August and is usually shut down for 3-4 weeks in August. The annual weather statistics for 2013 are shown below.



Wind. The WIYN telescope is affected by wind shake. At wind speeds exceeding 12 m/s (28 mph), WIYN can continue to operate, but generally cannot observe into the wind. Typically, about 30% of the available sky becomes inaccessible under these conditions. Wind speeds as low as 7 m/s (16 mph) can degrade tracking performance depending upon the orientation of the telescope with respect to the wind direction.

What are the optical design parameters and optical prescription of the WIYN telescope?

The optical design parameters of the WIYN telescope can be found at:

http://www.wiyn.org/About/wiynspecs.html

How are wavefront and focus drift corrected?

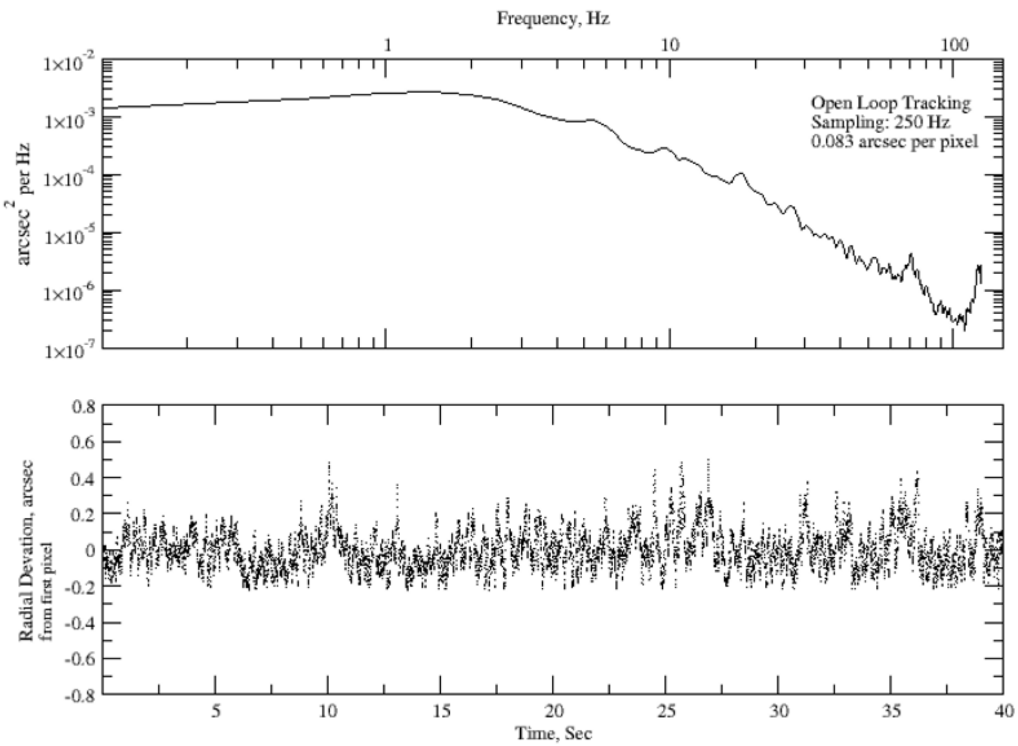
The primary mirror shape is actively controlled using look-up tables based on telescope zenith angle and temperature. These parameters are highly stable over periods of months (small seasonal variations) and are updated as part of the observatory's periodic engineering maintenance activities.

The telescope's focus does drift and needs to be actively sensed and controlled. Ten percent degradation in image size, FWHM, can occur during a period of 5-10 minutes. At the Nasmyth port, the focus sensing and target tracking are accomplished simultaneously by the guider. Thus, data collection need not be interrupted for frequent focus updates. Similar capability should be designed into the EPDS instrument.

What are the pointing and tracking accuracies of the WIYN telescope?

The open loop pointing accuracy of the WIYN is 30-40 arc seconds, rms. Offset pointing from a known stellar position is typically a few tenths of an arc second. For open loop pointing, an acquisition camera is used to facilitate target centering on small field-of-view instruments.

When tracking in unguided mode, the telescope has an RMS jitter of 0.15 to 0.2 arc seconds. A time series plot of tracking jitter and its frequency content is shown below.



Precision tracking is accomplished by closed-loop tip-tilt correction. The tracking control sensor can also provide focus control feedback.

