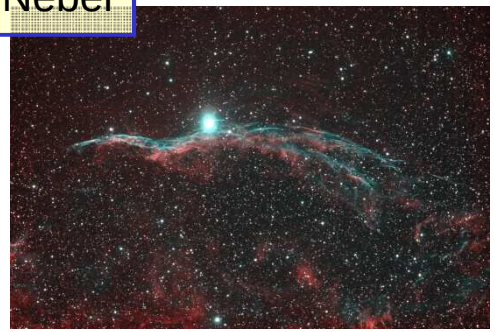
„Fernrohrbau“

Astrophotografie:

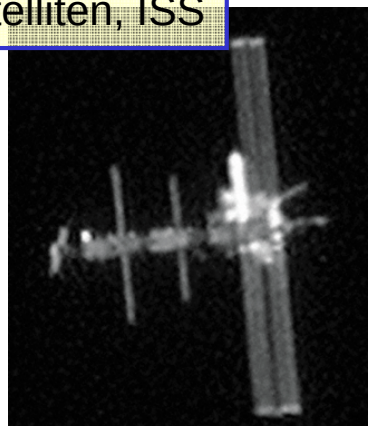
Planetarische Nebel

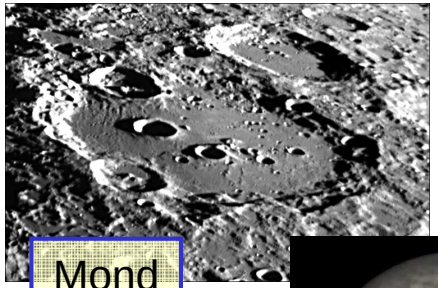
Nebel



Sternhaufen

Satelliten, ISS



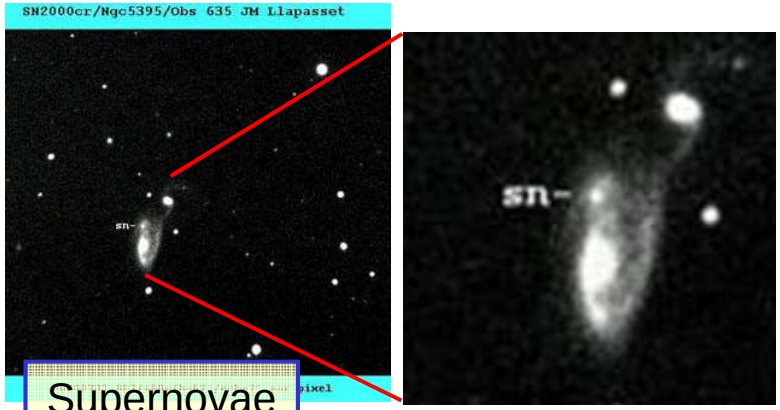


Mond

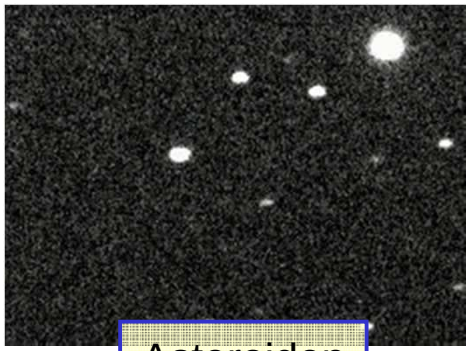
Planeten

Galaxien

Amateurastronomie:

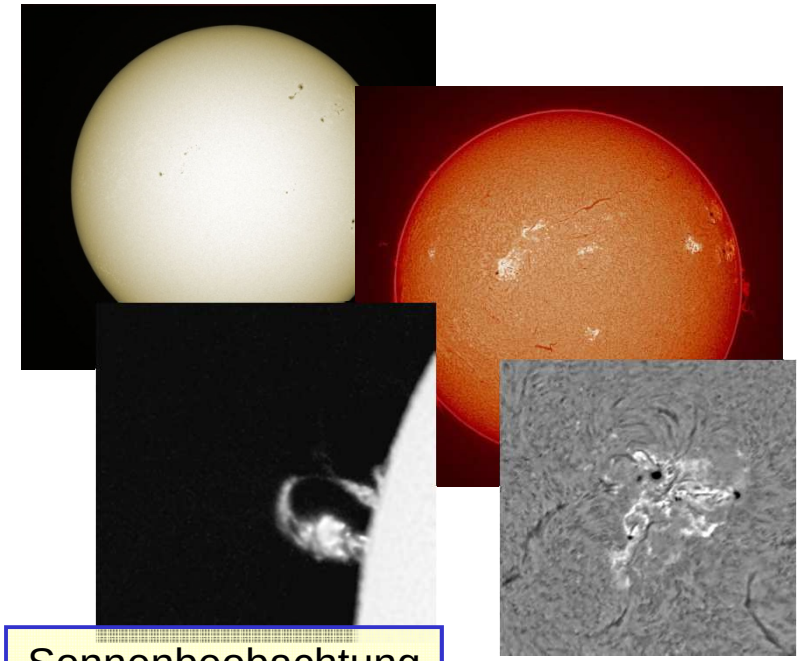


Supernovae



Asteroiden

Kometen



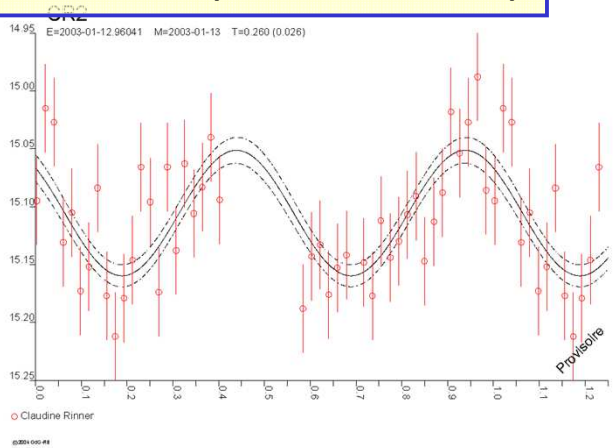
Sonnenbeobachtung

Teleskop - Sternwarte

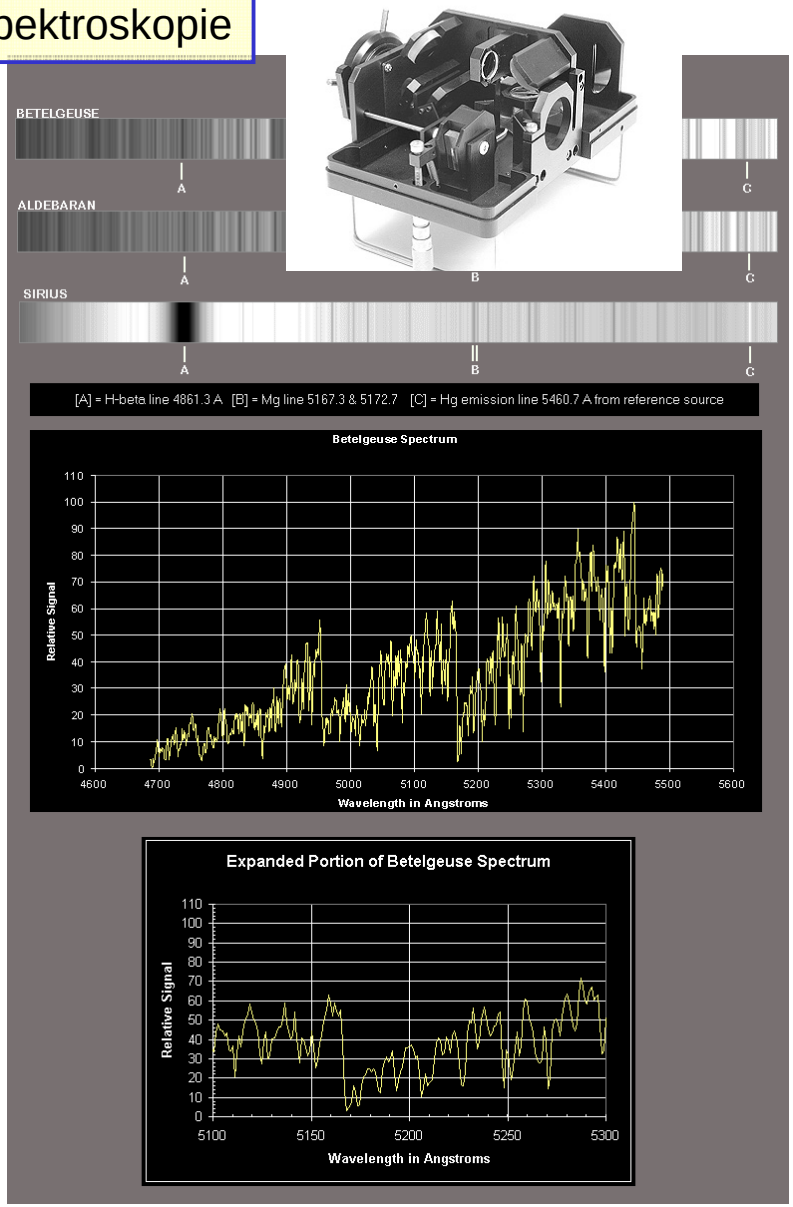
Amateurastronomie:

OBERÖSTERREICH

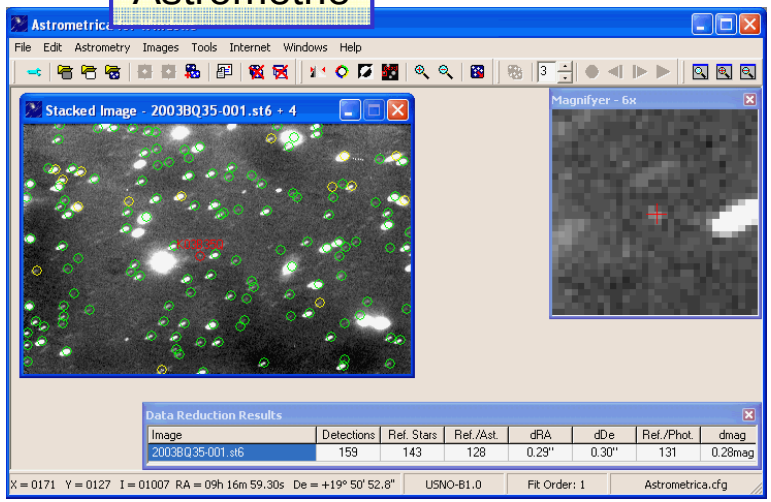
Lichtkurven (Variable Sterne)



Spektroskopie



Astrometrie



Teleskop - Geschichte:

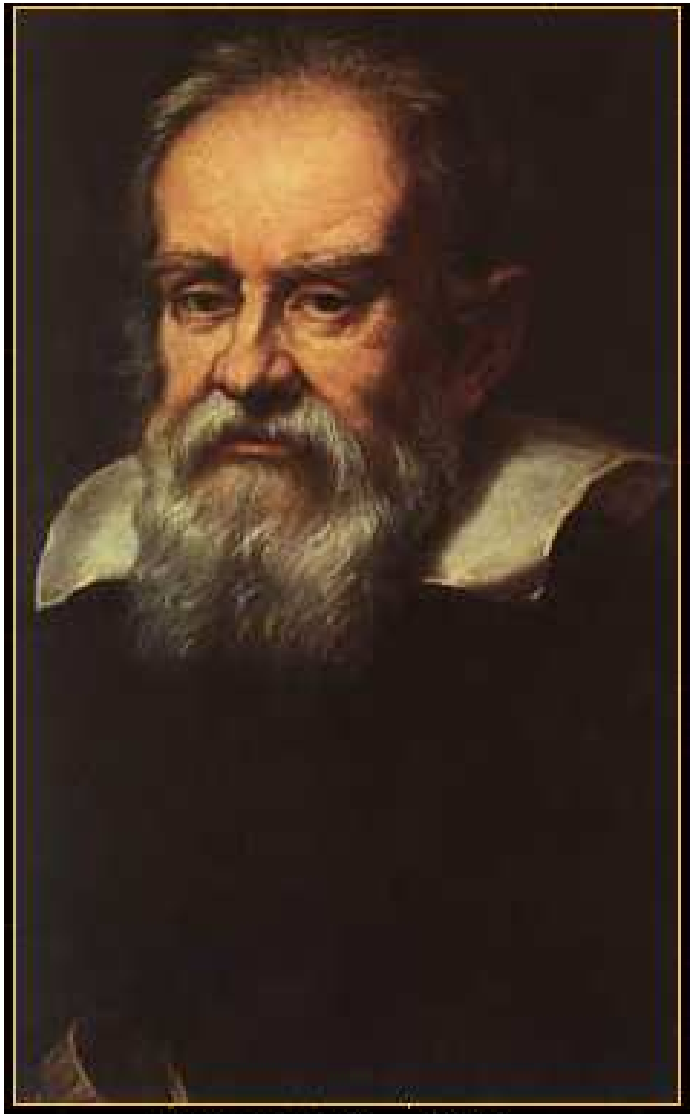


Bild 1: Galileo Galilei

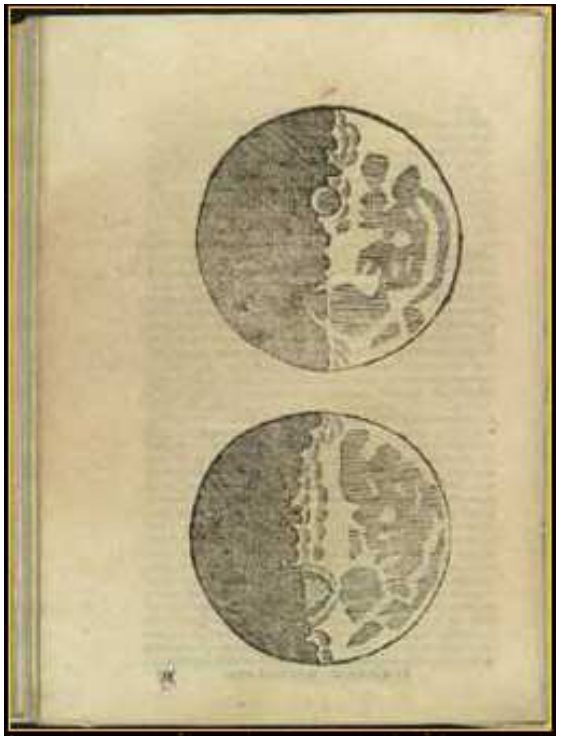


Bild 4: Galileis Mondzeichnungen

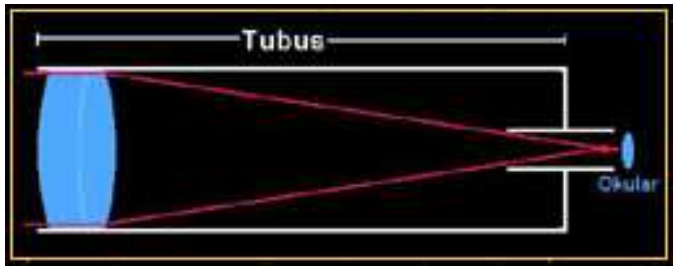


Bild 7: Das optische Prinzip des Linsenteleskops

Teleskop - Geschichte:

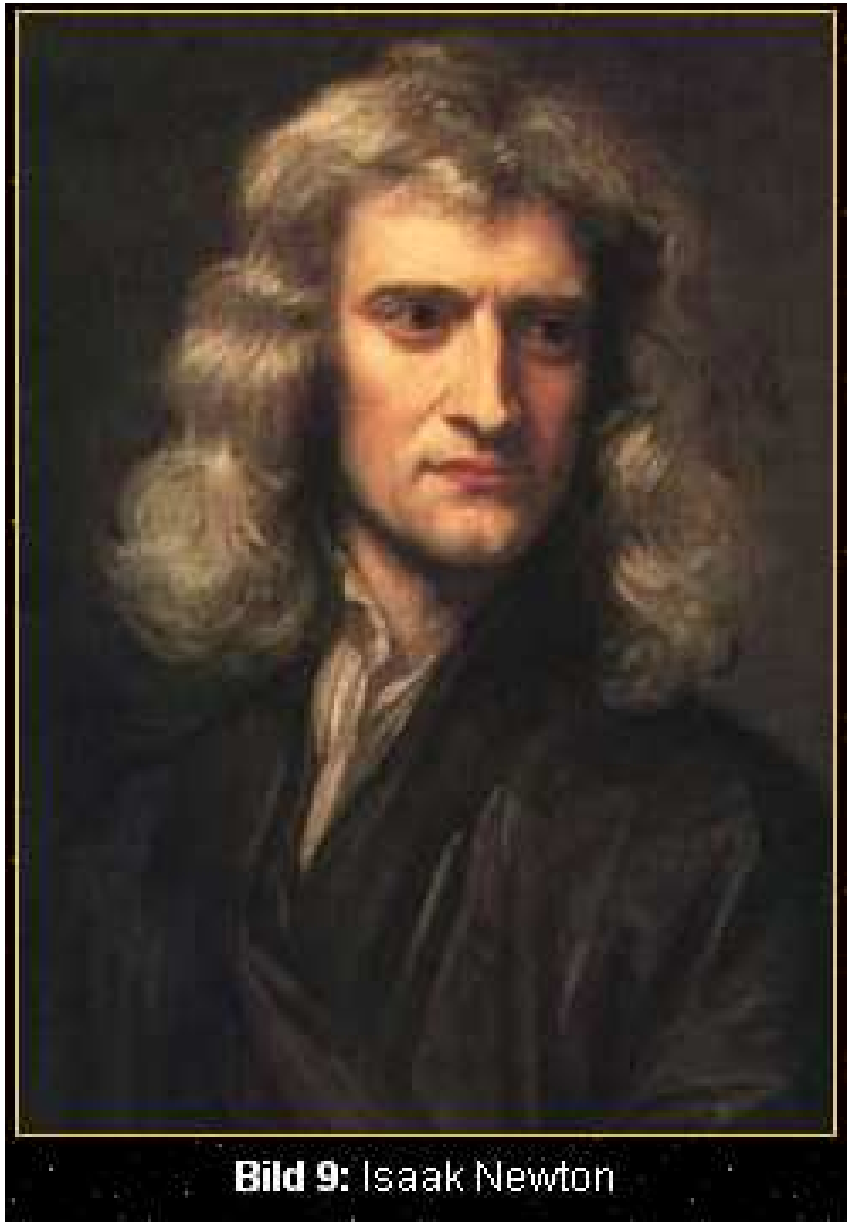


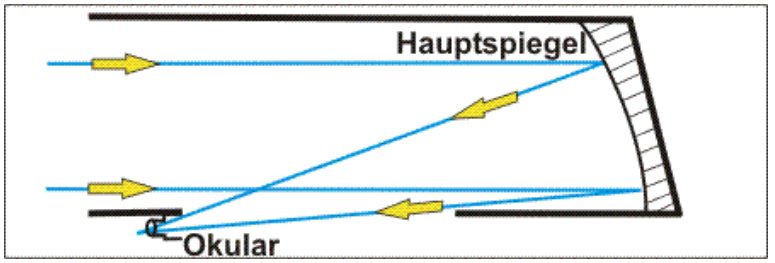
Bild 9: Isaak Newton

Bild 12: Das optische Prinzip des Newton-Spiegelteleskops

Replica des 6"-Telekopes von Newton

Teleskop - Geschichte:

Bild 15: William Herschel



1,2m Spiegeldurchmesser

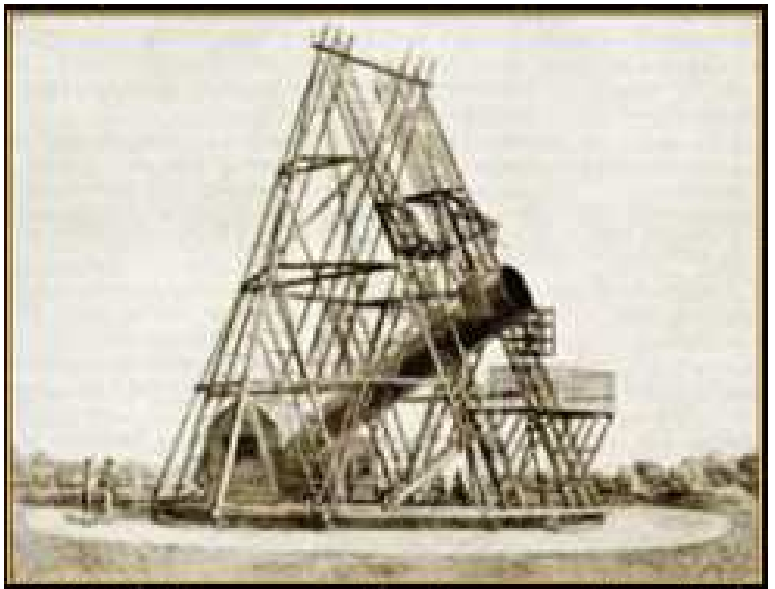
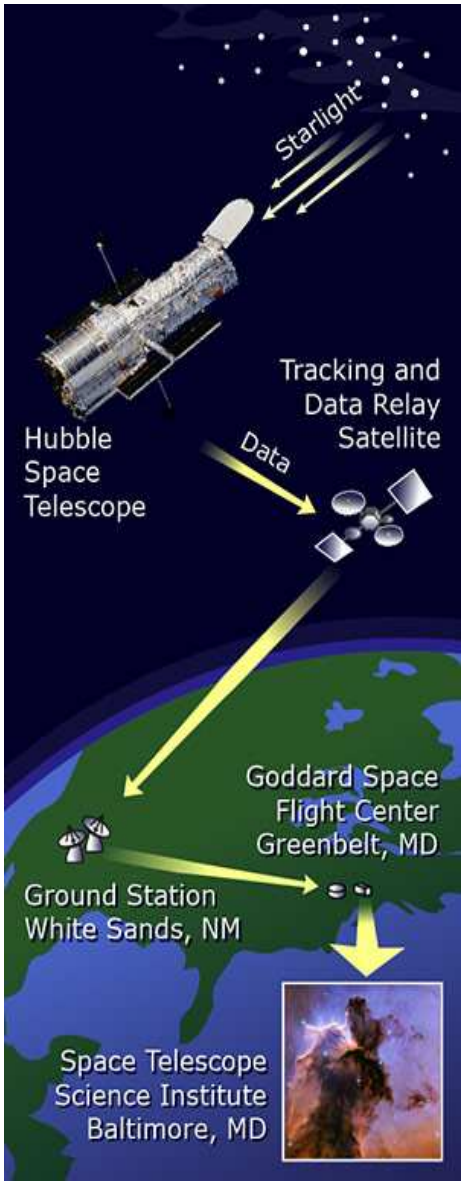
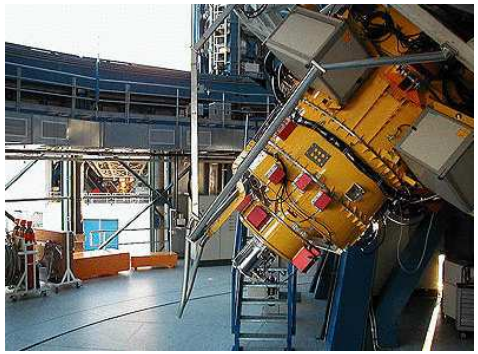


Bild 16: Das große Teleskop von Herschel

„moderne“ Teleskope:



„moderne“ Teleskope:



Teleskop Varianten:

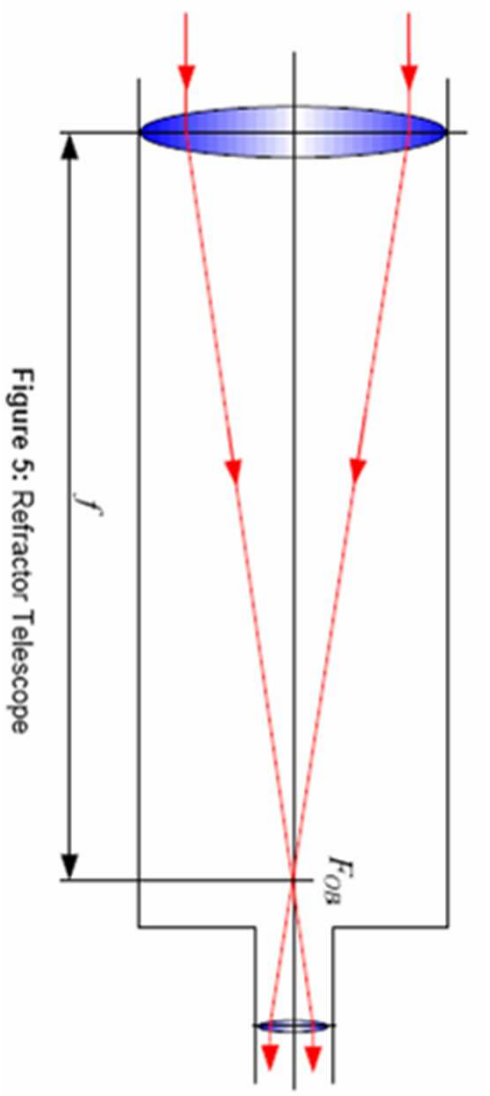


Figure 5: Refractor Telescope

Teleskop Varianten:

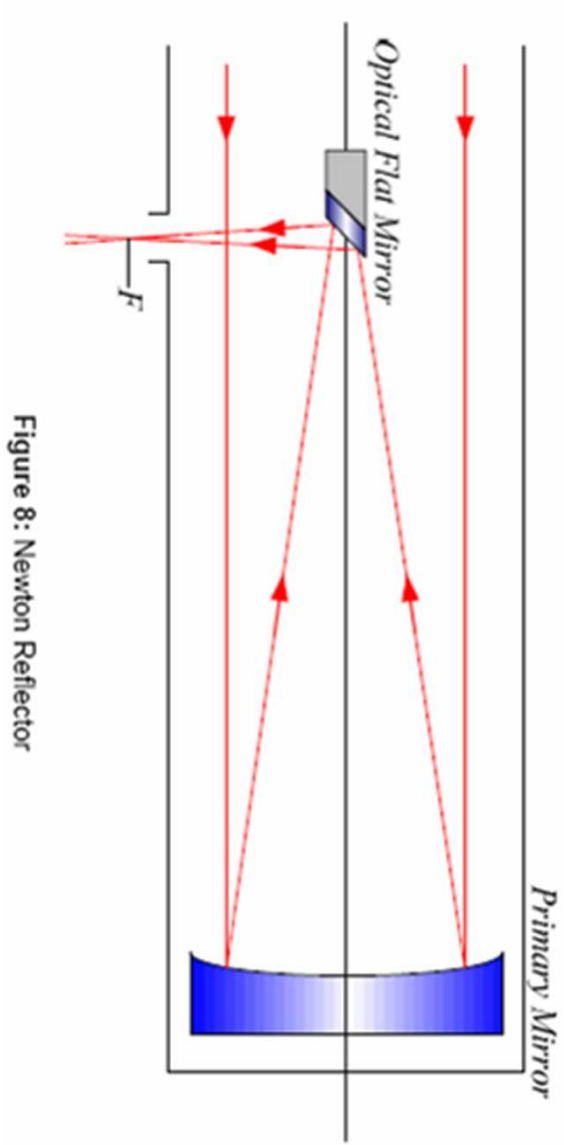


Figure 8: Newton Reflector

Teleskop Varianten:

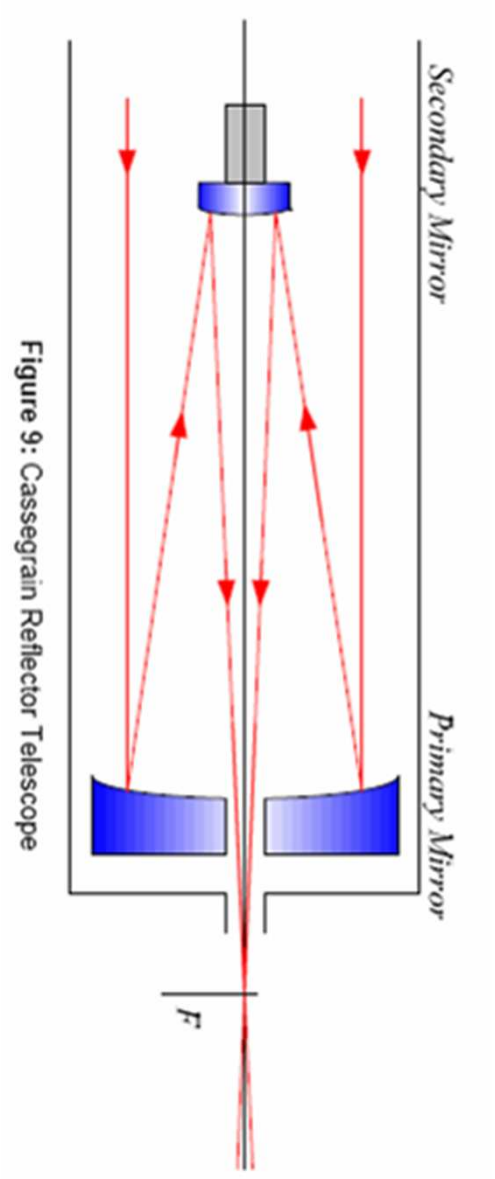


Figure 9: Cassegrain Reflector Telescope

Teleskop Varianten:

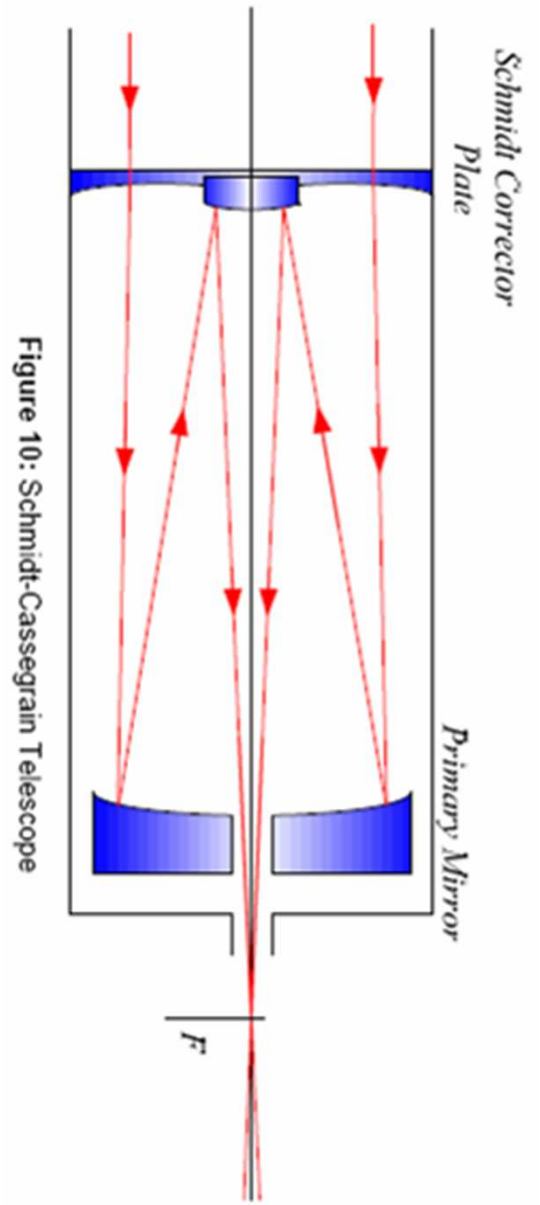
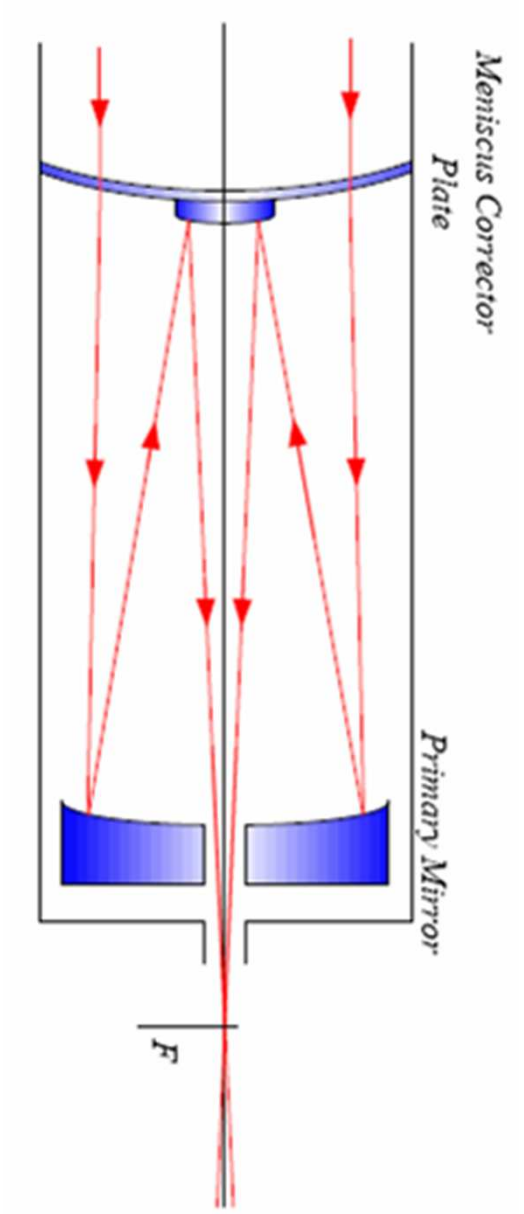


Figure 10: Schmidt-Cassegrain Telescope

Teleskop Varianten:



Beugung – Airy Disc / Beugungsscheibchen:

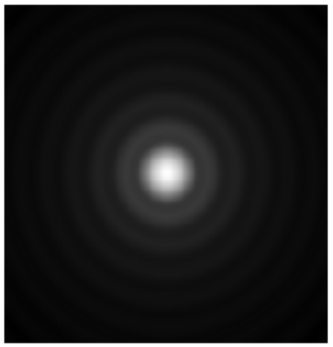


Figure 22: Airy Disc

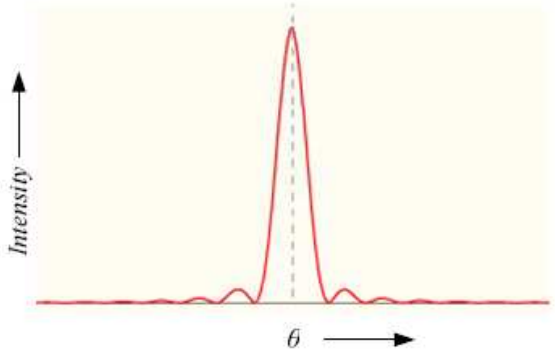
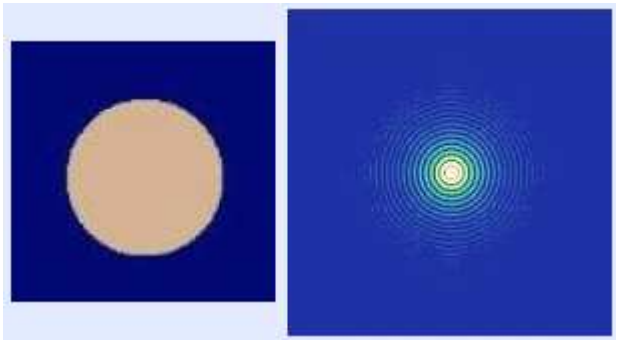
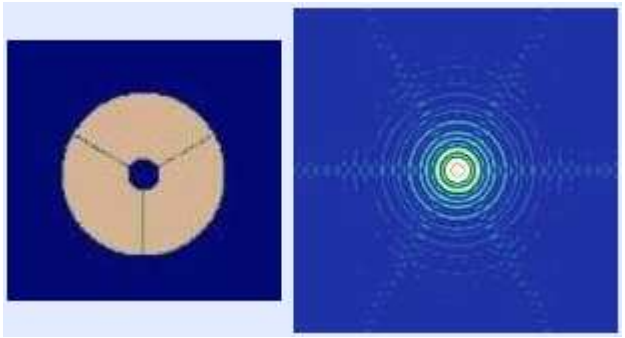
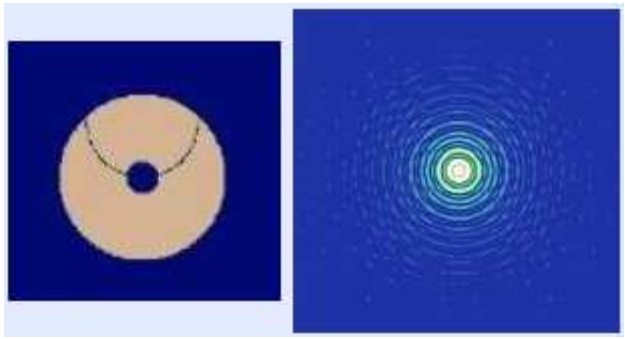
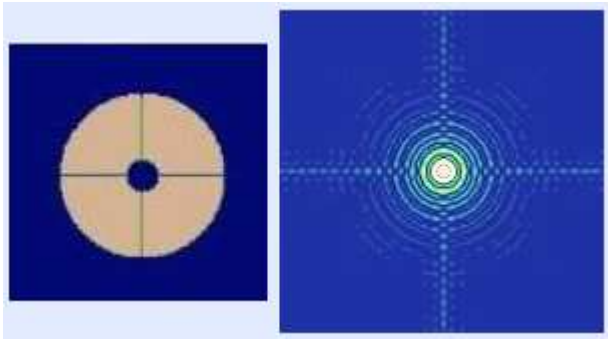


Figure 23: Diffraction Pattern

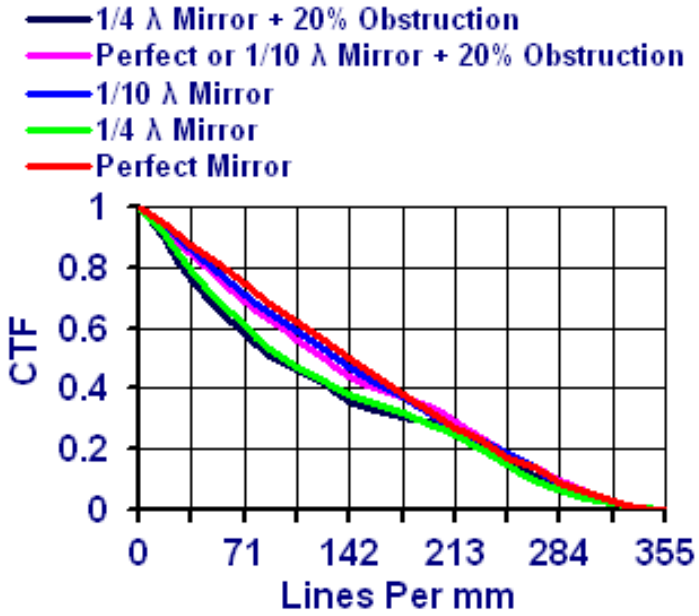


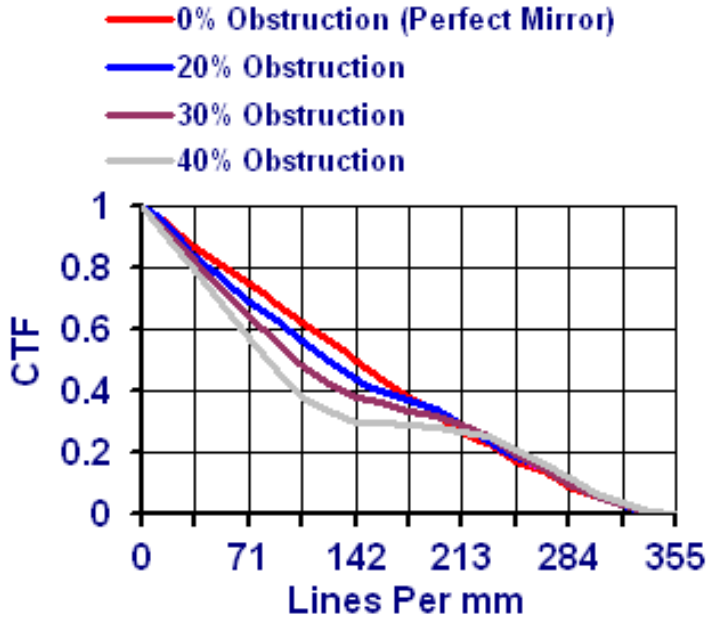






Kontrast - Contrast Transfer Function (CTF):





Abbildungsfehler:

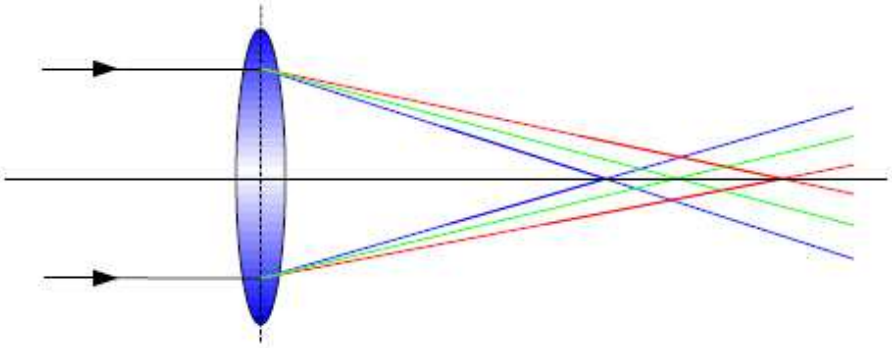


Figure 15: Longitudinal Chromatic Aberration

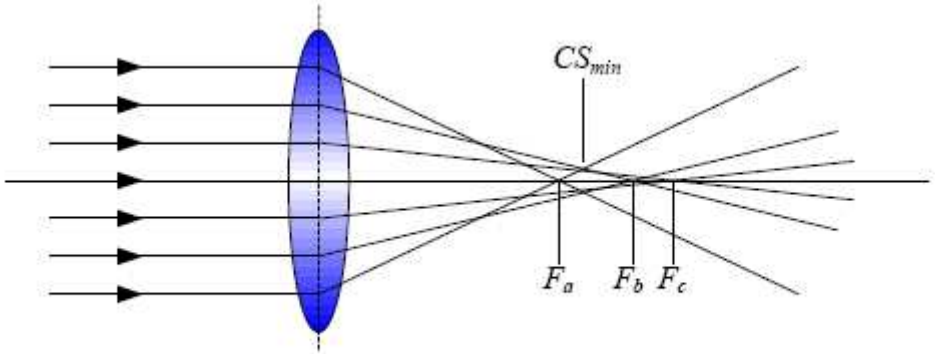


Figure 16: Spherical Aberration

Abbildungsfehler:

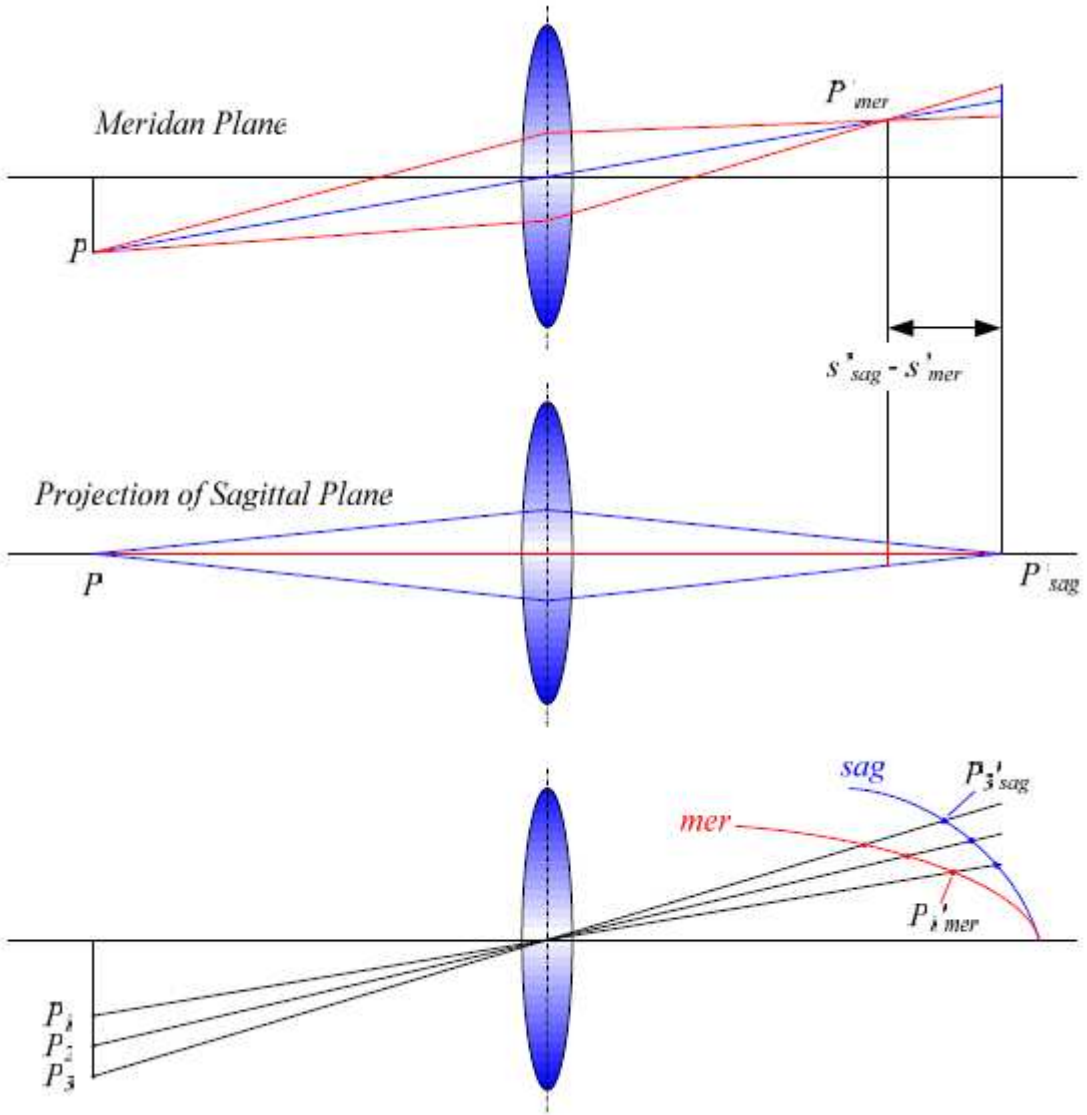


Figure 19: Astigmatism

Abbildungsfehler:

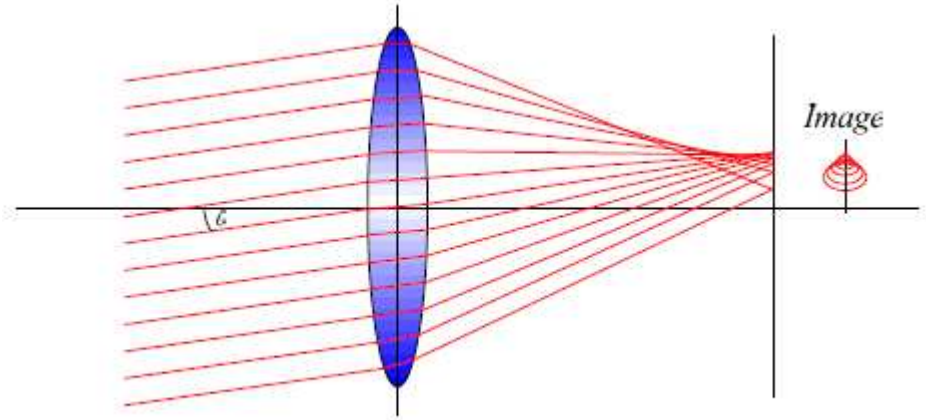


Figure 20: Coma

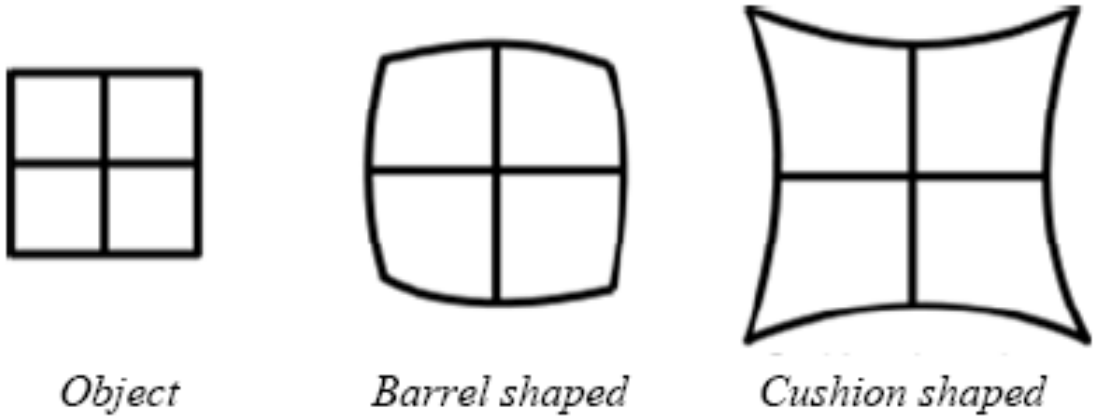
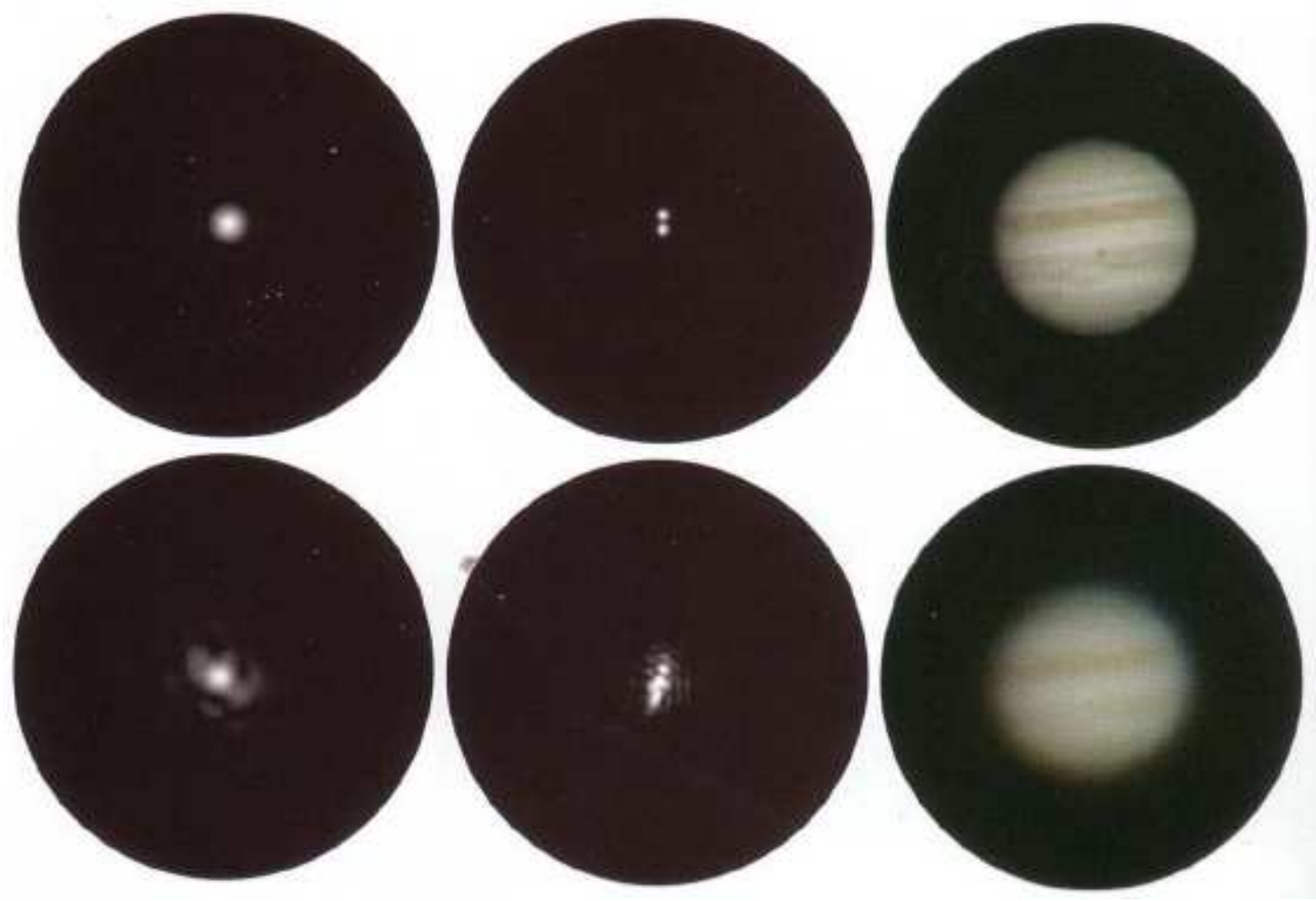


Figure 21: Distortion of the Image

„Seeing“:



Thermische Effekte:

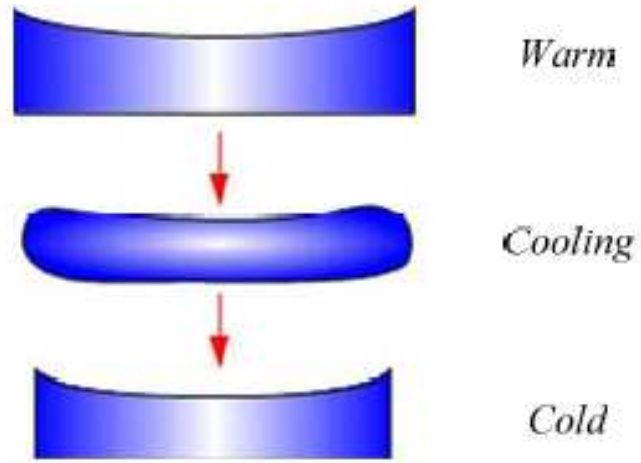


Figure 25: Glass Cooling

Wärmeausdehnung: $L = L_0(1 + \alpha \cdot \Delta T)$

Wärmeleitfähigkeit: $\lambda = \frac{Q}{t} \cdot \frac{L}{A \cdot \Delta T}$ $W/m*K$

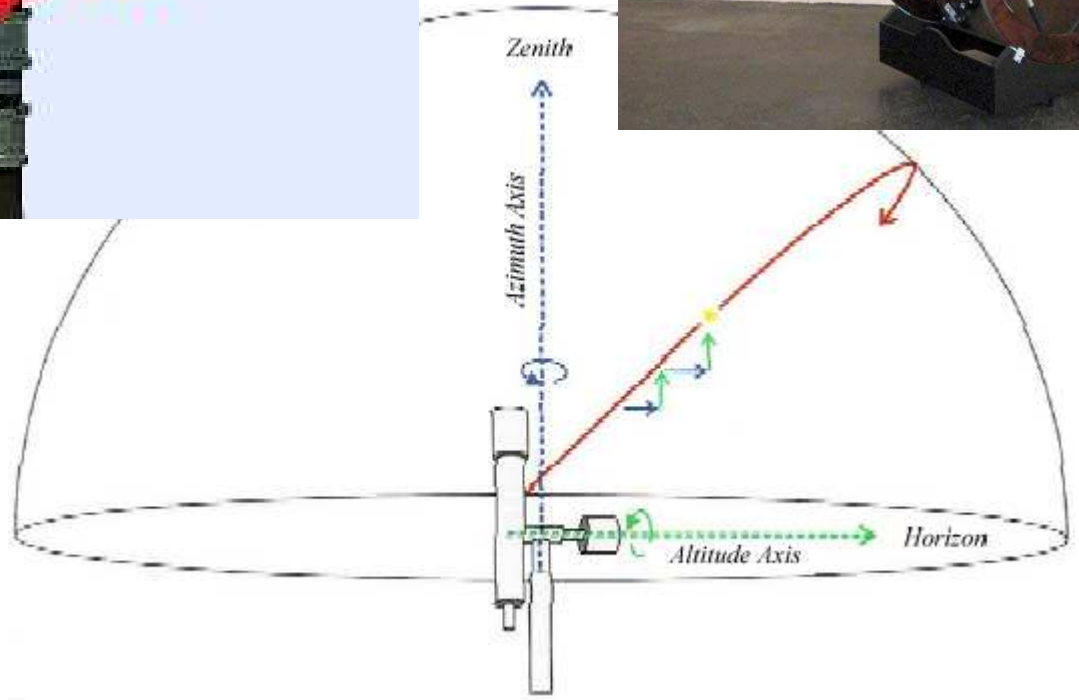
Wärmekapazität: $c = \frac{Q}{m \cdot \Delta T}$ $J/Kg*K$

Thermische Effekte:

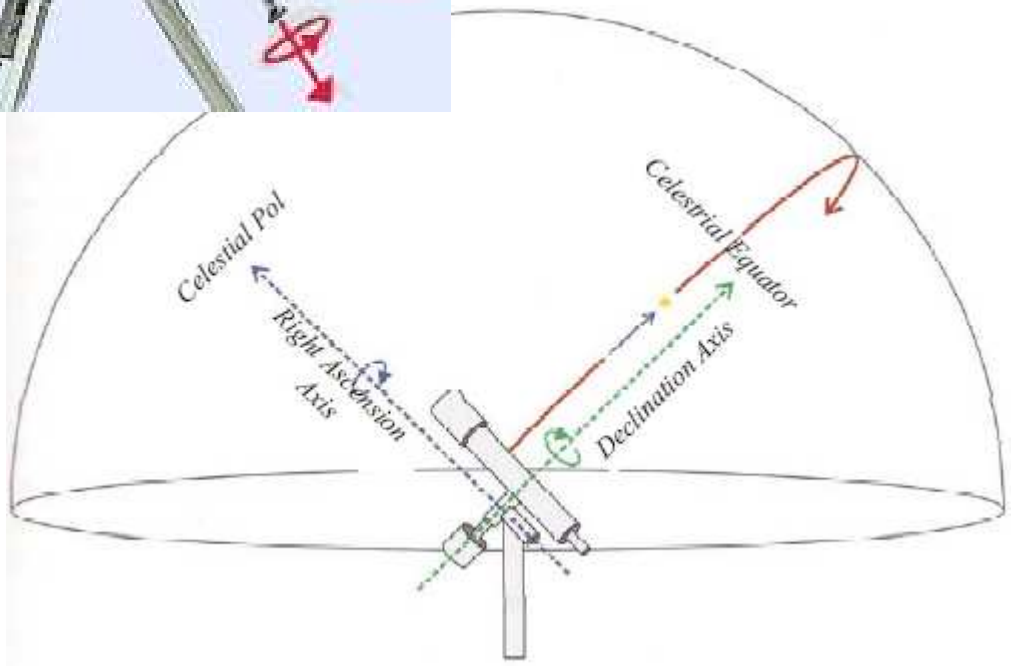
Glass Type	Thermal Coefficient of Expansion (10^{-6}/K)	Thermal Conductivity (W/m*K)	Specific heat (J/KgK)	Relative Material Cost (Plate Glass=1)	Comments
Plate Glass	>8.6	0.75	730	1	Produced by Everybody. Suitable for Elliptical flats and quite suitable for mirrors up to 12", as these smaller and thinner mirrors stabilize quicker. But most customers are now going for a lower expansion glass, even for these smaller sizes
Suprax 8488	4.3	1.2	?	1.1	Produced by Schott. Our main "Low Expansion Glass" manufactured up to mid 2004 and then the kiln was shut down. A supply became available again in 2006. It is popular because its price is close to that of Plate Glass.
Pyrex 7740	3.25	1.13	726	1.3	Produced by Corning. Saw more use from mid 2004 as a replacement for Suprax. Thermal Coefficient is marginally better than Suprax, but more expensive at current prices
BK7	7.1	1.11	858	1.1	Produced by Everybody. Our main use is Cassegrain secondaries, where we need the good transmission characteristics for testing
BVC	2.4-2.8	?	?	1.2	Produced by ASM products of Canada. Definitely a serious option for very large mirrors, but not currently popular for smaller mirror, due to its "looks" (It's Black!) Became more popular in mid 2004.
Fused Silica	0.55	1.38	703	?	
Zerodur	>0.02	1.64	821	>10	Produced by Schott. This has extremely low thermal expansion, but you have to be able to afford it!
ULE 7971	>0.05	1.31	776	?	Produced by Corning. As an alternate to Zerodur.
Borofloat	3.25	1.11	830	?	Produced by Schott. As an alternative to Pyrex.
E6	2.8	1.1	730	?	Produced by Ohara. As an alternative to Pyrex.

Table 1: Glass Types for Telescope Mirrors

Alt-Azimuth Montierung:



Äquatoriale Montierung:

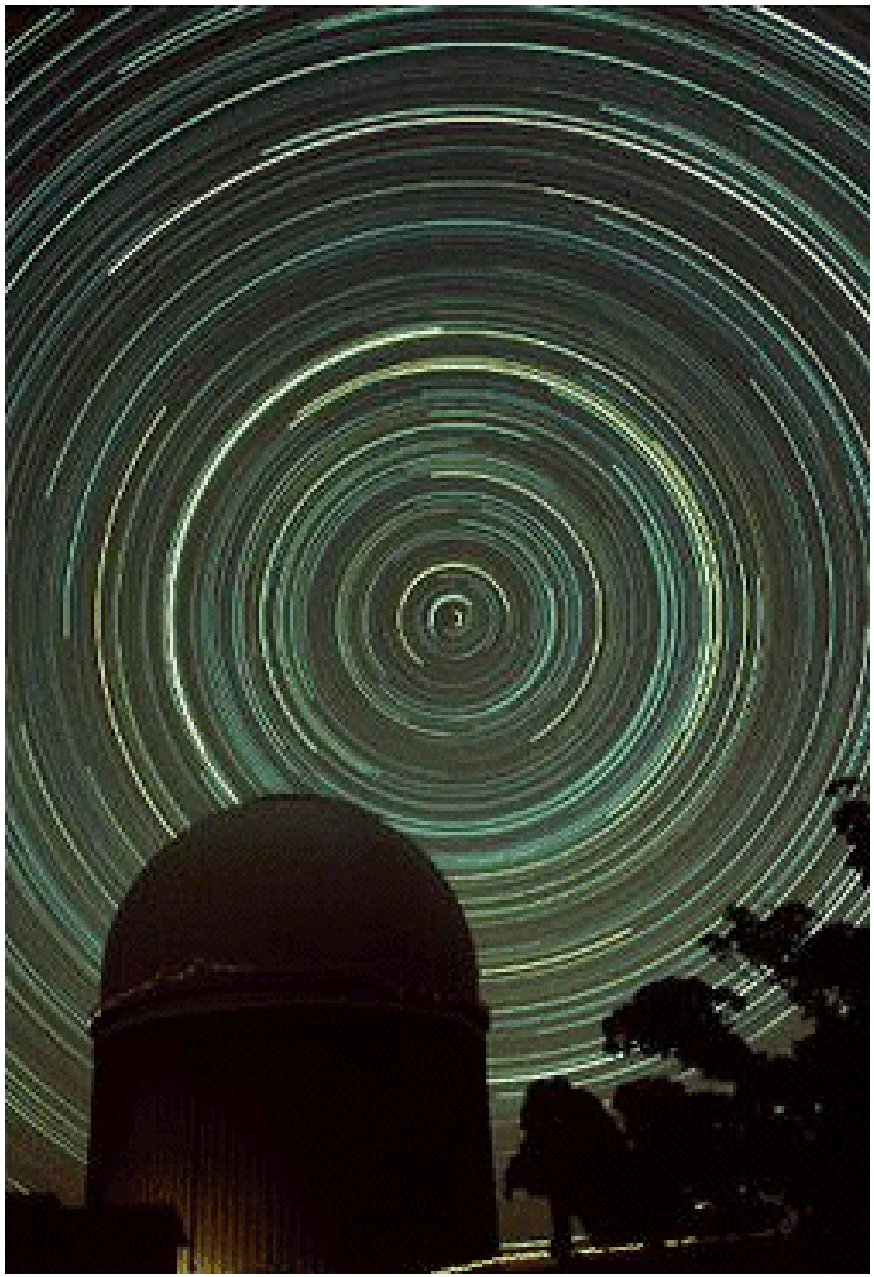


Formen Äquatoriale Montierung:

Deutsche Montierung

Gabelmontierung

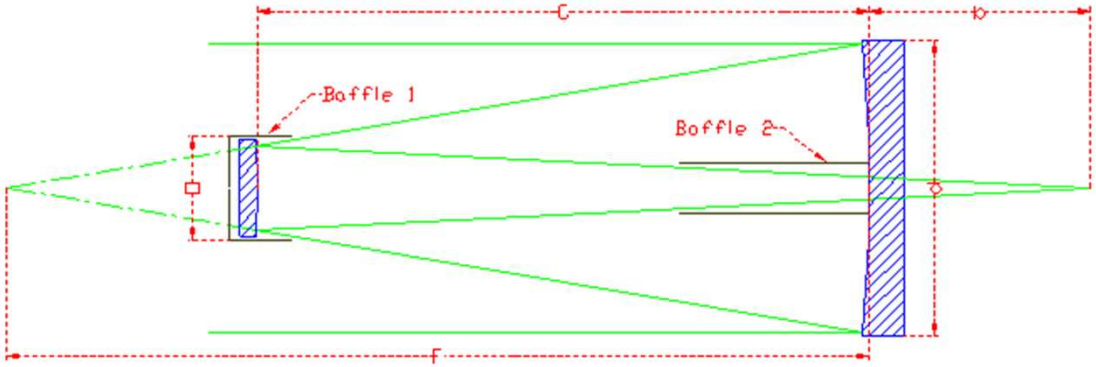
Montierung - Nachführung:



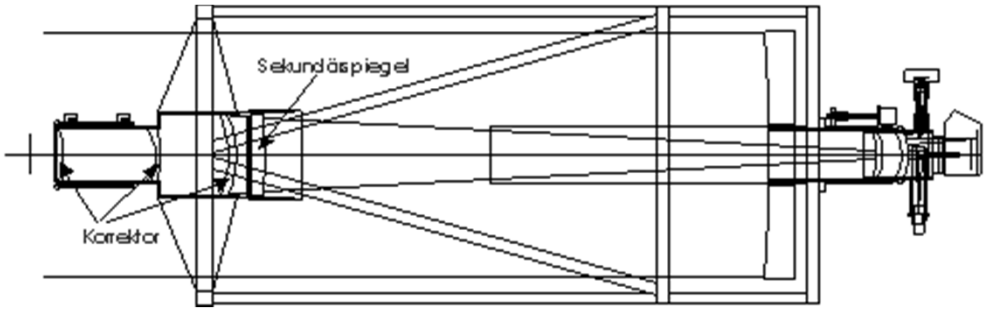
Das FH-Teleskop:

Selbstbau eines 40cm Spiegelteleskops:

Cassegrain Sekundärfokus (F/10 = 4000 mm):



Primärfokus mit Korrektor (F/2,2 = 880 mm):



Die Optik:

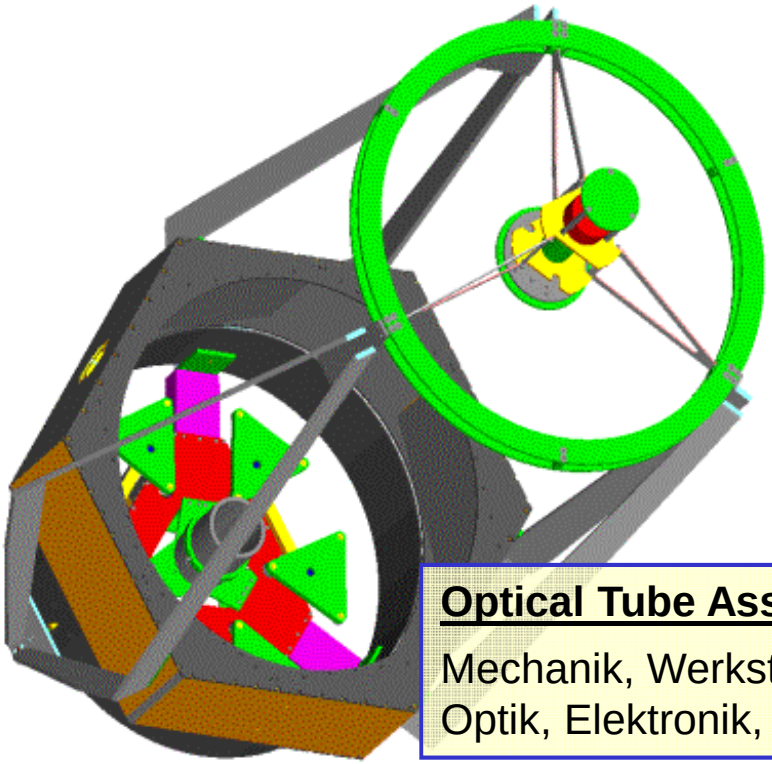
WAVE FRONT DETAILS

Listing of Zernike Fringe Coefficient Data

Title: Steinbatz
Date : Friday May 19 2006

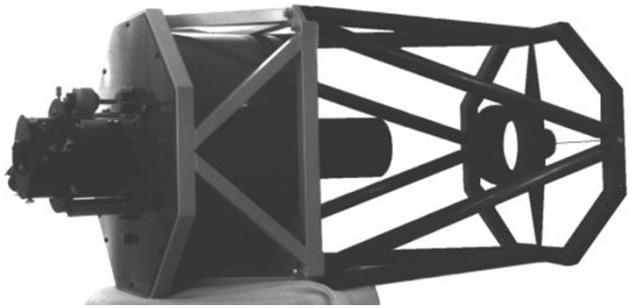
Wavelength	:	0.550 microns
Peak to Valley	:	0.104 waves
RMS (to chief)	:	0.030 waves
Strehl Ratio	:	0.964

Optischer Tubus:

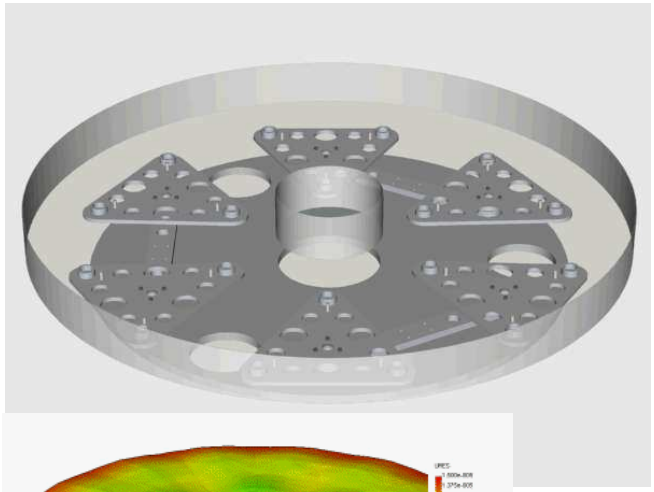


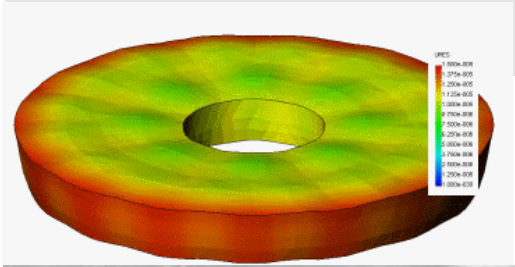
Optical Tube Assembly (OTA):

