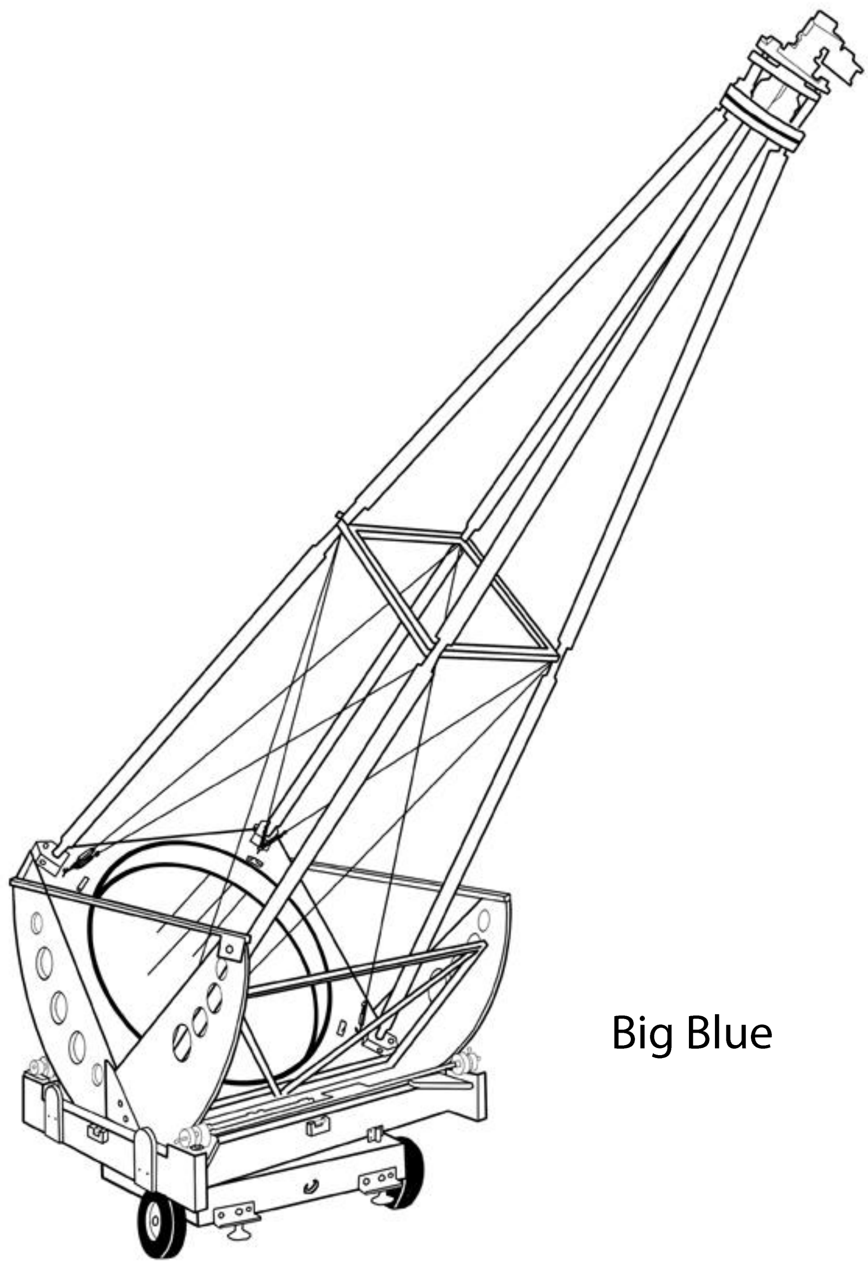
ALT-AZ TELESCOPE INITIATIVE
1-METER PROTOTYPE
LIGHTWEIGHT, PORTABLE
ALT-AZ TELESCOPE

ASSEMBLY, OPERATIONS & MAINTENANCE MANUAL



Big Blue

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Alt-Az Telescope Initiative 1-Meter Prototype Lightweight, Portable Alt-Az Telescope: Assembly, Operations & Maintenance Manual

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SAFETY WARNINGS

- Never look directly into the sun with any telescope without the proper solar filters.
- Glancing reflections off the mirror uncovered in sunlight can be a fire hazard.
- The telescope may move with or without warning, knocking into equipment and ladders.

