

# El Cryo, a new cryocooler system for the infrared camera for REM

**REM**  
RAPID EYE MOUNT

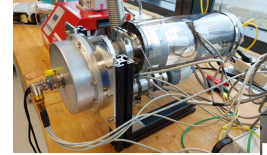
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INAF-OA Brera, INAF-OA Roma, INAF-OA Torino, INAF-IASF Bologna, Universitat de València, ESO

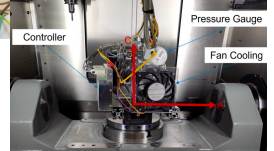


REMIR is a NIR camera mounted on the REM telescope at ESO-La Silla Observatory [1,2]. A new era for the cryogenic system in the REM dome. After different scenarios, a substitute for the long lasting CFC LN2 based cooling for the IR detector, a CryoTel GT cryocooler with its onboard Anti-Vibration-Cancellation system (AVC Gen II) from Sunpower has been installed onboard of the REMIR infrared camera in May 2024. This device is the first choice that ESO selected for replacement of its cryogenics in the mountain instrumentation. REM served as pilot in this effort and the first months of operations went smoothly. Recently a new system based on a software PID control, closing the loop on the detector temperature instead of the cryocooled head, led to an extremely stable temperature for the HawaiiL detector, using less than half the power that the cryocooler can use. Further tests will be performed during the coming Chilean Summer.

## THE LAB TESTS

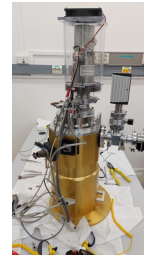


The Cryocooler has been intensively tested in the ESO and INAF laboratories, to verify the function and the performance of the system.



A motion test has also been performed to simulate the telescope and derotator movements. For this test, the CryoTel CFC Adapter cryostat has been mounted, with its controller, on the handling structure inside a milling machine.

The cryocooler was finally integrated on the REMIR camera and mounted on the telescope for the final operational tests. (2024)



## CRYOTEL GT AVC COOLER

The cooler used for this application is the CryoTel GT (generation 2) from Sunpower. It is a standard part at ESO. ESO orders this cooler with a customized cold interface. The cooler can be cooled both with a water- and an air-cooling system, this last being the case of the REMIR camera, added with removable cooling fins and a fan.

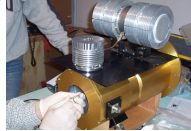
## THE CRYOTEL CFC ADAPTER CRYOSTAT

The CryoTel CFC Adapter is a cryostat with a mechanical cooler, which replaces the CFC cryostat. The advantage of the mechanical cooler is that it is maintenance free and there is no need of liquid nitrogen. The CryoTel CFC Adapter has been assembled and integrated at ESO in Europe, where it has been fully characterized and tested. The cryostat can then replace in the future any CFC cryostat in Europe and on the ESO observatories in Chile.

## THERMAL DESIGN DESCRIPTION

The aim for the thermal design is to keep it as simple as possible. The CryoTel GT AVC (Gen II) cooler provides one cold interface, which can be controlled from 40K to 300K. According to the datasheet it has a cooling power of 18W at 80K (2W at 40K).

2003



From cryocooler to CFC LN2

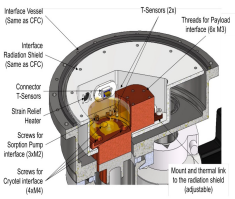
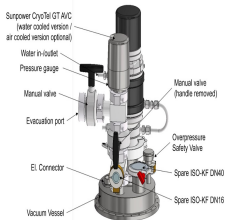


2006



From LN2 to cryocooler again

2024



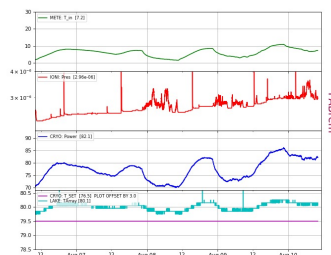
An overview of the design of the CryoTel CFC Adapter Cryostat

## THE CONTROL SYSTEM

The cryotel GT cooler AVC (Gen II) is delivered with its own controller, that operates the GT cryocooler in one of two modes: temperature control mode, or power control mode. The temperature control mode is the factory default and the one used by REMIR with a temperature stability at the cold head < 0.05 K.

A software based PID control was introduced closing the loop in the temperature of the detector instead of the cryocooler head, which is now changed, if necessary, every 3 minutes. This allows the detector to keep its temperature well within 0.1K rtw, 0.02K rms.

The first cooling of the REMIR camera has showed the optimal functioning of the new CryoTel cryocooler, that was able to cool down the camera to about 80 K (with Tset 76.5 K) in about 14.5 hours. The cooling rate was always lower than 0.4 K/min, then always in safe condition. At regime, the power consumption is typically less than 100 W. The performances of the cryocooler were absolutely not affected by the movements of the telescope (alto-azimuthal and derotation) but the required power and the temperature of the detector were following the room temperature.



## REFERENCES

[1] Vitali, F. et al., Proc. SPIE, Vol. 4841, 627-638 (2003) - [2] Molinari, E. et al., Advances in Astronomy, id. 253675 (2010) - [3] Vitali, F. et al., Proc. SPIE, Vol. 6269, id. 62695A (2006)