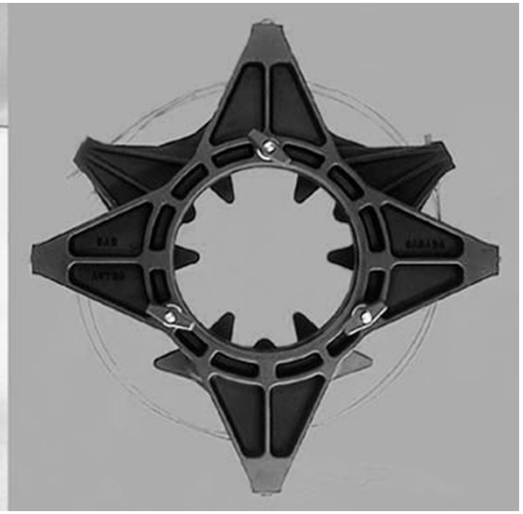
Mechanik, Werkstoffe (CFK),
Optik, Elektronik, Sensorik

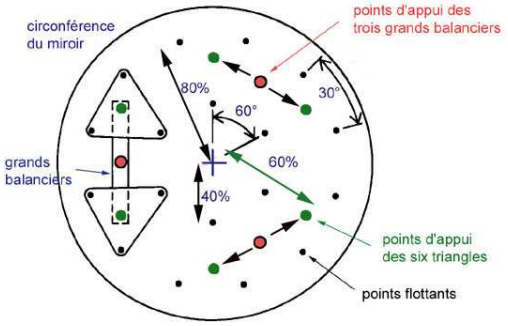


Spiegelhalterungen:









Montierung:

Montierung:

Mechanik, Automatisierung, Antriebstechnik, Elektronik, Sensorik

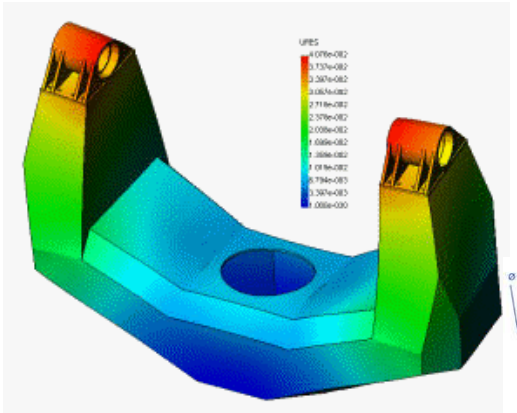
Tragwerk: Alu, Niro, CFK, …

Antrieb: Schrittmotoren + Steuerung + Untersetzung

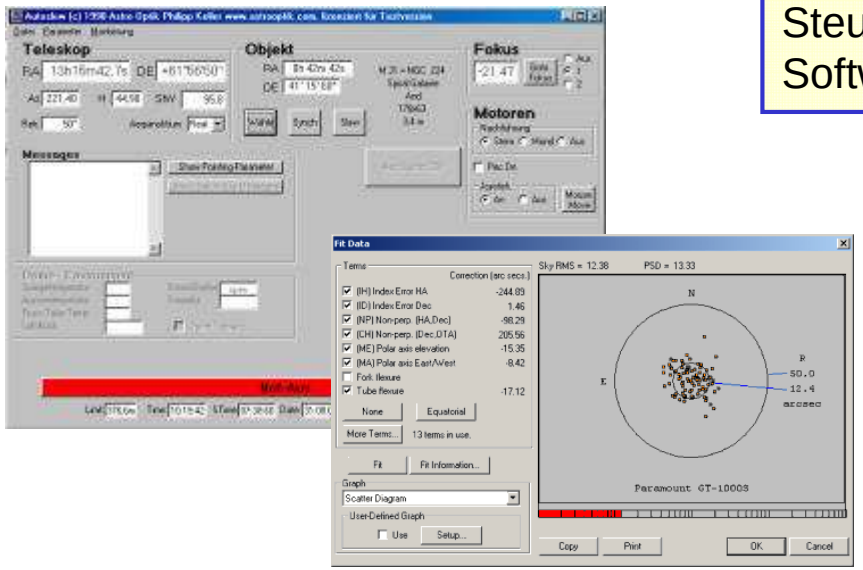
Direktantriebe!

Sensoren: Optische Encoder

Lager: Teflon-Speziallager (Eigenbau)



Steuerung:



GOTO + Guiding:

Steuerungs- & Regelungstechnik, Software-Entwicklung

Vollautomatische Beobachtung (remote controlled – Internet)

Satelliten-Tracking

„Mietbare“ Beobachtungszeit

Justierung der optischen Komponenten:

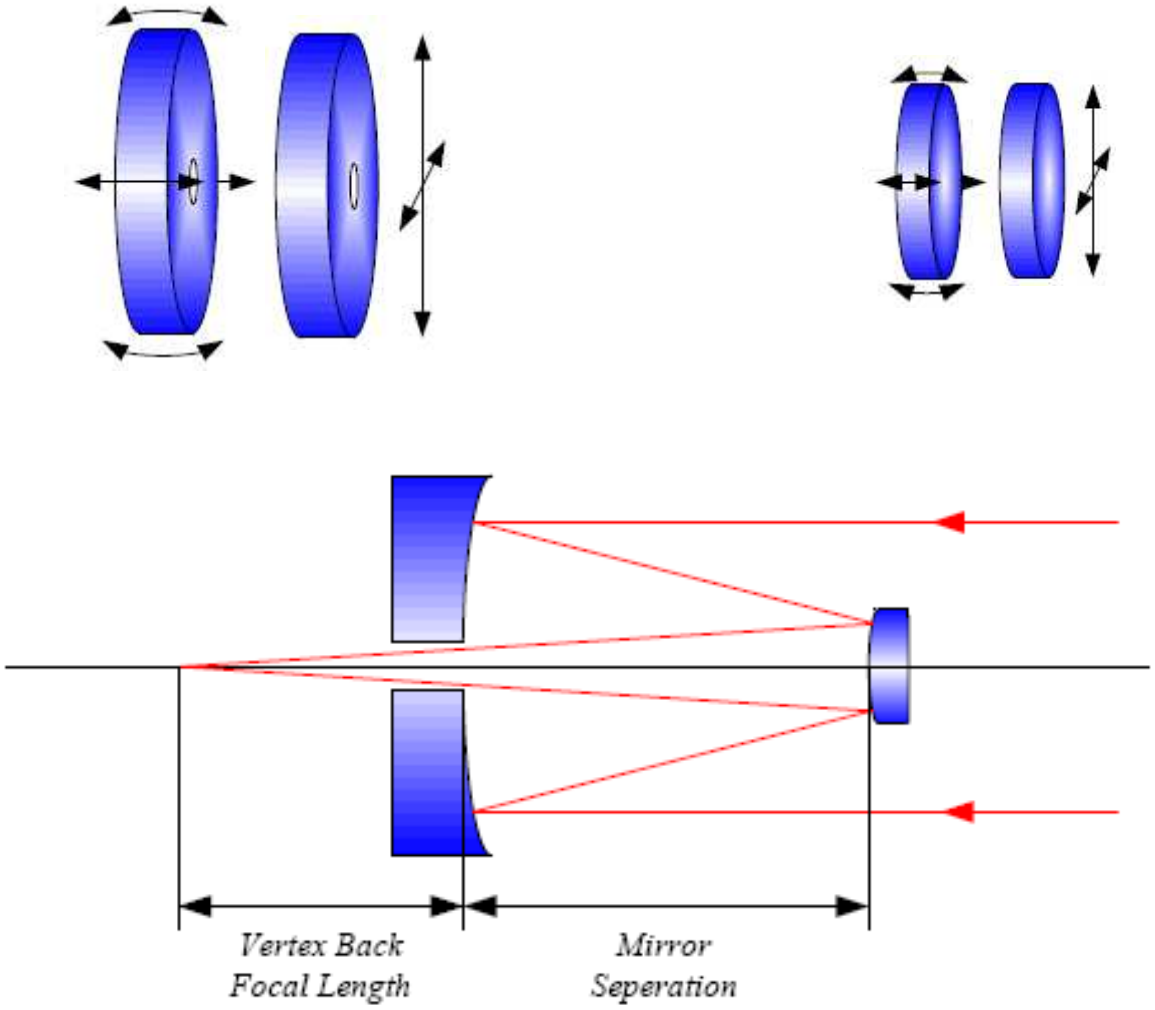
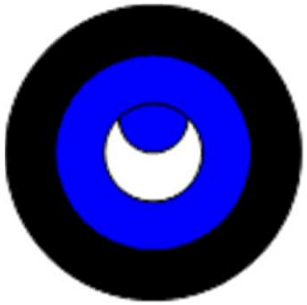
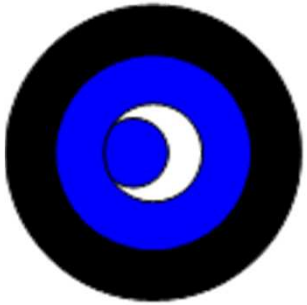


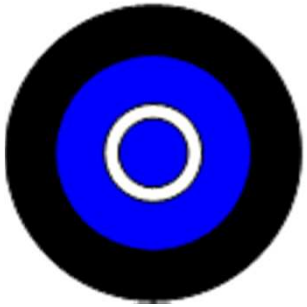
Figure 31: Critical Dimensions of a Cassegrain

Collimation:

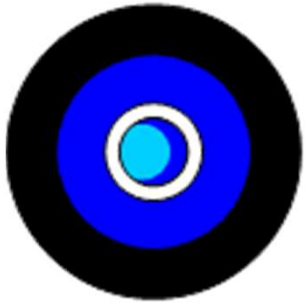
Adjusting Seconary Lateral





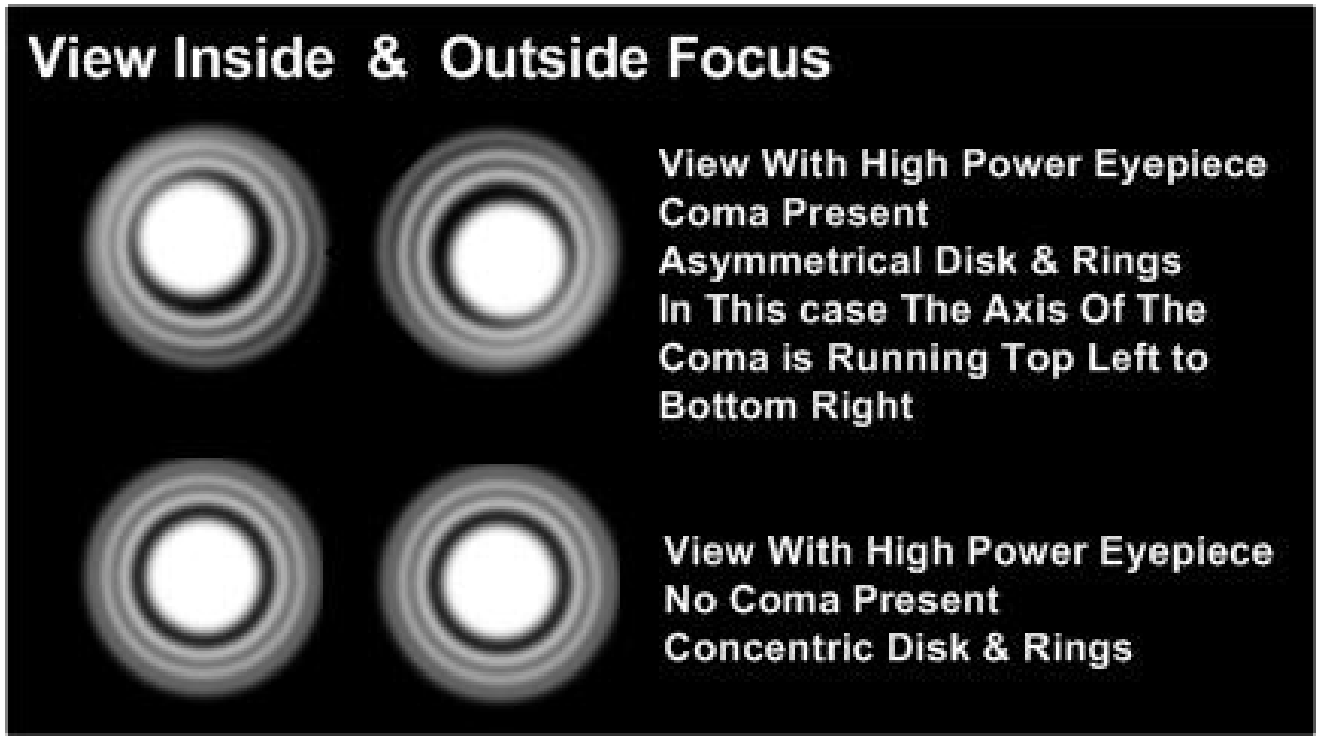


Adjusting Secondary Tilt



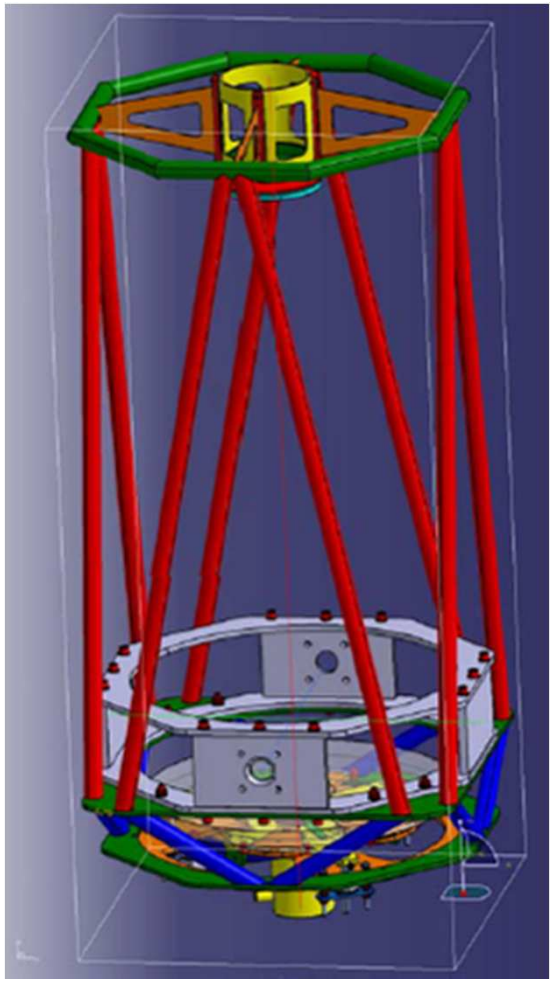
Collimation:

Adjusting Primary Tilt

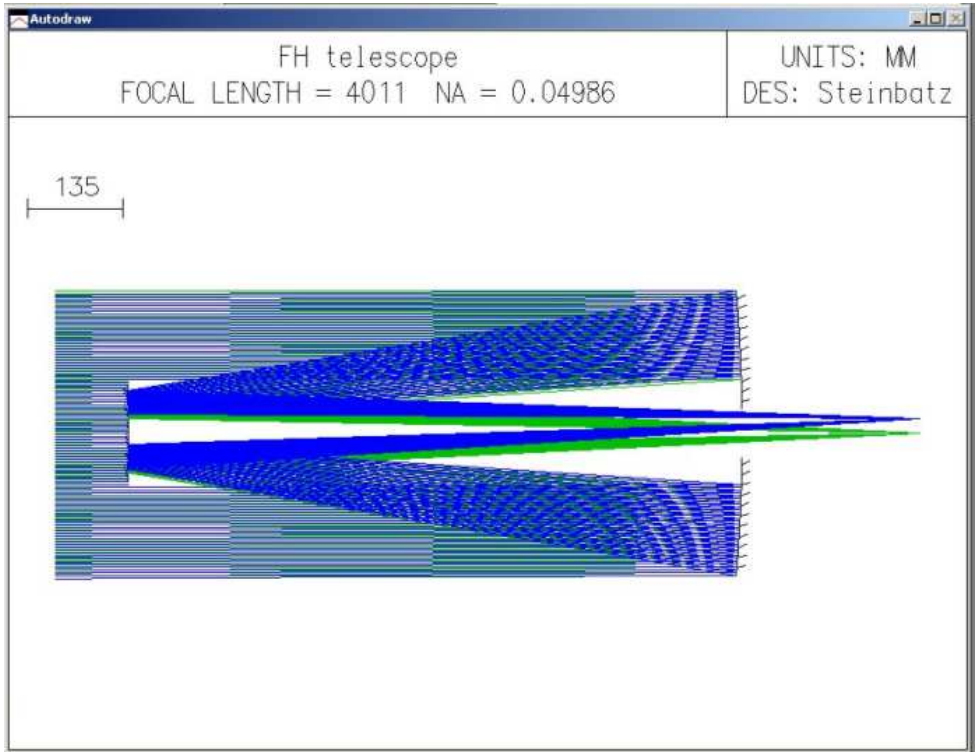


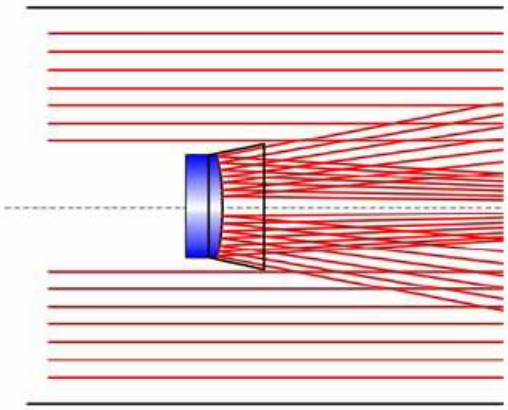
Der Gitterrohr-Tubus:

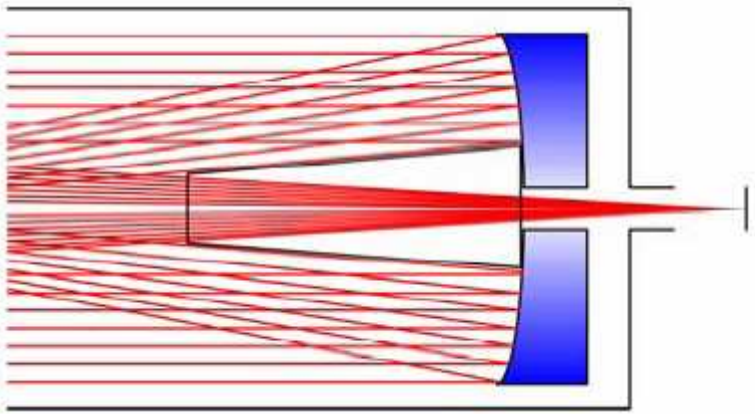
CAD Modell



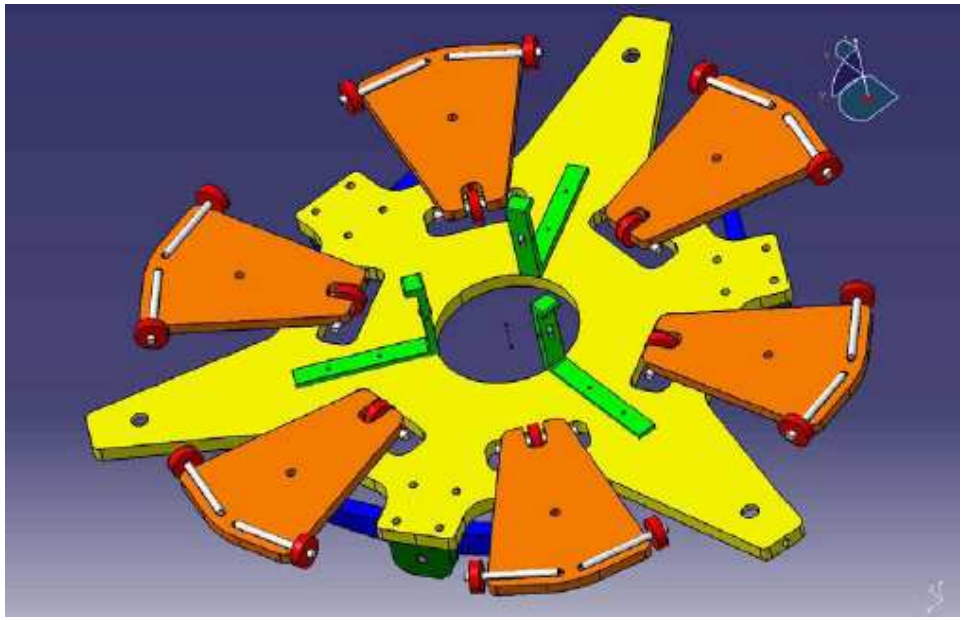
Baffles:

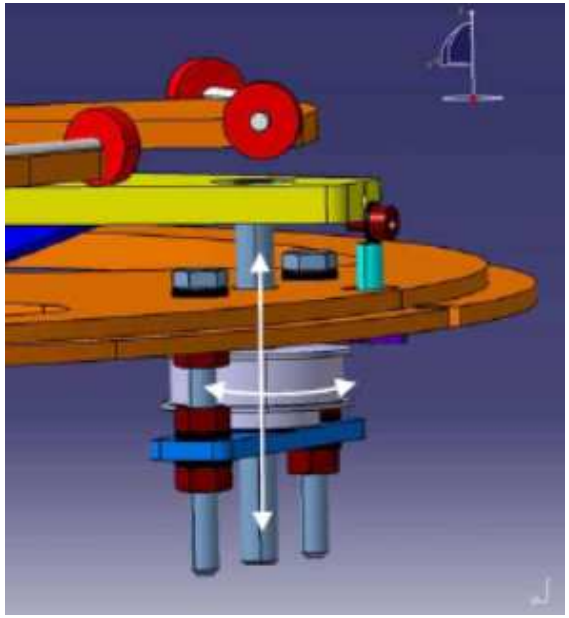

Autodraw
FH telescope
FOCAL LENGTH = 4011 NA = 0.04986
UNITS: MM
DES: Steinbatz
135

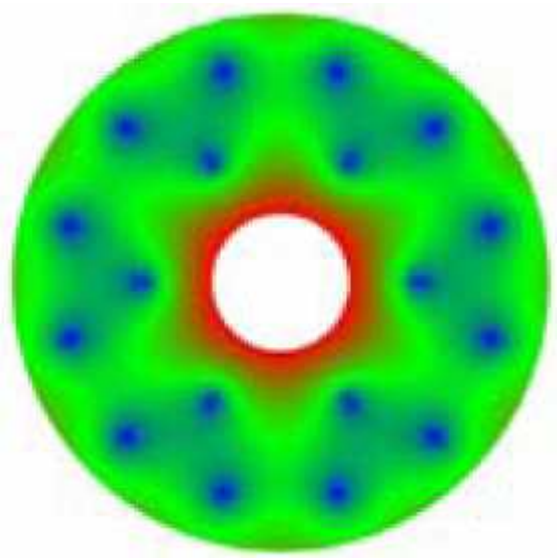


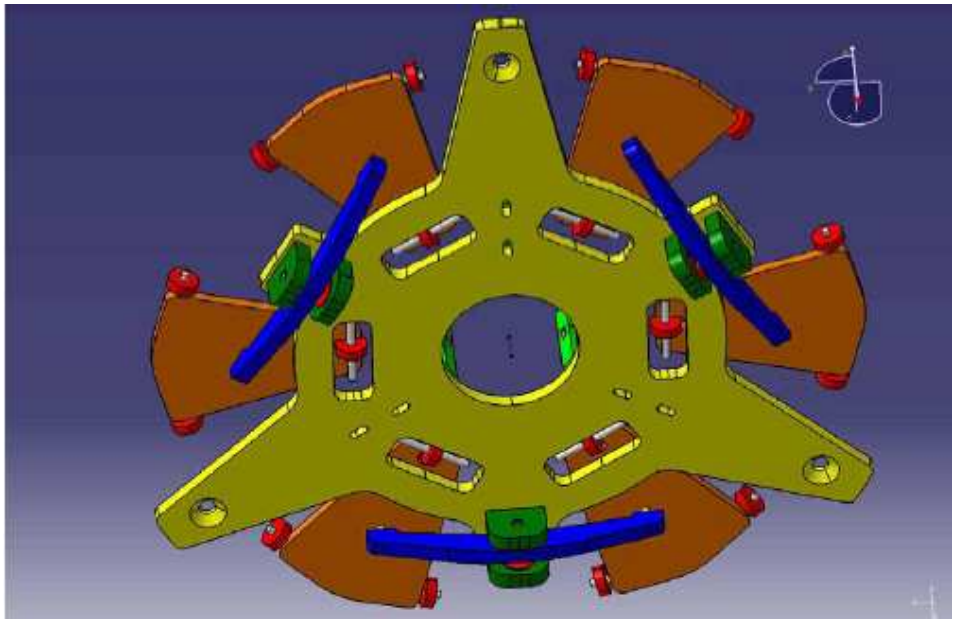


Die Hauptspiegelzelle:



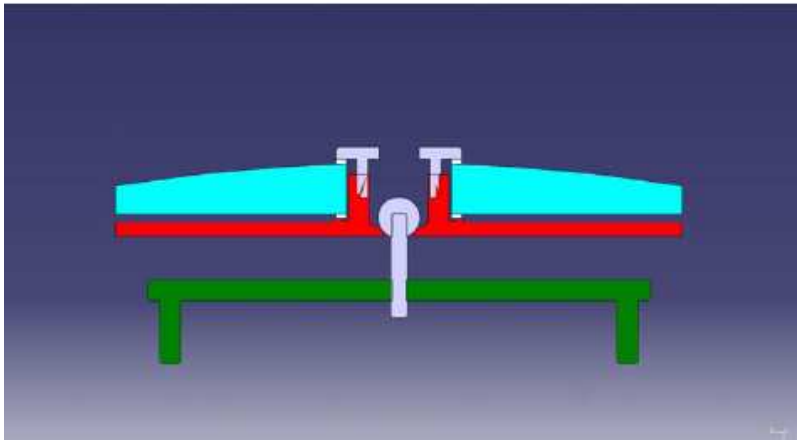


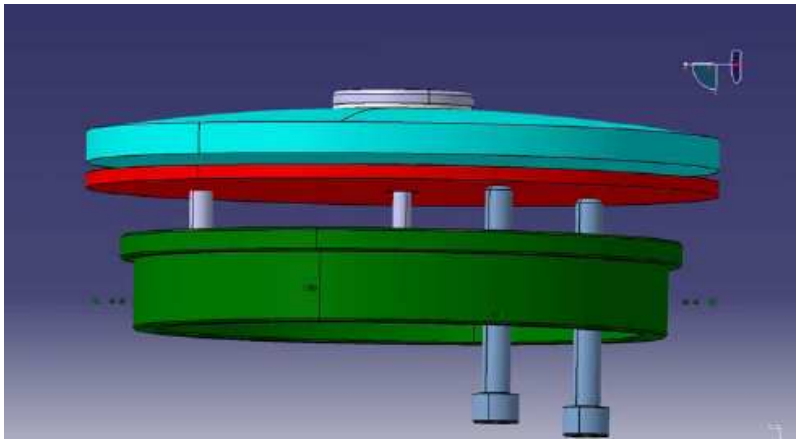


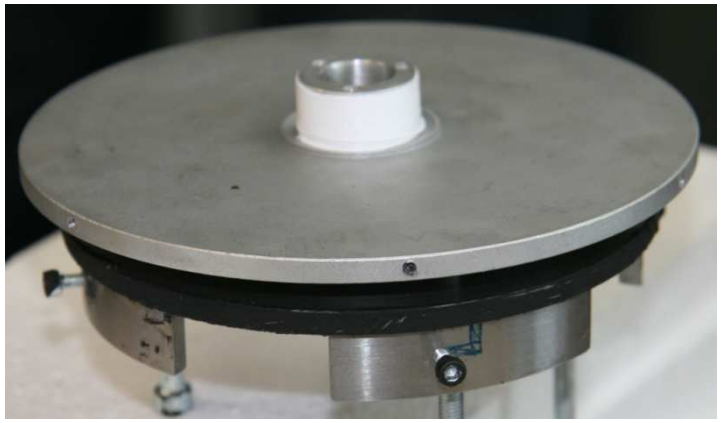


Die Hauptspiegelzelle:

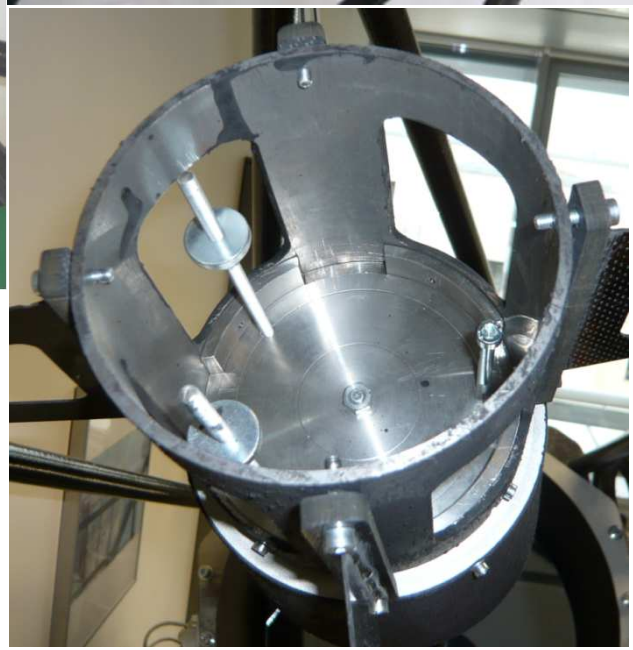
Die Sekundärspiegelhalterung:



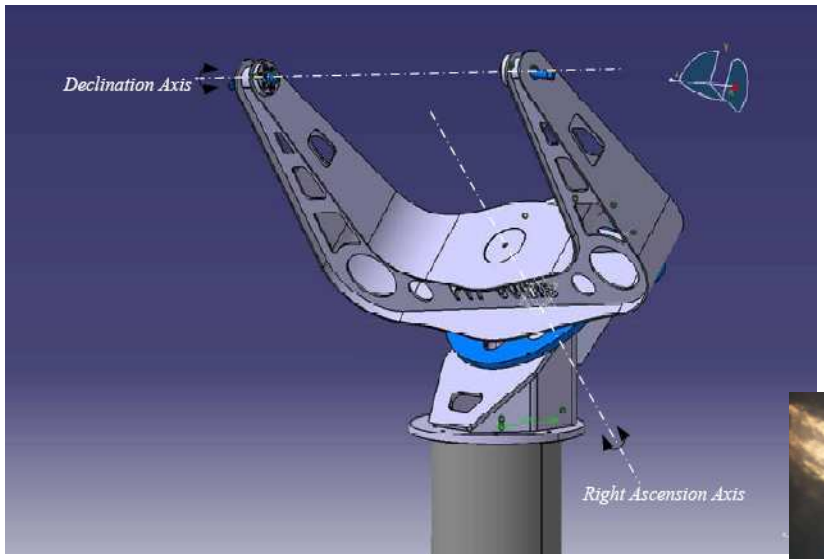


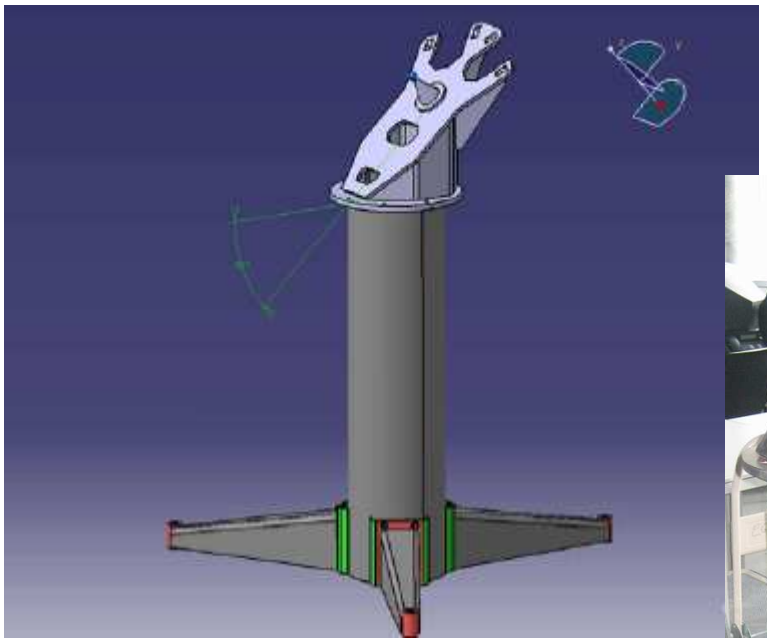


Die Sekundärspiegelhalterung:

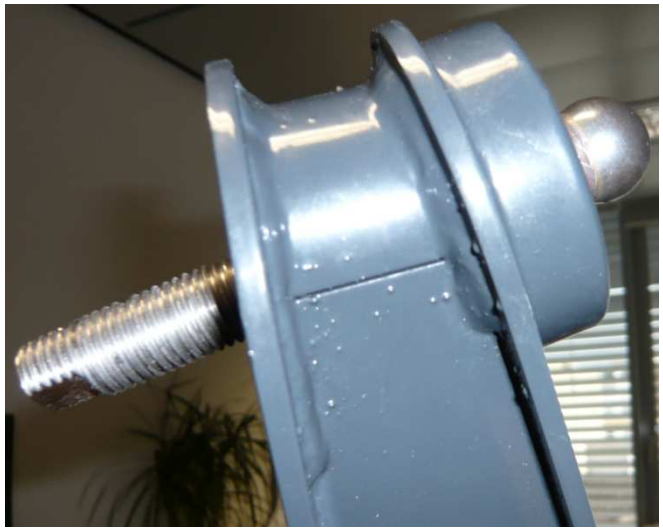


Die Gabelmontierung:



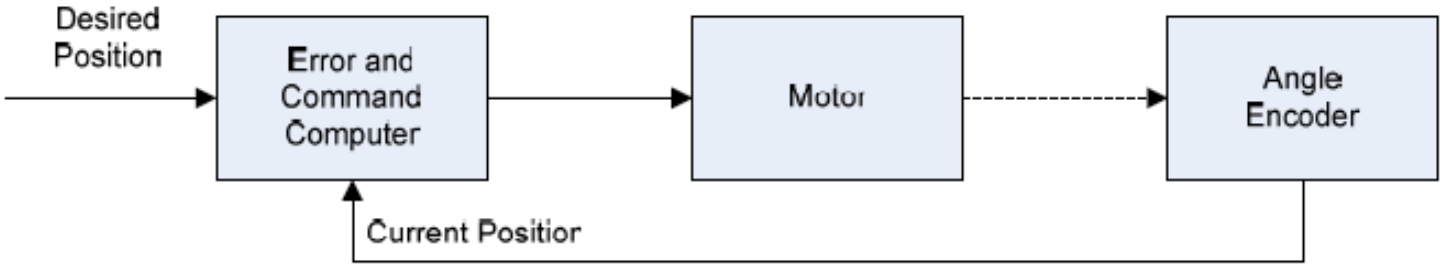


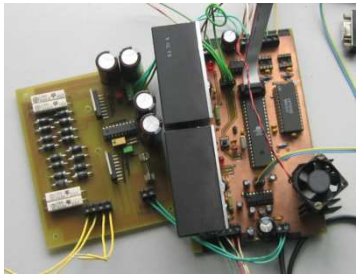
Die Gabelmontierung:

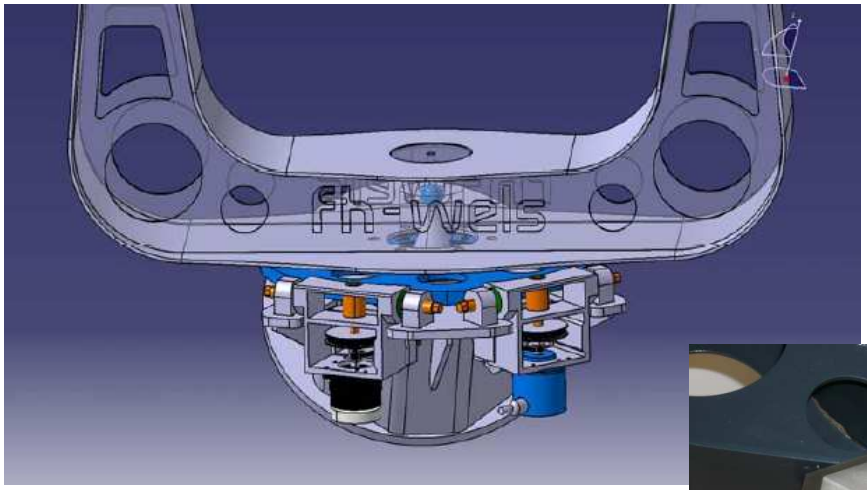


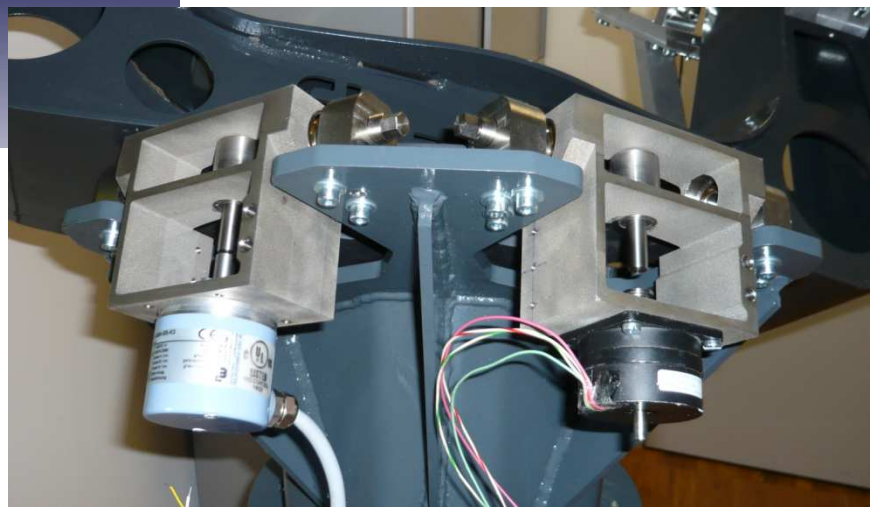
Einige Komponenten des Antriebs:

Antrieb / Nachführung RA:

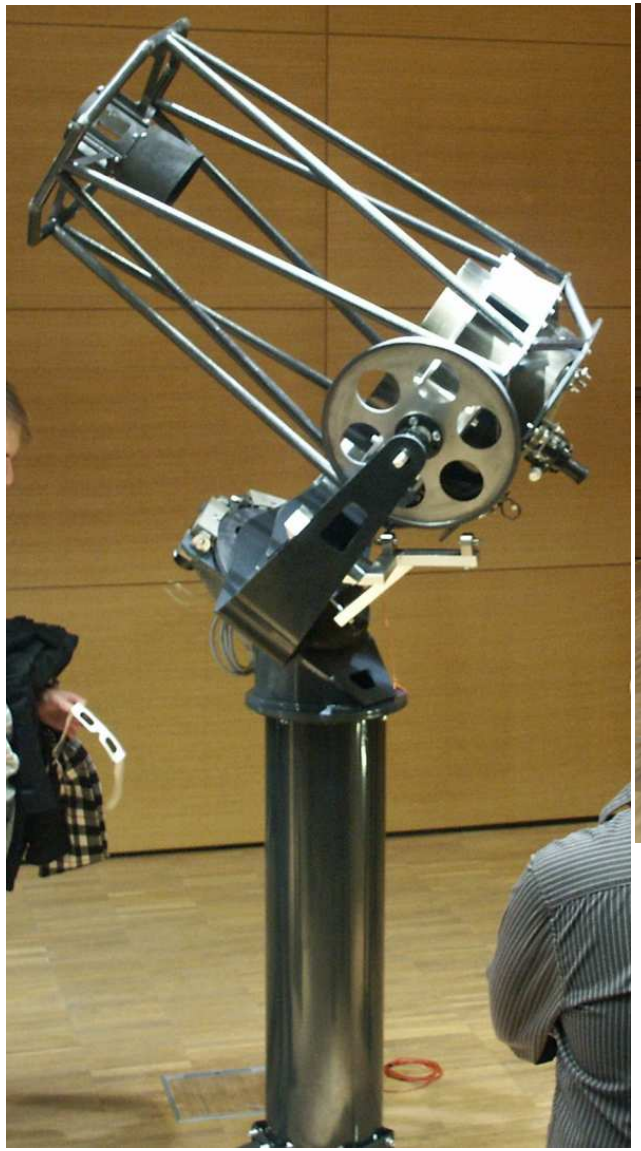








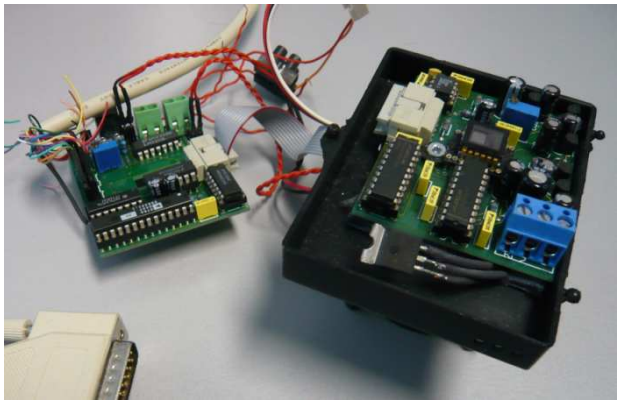
Der Zusammenbau:



CCD-Kamera:

- Entwicklung der Kamera-Elektronik samt Software
- Modulares Konzept für verschiedene CCDs
- CCD Analog Borad
- CCD Amplifier Board
- Controller Borad (MCU)
- Comunication Board (USB, Ethernet, …)
- Optimiert an Anforderungen (bestes S/N Verhältnis)
- DSP für digitales Auslesen des CCD

Erster Prototyp mit TC237H CCD realisiert



Erweiterung auf KAF6303E

Bildbearbeitung:

Bildaufnahme & -Auswertung:

Messtechnik & Algorithmen (CCD-Technik, Bildverarbeitung, Interferometrie, Spektroskopie,…)

Astronomische CCD-Kamera für Langzeit-belichtungen (Peltier-Kühlung)