1.0 INTRODUCTION

The concept for the Alt-Az Telescope Initiative's 1-meter (40 in.) prototype, nicknamed Big Blue, came from the desire to make low cost, portable telescopes that are easily used by amateur astronomers and small research institutions. Often these programs do not have the budget or the space to make scientific progress, and would greatly benefit from use of this technology. A traditional telescope costs in the neighborhood of $1,000,000, far out of reach for most science programs. The engineering used to build Big Blue demonstrated the transfer of sophisticated mountain top observatory technology to medium aperture telescopes utilized by astronomy groups which wouldn't ordinarily have access to such innovative machinery. With the donation of a few materials, Big Blue was constructed for $5,000, less than 1% of a traditional telescope.

The Alt-Azimuth Telescope Initiative, founded by Russ Genet of California Polytech State University, was established ultimately to disseminate useful technology utilized by advanced observatories and make it affordable for hobbyists and small scale scientific centers. The first attempt at merging their goals of both low cost and portability into a telescope was this 1-meter prototype, built from Baltic Birch, a strong and light-weight wood. Shiny Sam was their second attempt, built from the same plans as Big Blue but out of aluminum.

Over 1000 man hours went into the creation of Big Blue. The telescope was designed to be quickly assembled and stored and transported easily for simplicity of use and to adhere to the, informally named, Banich Bylaw. This bylaw states: "*For a telescope to be enjoyably and repeatedly used it must be easily set up by no more than two people of ordinary strength and dexterity in 30 minutes or less…*"

Big Blue can be assembled in twenty minutes by two people, making the prototype a success and a building block for future prototypes such as one which is currently in the making, Big Woody, a second generation light-weight and portable scope. Big Woody's mirror is larger than Big Blue's at 1 ½ meters (60 in.), and is made out of ApplePly, an advanced wood laminate. Big Woody, unlike Big Blue, will have a high quality precision mirror making it more sophisticated and more expensive than the 1 meter prototype.

Big Blue's mirror was salvaged from a decommissioned flight simulator which used the mirror to projected distant images on the simulator's display. Flight simulators do not need as precise mirrors as those used by traditional telescopes. Big Blue was shaped with a "spotty mirror" with a long focal length causing it to act like a light bucket flux collector. Flux collectors are ideal for measuring intensity or carrying out spectral analysis but not for forming images. This is still useful because a lot of very important science can be conducted with this kind of telescope. The capabilities of telescopes like Big Blue, especially when used in arrays, can rival huge mountaintop observatories, as they are able to produce comparable signal-to-noise ratios when viewing program objects.

Banich Bylaw of Portability

For a telescope to be enjoyably and repeatedly used it must be easily set up by no more than two people of ordinary strength and dexterity in 30 minutes or less, even better if only one person is needed. This "rule" has been formulated through personal experience and observing "large" amateur telescope enthusiasts since 1991. Important note –the useful life span of the scope will be short if it takes grudging effort to set up and take down. All attachments must be robust to stand up to repeated set up and take down, which also aids in repeatable collimation.

Big Blue also rivals precision telescopes in other ways; Big Blue was built and mounted on a hand-cart with a tow-bar which allows for the telescope to be transported easily. The hand cart also allows for the telescope to be winched into the backs of vehicles quickly and easily where it then can be transported without the need of special permits or hauling devices.

To prove the portability of the 1-meter prototype, it was driven across country from San Luis Obispo, CA to Philadelphia, PA in the back of a Dodge Grand Caravan. With all of Big Blue's equipment loaded in the van as well, there still was enough room for a crew of two members and their assorted luggage and camping gear. The telescope stands about nineteen feet tall when assembled making the stowing of this apparatus very impressive.

The Alt-Azimuth Telescope Initiative in the future will continue to further their original goals. The next milestone, after Big Woody is to build the world's largest telescope that can be transported readily and complies with the Banich Bylaw. Plans for this telescope are already in the making. The mirror they plan on using is 2.4 meters in diameter and the main telescope mount will be made out of aluminum. This 2.4 meter telescope is named Big Al, and is a refinement on Big Woody's blueprints. The Initiative hopes to finish planning for the telescope in the fall of 2012 and construct the main telescope mount in the spring of 2013.

Big Al will be used for tracking stars for science and also tracking the sun for use in power generation. The final goal of the Big Al series of scope is to build multiple telescopes for utilization in arrays. The group plans on using the telescopes much the same way radio telescope arrays are used to improve resolution and flux collection.

