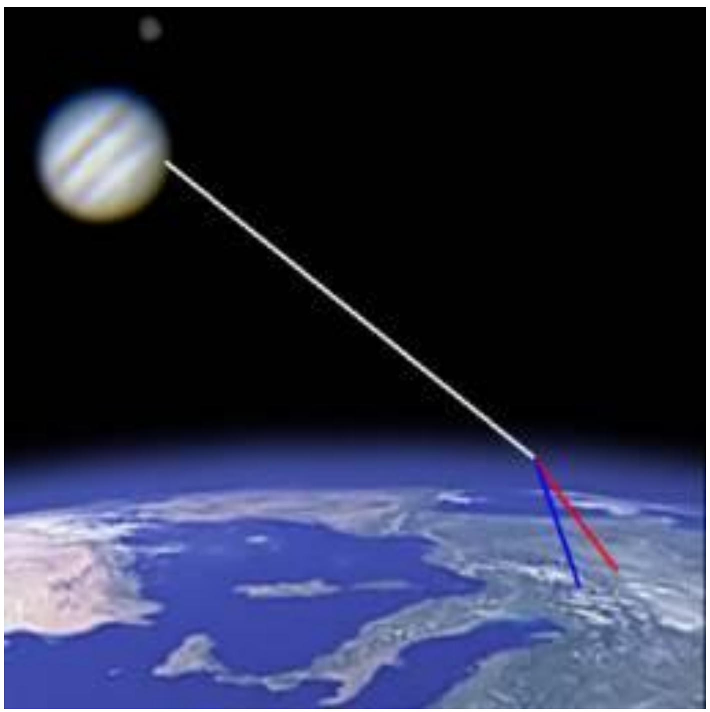
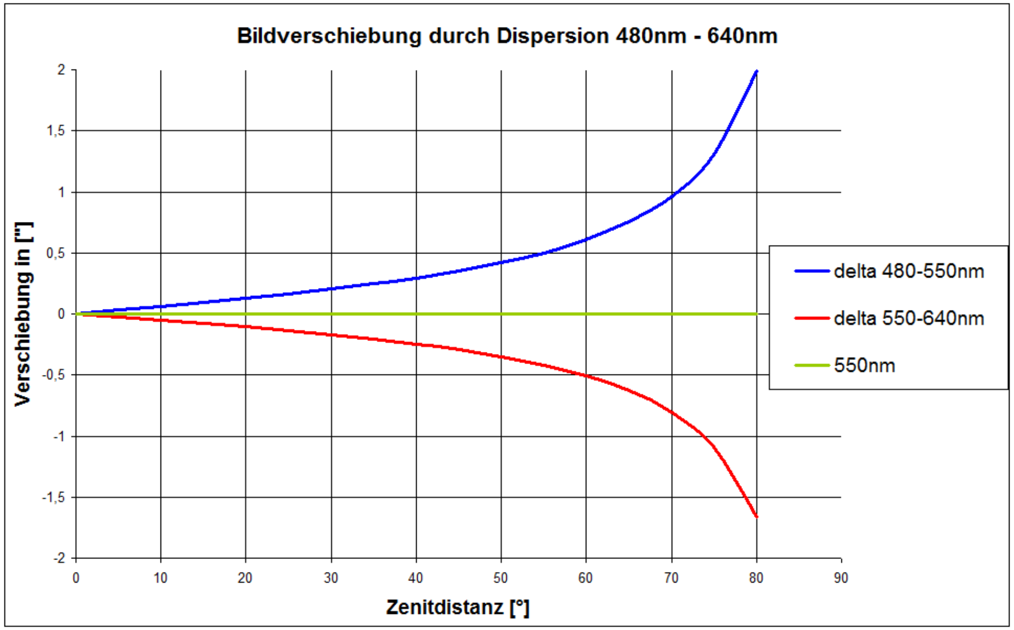
ADC Theory I

Characteristics of the atmosphere: Dispersion: „refraction“ of the atmosphere

Dispersion: blue Light is stronger refracted as red light

Consequently the image of a point will be expanded as a line in vertical direction:
The graph (calculated by Zeemax) shows that the image of star which is 30° above horizon has already a vertical extension of about 1“.



