

AiryLab

HαT



For high resolution chromosphere observation
and imaging in H α band

Warning : *H α T telescope must NOT be used for solar observation without additional filters. This is the user responsibility to check that his filter stack is safe for visual or imaging utilization.*

When using an air Fabry Perrot etalon such as PST, Coronado or Lunt, it is mandatory to use the blocking filter as well. In any case the end user must check the correct filtering of the UV and IR/SWIR bands.

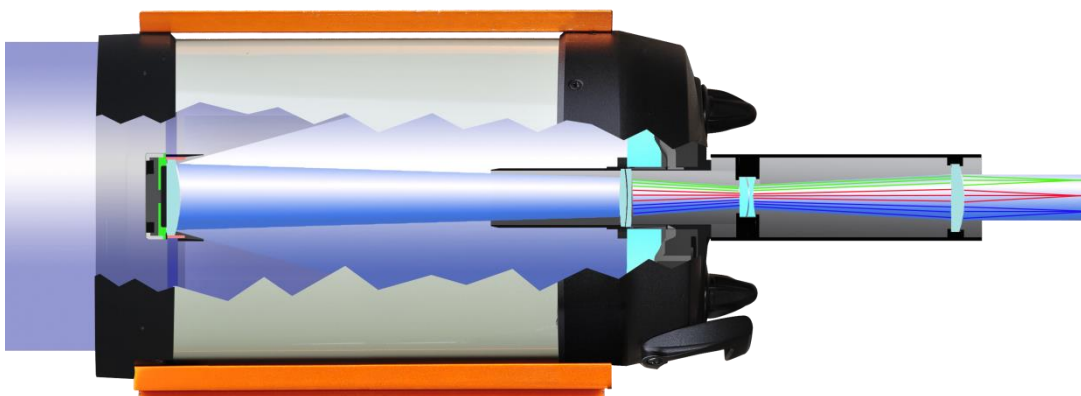
In case of doubt, please contact imperatively Airylab.



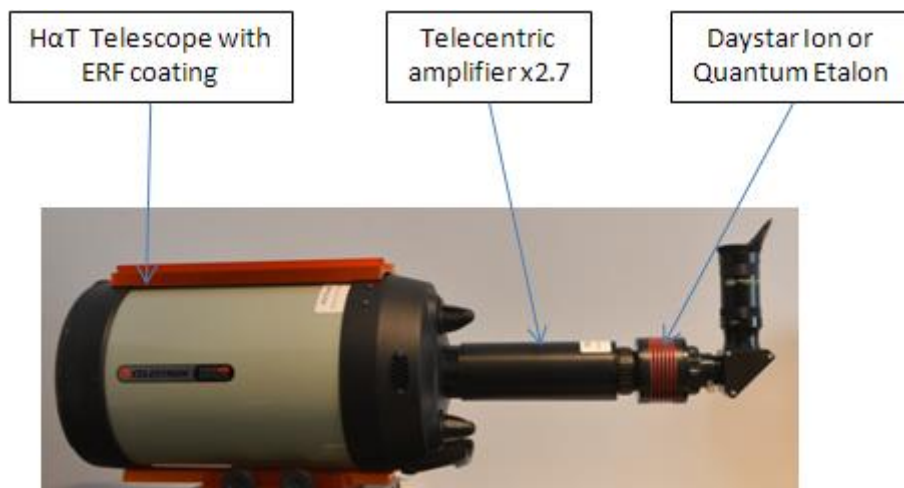
Presentation

Airylab proposes for the first time a large reflecting instrument for high resolution observation and imaging of the Sun's chromosphere in the $H\alpha$ band. Based upon Celestron's proven design EdgeHD C8, C9.25 and C11, we apply a specific di-electric coating to make an ERF out of the corrector plate. A specifically calculated telecentric amplifier bring the incoming rays to a geometry compatible with most of the market unobstructed Fabry Perrot $H\alpha$ etalons up to a 44mm in diameter (not included). No optical relay is needed besides the telecentric amplifier.

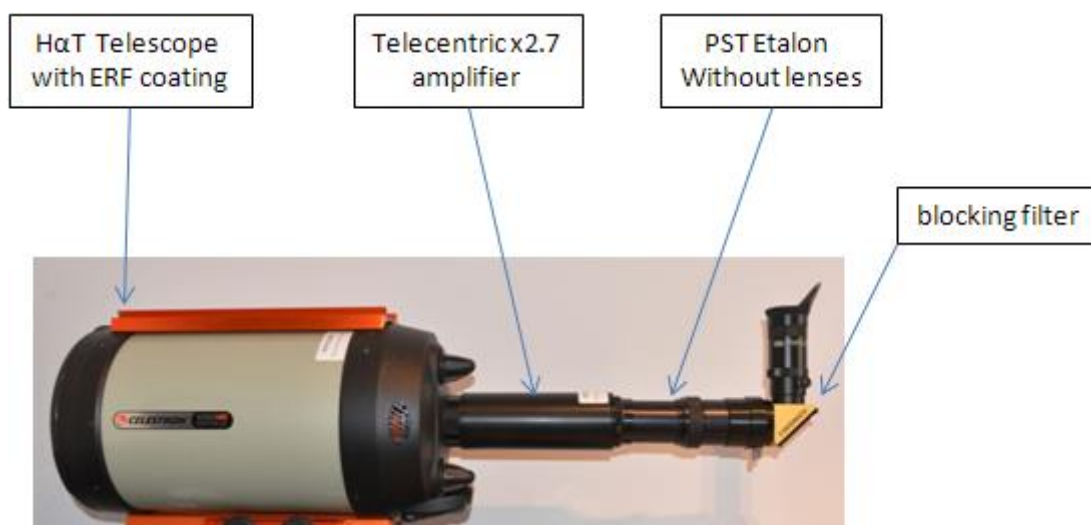
Airylab's $H\alpha$ T brings high resolution to Sun's difficult figures such as spicules or great details in prominences and inside the surface's spots. The telescope is also usable for white light observation in red or continuum specter with additional neutral density filtering. It can also be used for more classical applications such as high resolution planetary imaging in the red layer, or deep sky $H\alpha$ imaging of emission nebulae.