2.0 ASSEMBLY

INVENTORY
8 Tension Wires
1 20x20 in Square Truss Brace
2 Removable Trunion Halves
2 Trunion Support Poles
4 Lower Truss Poles
4 Upper Truss Poles with ¼ in hole in tube for attaching to Truss Brace
4 Lower Truss Pole Sockets
1 48x30 in Trunion Brace
1 Optical Head

TOOLS NEEDED
9/16 Wrench
1in Wrench
Large Flathead Screwdriver

The steps for constructing the telescope are contained in the following sections. Refer to the figure in Appendix A1 for unfamiliar parts.

2.1 UNPACKING & SITE SELECTION

Carefully unpack the telescope and wheel it out of the travel trailer. You will need level ground, preferably with a hard surface and a 20ft radius to construct the telescope. The area should have a clear view of the sky for observing.

Note: Blacktop is not ideal during the hotter months as it absorbs heat during the day, and will give off heat waves at night making observing conditions less than ideal.

Once the telescope is in position, remove the tow bar from the base by pulling the pin from the left side of the bar attachment, and removing the bar from the right.

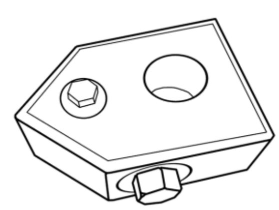
If you wish to level the telescope before assembly, skip to the end of this section.

2.2 TRUSS ASSEMBLY

Step 1
Assembling horizontally, take the upper truss poles and insert them into the four sockets in the optical head. Tighten the knobbed screws on the side of the optical head where the truss poles insert. Do not over tighten.

Step 2
Using the screws on the bottom of the upper truss poles, attach the 20x20 square truss brace. Do not over tighten; there must be enough room to slide on the lower truss poles.

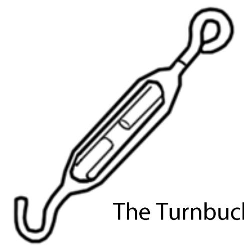
Step 3
Slide the four lower truss poles over the ends of each of the upper truss poles. To secure the lower truss poles fully tighten the knobs from step 2.


Truss Pole Socket

Step 4
This step requires two able bodied people to lift the truss.
Carefully tip the truss pole assembly vertical; the individuals stand on opposite sides of the truss assembly and holding the lower truss poles, lift vertically. Insert the lower truss into the truss pole sockets located on each corner of the mirror box. Position the

truss assembly so the lone eye-ring on the optical head is above the tow bar. This eye-ring can be used as a tie-down point.
Once the truss assembly is mounted use the 1-in. bolts on the side of the truss pole socket blocks to lock the truss pole in place.

Step 5
Attach the eight tension wires. Two tension wires crisscross over each lower truss panel. The looped end of the wire is attached to the hook on the 20x20 truss brace and stretched to the bottom of the opposite truss pole where its hooked end connects to the eyehook in front of each truss pole socket.
After all eight wires are attached, uniformly tighten the turnbuckle on each wire by turning the turnbuckle body with your hand.


The Turnbuckle

The truss assembly is now mounted and completed.

2.3 TRUNION ASSEMBLY

Step 6
Mount the removable trunion halves. The yellow tabs at the bottom fit like a puzzle piece onto the mirror box trunion. Tighten the two screws located on the lower part of each of the removable trunion halves with a large flathead screwdriver.

Step 7
Attach the 48x30 trunion brace between the trunion halves. Tighten the two screws on the vertical bars of the brace, and tighten the three screws located on the bottom horizontal bar.

Step 8
Attach the trunion support poles; you will need the 9/16 wrench for this step. With a 7/16 sized bolt; Bolt the flagged end into the top of the removable trunion half while the straight ends of the support poles attach diagonally down to the sides of the mirror box.

Step 9
Mount the finder scope on the dovetail mount located on the back of the mirror box by sliding the scope onto the grooves of the mount. Tighten the side bolts to secure the scope.