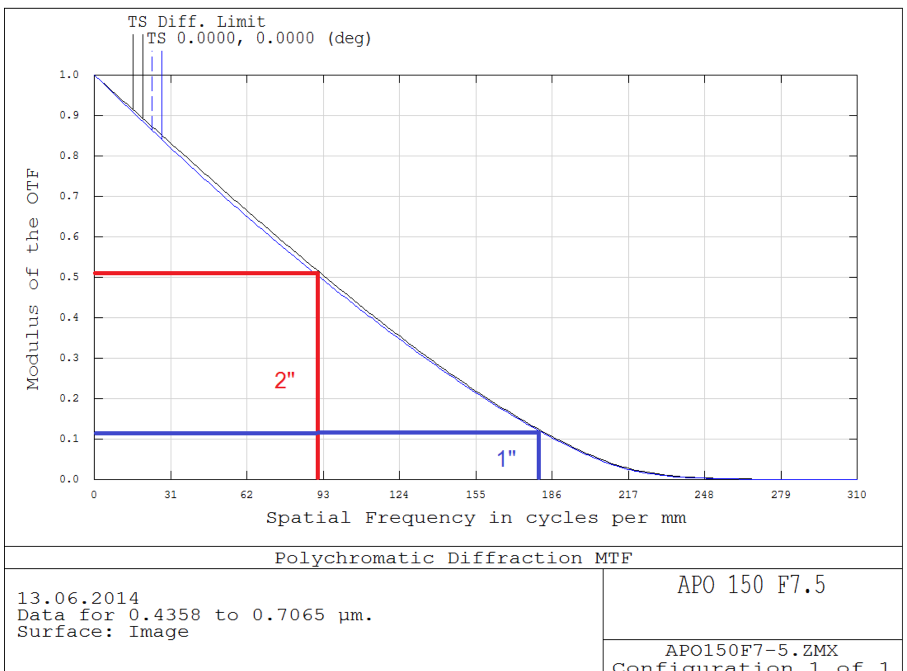


ADC Theory II

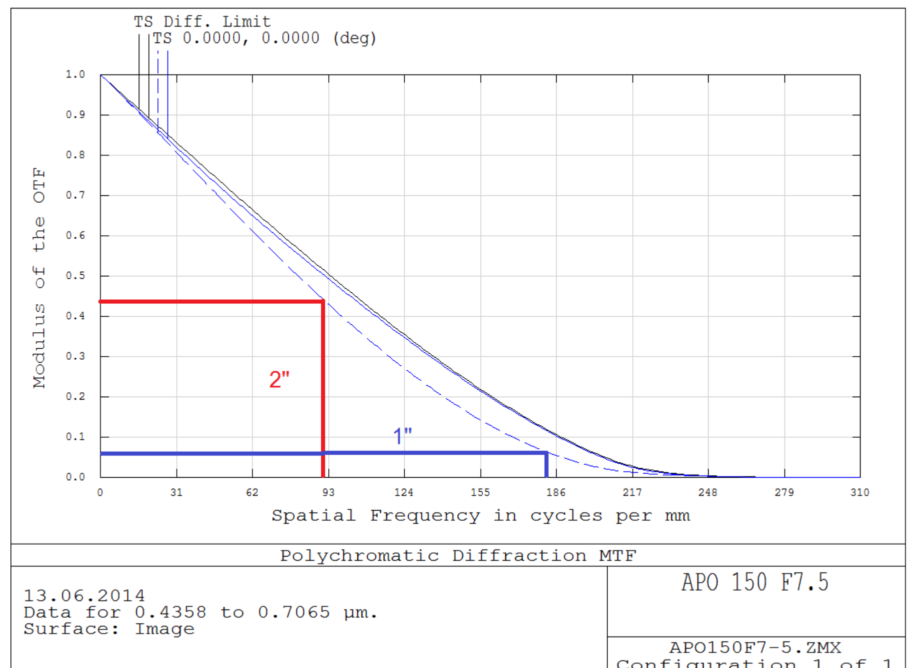
The dispersion of the atmosphere reduce considerable the contrast:

The graph shows the MTF (Modulations-Transfer-Function)
of an APO with D= 150 and 1125mm focal length
Y-Axis: Contrast,
X-Axis: Linen pairs/mm: a structure of 1” corresponds to 183lp/mm:
Black line: absolute perfect telescope (Strehl = 100%)
Blue line: contrast horizontal structures
Blue dashed: contrast vertical structures

Object in zenit: contrast 11.2% for 1“ structure



Object 45° over horizon: contrast only 6.2% !



ADC Theory III

Goal of the atmospheric dispersion corrector (ADC):

The atmospheric dispersion produce not only color fringes round planets, it reduce the contrast for vertical structures considerable !

This loss of contrast can be observed even with small telescopes and for objects with high altitude:

For a 15cm telescope following values can be calculated for 1“ vertical structures:

Object 30° above horizon: contrast reduced from 11.2% to 2,7% factor 4!

Object 45° above horizon: contrast reduced from 11.2% to 2,7% factor 1.8!

The optimal ADC should have following characteristics:

- To compensate the loss of contrast completely. Also for high altitude objects**!**
- Maintain the optical performance of the telescope.
- Easy handling, especially the adjustment of the dispersion correction.
- Easy to adapt the ADC to the telescope.

ADC Compact I

Characteristics of the ADC:

- **Free optical aperture of 28mm diameter** → no vignetting for 1.25“ eyepiece systems inclusive binocular viewer.

- **Easy handling:**
  - Decoupling of the vertical alignment and the dispersive correction:
    - Turn ADC housing until adjustment button is in vertical position.
    - To adjust the dispersion correction turn only one button until the color fringes disappear.
  - During the adjustment procedure the object keeps its position and allows exact control of the adjustment

- **The special optical design and components with highest quality maintain the full optical performance of the telescope.**

ADC Compact II

Optical design of the ADC Comapct:

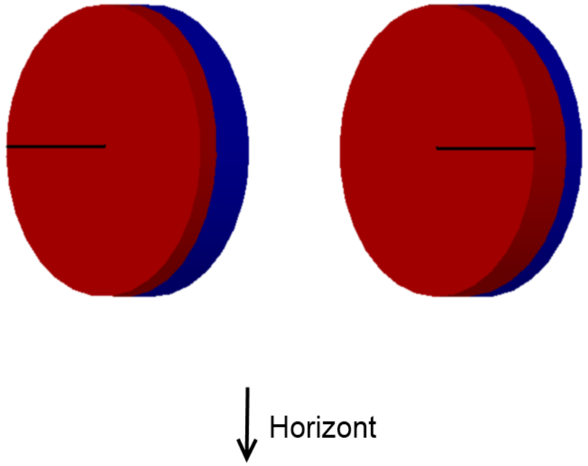
In general atmospheric dispersive correctors have two optical elements with dispersive power.
Simple correctors have two single prisms which have to be turned contrary to find the optimal correction. These simple prisms introduce an asymmetry into the optical system which is responsible for a dramatic reduction of the image quality. This setup leads to a non-diffraction limited optical performance.

Consequently we have designed our ADC to keep the diffraction limited performance by using plane plates as dispersive elements. These plan plates consists of two complementary prisms of different glasses. The glasses are selected to have the identical refraction index but different dispersions.
The additive advantage is, that the object keeps its position during the adjustment process to compensate the atmospheric dispersion.