What are the mechanical dimensions and load limits of the “undeveloped” instrument mounting locations?

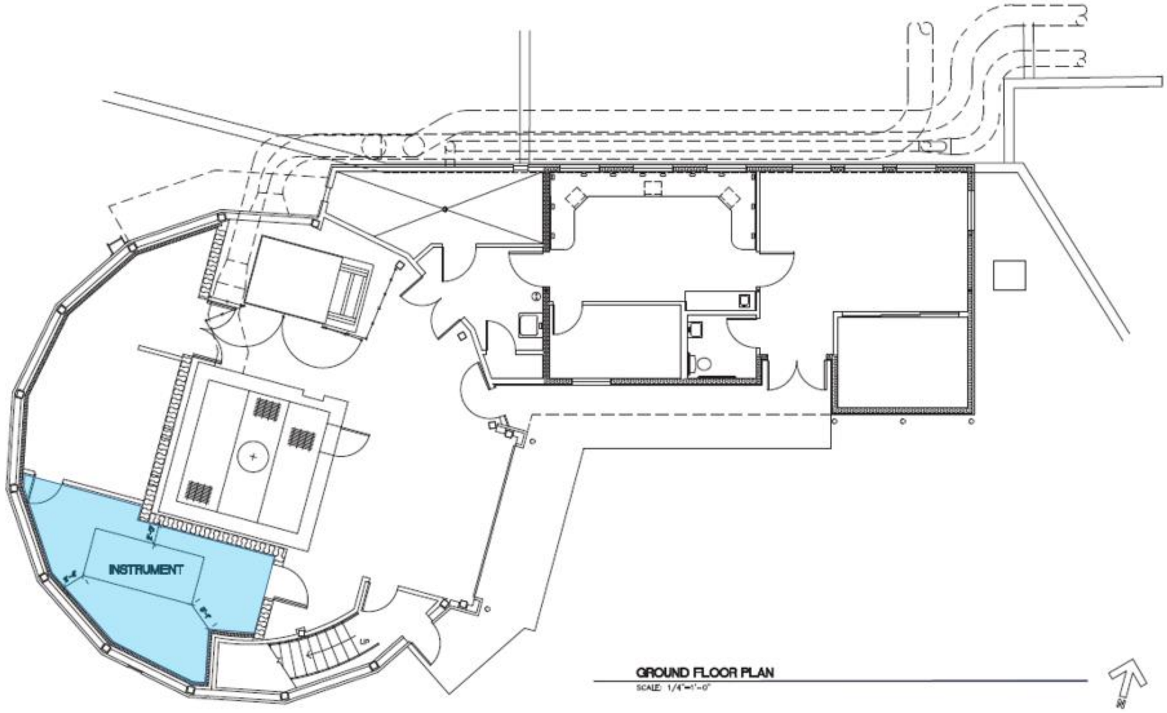
The location of optical focus at the Bent-Cass location is approximately one meter beyond (outside) the existing instrument mounting flange. The Bent-Cass flange has a clear inside diameter of 21 inches, an outside diameter of 26 inches and a bolt circle diameter of 24 inches. The Folded Cass focus is approximately two meters beyond the existing aft flange. Its internal dimensions are available on request. At both of these locations, the maximum allowable added instrument mass is 400kg (880 lb) and the maximum allowable cantilevered moment is 200 N-m (1475 ft-lb).

What accommodations are available for large laboratory-class instruments?

The WIYN 3.5-meter facility includes accommodations for large, laboratory-class, fixed location, thermally isolated spectrometers. The existing spectrometer laboratories are located on the ground level below the observing floor and include thermal isolation from the rest of the facility. The optical path from the telescope is a fiber optic feed. The required length of the fiber is estimated to be 7.5 meters (25 feet).

Adding a second large spectrometer will likely require facility modifications. These could include expanded laboratory floor space, additional thermal isolation, vibration isolation, separate electronics and support equipment accommodations, waste heat ducting, and electrical power requirements.

One concept for adding additional ground floor instrument laboratory space is shown in the figure below. The shaded area represents a new, thermally isolated space. It adds approximately 175 square feet of floor space. The instrument outline, for scale, is 3.5m x 1.5m (11.5ft x 5ft). It has a minimum of 0.6m (2ft) clearance from all of the surrounding walls. There are other options including the possibility of an external spectrometer facility.



Acknowledgement

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