REM RAPID EYE MOUNT

INAF ISTITUTO NAZIONALE DI ASTROFISICA

The REM Observatory
Observatorio La Silla, La Higuera,
Chilean Andes

Status report on the REM Observatory September 2023

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REM (Rapid Eye Mount) is a 60 cm diameter fast reacting telescope located since 2003 in the La Silla premises of the ESO Chilean Observatory. This telescope has been conceived and designed to immediately point and observe the GRB detected by Gamma Rays satellites. In fact, its relatively small size is balanced by a 10 deg/sec accurate fast pointing. The telescope optical quality is optimised for the infrared wavelength range .
The telescope hosts two instruments: REMIR, an infrared imaging camera, and ROS2, a visibile imager with 4 simultaneous passbands. The two cameras can also observe simultaneously thanks to a dichroic placed before telescope focus the same field of view of 10×10 arcmin. Thus, 5 images are obtained at the same time: g,r,i,z, and IR.
The Observatory is operated for INAF by the REM Team, a delocalised group of people.
See www.rem.inaf.it for more details.

The ESO-INAF Agreement.

The possibility to operate in the ESO La Silla site is regulated by an Agreement, renewed more than once, between ESO and INAF.
Basically in change of a fixed lump sum (around 35/40k€/yr, subject to inflation) ESO guarantees the right to stay, the supply of electricity, internet connection and liquid nitrogen.
Other interventions can be asked for at an hourly price.

The ESO La Silla technical personnel has always received a basic training on the REM systems and is normally able to make effective interventions under remote guidance.

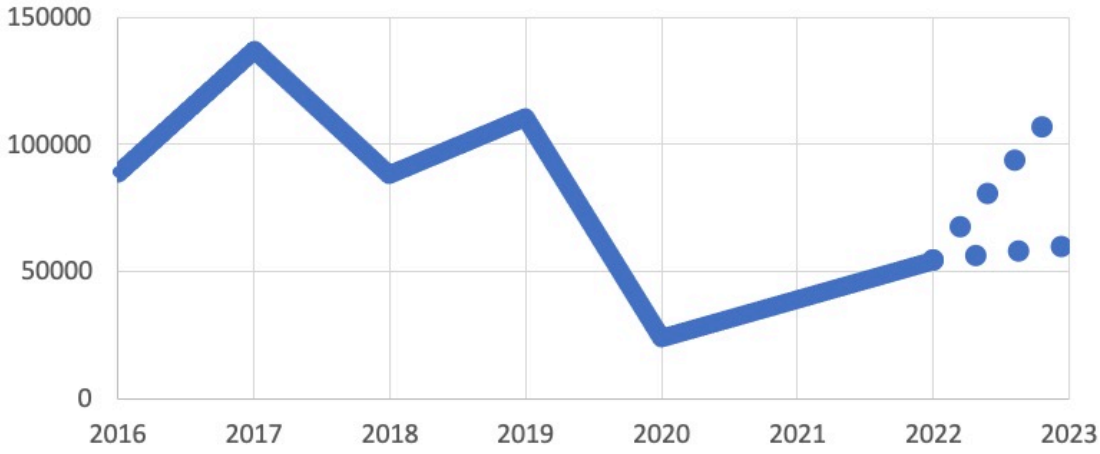
ESO has also set up an internal financial accounts for REM operations, where it charges all expenses that are made in advance, like domestic travels, lodging, purchases authorised by the REM director. Relevant invoices are then sent to the INAF structure which keeps the relevant funds, mainly OA Brera at the time of writing.

The three-years renewal in force ends December 2023, and its renewal process has to be triggered well in advance. Communication in this sense have been already received by ESO administration

Total expenditure

We report here the total expenses (euro) as extracted from the TEAM program on the relevant Ob.Fu. The main items are the lump sum to ESO, the travels to site of the REM team and, up to 2019, one Assegno di Ricerca, then suspended (we lost our only dedicated optician). During 2020 and 2021 the expenses are reduced barely to ESO contribution and IR camera repair, due to

COVID-19 related observatory closure and travel restrictions. For 2023 forecast the range is due to the new cryocooler, possibly installe during 2023 (two dotted lines).