Drawing by Marc Khatchadourian



Setup for visual observation with Daystar filter (not included)



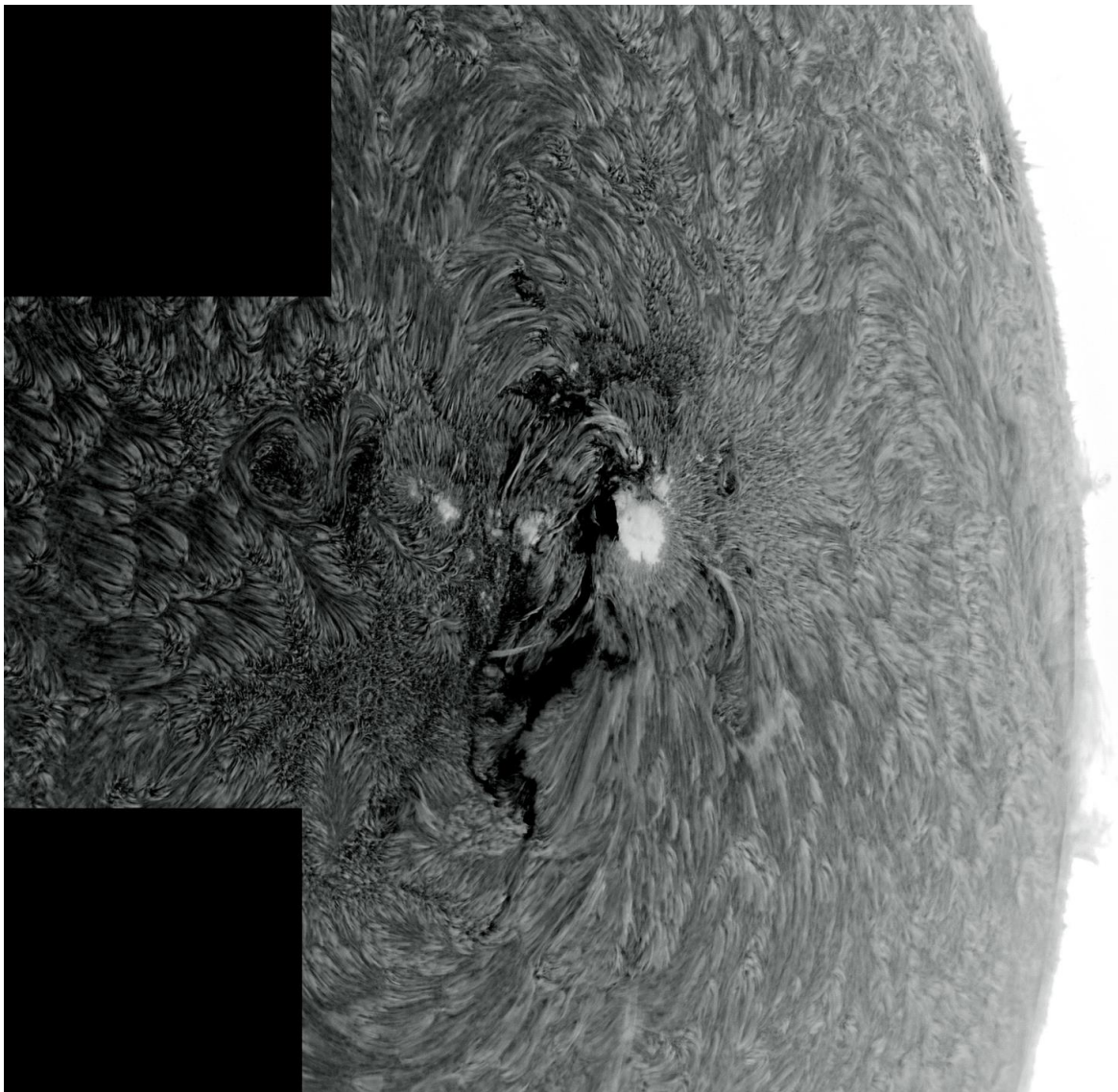
Setup for visual observation with PST etalon and blocking filter (not included)

Celestron EdgeHD optical tube assembly

The Celestron telescopes used to build the H α T are measured at the 635nm wavelength on the professional optical metrology platform of Airylab before and after the ERF coating and they are guaranteed to be better than $\lambda/4$ in the red spectrum. Each telescope is delivered with its metrology report. The aplanetic design delivers a large corrected flat field that is very tolerant to alignment uncertainties. The closed tube design limits the heat exchange with the outside and the subsequent internal turbulence. Unlike the solar refractors that get big and clumsy above 150mm, the H α T is small even at 280mm diameter. The small 203mm C8 based model can fit on a light Vixen GPDx or a HEQ5 mount. The observation position on this short OTA is comfortable even when the sun is at the zenith.

