Telescopi Italiani s.r.l. Web: www.italiantelescopes.net
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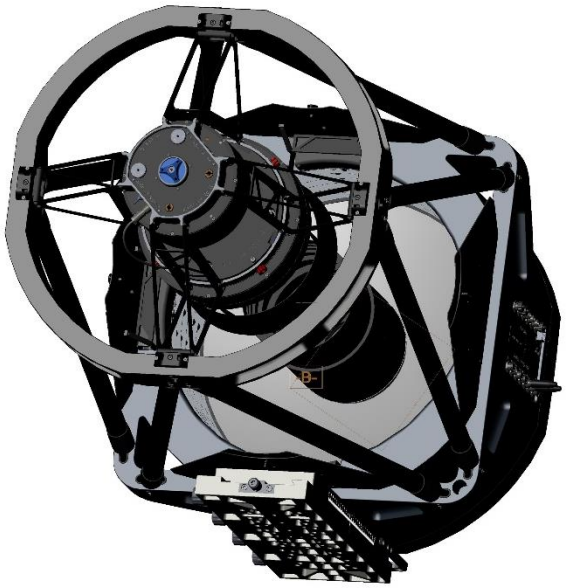
Telescope Model: TI-45 DFL (Dual Focal Length)

Overall description:

The TI 45 is a new generation astrograph born after in-depth and extensive studies lasted five years. It combines a number of innovative features and special solutions.
The design was carried out by a professional team driven by an aerospace engineer. Mechanical design was performed in a 3D environment and FEM analysis have driven the sizing of the components for less weight and less deformation.
From optical, mechanical, electronic and design point of view, the TI45 DFL Astrograph is the most advanced telescope which you can find on the world market.

The TI 45 astrograph, in the fast f/4 configuration, is derived from the configuration Harmer-Wynne (designed for the first time and published in 1976 – Royal Astronomical Society, Monthly Notices, vol. 177, Oct. 1976, p. 25P-30P). The Harmer-Wynne instruments have the particularity of combining a parabolic primary mirror with a spherical secondary mirror and obtain a corrected wide field with the aid of a two elements corrector.



In our TI 45 Astrographs, it is introduced a further refractive element correction (in ED glass) – this 3th lens introduction was done by Leonardo Priami in late 2010, reaching a real diffraction limited corrected field of over 80 mm in diameter without introduce color aberrations (from 400 nm to 1,6 micron of wavelength). These performances of very fast and very corrected optics allows to this optics to be used with success both in narrow band filter imaging and in Near Infrared imaging.

For the most deep sky imaging, the TI 45 astrograph, in the “all-around” f/8 configuration, is a Corrected Cassegrain with an hyperbolic secondary mirror and two elements corrector. It delivers an awesome performances and real diffraction limited from 380 nm up to 3 micron wavelenght (and over), for more than 70 mm of field. The real obstruction is limited at 38,7% with a useful 83,8% of incoming light.

The TI 45 Astrograph is not a simple telescope, but it is really two telescopes in one.
It is the best solution for professional imaging setup.

The TWO configurations (the fast f/4 and the “all-around” f/8) are “native” and both optimized. No “Barlow” lenses are used, neither “focal reducer”. You can shift from one to the other in less than five minutes without loss of collimation thanks to the special secondaries holder and thanks to the spherical secondary mirror of the f/4 setup. You can leave in place all your instruments (CCD camera, filter wheel, focuser, AO, OAG, ecc), after a configuration change, you only have to refocus a little!