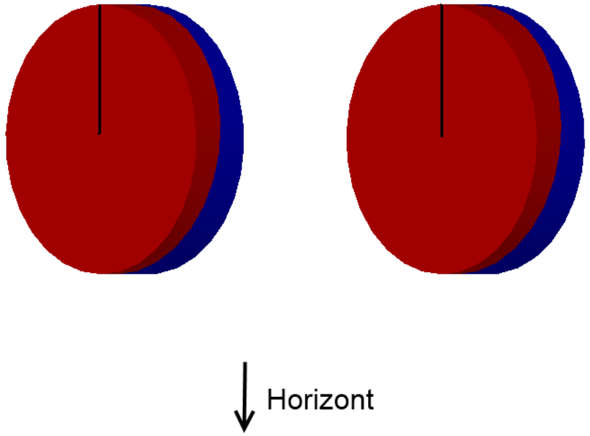
ADC Compact III

How the ADC works

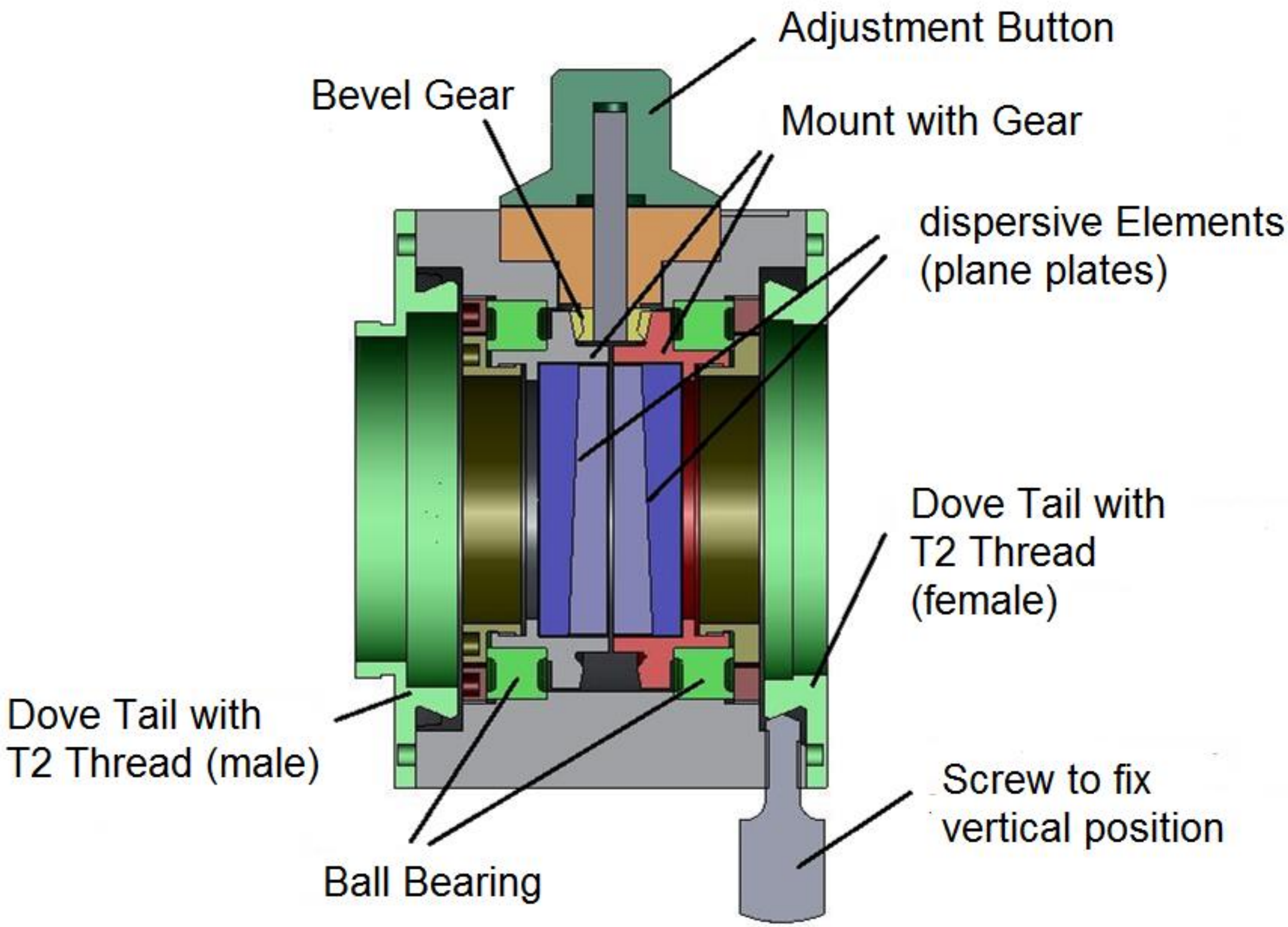
Plane plates
In opposite orientation:
no dispersion correction



