GTC Science Operations Status

A. Cabrera-Lavers

GRANTECAN
Operation statistics: down time

GTC science time losses

- Weather losses
- Technical losses

Semester:
- 2009A
- 2009B
- 2010A
- 2010B
- 2011A
- 2011B
- 2012A
- 2012B
- 2013A
- 2013B
- 2014A
- 2014B
- 2015A
- 2015B
- 2016A
- 2016B
- 2017A
- 2017B
- 2018A
- 2018B
- 2019A
- 2019B

Percentage:
- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%

GTC GUC Meeting
CALP, La Palma, 20-21 Jul 2020
Operation statistics: Time demand

6 instruments offered for S19B, and 4 instruments for S20A
Operation statistics: Time demand

Oversubscription factor 3.5

GTC GUC Meeting
CALP, La Palma, 20-21 Jul 2020
Science time requested time per instrument

TOTAL = 1938 h
TOTAL = 1957.4 h
TOTAL = 2425.6 h
TOTAL = 2070.7 h
Science time allocated time per instrument

TAC time allocated by instrument mode

Semester

GTC GUC Meeting

CALP, La Palma, 20-21 Jul 2020
Science time delivered

Night time available in 1 yr (within twilights) is 3285 hours (1642 each semester)
Science time delivered

Night time available in 1 yr (within twilights) is 3285 hours (1642 each semester)
GTC science time use (queue + visitor mode) by instrument
## Balance of time use by stakeholder group

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<th>UF</th>
<th>ES-MX</th>
<th>ES-FL</th>
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<td>6,9</td>
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| % TOTAL | 89.1 | 4.1 | 2.0 | (1.7) | (0.8) | 2.5 |
| TARGET  | 86.875 | 3.75 | 1.875 | 2.5 | 0 | 5.0 |
**GTC time delivery**

- 75% total data delivered to Spanish TAC proposals.
- IAC proposals take 45% of total delivered time (62.5% of Spanish time)
- 80% OSIRIS / 5% CC / 2% CIRCE / 6% EMIR / 5% MEGARA / 1% HIPERCAM / 1% HORuS data.

Queue execution follows strictly TAC priorities:
- 70% of the proposals in queue get some data.
- 75% A band and 40% B band programs are completed.
GTC time delivery

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- 75% A band and 40% B band programs are completed.
GTC operational efficacy

Comparing real time available (corrected for weather and technical losses) to hours delivered:

Efficacy metric includes all factors; human, environmental changes, scheduling but not intrinsic OB assumed overheads.
**GTC operations (in numbers)**

- > 15,000 observing hours delivered to date (1800 h / year), including 1098 h for ESO/GTC and > 1000 h of GT.
- > 770 programs 100% completed with conditions guaranteed.
- Observatory overheads decreased to <1%.
- ~ 4-5% technical losses.

**GTC science time losses**

<table>
<thead>
<tr>
<th>Semester</th>
<th>weather losses</th>
<th>technical losses</th>
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**GTC queue observing overheads**

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</table>

**GTC science time use (queue + visitor mode) by stake holder**

**GTC GUC Meeting**

CALP, La Palma, 20-21 Jul 2020
GTC science productivity

  - 243 from Spain / 31 from MEX / 18 from UF.
  - 500 OSIRIS / 43 Canaricam / 10 CIRCE / 8 EMIR / 6 MEGARA / 4 HiPERCAM / 1 HORuS data.
  - DDT proposals: 1 paper / 6 h - ESO-GTC: 1 paper / 12 h - regular TACs: 1 paper / 23 h.


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  - DDT proposals: 1 paper / 6 h - ESO-GTC: 1 paper / 12 h - regular TACs: 1 paper / 23 h.
GTC operation updates – operational improvements

- Quality Control upgrade by including DRP-online products still ongoing.
- Optimization and automation of operations still progressing.
- Requirements for a new Phase 0 Tool (Time allocation tool) are being defined.
A new way for defining observations will be allowed, providing more flexibility to the user.

Configure as many templates as needed:

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<th>-Grim-</th>
<th>-On source exptime- (s)</th>
<th>-Single Int. Time- (s)</th>
<th>-Initial offset- (along the slit)</th>
<th>-ABBA Throw - (arcsec)</th>
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Number of times the above template(s) should be repeated (up to 99): 1

Configure as many templates as needed:

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<th>-Number of exposure per NOD-</th>
<th>-Single Int. Time- (s)</th>
<th>-Initial offset- (along the slit)</th>
<th>-ABBA Throw - (arcsec)</th>
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Number of times the above template(s) should be repeated (up to 99): 1

Works for using a single xml file for EMIR MOS observations in progress.
GTC operation updates – Remote Operation mode in S20A

- GTC Night operations were **suspended from March 27 to April 22 due to COVID-19**.