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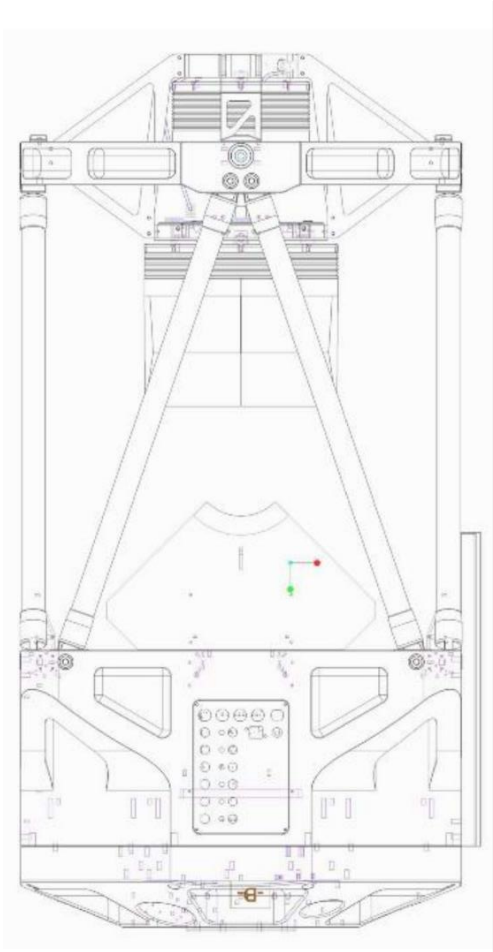
Dimensions and weight:
Overall length: 1.010 mm
Overall diameter: 560 x 560 mm
Expected weight: about 43 kg (110 mm field rotator and electronic focuser included)
Back Focus from primary vertex (mm): 347 mm
Back Focus from rear flange (mm): 182 mm – 192 mm (110 mm field rotator and electronic focuser included)

Optical Characteristics:

- *Primary mirror:*
  Overall diameter: 456 mm
  Clear aperture: 450 mm
  Thichness: 50 mm
  Shape: Parabolic
  Material: Schott Suprax
  Coatings: Aluminium enhanced>94%
- *Secondary mirror f/4:*
  Overall diameter: 238 mm
  Clear Aperture: 234,5 mm
  Thichkness: 25 mm
  Shape: Spherical
  Material: Schott Suprax
  Coatings: Aluminium enhanced >94%
- *f/4 Group Lenses (Corrector):*
  Lens number: 3 – ED element
  Lens diameter: 126 mm
  Coatings: Multylayers 400-900 nm



f/4 Performances:

- Real Diffraction Limited field diameter (mm) (considering Polychromatic 400/700 nm): 83 mm
- Spot Diagram RMS Diameter @ 26 mm from axis - Poly 400-700 nm (micron): 2.20μm
- Spot Diagram RMS Diameter @ 30 mm from axis - Poly 400-700 nm (micron): 2.58 μm
- Total Effective Obstruction: 54.4 %
- Light incoming (% of aperture area): 70.0 %
- Loss of light (vignetting) @ 26 mm from axis (%): 5.0 %
- Loss of light (vignetting) @ 30 mm from axis (%): 11.0 %

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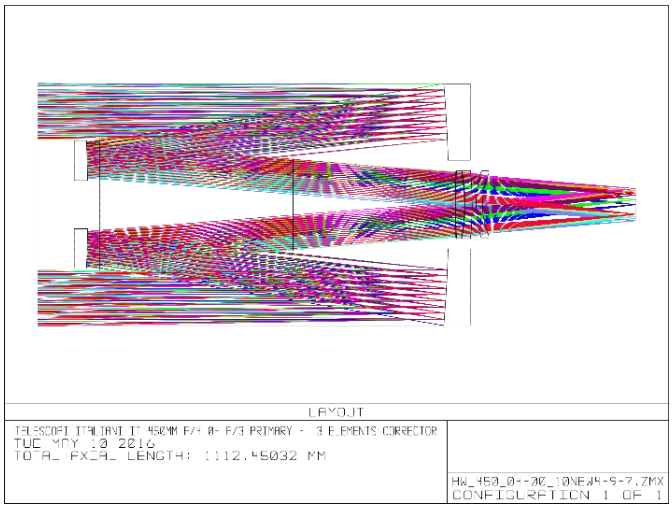

