Sunset Astronomical Society

The Sunset *Gazette*

Serving the Tri-Cities since 1975

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Meeting information

Meetings are generally in the theater in the Delta College Planetarium in Bay City. The meetings will usually be on the 2nd Friday of each month at 7:00 PM. Watch the newsletter for changes in dates and times. Membership is not required to participate in meetings and activities. See last Page for this month's meeting site.

Membership Information

Our club has switched to e-mailing our newsletters. For those wishing to receive a hard copy mailed an additional dues of $10.00 per year is required.

New Membership Rates:

5$ per Year

Treasurer's address for renewals and subscriptions:

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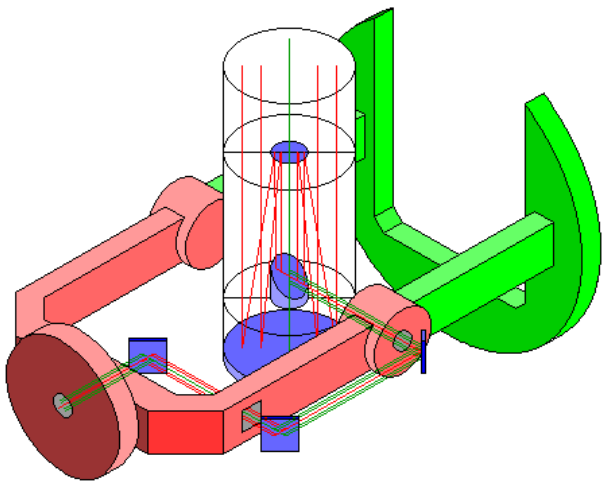
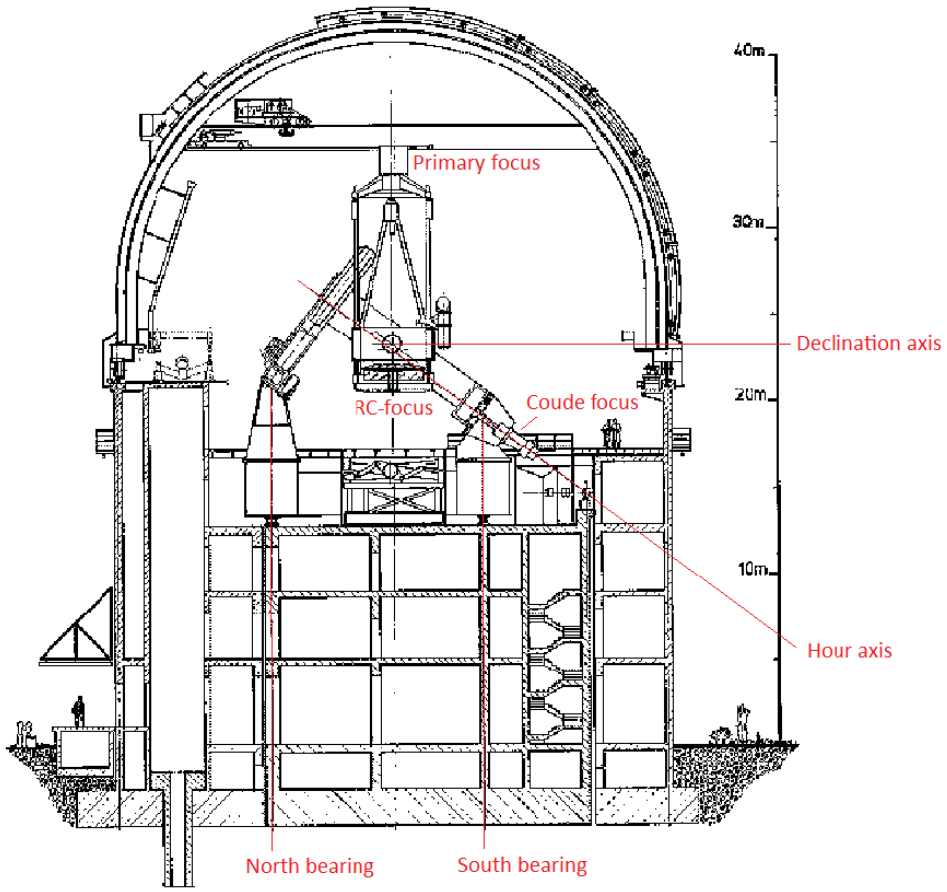
The Technology of large and super large Telescopes

Time to start a new series in the SAS newsletter! The themes of the last series were rather historical or even pre-historical so we are jumping into the presence and even near future to look at the engineering and optical technology of the current large 8 - 10 m class of telescopes and the even larger ones who are either in the planning state or whose construction has already begun.