ERF Energy Rejection Filter

The complex di-electric coating is performed in France by a thin layers specialist. The coating doesn't change the optical quality of the corrector plate and pass only 120nm FWHM bandwidth inside the telescope, thus dramatically limiting the heat. The effective transmission in the H α band is about 85%. The optical density is above 3 below 530nm and above 780nm up to 1100nm in the short wave infrared. The secondary mirror stays cool and its support is protected from the direct exposition to Sun's light by a white plastic cap. The di-electric coating is hardened and can be easily cleansed the same way as for a non coated plate. The remaining light allows performing the alignment on a bright star with an eyepiece or using the dedicated feature of Genika Astro with a camera.

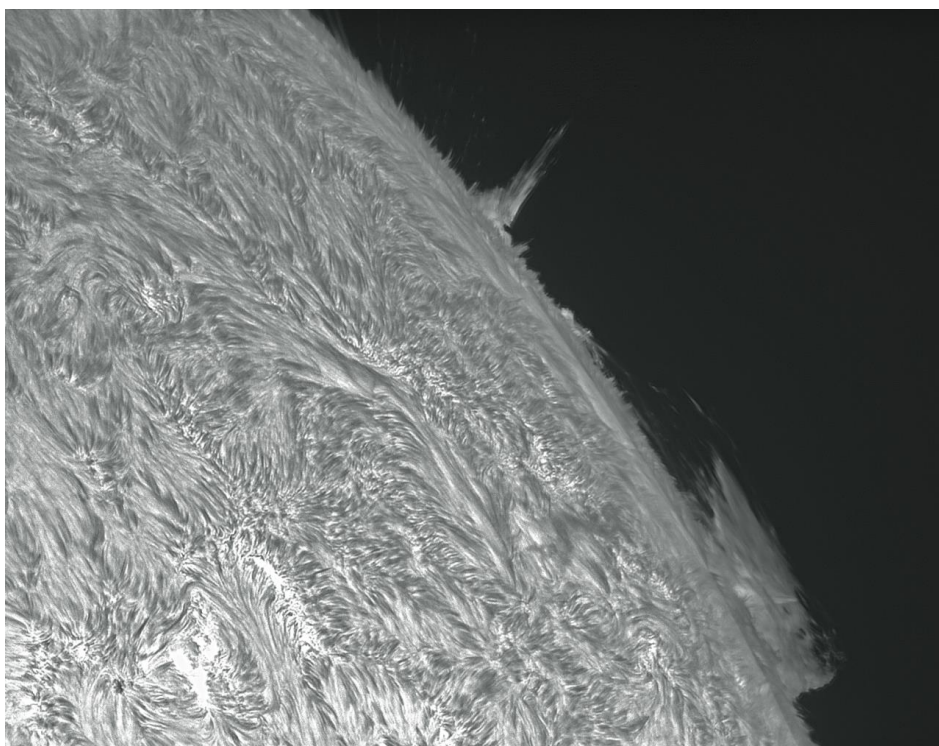


AR2192 spot in October 2014, acquisition Frederic Jabet. Basler acA1920-155um camera with PST Etalon

Telecentric amplifier x2.7or x3.5

The telecentric amplifier has been calculated specially for the EdgeHD that shows much more angle for the field chief rays than an equivalent F10 refractor. The resulting F/D is 27.59 with marginal rays angle of 1° . This F/D is particularly adapted to high resolution imaging. On the 203mm model the field is corrected for a $0,25^\circ$ field radius which is Sun's full disk size. The field is limited to a 44mm circle due to the 2" SCT thread diameter which is still more than 80% of the Sun's surface. Practically the field of view is only limited by the etalon size. The field is diffraction limited for a 30mm image field: that matches the size of a Daystar Quantum filter. A huge back focus range is possible from 100 to 250mm without impact on the optical performances: you can use whatever etalon stacking possibilities and even a binocular head without its amplifier. The amplifier shows no soft spot effect in the field and keeps the bandwidth perfectly centered on the 656.28nm band for the whole field of view. It is possible for imaging to reduce the F/D after the etalon by using a focal reducer. That is not needed for visual observation.

An optional F/D 35 telecentric amplifier allows to reach the maximal resolution with an IMX174 sensor under an excellent seeing. This telecentric also narrows the etalon FWHM by 0.1Å for both visual and imaging.



Prominence and spicules. Basler aca1920-155um camera, PST etalon.