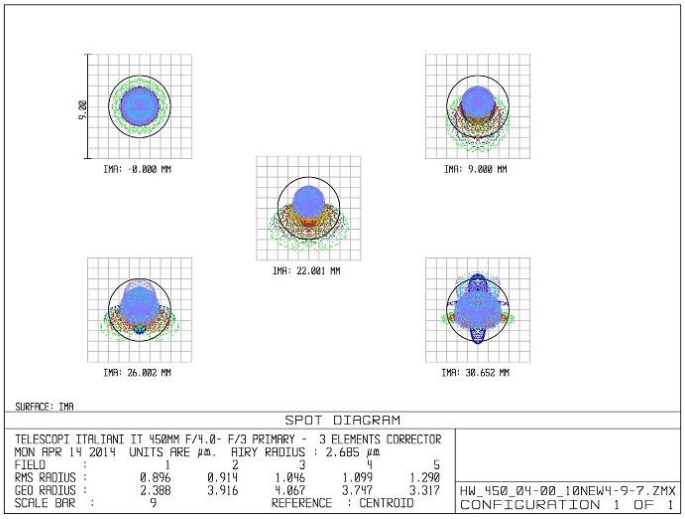

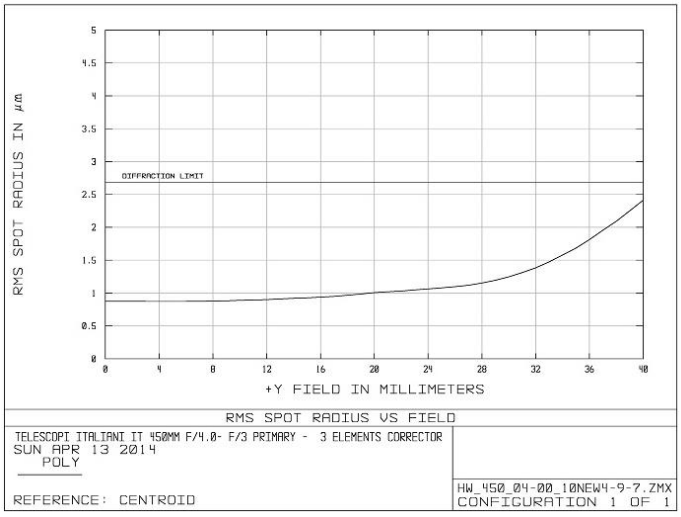

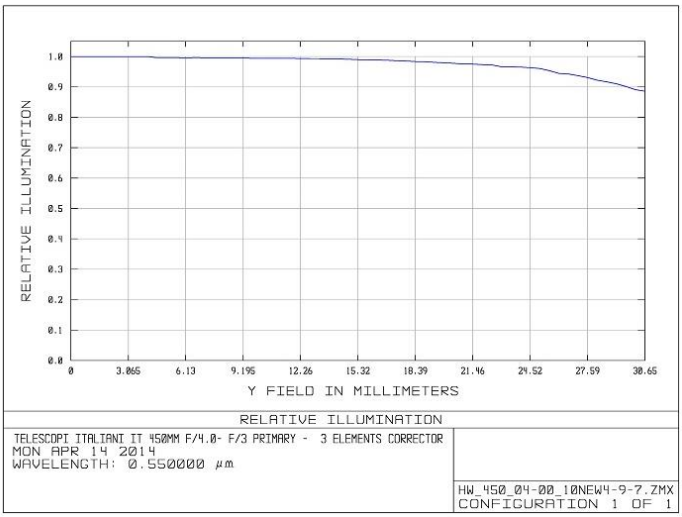

- *Secondary Mirror f/8:*
  Overall diameter: 166 mm
  Optical Diameter: 163 mm
  Thickness: 20 mm
  Shape: Hyperbolic
  Material: Ohara BSL-7
  Coatings: Aluminium enhanced >94%
- *f/8 Group Lenses (Corrector):*
  Lens Number: 2
  Lens diameter: 94 mm
  Coatings: Multylayers 400-900 nm

f/8 Performances:

- Real Diffraction Limited field diameter (mm) (considering Polychromatic 400/700 nm): 72 mm
- Spot Diagram RMS Diameter @ 26 mm from axis - Poly 400-700 nm (micron): 4.52 μm
- Spot Diagram RMS Diameter @ 30 mm from axis - Poly 400-700 nm (micron): 6.64 μm
- Total effective obstruction: 38.7 %

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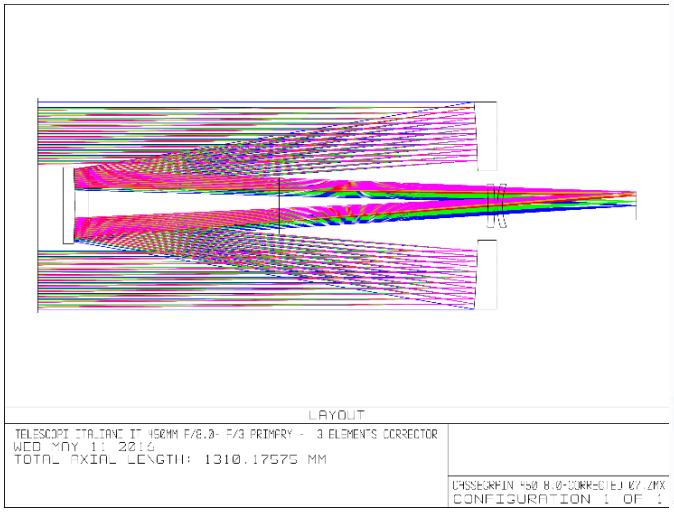
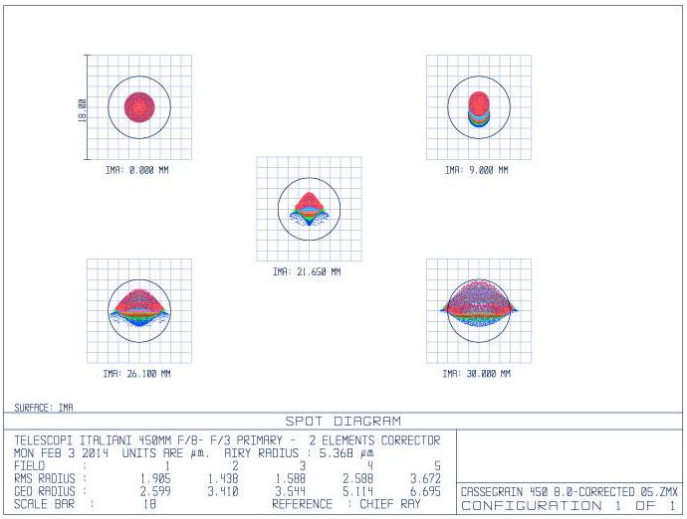
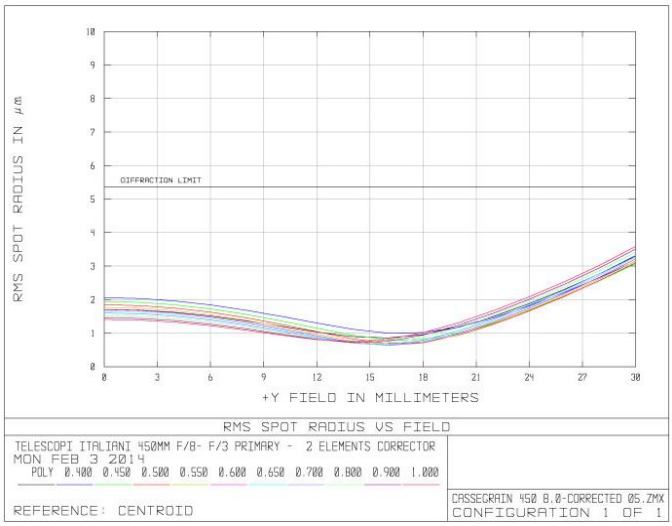
- Light incoming (% of aperture area): 83.8 %
- Loss of light (vignetting) @ 26 mm from axis (%): 5.0 %
- Loss of light (vignetting) @ 30 mm from axis (%): 7.0 %