As technology progressed the observer at the eyepiece was increasingly replaced by an ever larger array of detectors which also tended to get bigger and heavier. Refractors soon came to their limits due to the fact that the objective lens could not be made much larger than 40" in diameter without encountering serious problems like deformation of the lens under its own weight or the difficulty making defect free glass lenses. Large Newton reflectors also had problems due to the awkward position of the eye piece and consequently the observer or detector. These disadvantages lead to the development of the Nasmyth platforms which we already covered to some extent in the previous issue and the Coude-laboratory. On the left hand side you can see James Nasmyth sitting on the "Nasmyth-platform" of his azimuth mounted reflector around 1845. The platform was originally a seat mounted on the base platform of the telescope turning with the azimuth. Nasmyth holds wheels with which he controls the azimuth and the elevation of the telescope tube and tracks the movement of the stars. This set up did not compensate the field rotation of the stars. Below you can see a Coudé set up for a horse shoe mounted telescope similar to the 5 m Hale telescope. The light beam is redirected several times and bend like an elbow. It allows an eye piece or other detector being placed in a comfortable fixed position completely decoupled from the movement of the telescope.



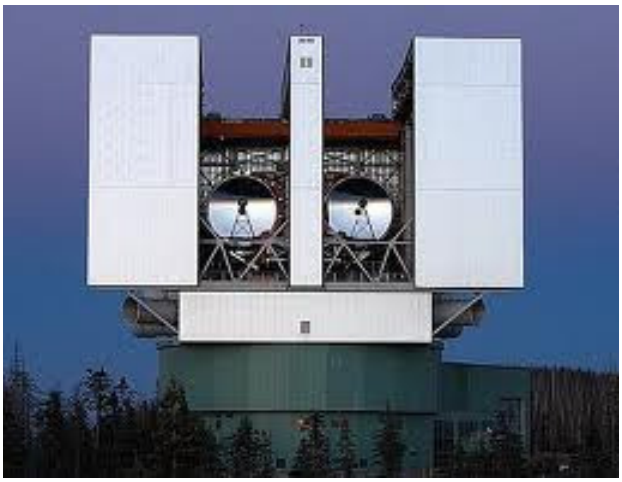


Scheme of the Calar Alto 3.5 m telescope: You can see the primary focus and the RC focus are independent from the declination and hour axis—they are not important for these foci. The Coudé focus on the other hand demands a number of mirrors in the cross-sections of these axis which leads to a high engineering effort.

The name of the inventor is unfortunately not known only the place where the first Coudé set up was used: It was the observatory of Paris.