- Instruments were progressively recovered, and **observations are currently done from Remote Control Room** with some additional security restrictions. This mode will be used during S20A.
TAC related issues (I): RA 10-12h oversubscription

http://www.gtc.iac.es/observing/observing.php#The_time_allocation_process

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CALP, La Palma, 20-21 Jul 2020
**TAC related issues (II): Undersubscription in bright time**

*Filler programs are being executed due to the lack of proposals for bright time.*
TAC related issues (III): Guaranteed time use

> 225 h of GT consumed in 2019, and increasing.

GTC Guaranteed Time use (cumulative hours)

- OSIRIS GT: 660 h
- CanariCam GT: 386 h
- EMIR GT: 660 h
- MEGARA GT: 411 h
Plan for Semester 2020B (time allocated by TACs)

- Approximately **80% of time for science**
  - GTCAO installation preparing works.
  - OSIRIS migration to Cassegrain works and instrument commissioning.
  - Technical telescope time.
- Offer the following **OSIRIS functionalities (September – December 2020):**
  - Broad-band imaging (including SHARDS filters)
  - Long-slit spectroscopy / Multi-object spectroscopy
  - TF-R / TF-B narrow-band imaging. (**NEFER is not offered**)
  - Frame transfer & fast photometry mode, only in visitor mode
- Offer **EMIR** imaging, longslit and MOS modes.
- Offer **MEGARA** both IFU and MOS modes.
- Offer **HORuS** (**while OSIRIS still available**).
Plan for Semester 2021A (call for proposals by mid-August)

- Approximately **80% of time for science**
  + MIRADAS installation and instrument commissioning.
  + Technical telescope time.
  + OSIRIS commissioning at Cassegrain.
  + GTCAO installation preparing works.

- Offer **EMIR** imaging, longslit and MOS modes.
- Offer **MEGARA** both IFU and MOS modes.
- Offer **HiPERCAM**, depending on final scheduling of MIRADAS.
- Offer **OSIRIS/HORuS partially during the semester**, depending on final scheduling of GTCAO.

**Still under discussion**
GTC Current Instrumentation Status

CANARICAM
EMIR
HORuS MEGARA
HiPERCAM

GTC GUC Meeting
CALP, La Palma, 20-21 Jul 2020
**OSIRIS imager and multi-object spectrograph**
Common-user instrument since 2009 (Nasmyth B).

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<th><strong>Spectral Range</strong></th>
<th>0.36-1.00 μm</th>
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<td><strong>Detector</strong></td>
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<td><strong>Plate Scale</strong></td>
<td>0.125 arcsec pix(^{-1})</td>
</tr>
<tr>
<td><strong>Field of view</strong></td>
<td>7.8 x 7.8 arcmin(^2)</td>
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<tr>
<td><strong>Imaging modes</strong></td>
<td>broad/medium band, TFs, fast photometry</td>
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<tr>
<td><strong>Spectroscopic modes</strong></td>
<td>long-slit, mask MOS</td>
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<tr>
<td><strong>Spectral resolution</strong></td>
<td>300 to 2500</td>
</tr>
</tbody>
</table>

- **Point source, S/N=3, dark moon, seeing 1".0**
- **To be moved to Cassegrain on March 2021 (fully available for S20B).**
- **New monolithic 4kx4k detector will be received by late 2021. OSIRIS commissioning at Cass will be done with the old detector Mosaic.**
OSIRIS future plans (OSIRIS at Main Cassegrain)

- OSIRIS will **be moved to Cassegrain focus in early 2021**, to leave room for GTCAO at Nasmyth B. A new Maintenance Platform for Cass/FCass is required.

- Some time before, the ICM will be dismounted to be moved to Cassegrain. **OSIRIS could be operated in a ‘non-optimal way’**, but with no impact in the science observations thanks to its well proven stiffness!.

- Main goal is **to have OSIRIS back into operations in 2021B** (probably with imaging/longslit spectroscopy only, TBC).

GTC GUC Meeting

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**EMIR NIR imager and multi-object spectrograph**

Common-user instrument since 2017 (Nasmyth A).