The observing process

REM observation time is now **regularly offered to the Italian and international community** via a regular, semestral call for proposals, which are evaluated by the Italian INAF TAC.
Apart from this, the 10% of the useful time is managed by the **Chilean CNTAC**, like for every other other telescope located in the ESO Chilean premises. Presently we are collator rating with ESO for a survey of the Chilean use of the observing facilities.
After the end of the UE OPTICON program, REM entered as part of the new **ORP** (Option Radionet Pilot) program, in force since 1.03.2022 [https://www.orp-h2020.eu/infrastructures]

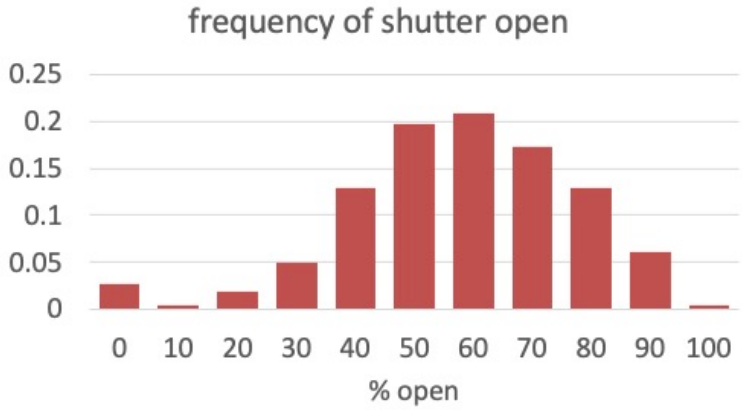
Starting semester 2022A REM accepted ORP proposal, evaluated by an international common TAC, and observations are reimbursed at a hourly rate of about 280€/hr.

The **DDT Directory Discretionary Time** is also a well exploited channel to access the telescope time, with 5, 2 and 6 accepted proposal in the last three semesters, respectively.

REM is official partner of the **RedDots collaboration** for the systematic monitoring of the (very) nearby stars Proxima Cen B, Barnard Star and Ross 154. See the collaboration web site www.reddots.space.

Two particular programs are always operating: the **GRB rapid follow-up**, which automatically interrupts all observation to gather data of GRBs immediately after satellite alert (via GCN, especially SWIFT, Integral, AGILE), and the filling program which co-points with the SWIFT satellite.

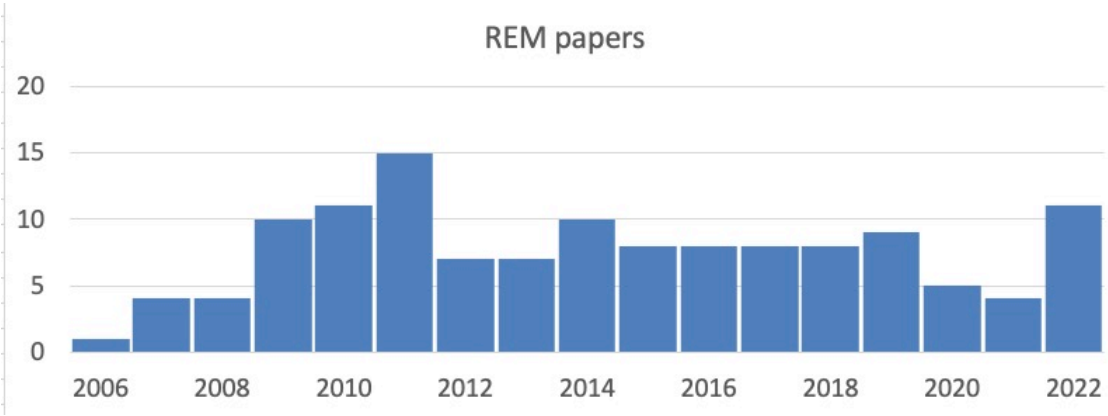
In general not all the available time is requested and the **undersubscription** has hitherto been used for DDT and collaborations by the REM team.



