MEGARA Spectrograph Mechanical Detailed Design

Multi Espectrógrafo en GTC de Alta Resolución para Astronomía

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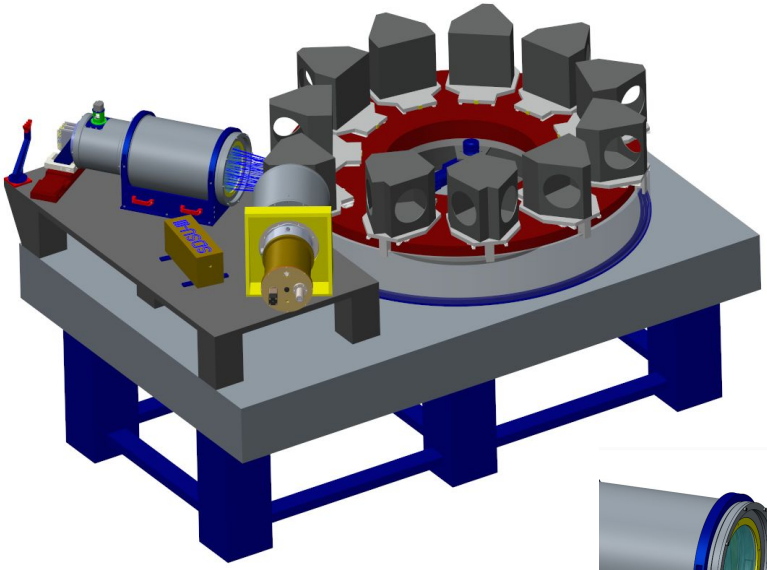
Abstract

We describe the current mechanical design and the adopted solutions for the Mechanisms and the opto-mechanical components of MEGARA spectrograph. MEGARA is the future optical Integral Field Unit (IFU) and Multi-Object Spectrograph (MOS) for the 10.4-m Gran Telescopio CANARIAS (GTC). MEGARA is in the final design phase.



VPH GRATINGS WHEEL AND INSERTION MECHANISM

The spectrograph includes the capability of the **automatic interchange of 11 VPH gratings** that are placed on a Ø1880 mm aluminum alloy wheel. The mechanical mount of each VPH is screwed to a platform that has a pair of guideways screwed on its downside. These guideways are inserted on their corresponding carriages that are screwed to the wheel. VPH mounts are to be seated in a kinematic system.

The insertion mechanism consists of an electro-mechanical actuator that translates a stud type track roller that moves on a railway. As the wheel rotates, platform protrusions are passing by the roller during grating selection. Once the desired VPH is located on position, this track roller engages the protrusion of the VPH mount platform and pushes it to the optical path or pulls it out of it. The **actuator** will be a precision electro-mechanical actuator comprised of a stepper motor, a high precision preloaded ballscrew with an absolute encoder on the motor. The actuators proposed for driving the wheel are a pair of servomotors with planetary reducers preloaded on a crossed rolled bearing gear by pinions in order to remove backlash.

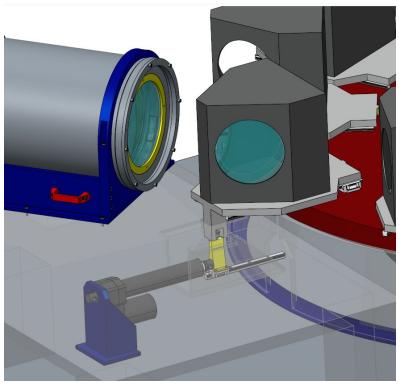


Fig: The linear actuator displacing a VPH platform

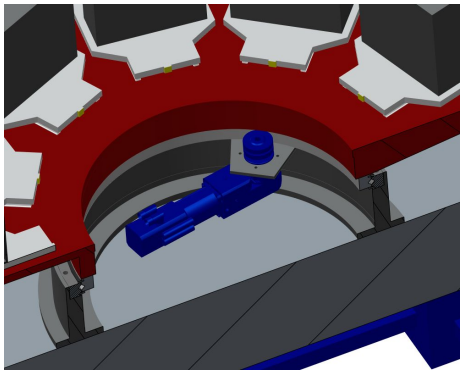
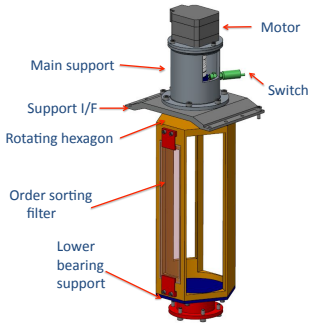