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<th><strong>Spectral Range</strong></th>
<th>0.9-2.5μm[1.1-2.5μm]</th>
<th><strong>MOS mode</strong></th>
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<tr>
<td><strong>Detector</strong></td>
<td>HAWAI2 2048²</td>
<td>F.O.V.</td>
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</table>
| **Spectral resolution** | 1000 (YJ, HK)  
               | 5000,4250,4000 (JHK) | Sensitivity  |
| **Spectral coverage** | 1 single window/exp. | K~20.0 in 3h @ S/N=3 (continuum) |
| **Imaging modes**   | Broad/narrow band    | Imaging mode |
| **Plate Scale**     | 0.2 arcsec pix⁻¹     | F.O.V.       |
| **Image quality**   | θ₈₀ < 0.3 arcsec     | Sensitivity  |

**Sensitivity**

- K~22.0 in 1h, for S/N=3 & 0.6 arcsec aperture

EMIR NIR imager and multi-object spectrograph

- EMIR sensitivity follows current ETC predictions (*ETC frequently updated!*).

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CALP, La Palma, 20-21 Jul 2020
**EMIR NIR imager and multi-object spectrograph**

- No major issues at least up to $m_{AB} = 19-20$. 
EMIR NIR imager and multi-object spectrograph

- Some work still in progress to achieve expected sensitivities for faintest magnitudes (mAB > 20).
EMIR NIR imager and multi-object spectrograph

Lot of hard work needed at faintest magnitudes, but results are attainable.

Hα+NII emitter
\[ z_{\text{spec}} = 0.7909, \ J_{\text{AB}} = 20.31, \ l_{\text{mass}} = 10.3 \ M_\odot \]

Hα emitter
\[ z_{\text{spec}} = 0.8970, \ J_{\text{AB}} = 21.78, \ l_{\text{mass}} = 9.38 \ M_\odot \]

Courtesy by J. Gallego.
MEGARA optical medium-res multi-object spectrograph
Common-user instrument since 2018 (FCass-F).

<p>| | |</p>
<table>
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<tbody>
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<td><strong>Spectral range</strong></td>
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<tr>
<td><strong>IFU field of view</strong></td>
<td>12.5 x 11.3 arcsec²</td>
</tr>
<tr>
<td><strong>IFU spaxel size</strong></td>
<td>0.62 arcsec</td>
</tr>
<tr>
<td><strong>MOS</strong></td>
<td>92 x 7-fiber mini-IFUs</td>
</tr>
<tr>
<td><strong>MOS field of view</strong></td>
<td>3.5 x 3.5 arcmin²</td>
</tr>
<tr>
<td><strong>Spectral resolution</strong></td>
<td>6000 to 20000</td>
</tr>
<tr>
<td><strong># of spectra</strong></td>
<td>650</td>
</tr>
</tbody>
</table>

GTC GUC Meeting

CALP, La Palma, 20-21 Jul 2020
MEGARA optical medium-res multi-object spectrograph

- A cover for MEGARA installed on September 2019 to minimize stray light contamination.
- First VPH changes done once RP issues were solved.
- Final repairing works on MOS positioners ongoing.
MEGARA optical medium-res multi-object spectrograph

- MEGARA DRP in continuous development to improve the data reduction.

3x60s on M15 GC with HR-R
(MEGARA DRP <= 0.9)

MEGARA DRP (0.9.3): https://github.com/guaix-ucm/megaradrp/

+ New data reduction tools available soon !!!
MEGARA optical medium-res multi-object spectrograph

- **MEGARA first science papers** already in press (commissioning & science data):
  
  
  
  
  
  + Herrero et al., Sánchez-Contreras et al., Chamorro-Cazorla et al., Mayya et al., Gil de Paz et al., Castillo-Morales et al., (all in prep.).
**HORuS: High Optical Resolution Spectrograph**

PI Carlos Allende (IAC). Accepted as visitor instrument (Nasmyth B, shared with OSIRIS), in operation since July 2019.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Spectral Range</strong></td>
<td>0.38-0.69 μm</td>
</tr>
<tr>
<td><strong>Detector</strong></td>
<td>4096 x 4096 Fairchild CCD486 BI</td>
</tr>
<tr>
<td><strong>IFU Field of view</strong></td>
<td>2.3 x 2.3 arcsec²</td>
</tr>
<tr>
<td><strong>Fiber size</strong></td>
<td>0.75 arcsec</td>
</tr>
<tr>
<td><strong>Spectral Resolution</strong></td>
<td>25000</td>
</tr>
</tbody>
</table>
**HORuS: High Optical Resolution Spectrograph**

- HORuS has been finally included in the **routinely operation queue** after GTC staff’s training conducted by the instrument team.