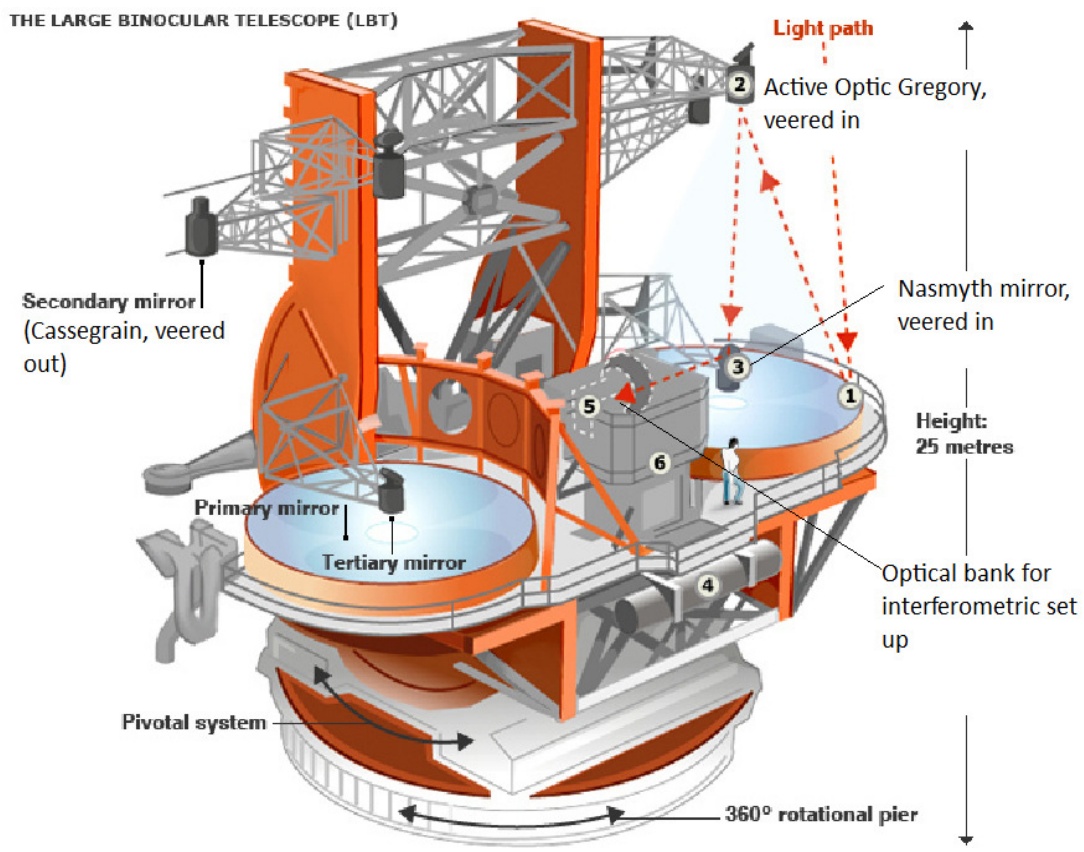
As mentioned the equatorial mounted refractors hit their technological limits around the turn of the 19th/20th century and the astronomers turned to equatorial mounted reflectors. The pinnacle was possible reached with the 1949 completed 5 m Hale telescope on Mt. Palomar and for several decades after most of the large research telescopes in the 2, 3, 4, 5 and 6 m class where mounted similar with an equatorial horse shoe mount. As an example we look at the 3.5 m telescope on the Calar Alto in Southern Spain which is quite similar to the Hale telescope. The telescope has three focal stations: primary , RC (Ritchey-Chretien) and Coudé focus. When the telescope was build in the 1970s it was still necessary for the observer to physically be in the primary focus to change photographic plates and oversee the precise tracking of the telescope. Of course that is only possible with very large telescopes of the 3 m class and beyond. The Ritchey-Chretien focus is the equivalent to the Cassegrain focus with an improved optic which was developed by George W. Ritchey and Henri Chretien at the beginning of the 20th century. The improvement did only affect the optic and the observer or the detector still has to follow the movement of the telescope.

The horse shoe mount of the 3.5 m telescope follows the classical design of the 5 m Hale telescope. The north bearing tracks the shape of a horse shoe which leads to a perfectly balanced overall structure: The declination axis is situated in the center of gravity

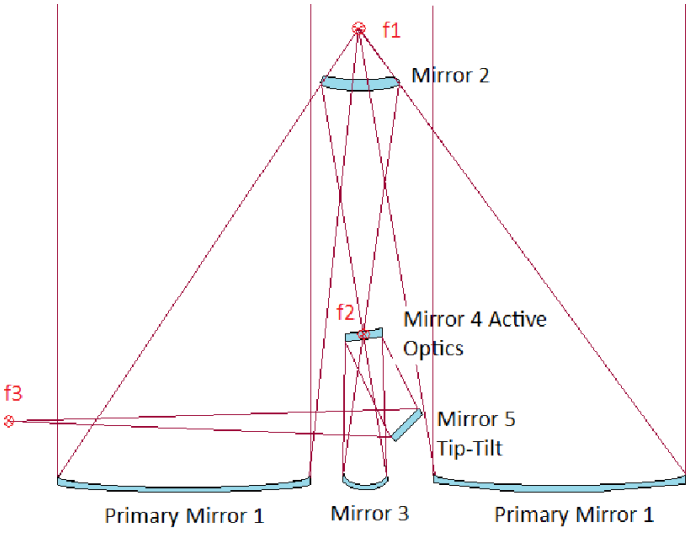


of the horse shoe shaped hour axis on which the center of gravity of the tube rests. Disadvantage is that the hour axis enclosing the tube and the overall structure of the telescope are quickly getting big, heavy and expensive. Therefore it did not make much sense to build telescopes larger that the 5 m Hale telescope in the same way. Improvements in computer technology made it possible to build large azimuth mounted telescopes where the movement in two axis and the compensation of field rotation was no longer a problem.