Fig: Cross section showing one actuator and the bearing

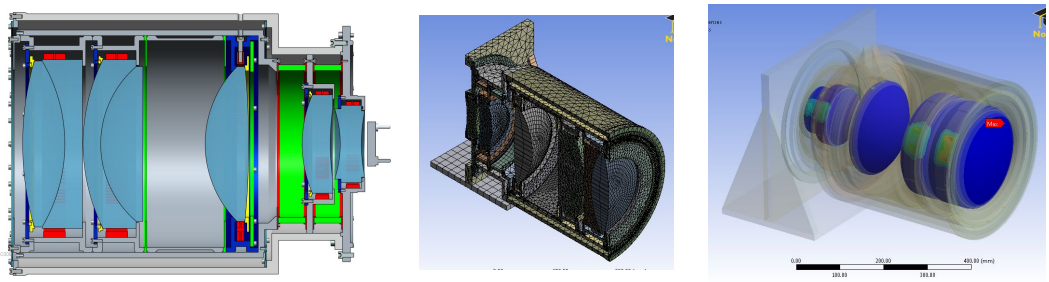
PSEUDO SLIT AND SHUTTER MECHANISMS

At pseudo-slit position, two orthogonal translation stages are included; one for fiber bundle selection and the second one to allow fine focusing for improving image quality in the different grating configurations. The translation stages proposed are commercial components. A **rotary shutter** is inserted in the collimator barrel. It has a mini-motor that rotates an hexagon. By rotating 60º, the cylinder allows light passing by. Another 60º allows light passing thru an order sorting filter that is placed in the hexagon. Another 60º turn blocks completely the light.



OPTO-MECHANICS: MAIN OPTICS AND VPH GRATINGS MOUNTS

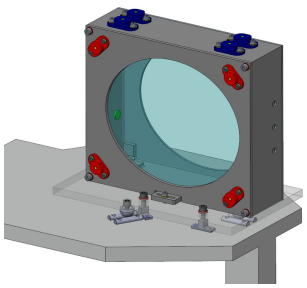
The lenses are inserted on the collimator and camera barrels inside subcells with several flexible elements to compensate for diameter thermal dilatation. Intensive Finite Elements analysis (FEA) has been done to simulate the behavior of the barrel, subcells and other mechanical elements, verify that the expected stress fields and the gravitational displacements on the lenses are compatible with the optical quality tolerances and validate the design of the passive athermalization of the camera.

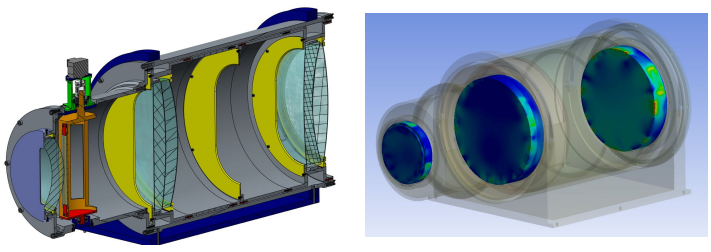


THE CAMERA BARREL : Cross section - FEM mesh – stress on lenses

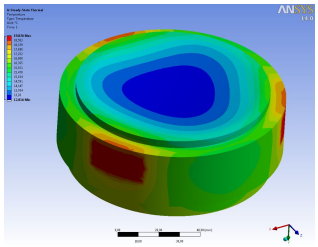
LR VPH MOUNT

Current detailed design of the LR VPH mount. The VPH mount is attached to an intermediate platform which has 3 semi-spheres that are seated on 6 cylinders that are attached to the platform.





COLLIMATOR BARREL : Cross section - stress on lenses



Temperature map of CAM-S7 lens (cryostat window)

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