

MEGARA CRYOGENIC SYSTEM

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MEGARA (Multi Espectrógrafo en GTC de Alta Resolución para Astronomía) is the new integral field unit (IFU) and multi-object spectrograph (MOS) instrument for the Gran Telescopio Canarias (GTC). The selected cryogenic device to harbor the CCD detector for the MEGARA spectrograph is a liquid nitrogen open-cycle cryostat. The LN₂ open-cycle cryostat is a custom made product which has been designed by the INAOE astronomical instrumentation group. The proposed cryostat offers modular stages for easy assembly and testing whilst also allowing future modifications to accommodate the required CCDs, electronics and optics.

MEGARA cryostat assembly consists of two main parts which are designed to be kept static and horizontal: (a) Dewar back, this part serves as vacuum jacket and contains the liquid nitrogen tank (7 liters capacity); it also has on the rear part the liquid nitrogen fill tube, an electrical port for temperature monitor and two vacuum ports. Aluminum has been selected as the primary material for the vacuum jackets and LN₂ tank, the tank will be surrounded by a radiation shield and MLI super-insulation to increase the performance of the device. The filling tube has a bellow system which helps to reduce thermal loading on the cryogenics. Cold plate will be made of gold plated OFHC copper to increase thermal conductivity. (b) CCD head, this part is assembled on top of the main body and will contain the CCD detector and its associated electronics; it will contain two electrical ports to read-out the signals from the CCD. CCD supports will be made of low thermal conductivity materials (i.e. G10). The CCD detector will be thermally connected to the LN₂ tank through a high purity free oxygen copper strap which can be adjusted to give the desired operating temperature of the detector. A lid on the front part will contain the last lens of the MEGARA spectrograph

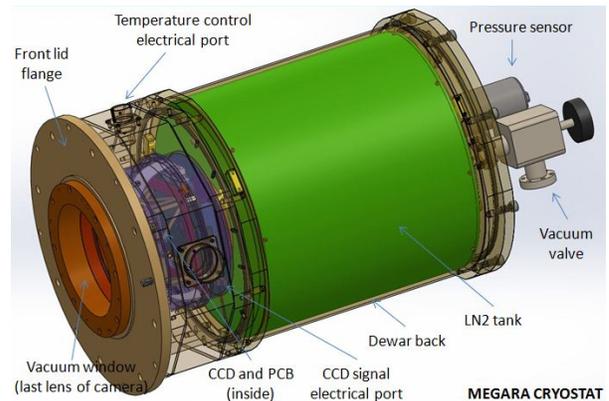


Fig. 1. MEGARA open-cycle cryostat preliminary design. The complete assembly of the cryostat will have a length of 270 mm and a maximum diameter of 255 mm.

which will also serve as a vacuum window. The CCD head mechanical module is intended to be disassembled completely from the cryostat main body for easy handling, integration and verification of CCD components. The CCD and its mountings will be surrounded by an aluminum radiation shield that will help to improve the hold-time of the cryostat. Inside the CCD head there will be a CCD mounting plate attached to an adjustable mechanism that allows to correct in X and Y by means of six screws distributed on the edge of a second plate; four extra screws on the back allows to correct in focus.

Figure 1 shows the main external components of the proposed cryogenic system for the spectrograph. The selected detector for this cryogenic system is a $4k \times 4k$ pixel CCD231 from E2V which will have a base temperature of (~ 158 K). Temperature is monitored by using PT-103 sensors and pressure by a 972 DualMag from MKS. CCD and sensor signals are expected to be monitored from the main GTC console.

Static structural finite element modeling and thermal analysis calculations have proven the feasibility of the proposed cryostat design which also fulfills all the technical requirements defined by GTC for the MEGARA project. Fabrication and testing of this device will be at INAOE facilities.

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