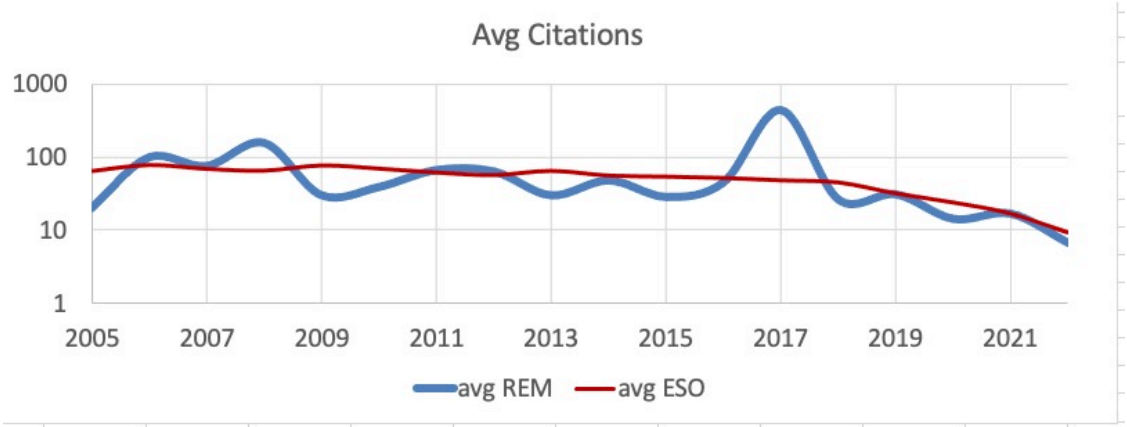
In any case the shutter open, summing all the programs and filler is typical for an imaging camera, and its is visualised in the above histogram.

The paper production

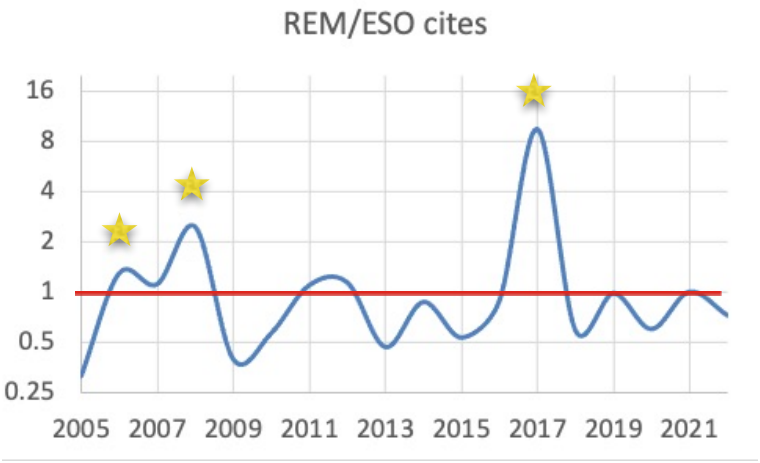
The publications which contain (also) REM data are monitored by ESO in the same way as for the other ESO telescope. Their automated research is not public, but is available to REM team under request. [https://www.eso.org/sci/php/libraries/pubstats/]
Here is the situation (courtesy of ESO library) in September 2023, for the number of papers:



along with a comparison with ESO mean citation per paper.



For clarification, a plot of the REM/ESO average citation ratio is plotted below.