HORuS: High Optical Resolution Spectrograph

- Some issues with sky subtraction for $16 < V < 17$ (Dark time mandatory).
- Possible simultaneous use with OSIRIS has been discarded.

HORuS pipeline: https://github.com/callendeprieto/chain
HORuS: High Optical Resolution Spectrograph

- Proposed **future upgrades of HORuS** to keep the instrument available after OSIRIS migration to Cassegrain **have been discarded** due to the lack of suitable windows in GRANTECAN’s technical scheduling.

HORuS-A

HORuS-U -> by using the platform below NasB currently reserved for GTC-HRS.

**HORuS will be offered while OSIRIS is available at Nasmyth B focus.**
CanariCam

- Canaricam was recovered on July after shutdown due to COVID-19, in order to extend the CC coldhead's lifetime.

- Canaricam will be in operation from July 2020, until CC GT completion (approx. 40 h).

- Canaricam usability window would be extended if longer delays in MIRADAS are produced, by using already approved proposals. (HiPERCAM?).

Uranus @ 24.5 μm
GTC instrumentation for 2020 (Osiris at Nasmyth)

- HORuS
- MEGARA
- EMIR
- OSIRIS

Resolution vs. Wavelength (µm)

- IMAGING
  - OSIRIS
  - EMIR

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GTC instrumentation for 2021 (Osiris at Cassegrain)

Resolution

Wavelength (µm)
GTC instrumentation plan (2017-2022)

Legend:
- "*" Visitor Instrument
- Transparent bars indicate that the focus may alternate hosting various instruments

GTC GUC Meeting
CALP, La Palma, 20-21 Jul 2020
GTC instrumentation plan (2025+)

- **Open call** (still) for ideas on April 2018.

- 5 proposal received:

<table>
<thead>
<tr>
<th>Instrument</th>
<th>GTCAO?</th>
<th>Wavelength range</th>
<th>Observing modes</th>
<th>FOV</th>
<th>Spectral Resolution</th>
<th>Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>BATMAN</td>
<td>No</td>
<td>0.36 - 1.0 μm</td>
<td>Imaging Multi-Object Spectroscopy</td>
<td>2.3 x 1.2 arcmin (DMD-based)</td>
<td>500 - 4000 (for 1-0.2 arcsec slits)</td>
<td>10 MEUR</td>
</tr>
<tr>
<td>GATOS</td>
<td>No/Yes</td>
<td>0.37 - 2.35 μm</td>
<td>Imaging Long Slit Spectroscopy High time-resolution IFU Spectropolarimetry</td>
<td>3 x 3 arcmin or 4.2 arcmin (diameter)</td>
<td>3 arcmin long slit 9.7 x 6.8 arcsec IFU 2.5 x 3.6 arcsec IFU (with AO)</td>
<td>9.7 MEUR</td>
</tr>
<tr>
<td>GTCMCAO</td>
<td>Yes (MCAO)</td>
<td>0.9 - 2.4 μm</td>
<td>Adaptive Optics Facility</td>
<td>40 x 40 arcsec</td>
<td>-</td>
<td>4.1 MEUR</td>
</tr>
<tr>
<td>MAGAM</td>
<td>Yes (MCAO)</td>
<td>0.9 - 2.4 μm</td>
<td>Diffraction Limited Imaging</td>
<td>85 x 85 arcsec</td>
<td>-</td>
<td>43 MEUR</td>
</tr>
<tr>
<td>NEREAN</td>
<td>No/Yes</td>
<td>0.8 - 1.7 μm</td>
<td>Fiber-fed Spectroscopy</td>
<td>-</td>
<td>R &gt; 70000 (req.) R = 110,000 (goal)</td>
<td>4 - 5 MEUR</td>
</tr>
</tbody>
</table>

- First scientific evaluation by GTC STAC on April 2019, recommended to define an external panel of experts to review these proposals, in a wider context of the strategic role of GTC from 2025 onwards.

- **Process is presently stalled due to the lack of funding commitment from Canarian Government.**

http://www.gtc.iac.es/instruments/nextgeneration.php