Applications

The H α T is specifically designed for Sun's chromosphere observation and imaging in the H α band. Nevertheless it can also fulfill other applications:

Application	Telecentric amplifier	Additional filters
Chromosphere H α band	Yes	Air Etalon (PST / Lunt) + BF Mica Etalon (Daystar / Solar Spectrum)
Photosphere in red	If needed	Neutral density + IR cut / Schott KG3 (visual use)
Photosphere continuum	If needed	Continuum , neutral density + IR cut / Schott KG3 (visual use)
Red layer planetary imaging	If needed	No
H α DSO imaging	No	DSO H α filter

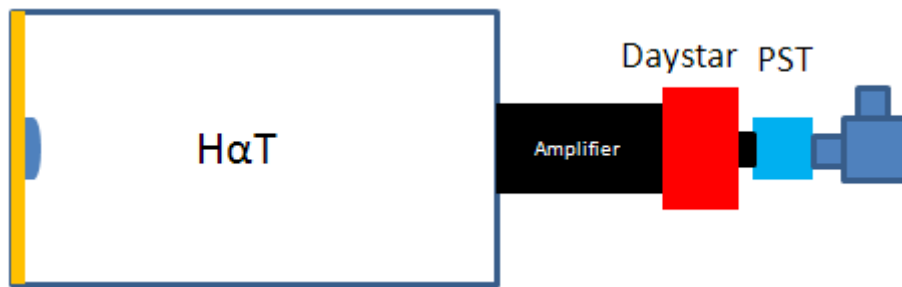


Moon at H α T native focal length. No filter.

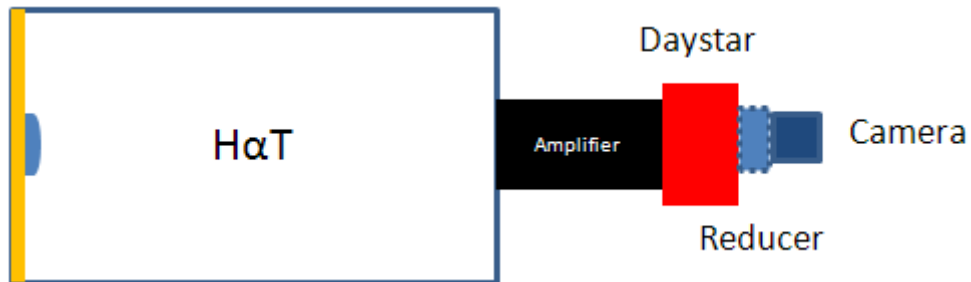
Chromosphere H α Etalons

H α T can use a wide choice of H α etalons thanks to its excellent telecentricity on the image side and the large back focus range.

We have validated several configurations such as the following ones:



Visual observation with a Daystar



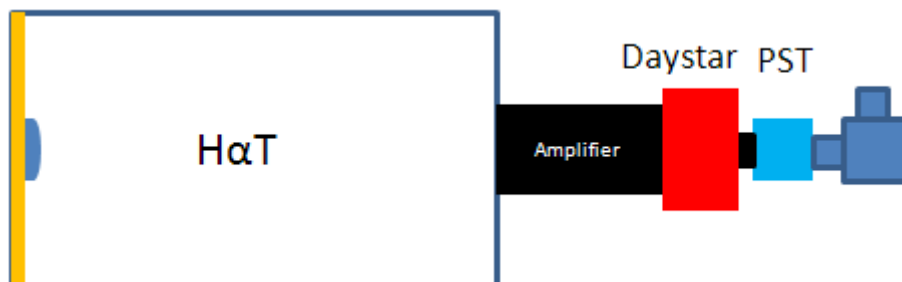
Imaging with a Daystar and additional reducer



PST etalon with its blocking filter

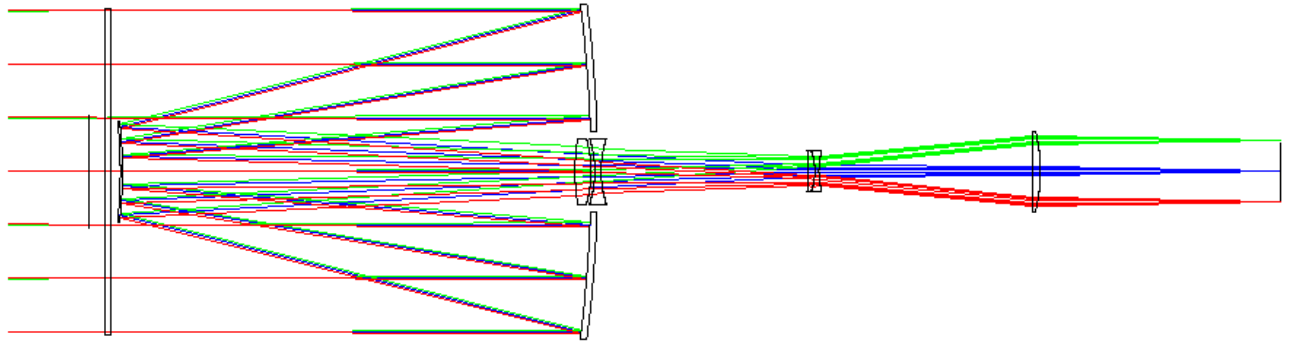


Double stacked PST



Double stack Daystar + PST. The blocking filter isn't required in this case.