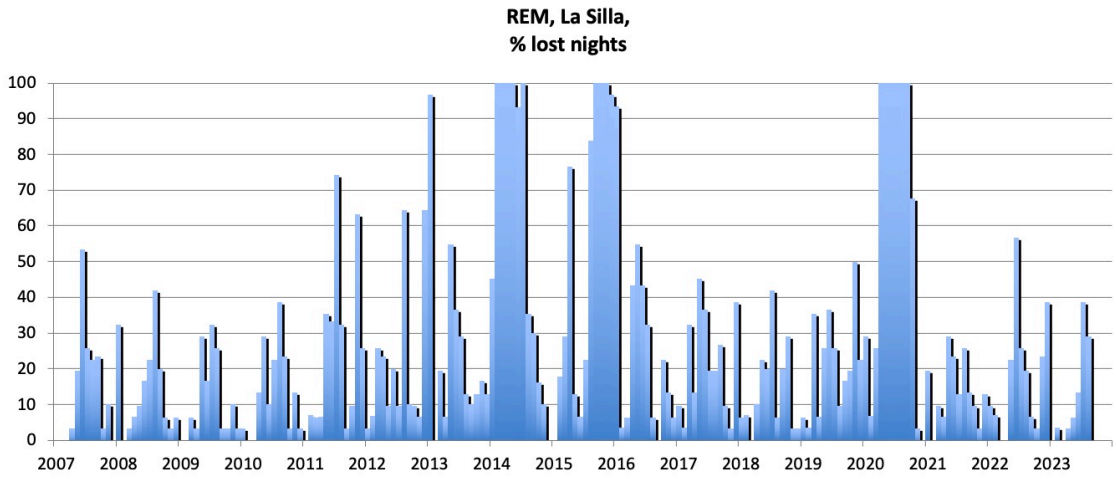


We can see three peaks in the plot, referring respectively to (2006) the first measurement of the onset of the GRB060418 fireball, (2008) the naked-eye GRB080319B, observed even before the burst, and (2017) the golden kilonova of the gravitational wave event GW170817. The transient **(time domain astronomy**) is well represented in the highlights of REM observations.
Lately, the use of REM for transients other that GRB opened a new line of observations, for **exoplanets transits** synchronised with spectrographic radial velocity measurements and for the follow up of the GAIA transients. This last line of observation is included in the wider collaboration under the ORP umbrella and REM is one of the first ranked facility, having embedded dynamically its observing procedure in the European scheduling portal BHTOM [https://bh-tom.astrolabs.pl/]

The observatory efficiency

REM is a robotic complex of telescope and cameras, therefore it relies on external data in order to take decisions about the schedule and the safety.
We thus record simply the dome open time, condition that is a mix of good weather (recorded by REM and ESO separately), technical problem of REM or other domes in la Silla (REM opens only if two other domes are open), communication problem (if no network is available REM shuts down).

A simple plot of % of lost time is shown here



from where we can infer that:

1) the ESO la Silla **support changed dramatically** after their decision to move all workshops and almost all technical personnel to Paranal, so that waiting time for problem solving increased from hours to days, and sometime weeks.

2) the **obsolescence** of the electronica equipment affects the rate of failures. This happened especially in2014 and 2016 due to La Silla hard meteo condition (electrical shocks).
3) The **2020 closure** of the ESO observatory due to COVID is evident. After reopening the situation returned to normal.

La Silla 50yr anniversary

In march 2019 REM was invited to give a talk on the presence and results of one small, national projects that are hosted and keeps the La Silla Site alive.