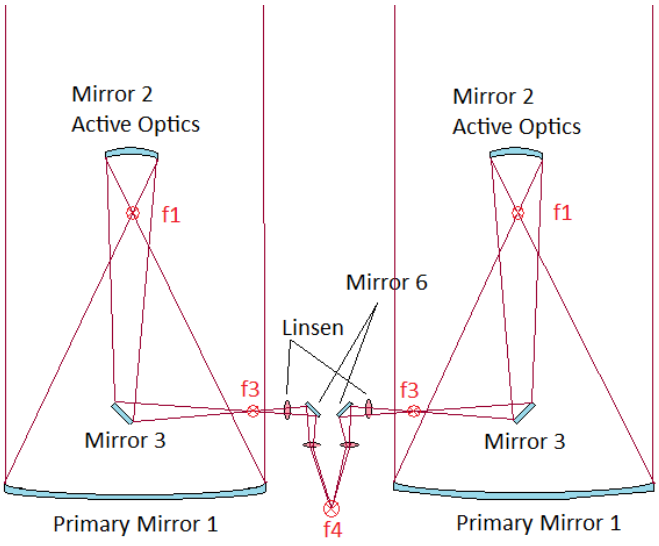
Now we will have a look at one of the most modern large telescopes: the Large Binocular Telescope (LBT) on (10,700-foot (3,300 m) Mt Graham in the Pinaleno Mountains of southeastern Arizona (see left picture).



All technological experiences to date are combined in one instrument so that the most diverse needs of the astronomers are met: The LBT is using two 8.4 m (27 ft) wide mirrors and is a real universal telescope: It has two identical primary foci, 2 Cassegrain respectively Ritchey Chretien foci, 6 Nasmyth foci and one Coudé focus which can also used as interferometer. All of these foci can be used in parallel or are interchangeable in a very short time and are all remotely controlled. The specialty of the Gregory mirror (see LBT scheme on the left) is the fact that it is very thin and equipped with an active optic consisting of hundreds of actuators at the back. These can change the shape of the mirror hundred times per second and compensate for atmospheric turbulences. Because of its azimuth mount the telescope has de-rotation units in every focal points.



On the left hand side you can see the ray tracing which lead to instruments placed on the Nasmyth platforms (focal point f3) . The lower picture describes the ray tracing in the interferometer mode. The two active optic Gregory mirrors (mirror 2) steer the beams to two mirrors (mirror 3) which then combine the beams in the interferometer focus f4 not without passing through two lens systems and reflection by mirrors 6. The tube itself is designed for maximum rigidity and the active optic makes up for any deformation of the tube structure.



Next issue: The future - super and ultra large telescopes.

SUNSET ASTRONOMICAL SOCIETY
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SERVING THE TRI- CITIES SINCE 1975

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This issue can be accessed in color on the website of the SAS!!!
http://www.sunsetastronomicalsociety.com

SAS Meeting

Start: 7:00 PM

Friday, May 9th, 2013

Delta Planetarium

Welcome members and guests

New and old business

Club Business

Treasure report

Refreshments Break

Presentation:

TBD

If clear we will observe on the observation deck.

What's up in the Sky

May 2: Last Quarter Moon

May 5 *Early Morning*: The Eta Aquarid meteor shower (best for southern latitudes) will be at its strongest just before dawn.

May 9: New Moon

May11, 12 *Dusk*: Watch out for a very thin crescent Moon very close to Venus low in the west-northwest shortly after the sun sets.

May17 *Evening*: Watch out for Regulus shining above the first quarter Moon.

May 18: First Quarter Moon

May 21,22 *Evening and Night*: Watch out for the waxing gibbous Moon close to Spica's right on 21st and Saturn's lower right on the 22nd.

May 24 *Dusk*: Good opportunity to see Mercury just 1.5 deg to the upper Venus low in the west-northwest shortly after sunset.

May 24-29 *Dusk*: Six evenings when Venus, Mercury and Jupiter fit into a 5 deg circle.

May 25: Full Moon

May 26 *Dusk*: Venus, Mercury and Jupiter are closest in the sky forming a nearly equilateral triangle.

May 28 *Dusk*: Jupiter can be found just 1 deg to the lower of Venus.

May 31: Last Quarter Moon

UPCOMING EVENTS