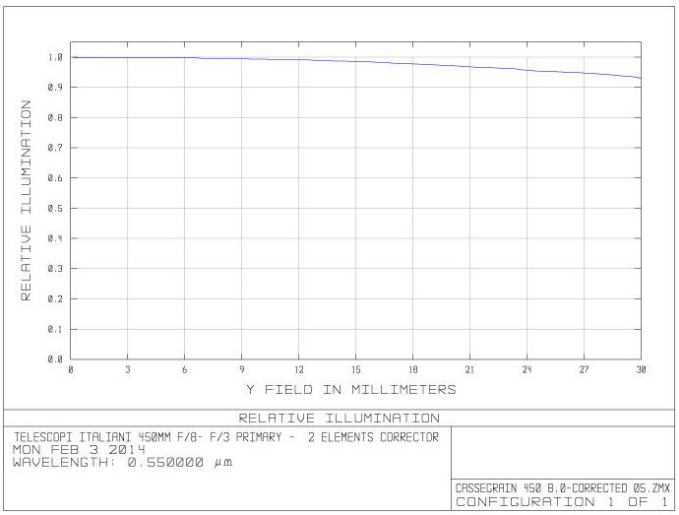


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Figure 1 - Front ring

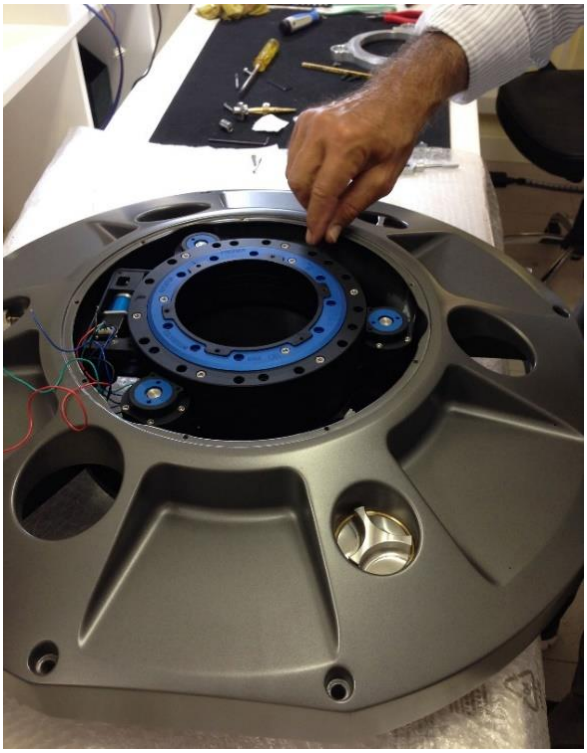

Figure 2 – Focuser and field rotator integration phase

Mechanical characteristics:

- *Overall structure:* Full carbon truss structure – The best structure stiffness, light weight and thermal stability
  - rear body: carbon sandwich
  - front ring: carbon sandwich - integrated 6068-T6 aluminium alloy inserts for truss structure.
- *Primary mirror cell:* Lightweighted FEM optimized Aluminium alloy cell, 18 pivoting points. With six lateral aluminium adjustable support double point each, three conical pivot bronze spring loaded adjustable screws for optical collimation and to avoid any lateral movement of the cell
- *Secondary mirror cells:* 2011-S Aluminium alloy, external surface excavated with conical surfaces in order to minimize reflected light. Adjustment system: two precision adjustable screws (100 TPI by Thorlabs) for a real x-y mirror collimating movements. This system allows to avoid axial movement of the mirror during tilt adjustment, thanks to the spherical joint near the backplate of the mirror. So reciprocal mirrors distance will not vary during collimation.