3.0 OPERATION

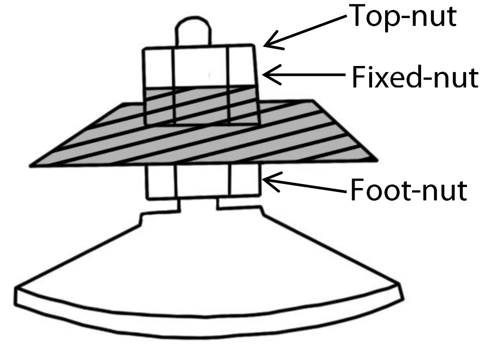
3.1 LEVELING

TOOLS NEEDED

1-in. Wrench
Woodblocks or Bricks

LEVELING THE TELESCOPE

There are two tubular spirit levels mounted on the front and left side of the rocker box to help in this process. There are also four leveling feet located on the telescope's base, two in the front and two in the back.



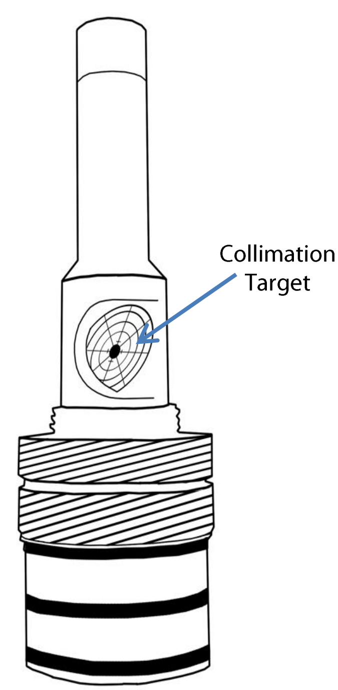
If the ground the telescope if being set up on is soft or too sloped for the feet to level the base place woodblocks or bricks under each foot as needed.
There are three nuts on the telescope's feet: the foot-nut, the fixed-nut and the top-nut. The fixed-nut is welded in place. To adjust the feet for leveling loosen the top-nut then loosen the foot nut to raise the telescope's level or tighten the foot-nut to lower the level. Do this for every foot as needed until the bubbles in both spirit levels are centered between their black lines.

Once the telescope is leveled the mirror cover may be removed. There are four sliding latches that secure the mirror cover, slide them to release the cover, and lift up evenly on both sides of the cover to remove. Carefully tip the mirror cover up and remove between tension wires.

3.2 Collimation

TOOLS NEEDED

Laser Collimator



Step 1

Position the telescope at the altitude where you will be doing most of your observing. Add weights to the optical head until the telescope is balanced, and pushing the telescope up requires the same force as pushing the telescope down.
Note: If you add additional equipment to the optical head (e.g. a camera) you may need to add or remove weight.

Step 2

Slide the laser collimator into the optical head.

Step 3

Turn on the laser collimator. The white ring located on the primary mirror is the geometric center. Adjust the three knobs on the top of the optical head until the laser is centered in the ring.

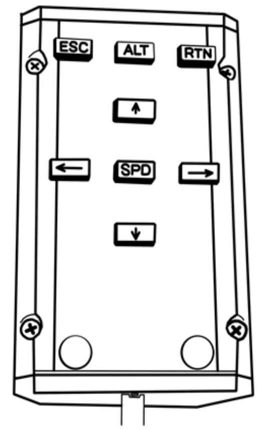
Step 4

For this step you need another person or a camera looking at the collimation target. Adjust the three collimating screws on the bottom of the mirror cell of the primary mirror until the laser points in the center of the collimation target.

Step 5
Once the telescope is collimated, remove the laser collimator and return to case.

Step 6
Add eyepiece, camera or other observing equipment to the optical head.

Now the telescope is ready for observing.



3.3 HANDPAD

Big Blue operates in SlewNTrack mode which is described in section 10.5 if the SciTech operations manual.

3.3.1 INITIALIZE

If the telescope latitude is not programmed into the Servo Controller, you must initialize it with the use of your HandPad.

Step 1
Point the telescope at the zenith (straight up) then press and hold the RTN key on your HandPad for more than 5 seconds. When the LED flashed on the controller you may release the button.

Step 2
Point the telescope at the celestial pole (near Polaris) then press and hold the ESC key on your HandPad for more than 5 seconds. When the LED flashed on the controller you may release the button.

Your scope is now initialized and the SlewNTrack mode will be working.