Plane plates
in same orientation:
full dispersion correction



ADC Compact IV



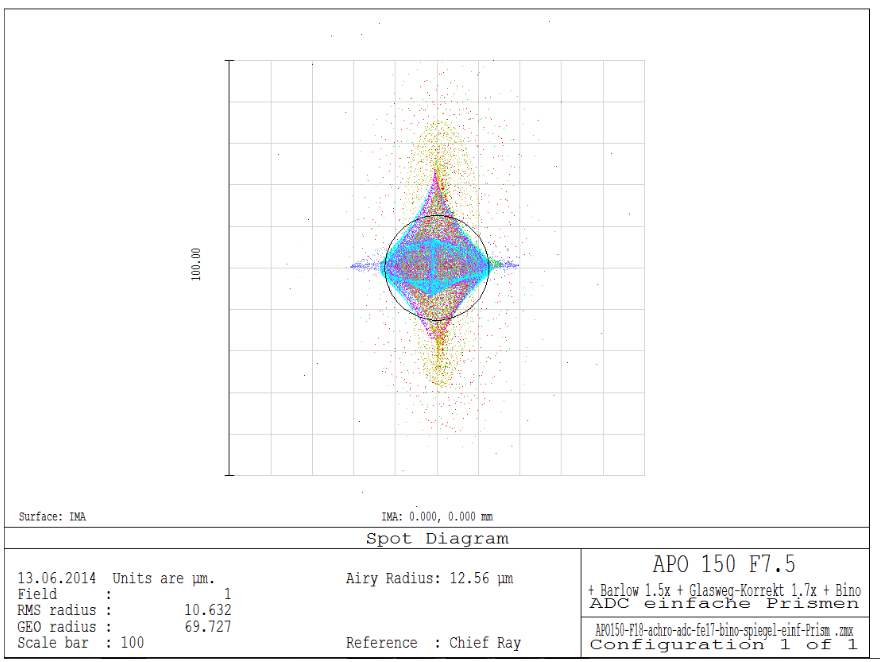
ADC Info-Material I

Optical performance of ADC's I: spot diagrams

Comparison of ADC with simple prism in respect to ADC with dispersive plane plats:
Object 45° above horizon, APO 150mm F 11.3, optimal adjustment!

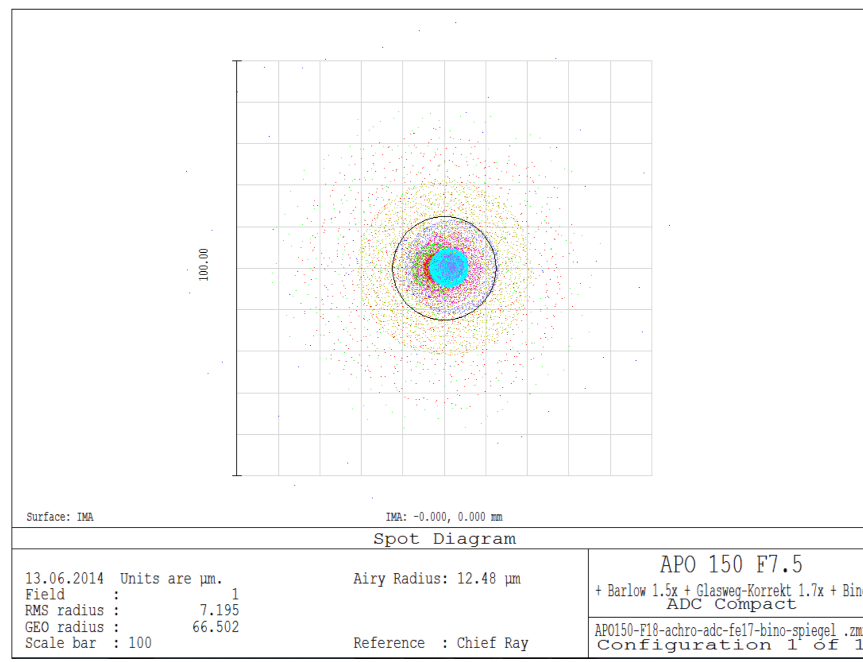
ADC with simple prism:

asymetric effects made by simple prism



ADC with dispersive plane plates:

Plane plates have no effects on optical performance: only minimal transversal color error.