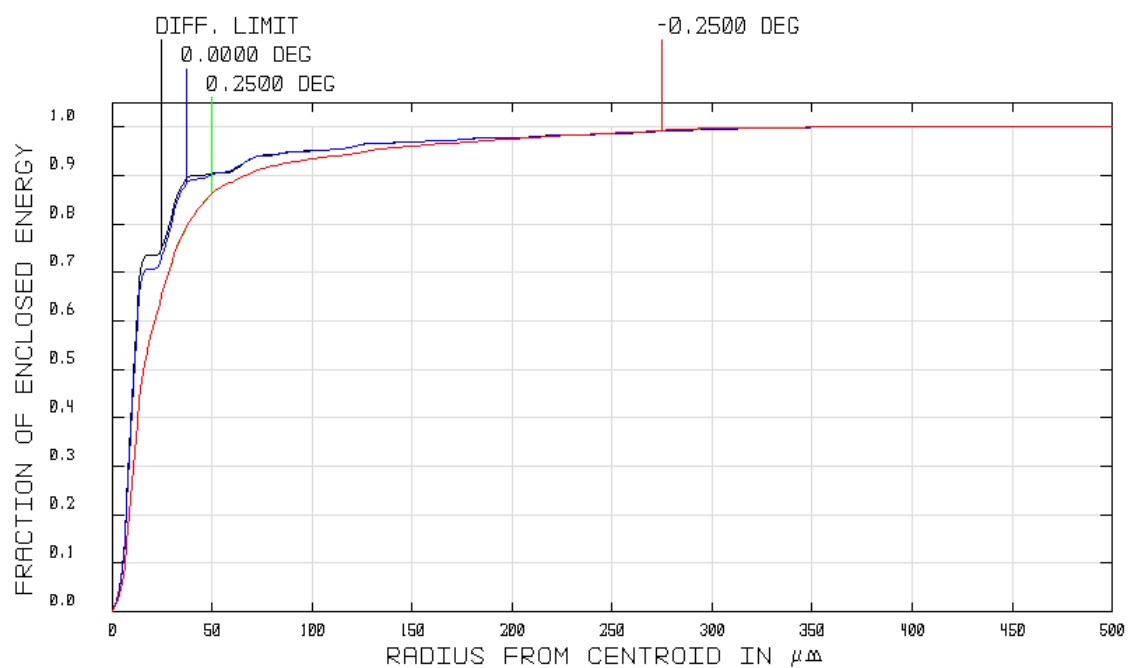
Specifications



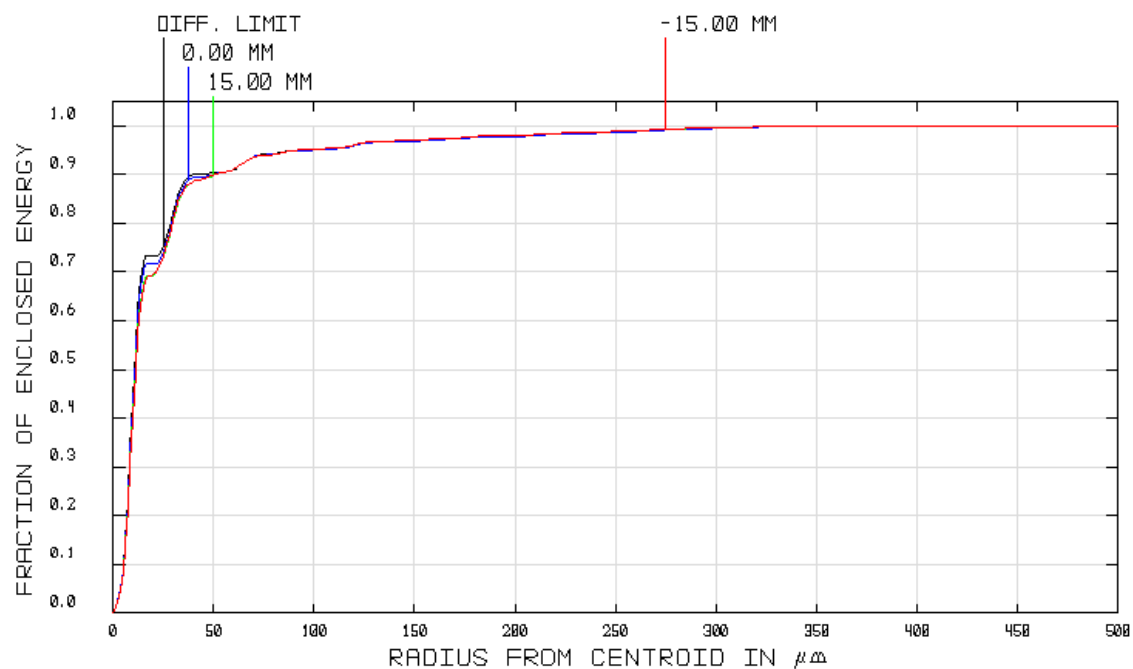
- Aplanetic Schmidt Cassegrain telescope better than $\lambda/4$ at 656,28nm.
- Effective diameter 203, 235mm or 280mm.
- F/D 27,59 with 150mm optical backfocus range or F/D 35 with 178mm backfocus
- Multicoated hard ERF with 85% transmission at 656.28nm.
- $\pm 0.25^\circ$ corrected field with x2.7 and x3.5 amplifier.
- Diffraction limited field $> 30\text{mm}$ (Daystar Quantum)
- Divergence angle of chief rays $< 0,001^\circ$ at 15mm of the axis at 656,28nm.
- Marginal angles $< 1.04^\circ$ on the axis at F/D 27.5 and 0.82° at F/D 35
- Amplifier chromatism corrected on a 100nm large bandwidth at a time for F/D 27.5, fully achromatic at F/D 35.