BUTTONS

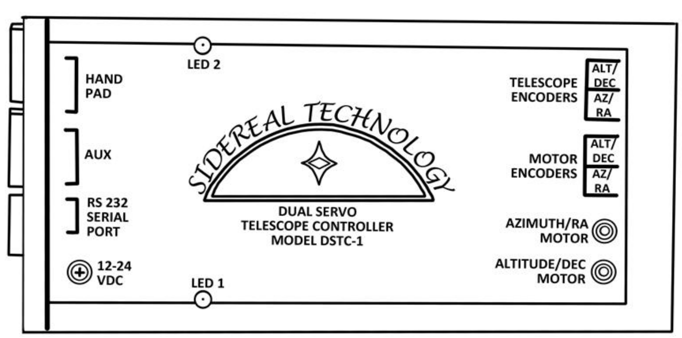
ESC- Escape Key
ALT- Alternate Key
RTN- Return Key

Hold various combinations of these buttons for different results. For full details see section 10.4 - 10.10 in the SciTech Manual

UP ARROW- Pans telescope away from horizon
DOWN ARROW- Pans telescope towards horizon
LEFT ARROW- Pans telescope left
RIGHT ARROW- Pans telescope right
SPD- Changes speed setting for telescope panning

3.4 SIDEREAL TECHNOLOGY BOX

Follow instructions on website to download and install current Sidereal Technology software.
www.siderealtechnology.com



4.0 MAINTNECE

4.1 CLEANING THE TELESCOPE & OPTICS

TELESCOPE
Use a damp cloth to wipe down all non-optical surfaces.

OPTICS
A small amount of dust will not affect instrument performance; however the primary mirror and secondary optics (at optical head) should be cleaned once a year.
Rise the primary mirror with de-ionized distilled water. Use a clean, lint free cloth to blot, not rub, left over water droplets.
You may mix dilute isopropyl alcohol and a couple of drops of dish detergent in a spray bottle to remove tough spots on of the mirror. Spray the mixture on and rise with de-ionized distilled water. Use a clean, lint-free cloth to blot, not rub, left over water droplets.
Use the same procedure for the secondary optics.

4.2 STORAGE
To properly store the telescope, follow these instructions:

Step 1
Lock the azimuth and altitude locks. The azimuth lock is located on the side of the mirror box while the altitude lock is located on the permanent trunion.

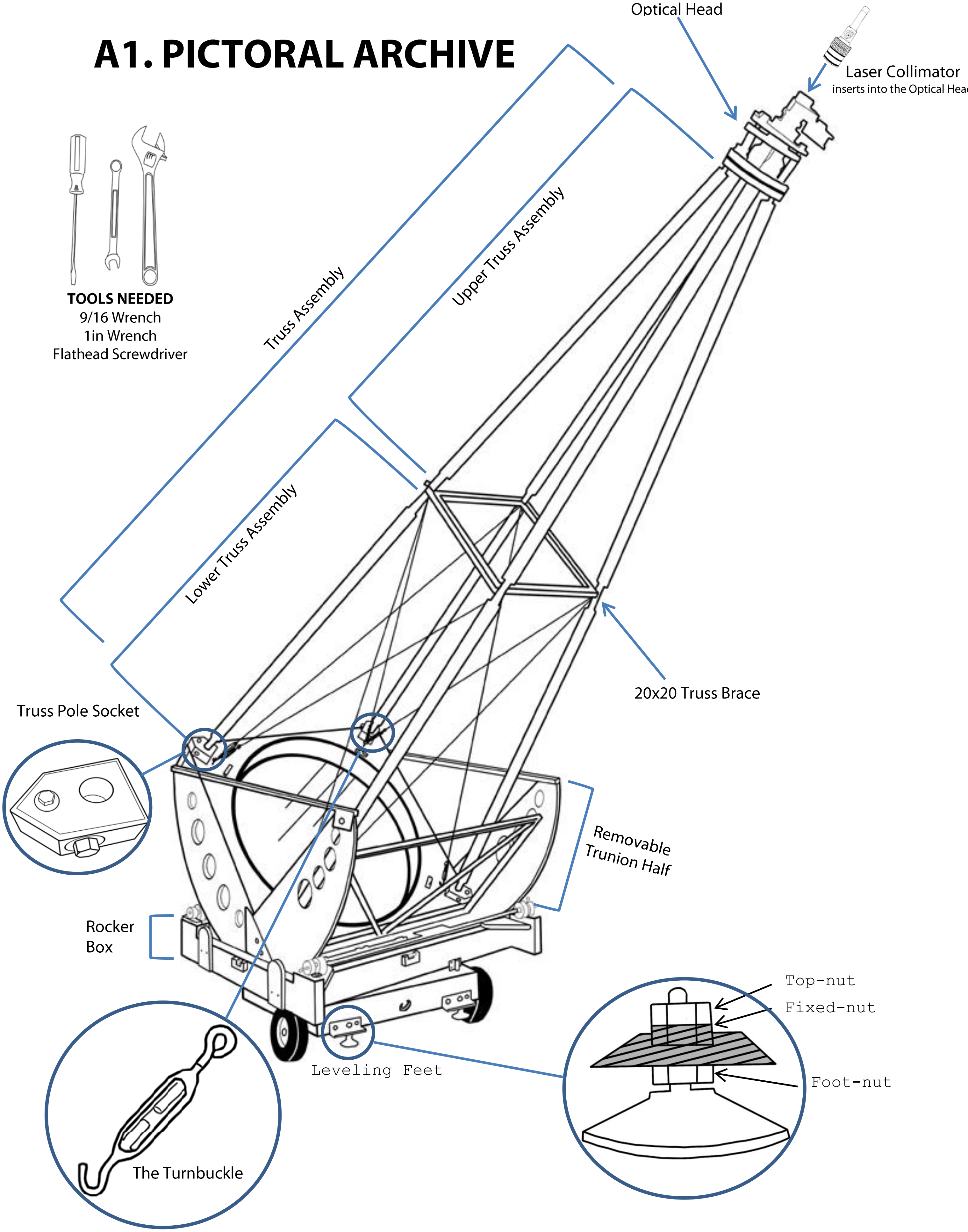
Step 2
Disassemble the all major assemblies. Put the truss poles in the truss pole bag and place all loose parts in the parts box.