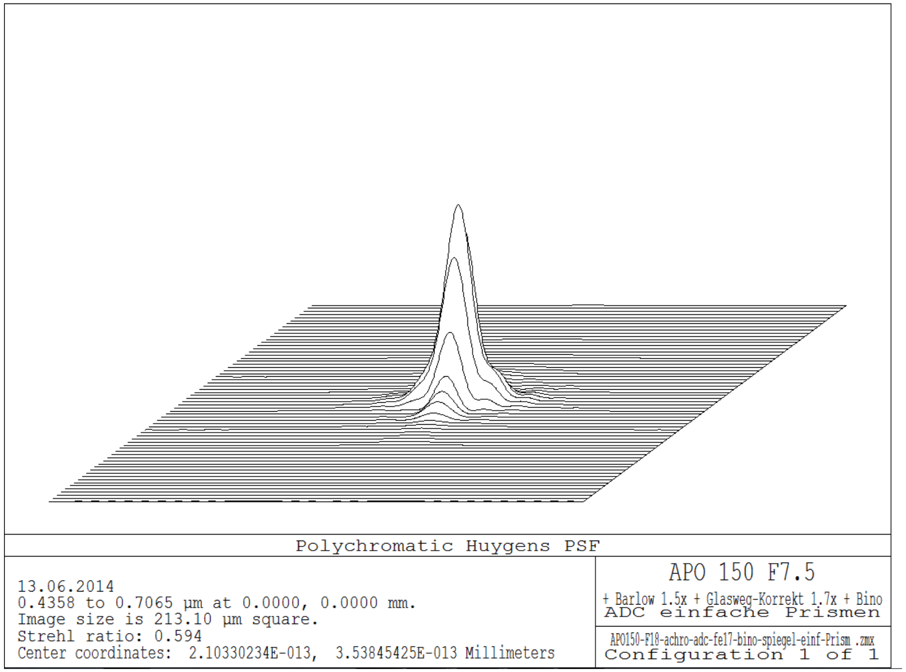


ADC Info-Material II

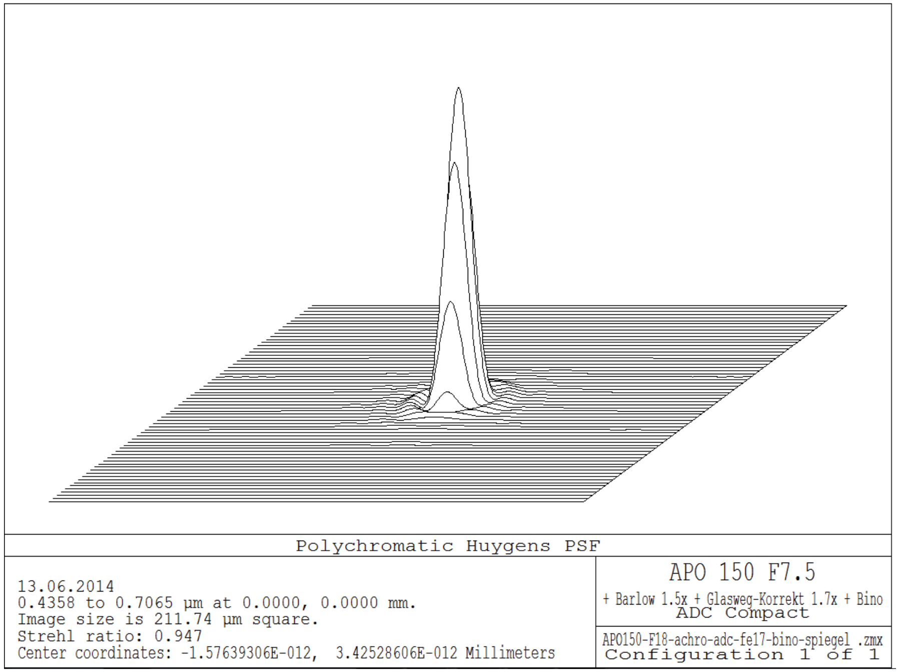
Optical performance of ADC's II: Effect on Strehl-value

Comparison of ADC with simple prism in respect to ADC with dispersive plane plats:
Object 45° above horizon, APO 150mm F7.5 +Barlow 1.5x + Glass corr 1.7x + Bino **(F18.7)**
optimal adjustment!

ADC with simple prism
Point spread function for APO150 with binocular viewer
original 94.7% Strehl: **now 59.4%**



ADC with dispersive plane plates
Point spread function for APO150 with binocular viewer
original 94.7% Strehl: **now 94.7%**

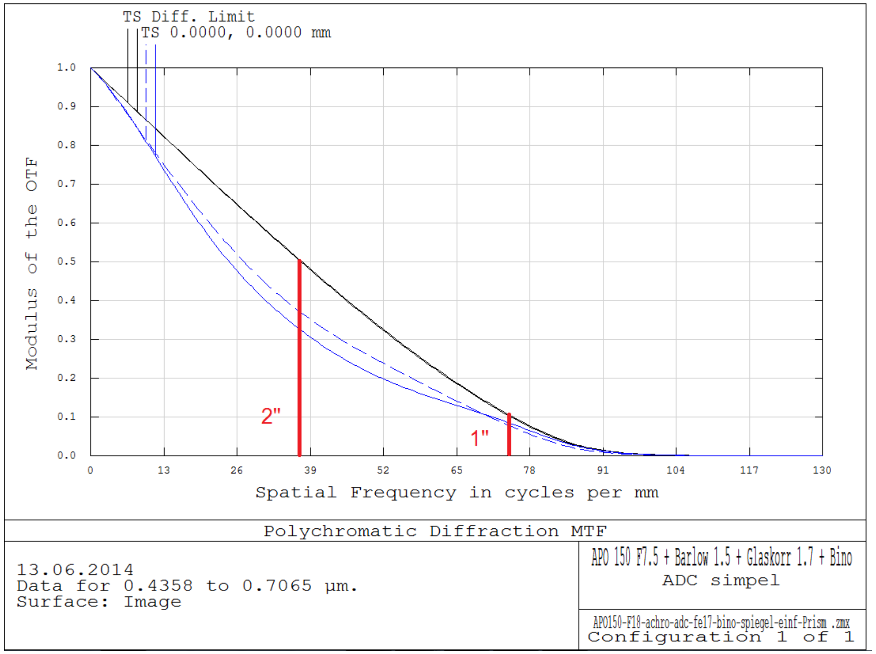


ADC Info-Material III

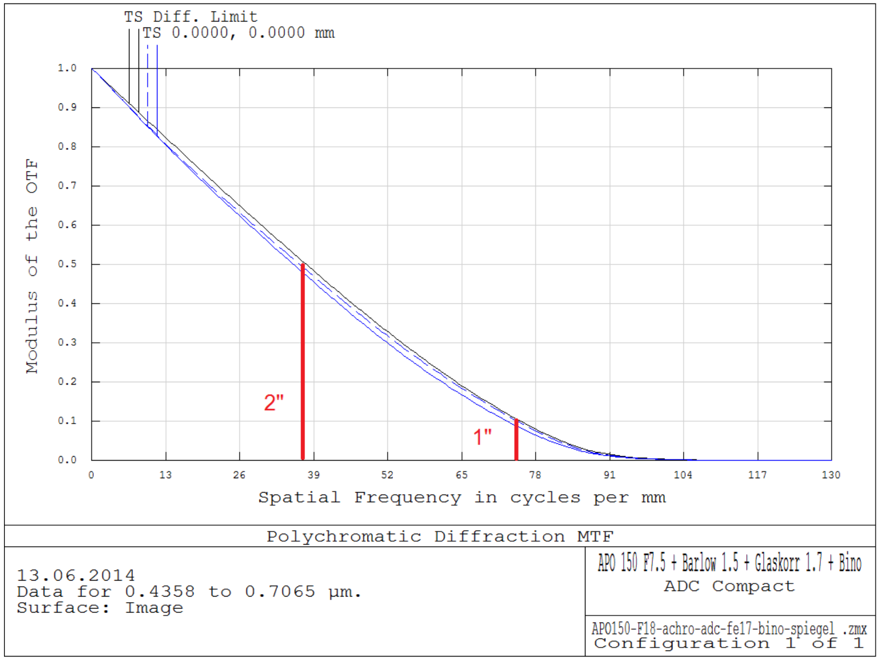
Optische performance of ADC's IV: effect on contrast