Figure 4 – f/8 secondary mirror cell anti-reflective surface

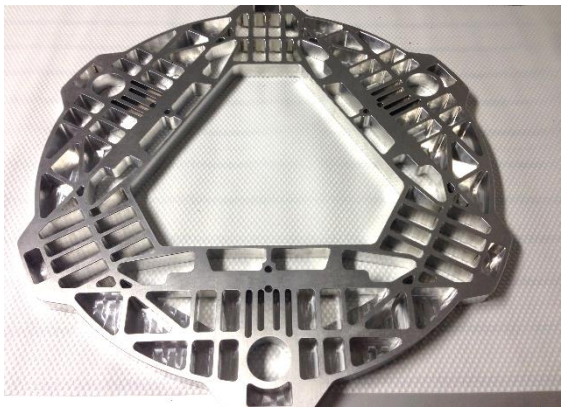

Figure 3 – Primary mirror plate cell

- *Secondary mirror cell vane: pre-tensioned* double vane spider (AISI 3014 stainless steel 1 mm thick) for the best stiffness and low diffraction effects
- *Primary mirror baffle:* carbon tube with internal circular baffling
- *Secondary mirror baffling:* **suspended conical carbon baffling**. This shape allows best baffling without adding obstruction

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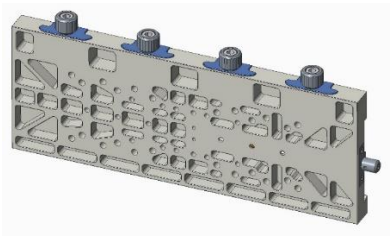
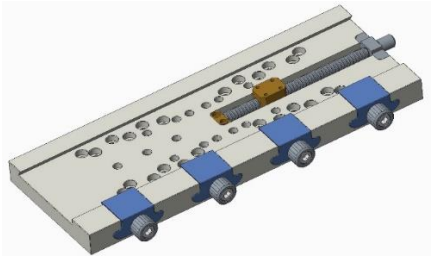
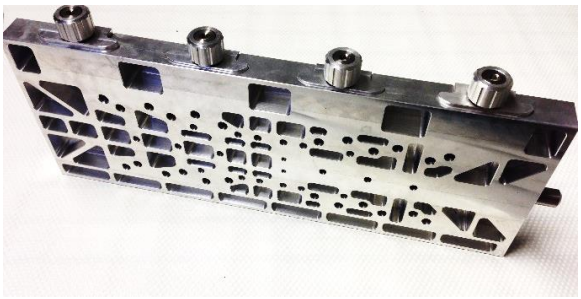
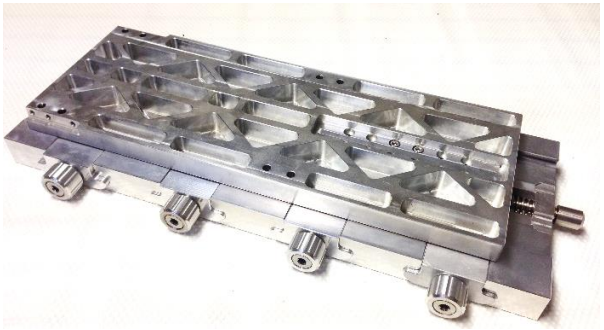
INCLUDED:

- ***110mm Field Rotator: 110 mm clear aperture rotator,*** integrated into the back plate, 160 mm warm wheel with a precision stepper motor drives **high precision preloaded steel cross roller bearing** for a stiff and precision rotation (0.64”/step) and **extremely Low axial/radial runout error** (less than 6 micron). It carries tens of kg payload, with no effect.
- ***Integrated Electronic Focuser:*** integrated into the backplate, it delivery great stiffness and precision. Preloaded with 600 N springs, it uses precision high-end ½” lead screws and nuts from ***Haydon Kerk Motion Solutions*** (USA). It can compensate focal shift follows the mean of primary mirror temperature after having some points on a interpolation map. Maximum payload (@ 6” from flange): 12 kg. Nominal resolution: 78 nm/step. Travel: 10 mm. **Repeatability: 1 μm**
- ***Primary mirror dust cover:*** four integrated motorized carbon cover will cover the rear body (and the primary mirror inside it) when needed.
- ***OPTIONAL: Intelligent dovetail system:*** an heavy duty 112 mm dovetail system allows a precise balance in the declination axes, only with a screw wrench. Saddle plate: four clamps heavy duty saddle with +/- 120 mm of adjustable position travel. This allows a precise balance in the declination axes, only with a screw wrench. Suitable for Paramount, AP and 10Micron Mounts.









Electronics, control and software:

- *Electronic boards:*
  Our Astrographs have a built in high-end electronic board. It is integrated into the rear body thickness and full accessible for check and dismounting.
- *Sensors installed:*
  - Primary mirror: two temperature sensors
  - Secondary mirror: temperature sensor
  - Air temperature sensor
  - Air relative humidity sensor
- *Active temperature control:* Three high quality fans PWM controlled will keeps the primary mirror temperature controlled avoiding both high temperature difference between air temperature and high temperature gradient within the mirror itself (thanks the two sensors installed close to the cooler area ant the other near the warmer area). A special air flow path allows the main parts of air to flow out from back without damaging the quiet air above the mirror. A full customized silicon secondary mirror heater with extremely low power density and PWM driven, will maintain the secondary mirror just above the dewpoint if needed.
- *Electronic panel:* in the lateral side of the rear body a control panel will allow to simplify all cable connections between OTA and PC. Here the characteristics:
  - *Six USB input with IP 65 screwed connection*
  - *Five 12V Output IP 65 3.5 mm jacks – with red led to detect if jack is powered*
  - *One 5V Output – IP 65 3.5 mm jacks– with red led to detect if jack is powered*
  - One Aux Output – IP65 *3.5 mm jacks – it allows to power instrument with a specific tension.*
  - One Aux Input – IP65 *3.5 mm jacks – where you have to arrive with your specific tension.*
  - *Two buttons to open/close manually the primary dust covers (IP 65)*
  - *One button to switch on/off a Green LASER for star pointing (IP 65)*
  - *One button to switch on/off a LED inside the rear body in case of maintenance (IP 65)*
  - *One connector to power the OTA (12 and 5 V powered with our external power supply) (IP 65)*
  - *One USB connector to connect to PC (IP 65)*
  - One connector to an external focuser (IP 65) – This output can drive a stepper motor for aux focuser system. It is used on our off-axis guider with a stepper helical focuser built-in, in order to synchronize the guide camera focus with the main camera focuser, in case of change of focus (i.e. in case of different thickness of filter glasses).
- ***Hardware Safety****:* all the onboard electronics are protected by over current thanks the use of two fuse. All the external hardware powered by our power hub has inside its own fuse that can be installed with the right current limitation in according to the hardware current rating.
- ***Wireless connection****:* the onboard electronic has its wireless connection to allow most important actions from your smartphone. We think the features for example to allow focuser and rotator command when the operator need to stay close to the telescope.