Step 3
Secure the mirror so that it is immobilized; use cloth rags to buffer the space between the mirror and mirror cell, and cover the mirror with the mirror cover. Lock the mirror cover in place with the four sliding locks in the top of the mirror box.

Step 4
Store the telescope in a cool, dry place out of direct sunlight. If such a place is not obtainable use a heat lamp or other heating device to keep the telescope slightly above ambient temperature to keep dew from forming on the various assemblies. Any kind of moisture will cause corrosion.

A1. PICTORAL ARCHIVE

TOOLS NEEDED
9/16 Wrench
1in Wrench
Flathead Screwdriver



Left: Big Blue stowed on the West Coast

Right: Big Blue assembled on the East Coast

A2. PAST ALT-AZ INITIATIVE CONFERENCES & WORKSHOPS

The 1-meter Prototype was planned in part directly or indirectly at the following conferences and workshops.

CONFERENCES

Meter-Class Astronomy	January 20-22, 2012
Telescopes from Afar	February 28 - March 3, 2011
Light Bucket Astronomy	Dec 2010-Jan 2011
Galileo's Legacy	January 2009
STAR Conference	June 2008

WORKSHOPS

Portland V	July 2011
Portland IV	July 2010
Portland III	August 2009
Pine Mountain Observatory	July 2009
Pasadena AAS	June 2009
Gemini Tour	January 2009
Vancouver BC	July 2008
Portland II	July 2008
Pine Mountain Observatory	July 2008
Gemini/Subaru II	February 2008
Gemini/Subaru I	January 2008
Dallas Alt-Az	October 2007
RATT II Cloudcroft NM	August 2007
Magdalena Ridge Observatory	August 2007
STAR Workshop	June 2007
Portland I	June 2007

For future conferences and workshops visit www.altazinitiative.org

A3. USEFUL LINKS

ALT-AZ TELESCOPE INITIATIVE WEBSITE

http://www.altazinitiative.org/
Yahoo Group: [AltAzInitiative]

SCITECH CONTROLLER WEBSITE

http://www.siderealtechnology.com/

WEATHER REPORTS

http://weather.rap.ucar.edu/satellite/
http://www.wunderground.com/cgi-bin/findweather/
http://www.cleardarksky.com/
http://www.weather.com/weather/map/interactive/
http://www.weather.gov/

OBSERVING

http://www.tonightssky.com/
http://www.heavens-above.com/
http://www.skymaps.com/

MAGAZINES

http://www.astronomy.com/
http://www.skyandtelescope.com/