Comparison of ADC with simple prism in respect to ADC with dispersive plane plats:
Object 45° above horizon, APO 150mm + Bino (F18.7), **optimal adjustment!**

ADC with simple prism
MTF for APO150 with binocular viewer:
Highest loss of contrast for structures at 2" (factor 1.5): flat images



ADC with dispersive plane plates:
MTF for APO150 with binocular viewer:
for 1" structures (56lp/mm)
original 27.5% contrast: **now also 27.5% !**

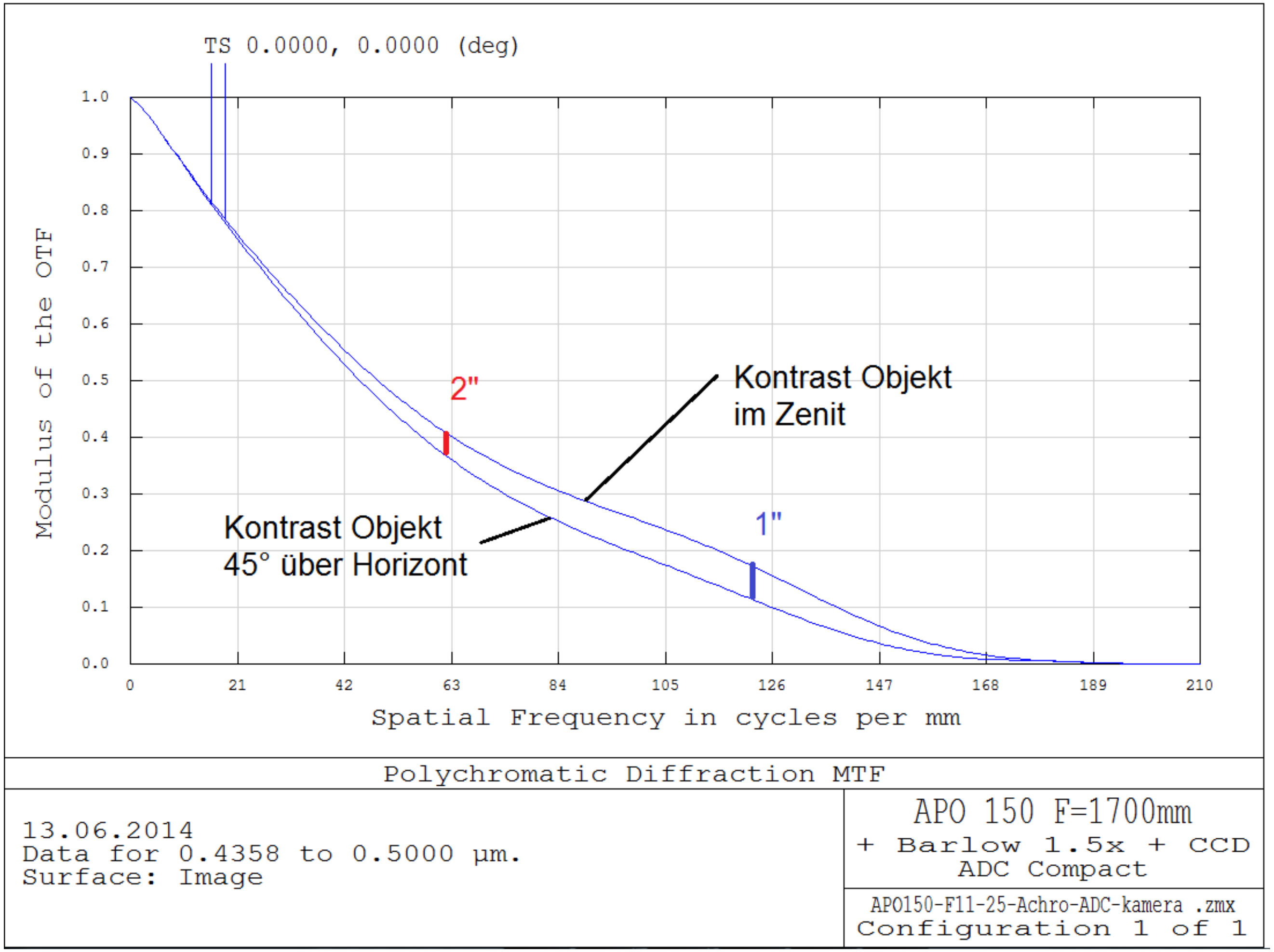


ADC Info-Material IV

Optical performance of ADC‘s V: Astrophotography

Contrast improvement in B-channel by ADC with dispersive plane plates (APO 150mm F11.3)