- ***Software Suite INCLUDED****:* the package include a software able to control all the functions and to connect it via ASCOM driver to MaxIm and other commercial software. The software will have:
  - *Window 1:* **Temperature controls**
    Where you ca see themperature graphs, fan speed, heater power, decide if manually or auto comand the fan and the heater
  - *Window 2:* **Focuser controls**

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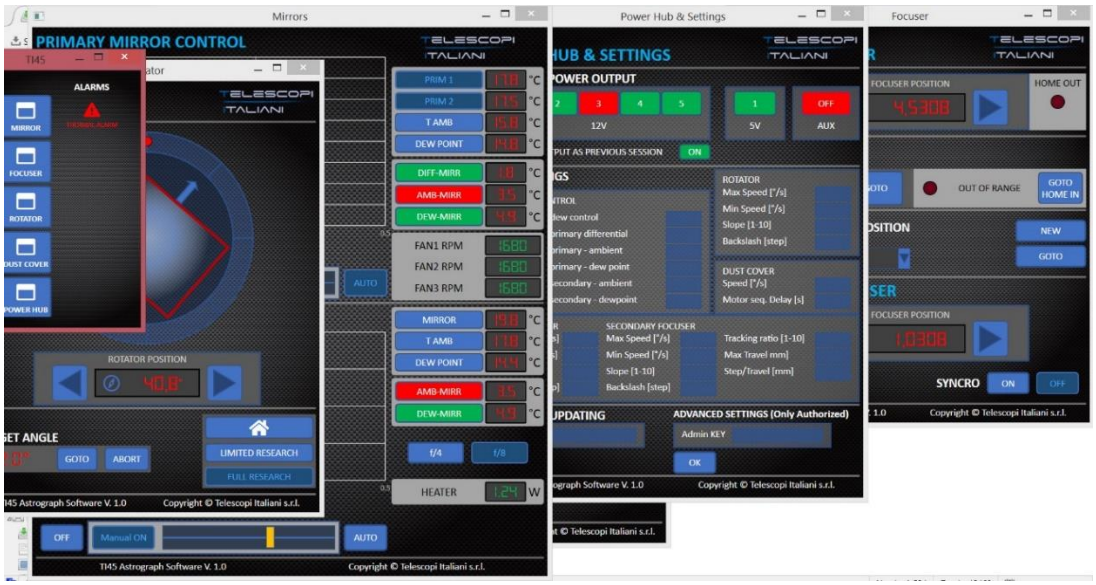
Where you ca see the focuser absolute position, move in/out focuser, see if reach the limits, load/store/rename focuser position, go to a target focuser position, go to home position, save temperature/focuser point for compensation curve, switch on/off temperature compensation, see secondary focuser position, move in/out secondary focuser, goto home for secondary focuser, syncro on/off secondary focuser to the main focuser.

- *Window 3:* **Field Rotator controls**
  Where you can see the absolute rotator position, goto target angle, research home (limited – full options)
- *Window 4:* **Dust cover / Laser controls**
  Where you can open/close the dust cover, stop the procedure, switch on/off the laser pointer
- *Window 5:* **Power Hub and Settings**
  Where you can switch on/off power relé on each power output (n. 5 12V, n. 1 5V, n. 1 Aux Volt), select to set power outputs as previous session, modify user setting parameters, make the firmware updating, access to the advanced setting (only authorized)



We emphasize that from OTA toward the PC only two cables are connected: power 12 / 5V (possibly to our optional TI power supply) and USB signal, while all other cables are internal to the structure or connect the electronic board to the external instrumentation: CCD camera, filter wheel or a guide camera. Since external cables are very short and screwed over IP65 sockets, the system is free from entanglement problems or crushing during the movement of the mount, as well as disconnections or bad contacts. <u>This solution is very important and useful for remote observatory use.</u>

Price: **TI-45 DFL – Price List - fully tested, Shack-Hartmann test analysis report**
PRICE: € 36.800,00 + VAT (shipment not included)

- OPTION: TI-112 dovetail system with adjustable saddle plate
  400 mm Aluminium Dovetail – Aluminium Saddle plate
  PRICE: € 1.080,00 + VAT
- OPTION: 4" Off axis guider, with motorized helical focuser PRICE: € 1.380,00 +VAT

Guarantee: *5 Years on optics and mechanical parts. 2 Years on electronic components.*