At F/D 27.5

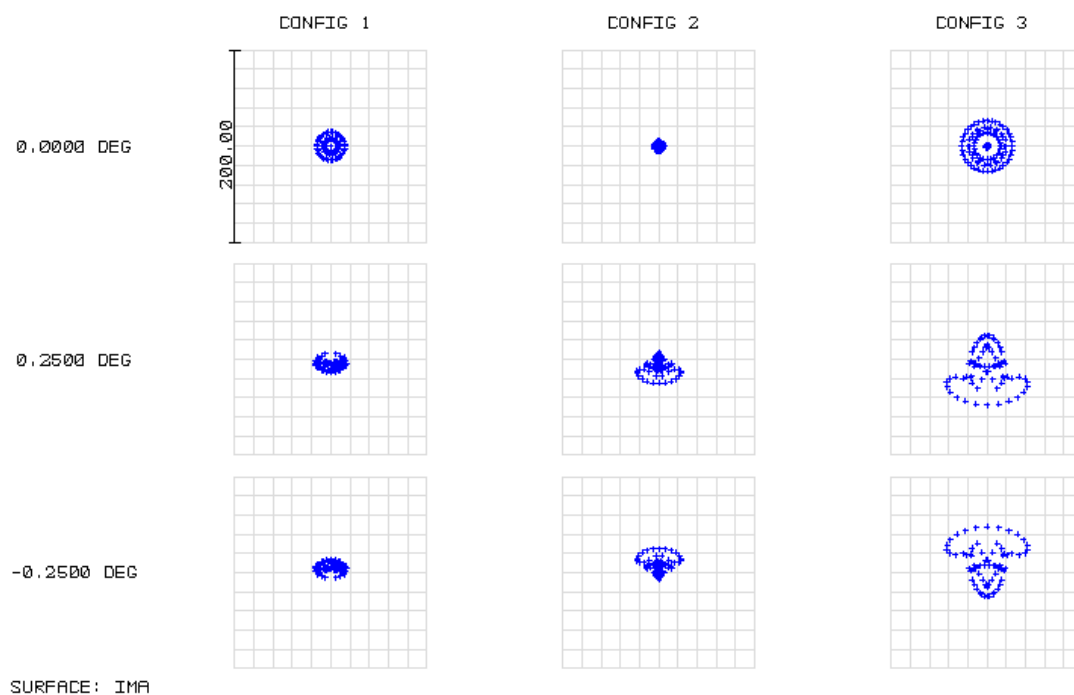
Encircled Energy Radius up to 0.25° (full sun) :



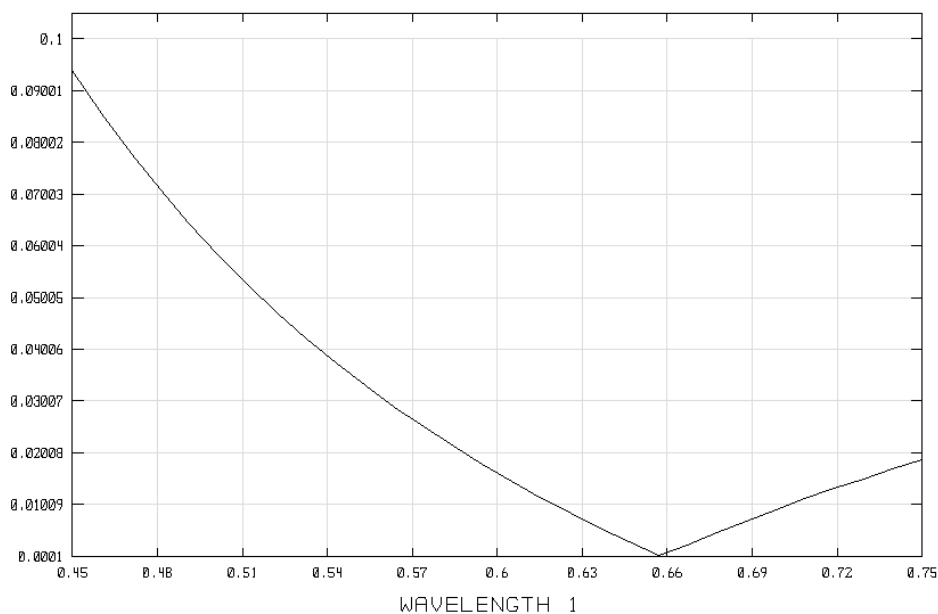
Encircled Energy Radius at 15mm off the axis for a 30mm Daystar Quantum etalon:



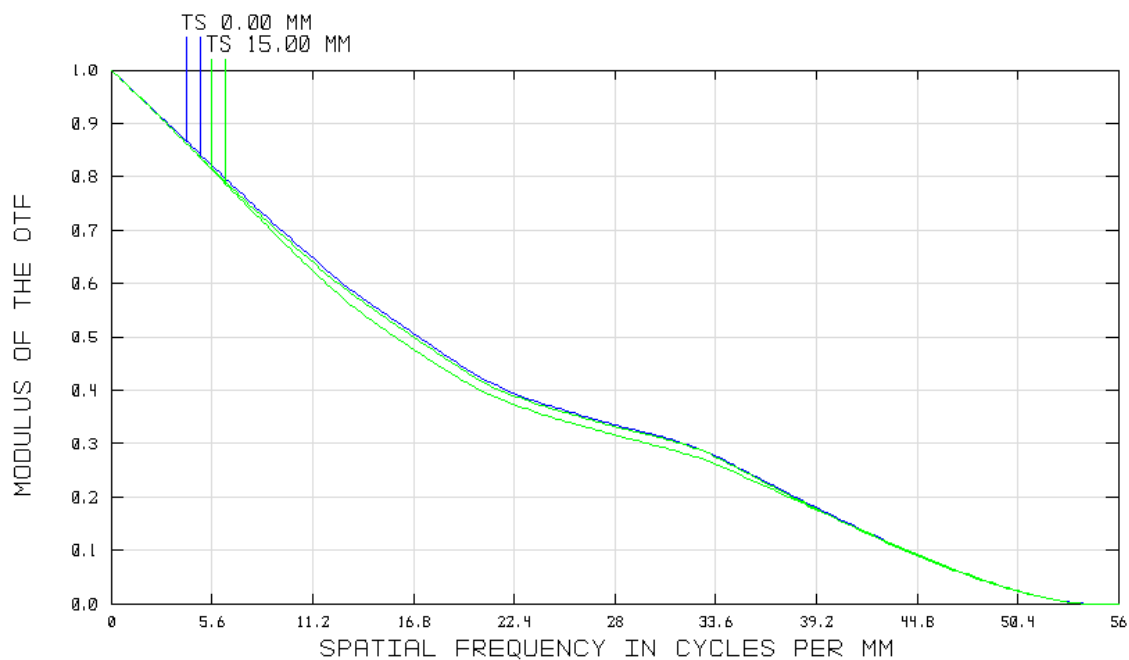
Spot diagram at 656nm (red), 532nm (green) et 450nm (bleue) at 0.25° off axis:



Chief rays angle at 15mm off axis for a 30mm Daystar Quantum etalon from 450nm to 750nm with 656,28nm optimization:

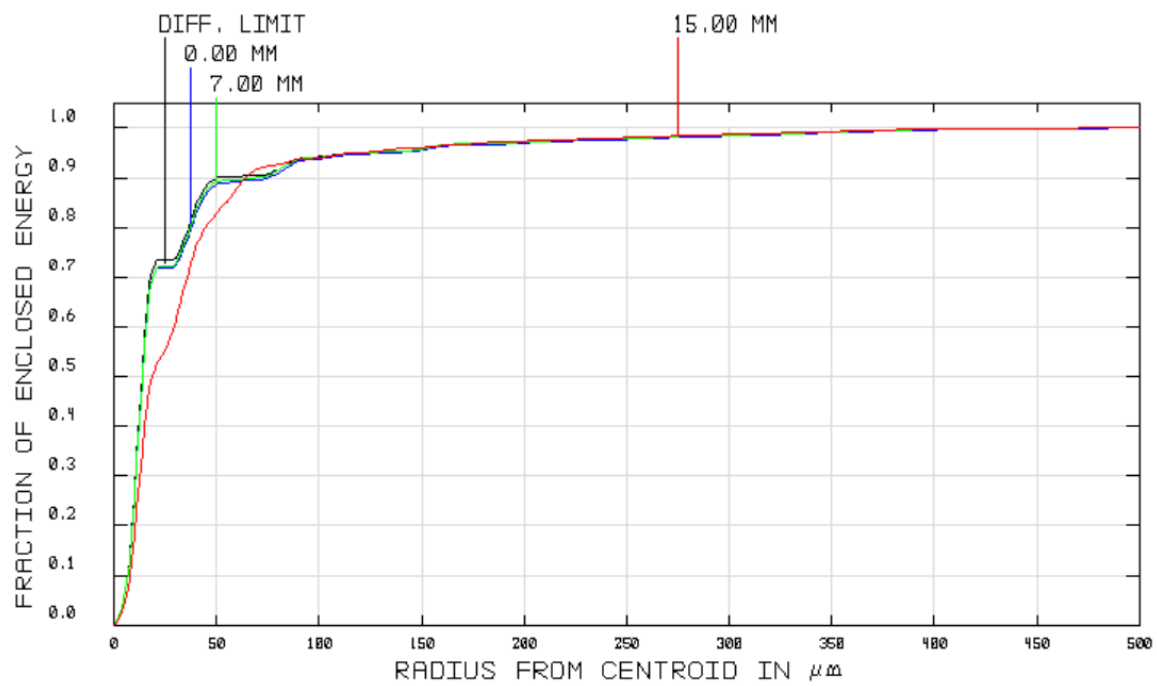


Modulation Function transfer at 15mm off axis for a 30mm Daystar Quantum:

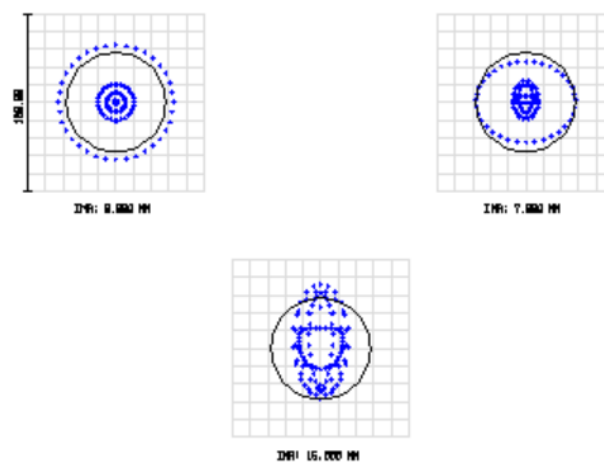


At F/D 35

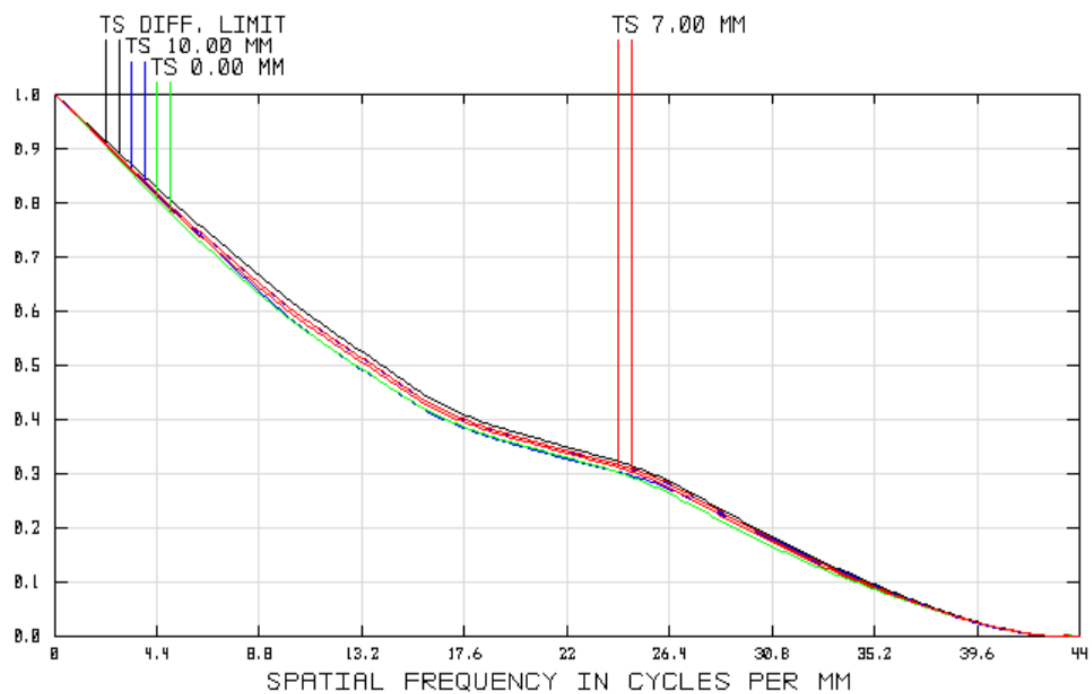
Encircled Energy Radius up to 5mm from axis :



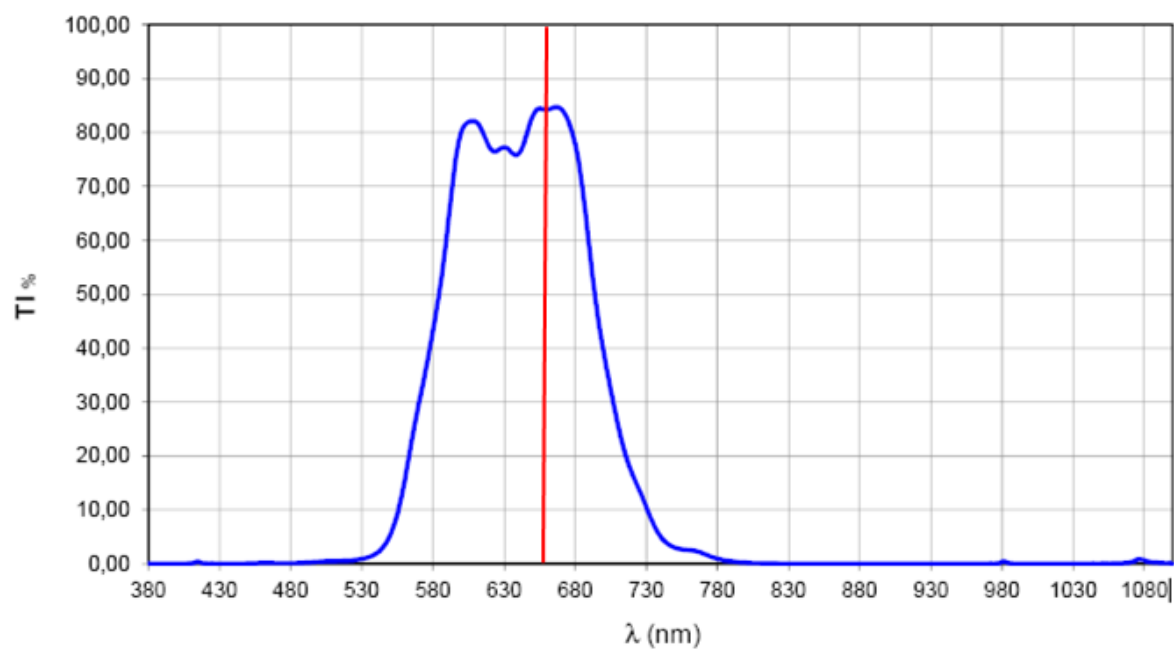
Spot diagram at 656nm up to 15mm from axis :



MTF up to 10mm from axis :



ERF transmission



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