- **Contrast considerable improved in B-channel (abnormal dispersion)**



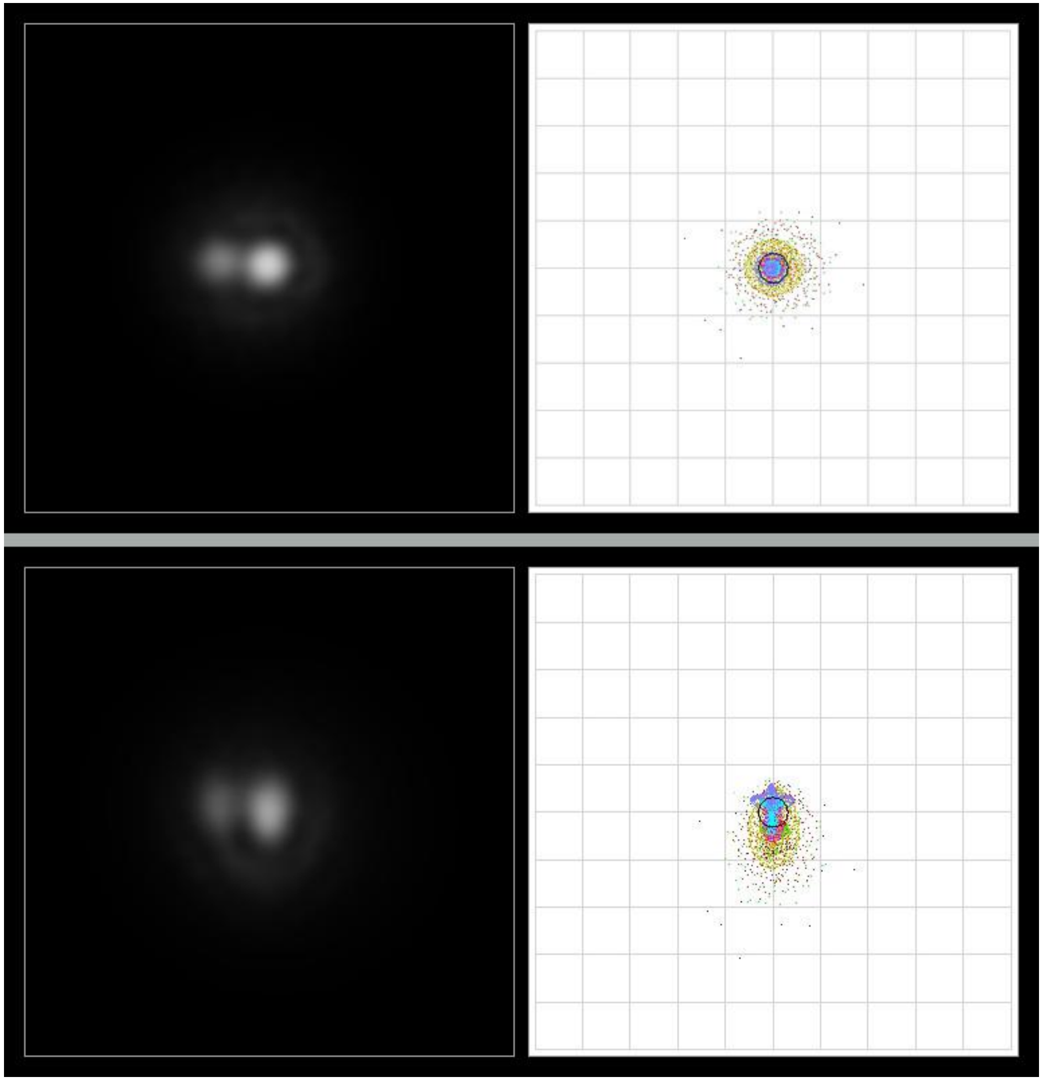
ADC Compact Experience I

Image Example I

Comparison ADC with simple prism in respect to ADC with dispersive plane plates **by Jörg Mosch**

0,96"-double star 14 Ori, 17. 2. 2014 with Lumenera LU165M and 180-mm-TEC Refractor:
Top: ADC von Gutekunst Optiksysteme,
Bottom: ADC from Pierro Astro

see the asymmetry by the simple prism !! (also well simulated with Zeemax)