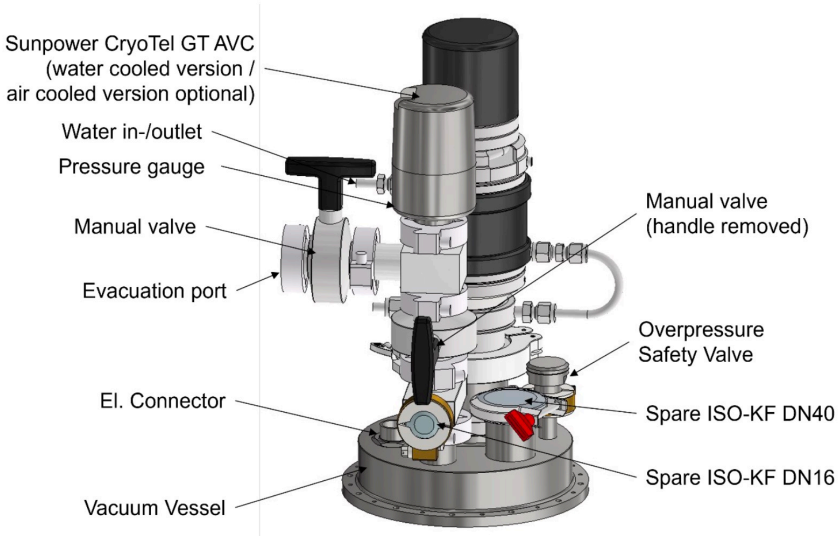
Space debris

During 2019 a collaboration for the space debris surveillance activities was started in collaboration with Italian Air Force and Politecnico di Milano. The collaboration aimed to have a large terrestrial base for orbit determination. During 2019 we were able to record the trails of the flying objects asked by the Air Force, as pilot images to train their software.

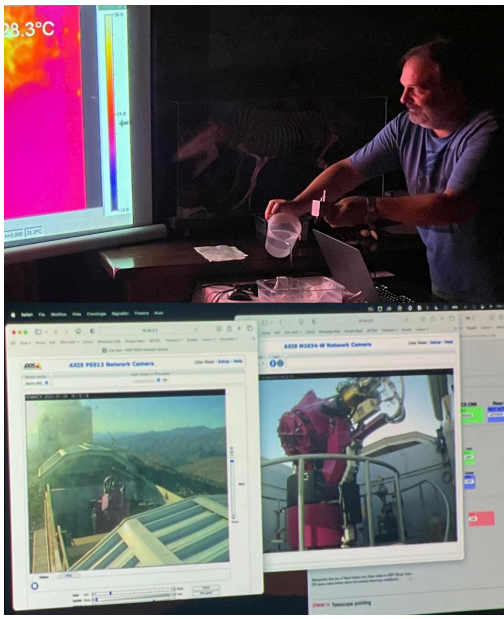
After the reopening after lockdown of the site different program were asking for exact timing of observation start, including monitoring of LEO and MEO satellite. We upgraded the telescope scheduler in order to allow such timing which was before uncertain.

The new cryocooler project

A new type of cryocooler is being tested at the REM telescope (for the infrared camera REMIR) together with ESO technologist. This is a new, compact cry which is able to cool down to 80K with a cooling power of 15W, consuming 280W of energy.
This will replace the present continuous cooling flow system , thus avoiding the liquid nitrogen refill which now occurs every 2-3 days. Also the telescope will be completely controllable remotely.
This is unimportant test for Rem and for ESO, who is intended to refurbish with this cryocooler several instruments in la Silla.



D&D with REM



The REM telescope participates as remote guest in various events. The connection with the indoor and outdoor web cameras allows the public to see the start of the operations and the telescope movement. The Researcher Night is a fixed appointment for REM, in the frame of the *** of OA Rome.

The tREMometer and the REM archive

The public page of the tREMometer allows a view at a glance of the situation in the REM dome, all subsystems health and the planned and performed observations. A small preview is accessible for all frames obtained.
The archive in IASF Bologna allows PI and collaborators to retrieve images few hours after the observations. The images aged more than 1 year and all the calibration frames are publicly available via the same archive, which is able also to perform astrometry and simple statistics.
All the pages are reachable from the REM main website [http://www.rem.inaf.it]

The d'REM team

The team dedicated to REM maintenance, operations and remote safety is composed mainly by INAF personnel, with different FTE fractions and duties. Including Chilean missions the fraction of FTE

for each member does not exceed 10%. There is a relevant entry in the "INAF schede" [https://schede.inaf.it/consulta/mostra?selezione=604895366674d7bd68922b7c]

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Giuseppe Malaspina - INAF OA Brera
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