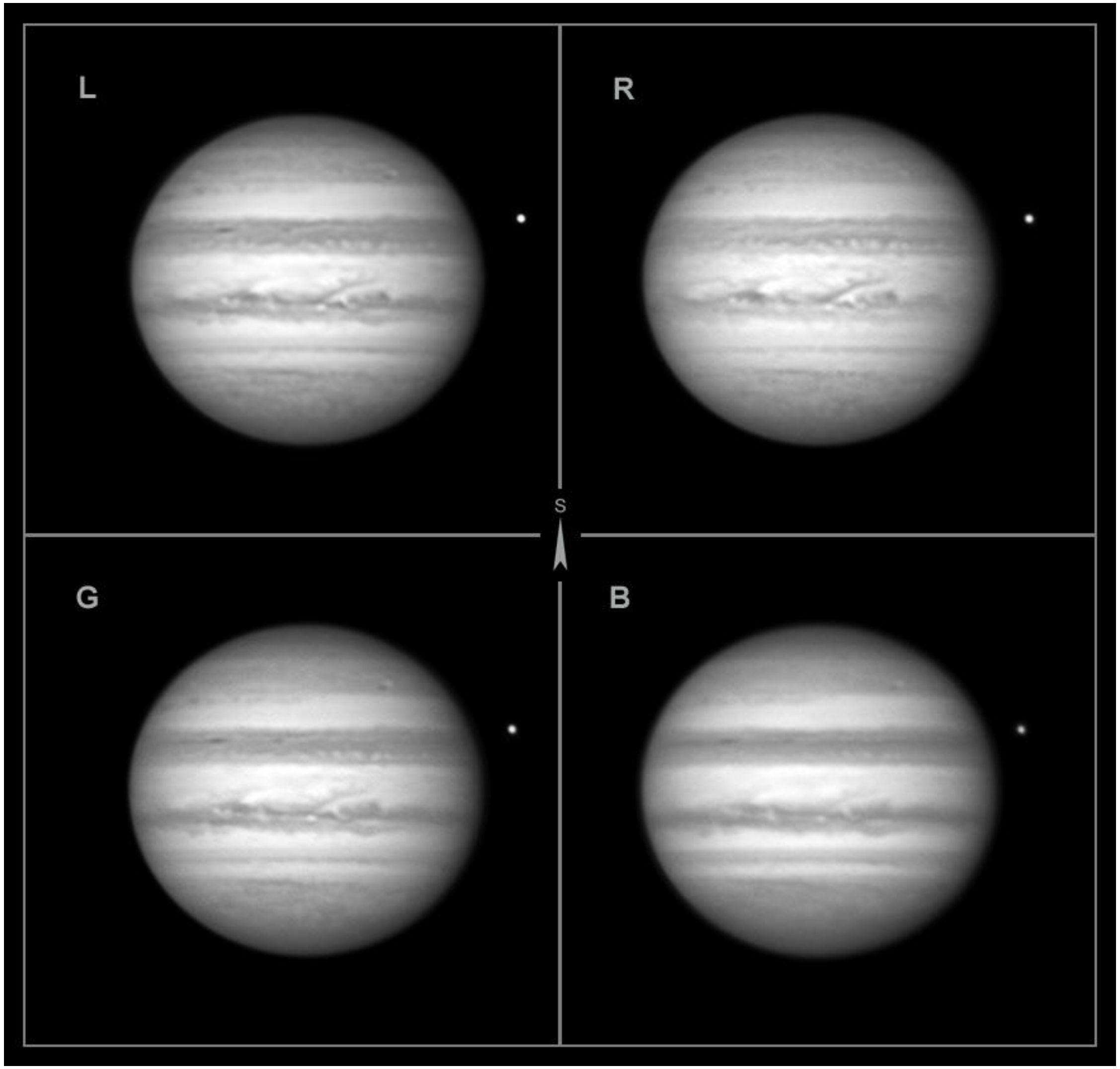
ADC Compact Experience II

Image Example II

Image made with ADC of Gutekunst Optiksysteme **by Jörg Mosch:**

Jupiter and Europa on 9. 2. 2014, monochrom video camera Lumenera LU165M and 180-mm-TEC-Refraktor.

See especially the good resolution in the L-channel !



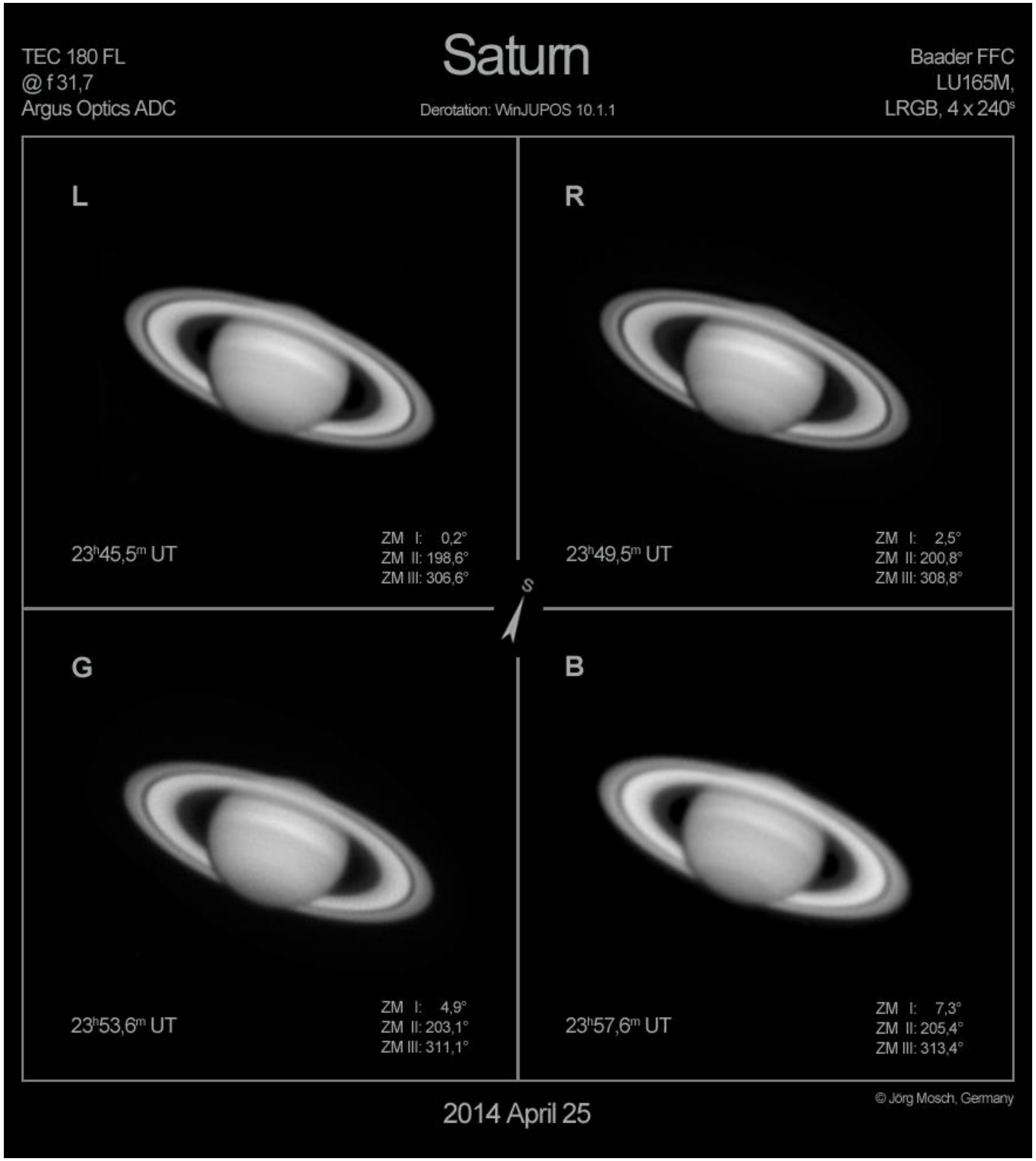
ADC Compact Experience III

Aufnahme Beispiele III

Image made with ADC of Gutekunst Optiksysteme **by Jörg Mosch:**

Saturn on 25.4.2014, monochrom video camera Lumenera LU165M and 180-mm-TEC-Refraktor.

See the good resolution in the L-channel !



ADC Compact Experience IV

Image Example IV

Image made with ADC of Gutekunst Optiksysteme **by Jörg Mosch:**

Gassendi on 12.3.2014, monochrom video camera Lumenera LU165M and 180-mm-TEC-Refraktor in **L-channel**

1500 Frames of 5928